Norman Wells Operations Annual Flowline Integrity and Break-Up Report

March 2023

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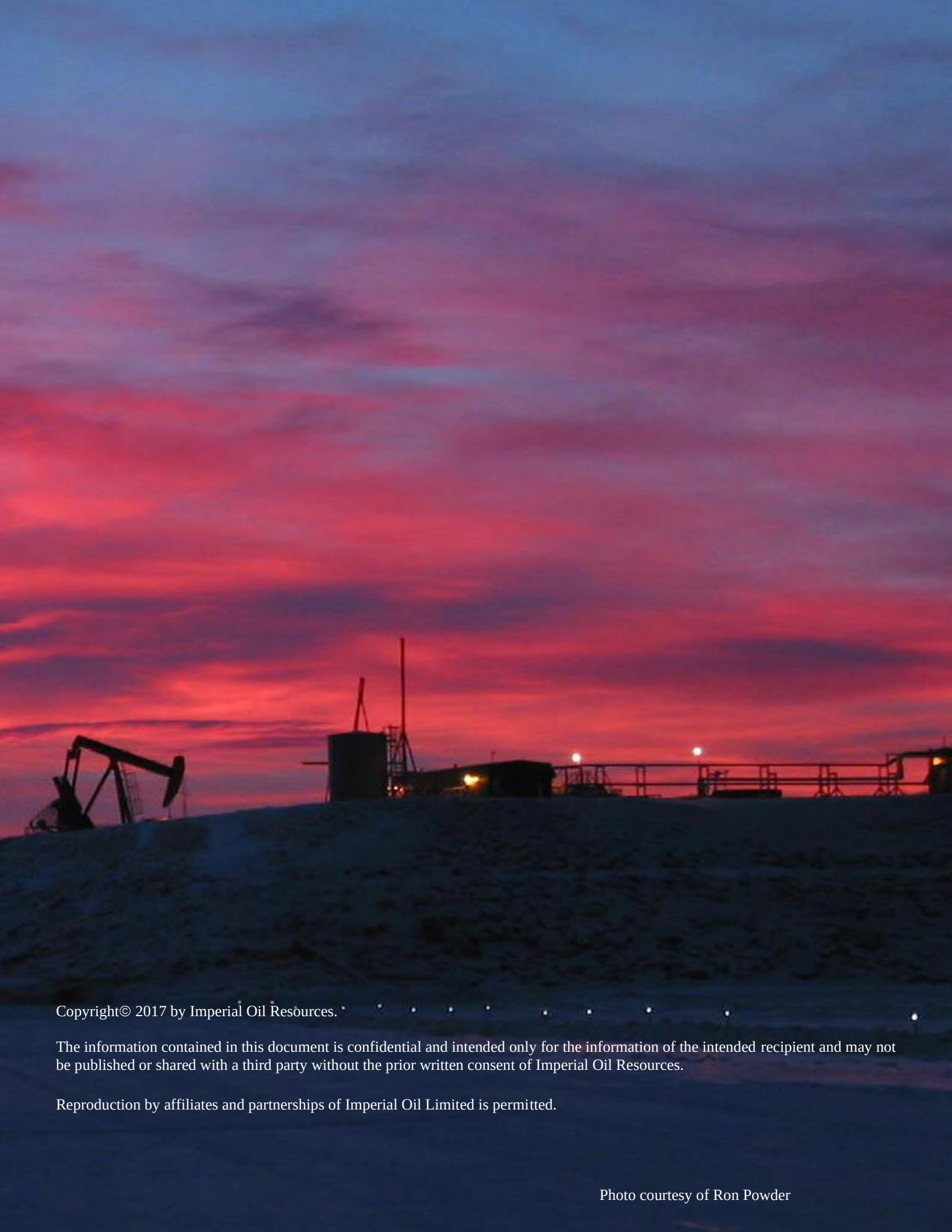

Photo courtesy of Ron Powder

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ACRONYMS

AANDC	Aboriginal Affairs and Northern Development Canada
BIT	Bear Island Terminal
cm	Centimeters
CER	Canada Energy Regulator
CPF	Central Processing Facility
DoC	Depth of cover
GIT	Goose Island Terminal
GPS	Global Positioning System
ILI	In-Line Inspection
IMU	Inertial mapping unit
IOR	Imperial Oil Resources
LT	Land Terminal
m^3	meters cubed
m	Meters
masl	meters above sea level
MFL	Magnetic flux leakage
N/A	Not applicable
NDE	Non-destructive evaluation
NWO	Norman Wells Operations
PM	Preventative Maintenance
RTK	Real Time Kinematic
SLWB	Sahtu Land and Water Board
SSSV	Subsurface Safety Valves

1 INTRODUCTION

Imperial Oil Resources N.W.T. Limited (Imperial) is required by the Sahtu Land and Water Board (SLWB) Water Licence S13L1-007 (Schedule 5, Item 1) and Canada Energy Regulator (CER) Operations Authorization OA1210-001 to annually submit a Flowline Integrity and Break-Up Report no later than October 31st of the year being reported.

Imperial advised the CER and the SLWB that submission of the 2022 report would be delayed for a number of reasons. The 2022 bathymetric survey was postponed from July 2022 to September 2022 due to high unsafe river levels in the Mackenzie River. This delayed Imperial's receipt of the bathymetric survey results and accompanying report from GeoVerra. Further, in reviewing the bathymetric survey results received in November 2022, another Imperial contractor noted apparent inconsistencies in the presentation of the riverbed profile along the Bear to Goose Island corridor in GeoVerra's 2020, 2021 and 2022 bathymetric survey reports. As a result, the 2020, 2021 and 2022 bathymetric data for all cross-river flowlines was further reviewed by that contractor to confirm the accuracy of the revised 2022 bathymetric survey report (Appendix A).

Details on the Licence requirements for this report and the corresponding sections within the report can be found in the following concordance table.

Licence Requirement			Section of Report
a)	The results and inspections of the physical condition of each Artificial and Natural Island, including channel erosion, island scour holes and erosion, flowline landfalls, the condition of rip rap and the following information:		Sections 4 & 5
	i.	Locations, depth, and volume of channel scour in the vicinity of any Flowline(s)	Section 4
	ii.	Locations and magnitude of Artificial Island slope erosion	Section 5
	iii.	Locations and severity of Artificial Island rip rap disturbance	Section 5
	iv.	Structural integrity of the Artificial Islands, and other related structures	Section 5
	v.	Structural integrity of the Natural Islands where it is applicable to project activities	Section 5
b)	The dates and results of Flowline(s) and fuel storage tank integrity tests		Section 6
c)	Details on necessary repair and maintenance work along with a schedule for completing such work prior to the following spring Mackenzie River Break-Up period.		Section 4 & 5

2 2022 BREAK-UP SUMMARY

As required by Water Licence S13L1-007, Imperial shall undertake any necessary annual maintenance required to preserve the structural integrity of the islands (Part F, Item 2). Imperial inspects the riverbeds, channels, and banks of the Mackenzie River in the vicinity of the flowline(s). To determine structural integrity of the islands, Imperial conducts an annual artificial island inspection. The results of these surveys are included in this report.

The average water level during the Mackenzie River break-up at Norman Wells is approximately 9 m (44.5 masl) and typically occurs between May 10th and May 15th. In 2022, break-up occurred on May 16th.

2.1.1 Annual Inspections

This year's bathymetric survey was completed in September 2022. The survey was originally scheduled for July 2022. However, due to higher than normal water levels, it was deemed unsafe for the boats to enter the Mackenzie River to complete the survey. As a result, the survey was postponed to September. The results of this survey are summarized in Section 4 of this report and Appendix A.

The annual artificial island inspection was performed in August 2022 and is summarized in Section 5.

3 BREAK-UP PREPARATION

Prior to each year's Mackenzie River break-up, a number of essential tasks must be completed. The key items are listed below.

- Spot heavy equipment on Bear and Goose Island
- Service equipment (e.g. compressors, operator trucks, etc.)
- Plug wells (e.g. wireline activity)
- Verify bunker lids and water intake hatch are secured and protected from ice flow
- Install and function test sub surface safety valves (SSSVs)
- Ensure adequate supply of chemical, fuel and potable water on island locations
- Remove equipment from low lying areas
- Inspect Bear Island purge equipment and review purge plan
- Finalize helicopter plans in preparation for ice road closure
- Execute weekly ice profiles
- Close ice road to equipment
- Remove ice road signage
- Monitor river levels and upstream break up conditions

4 2022 BATHYMETRIC SURVEY

The annual bathymetric survey was performed in September 2022 by GeoVerra. The purpose of the survey is to:

- Determine the amount of instream cover over Imperial's eight cross river flowline bundles located in the bed of the Mackenzie River
- Monitor the river bed immediately adjacent to eight cross river flowline bundles enabling interception of scour hole movement towards flowline bundles
- Monitor the river bed at the base of the six artificial islands and Bear and Goose causeways for possible erosion or scouring
- Monitor the build-up or movement of the sandbars over the flowline bundles
- Identify any changes in the shape and elevation of the river bed in the areas adjacent to the islands, causeways, and docks

Information on typical bathymetric survey equipment used for the Norman Wells survey can be found in Section 2.6 of the 2022 Norman Wells Bathymetric Survey Report (Appendix A), prepared by GeoVerra.

4.1.1 Bathymetric Survey Results

The scope of work for the annual bathymetric survey is to measure the elevation of the river bottom for the entire length of each cross-river flowline corridor and compare to the construction survey elevations of the flowlines to determine the depth of cover along the entire channel. Flagged monitoring sections that have been identified from previous surveys are further examined to determine whether the cover at these locations has decreased or remained constant compared to previous years. Bathymetric surveys are also completed for the areas surrounding the artificial island locations, the mainland dock, and the Bear Island to Goose Island causeway. No depth of cover repair work is planned for 2023.

The 2022 cross-river flowline bundle survey results can be found in Section 3.2 of Appendix A. The bathymetric survey drawings for each flowline corridor are found in Appendix B. The list of flowline corridors and the corresponding bathymetric survey drawing is provided in Table A below.

Table A: List of Flowlines and Associated Bathymetric Survey Drawings

Island 1 to Mainland Flowline	Dwg. No. 096-0179-700-801 71
Island 2 to Mainland Flowline	Dwg. No. 096-0179-700-801 72
Island 3 to Goose Island Flowline	Dwg. No. 096-0179-700-801-73
Island 3 to Mainland Flowline	Dwg. No. 096-0179-700-801 74
Island 4 to Goose Island Flowline	Dwg. No. 096-0179-700-801-75
Island 4 to Bear Island Flowline	Dwg. No. 096-0179-700-801 76
Island 6 to Bear Island Flowline	Dwg. No. 096-0179-700-801-77
Bear Island to Goose Island Flowline	Dwg. No. 096-0179-700-801 78
Island 1 and surrounding area	Dwg. No. 096-0179-700-801 79
Island 2 and surrounding area	Dwg. No. 096-0179-700-801 80
Island 3 and surrounding area	Dwg. No. 096-0179-700-801 81
Island 4 and surrounding area	Dwg. No. 096-0179-700-801 82
Island 5 and surrounding area	Dwg. No. 096-0179-700-801 83
Island 6 and surrounding area	Dwg. No. 096-0179-700-801 84
Riverbed and Island Contours	Dwg. No. 096-0179-700-801 86
Bear Island to Goose Island Causeway	Dwg. No. 096-0179-700-801 89

A specific cross river flowline corridor depth of cover has not been identified for Norman Wells. The corridors are managed on a case-by-case basis. Cover material is intended to:

1) Provide protection against physical impact, and
2) Provide protection against failure modes due to pipeline free-span (e.g. vortex induced vibration, bending)

The primary intent of the bathymetric survey is to verify that flowline bundles are not exposed (i.e. depth of cover remains >0m), such that the risks outlined above are reduced to the extent possible. Areas which show relatively low cover (<1.0m) or significant

increases or decreases in cover between surveys are flagged for review on an annual basis as monitoring locations.

A summary of the depth of cover measured over the last 4 years is included below in Table B and discussed in Section 4.1.2, below.

In cases where exposure or near-exposure of the bundle is confirmed, appropriate remedial action is triggered.

Remedial action typically consists of deposition of armoring rock on the pipeline corridor. This armoring rock is sized to be stable during anticipated river flow rates and is not expected to be subject to scour. If armoring material is confirmed to be in place, the flowline corridor is considered to be protected from the risks described above.

4.1.2 Summary of Depth of Cover Readings

Section 3.2 of Appendix A sets out the depth of cover survey findings for all flowline corridors surveyed as listed in Table A above. Table B below summarizes the depth of cover measurements for the flowline corridors identified for closer monitoring.

Table B: 2022 Bathymetric Survey Depth of Cover Summary for Corridors for Closer Monitoring

	Monitoring Location				Depth of Cover (m)					
Corridor Name	**Start**	**End (if applicable)**	**Initial Notification**	**Reason for Monitoring**	**2022**	**2021**	**2020**	**2019**	**Volume Difference**	**2022 Comments**
Mainland to Island 1	1+498	-	**2019**	**Low DoC**	**1.3**	1.3	1.2	1.2	+0.4 m^3 (39 $m^{2)}$	-
Mainland to Island 1	1+620	-	**2019**	**Low DoC**	**1.4**	1.3	1.2	1.2	+4.0 m^3 (122 m^2)	-
Mainland to Island 2	1+525	1+594	**2019**	**Low DoC**	**0.9**	0.7	1.2	1.2	+19.3 m^3 (176 m^2)	-
Mainland to Island 2	1+579	-	**2016**	**Low DoC**	**0.9**	0.7	1.2	0.9	+1.0 m^3 (45 m^2)	-
Goose to Island 3	0+550	0+700	**2014**	**Low DoC**	**-**	-	-	-	-	Unable to survey, low water levels – to be surveyed in 2023
Goose to Island 3	0+935	0+970	**2020**	**Low DoC**	**1.0**	1.0	1.4	-	-5.3 m^3 (44 m^2)	-
Goose to Island 3	1+080	1+124	**2016**	**Low DoC**	**1.1**	1.0	1.0	1.2	-	

Goose to Island 4	0+348.2	0+400	**2011**	**Low DoC**	**-**	-	-	-	-	Unable to survey, low water levels – to be surveyed in 2023
Goose to Island 4	0+475	0+485	**2015**	**Low DoC**	**-**	1.3	1.3	-	-	Unable to survey, low water levels – to be surveyed in 2023
Goose to Island 4	1+000	1+025	**2010**	**Low DoC**	**1.6**	1.6	1.7	1.8	-2.0 m^3 (100 m^2)	-
Bear to Island 5	0+148.2	0+233	**2015**	**Low DoC**	**-**	-	1.2	-	-	Unable to survey, low water levels – to be surveyed in 2023
Bear to Island 5	0+334	0+350	**2017**	**Scouring**	**1.5**	-	1.4	1.9	+7.0 m^3 (96 m^2)	-
Bear to Island 5	0+628	0+675	**2015**	**Scouring**	**1.4**	1.2	1.2	1.0	-6.0 m^3 (153 m^2)	-
Bear to Island 5	0+790	0+820	**2014**	**Scouring**	**1.2**	1.3	1.5	1.5	-5.0 m^3 (120 m^2)	
Bear to Island 6	0+125	0+205	**2014**	**Measurement Uncertainty**	**-**	-	-	-	-	Unable to survey, low water levels – to be surveyed in 2023
Bear to Island 6	0+237	0+273	**2017**	**Low DoC / Scouring**	**0.8**	0.7	0.7	1.7*	-	Measurement taken at edge of dataset. Unable to survey, low water levels
Goose to Bear	0+150	0+232	**2014**	**Scouring**	**0.0**	1.2**	1.5**	1.3	-	52 m exposed section of flowline corridor

* Data extrapolated for 2019 measurement

** DoC (m) corrected for 2020 and 2021 as a result of the bathymetric data review for Goose to Bear corridor noted in Section 1.

There were two sections in the 2022 bathymetric survey indicating flowline depths of cover below 1.0 m (listed below), and one area of exposed pipe. The path forward for these locations is as follows.

- Mainland to Island 2 – Station 1+525m to 1+594m (low point at 1+579m) with a depth of cover of 0.9m.
  - Continue to monitor. Depth of cover has remained relatively constant between 2019 and 2022 as outlined in Section 3.2.2 of Appendix A. Reconfirm depth of cover during 2023 survey.

- Bear to Island 6 – Station 0+237m to 0+273m with a depth of cover of 0.8m.
  - Continue to monitor. Riverbed profile has remained relatively constant between 2020 and 2021 as outlined in Section 3.2.7 of Appendix A.

Reconfirm depth of cover during 2023 survey and collect riverbed profile in locations that could not be fully surveyed in 2022 due to low water levels.

- Goose to Bear – Station 0+150 to 0+232 with a depth of cover to 0m.
  - On July 27, 2022, NWO experienced a flowline failure on Line 490 (6" produced water line) along the cross-river portion between Goose Island Terminal 4 (GIT 4) and Bear Island Terminal 4 (BIT 4) at chainage location 0+186.0m, releasing 55 m^3 of a comingled product (77% produced water, 23% freshwater) into the Mackenzie River. A water sampling program was conducted and shared with regulators and indicated no risk to public health or freshwater aquatic life downstream.
  - As noted in the final incident report submitted to the CER and SLWB on November 15, 2022 (Spill # 2022-382, INC2022-122), the investigation identified an exposed, unsupported, suspended pipeline span of approximately 52m along the riverbed, at the location of the failure. The failure was caused by unprecedented riverbed scouring between 2021-2022.
  - As a cautionary measure, the three other flowlines within the cross river corridor were safely shut-in by August 18, 2022 and cleaned. To complete the safe shutdown and isolation of these flowlines, all production was shut-in and winterized on Islands 5, 6 and Bear Island and production remains shut-in as NWO evaluates production re-instatement options.
  - The exposed section of Line 490 is visible in the corresponding 2022 bathymetric survey drawing (096-0179-700-801-78) found in Appendix B. This drawing shows two flowline corridor profiles as hashed lines. The hashed grey line is the 1983 flowline construction profile. The hashed lime green line represents inertial mapping unit (IMU) data from Line 491 collected in September 2022. The IMU profile of the flowline has a margin of error of approximately +/- 1.5m. This margin of error accounts for the differences between the two profiles on the drawing.

As noted above in Table B, there are several sections that were inaccessible to survey in 2022 due to low water levels in the Mackenzie River. In 2023, efforts will be taken to ensure areas previously inaccessible are surveyed to confirm river bottom profile using a combination of on-foot surveying methods and deploying a Zodiac watercraft.

Imperial has engaged a separate contractor to execute the bathymetric survey program in 2023. As noted in the final incident report referenced above, this contractor is also preparing a plan to monitor ongoing hydrodynamic conditions in the Mackenzie River for future operation of cross-river flowlines and is conducting an engineering assessment of all cross-river corridors to assist further evaluations of scouring potential.

5 PROTECTION ASSESSMENT AND MAINTENANCE

5.1.1 Summary of Protection Assessment and Maintenance

5.1.2 2022 Repairs

Island repair work was completed in March 2022 as per recommendations in the 2021 artificial island inspection. Details of the repairs completed are described in the next sections.

5.1.3 Island 1

Per the findings from the 2021 island inspection, a 22m x 18m area and 5m x 5m area both on the south side of the Island indicated a loss of riprap protection. In March 2022, Class E riprap was placed on the south side of the island in both locations to fill the gap based on the recommendations provided by TRS Advisian.

5.1.4 Island 2

The inspection showed Island 2 to be in good condition; therefore, no repairs were required during the winter 2022 season.

5.1.5 Island 3

The inspection showed Island 3 to be in good condition; therefore, no repairs were required during the winter 2022 season.

5.1.6 Island 4

The inspection showed Island 4 to be in good condition; therefore, no repairs were required during the winter 2022 season.

5.1.7 Island 5

The inspection showed Island 5 to be in good condition; therefore, no repairs were required during the winter 2022 season.

5.1.8 Island 6

The inspection showed Island 6 to be in good condition; therefore, no repairs were required during the winter 2022 season.

5.1.9 2023 Proposed Repairs

The 2022 Artificial Island Inspection was completed in August by Wim M. Veldman Consulting and TRS Advisian. The 2022 recommendations put forth by the inspectors form the basis for the island repairs to be completed during the 2022/2023 winter season.

5.1.10 Island 1

The inspection showed Island 1 to be in good condition; therefore, no immediate repairs are required during the 2022/2023 winter period.

5.1.11 Island 2

The inspection showed Island 2 to be in good condition; therefore, no immediate repairs are required during the 2022/2023 winter period.

5.1.12 Island 3

The inspection indicated slippage of concrete blocks along the NE corner of Island 3. TRS Advisian recommends moving the concrete blocks back into their original positions and then abutting Class E rip rap (approximately 1300 m^3) up against the blocks to secure their positions. Imperial plans to complete these recommended repairs in March of 2023.

5.1.13 Island 4

The inspection indicated slippage of concrete blocks along the NE corner of Island 4. TRS Advisian recommends moving the concrete blocks back into their original positions and then abutting Class E rip rap (approximately 100 m3) up against the blocks to secure their positions. Imperial plans to complete these recommended repairs in March of 2023.

5.1.14 Island 5

The inspection showed Island 5 to be in good condition; therefore, no immediate repairs are required during the 2022/2023 winter period.

5.1.15 Island 6

The inspection showed Island 6 to be in good condition; therefore, no immediate repairs are required during the 2022/2023 winter period.

6 FLOWLINE AND FUEL STORAGE TANK INTEGRITY

The operational integrity of all critical equipment is stewarded through Imperial's preventative maintenance program, which is derived from the OIMS Facility Integrity Management System (FIMS). FIMS is the system that identifies critical equipment and sets forth the required preventative maintenance programs and frequencies.

6.1.1 Fuel Storage Tank Integrity Inspections

Table C lists the fuel storage tanks on site, the type and frequency of inspection performed on each tank, along with the results.

Table C: 2022 Fuel Storage Tank Integrity Inspections Results

Tank Name	Type of Inspection	Results
Goose Island Diesel	5 Year External Visual	– Last inspection completed in 2020; no issues – Next inspection due in 2025
	10 Year External Visual and UT Survey	– New vessel installed in 2015. Baseline UT survey completed in 2015; no issues – Next inspection due in 2025
	1 Month External Visual	– Completed monthly; no issues
Goose Island Gas	5 Year External Visual	– Last completed in 2020; no issues – Next inspection due in 2025
	10 Year External Visual and UT Survey	– New vessel installed in 2015. Baseline UT survey completed in 2015; no issues – Next inspection due in 2025
	1 Month External Visual	– Completed monthly; no issues
Bear Island Gas	5 Year External Visual and UT Survey	– 2021 inspection completed; no issues – Next inspection due in 2026
	1 Month External Visual	– Completed monthly; no issues
Bear Island Diesel	5 Year External Visual and UT Survey	– New vessel installed in 2020 – Next inspection due in 2025
	1 Month External Visual	– Completed monthly; no issues
Mainland Diesel	5 Year External Visual	– New vessel installed in 2015 – Last inspection completed in 2020; no issues – Next inspection due in 2025
	10 Year External Visual and UT Survey	– New vessel installed in 2015. Baseline UT survey completed in 2015; no issues – Next inspection due in 2025
	1 Month External Visual	– Completed monthly; no issues
CPF T-103 Diesel	5 Year External Settlement	– External settlement inspection completed in 2022; no issues – Next inspection due in 2027
	5 Year External Visual	– Last completed in 2021; no issues – Next inspection due in 2026
	10 Year Internal	– Last completed in 2015; no issues

		– Next inspection due in 2025
T-104 Emergency Generator Diesel	5 Year External Visual	– Last completed in 2019; no issues – Next inspection due in 2024
	10 Year External UT	– Last completed 2017; no issues – Next inspection due in 2027
Mainland Heating Oil	1 Month External Visual	– Completed monthly; no issues.
CPF Heating Oil Double Wall Tank	1 Month External Visual	– New tank installed in 2018 – Completed monthly; no issues.
Warehouse Heating Oil Double Wall Tank	1 Month External Visual	– New tank installed in 2018 – Completed monthly; no issues.
Mud Plant Heating Oil Double Wall Tank	1 Month External Visual	– New tank installed in 2018 – Completed monthly; no issues.

6.1.2 Flowline Integrity

There are approximately 25 cross-river flowlines that are inspected using a combination of in-line inspection and non-destructive evaluation (NDE). Conservative assumptions coupled with an evaluation of inspection results are used to determine the inspections frequencies. Table D lists the planned flowline integrity (cross-river and land based) inspections that were completed in 2022, along with the inspection type for each of the flowlines, and the inspection results.

Table D: 2022 Flowline Integrity Inspections Results

Flowline	Route	Cross-river (Y/N)	Date	Scope	Comments
44	LPT1 to CPF	N	7/14/2022	Inline Inspection (ILI)	An ILI was completed. The results are currently being reviewed. Predominantly external metal loss, and some internal metal loss, was reported.
71/82	GIT4 to CPF	Y	10/19/2022	Non-Destructive Examination (NDE)	External metal loss was identified and repaired with coating.
111	BIT4 to GIT4	Y	9/18/2022	ILI (MFL)	Minor external metal loss (<=30% wt) and one shallow dent reported.
111	BIT4 to GIT4	Y	9/21/2022	ILI (Circumferential Crack)	Four circumferential crack-like features reported.
491	BIT4 to GIT4	Y	9/1/2022	ILI (MFL)	Minor external metal loss (<30% wt) reported.
491	BIT4 to GIT4	Y	10/8/2022	ILI (Circumferential Crack)	No circumferential crack-like features reported.
448	CPF to GIT4	Y	5/15/2022	NDE	Minor metal loss (<20% wt) found.
1037	O45X to BPT2	N	5/12/2022	NDE	Repeat inspection (prior was in 2015).
65/77	GIT 4 to CPF	Y	5/14/2022	NDE	NDE on land section in utilidor where there is no Flexsteel liner. External metal loss from ubolt

					rubbing hasn't increased since 2019 inspection.
186	GIT 9 to GIT 4	N	10/17/2022	NDE	External corrosion aligned with ILI tool call from 2021 and was recoated.
450	CPF to GIT 4	Y	9/20/2022	Ground riser inspection	Shrink sleeve was found to be disbonded. Some iron scaling was detected but no pitting. Riser had new coating applied.
529	LINE 596 TO D-47X	N	7/9/2022	NDE	Minor external metal loss found.
419	CPF to Mainland West	N	5/17/2022	NDE	Minor metal loss found.

LIST OF APPENDICES

Appendix A: 2022 Norman Wells Bathymetric Survey Report (GeoVerra)
Appendix B: 2022 Bathymetric Survey Drawings (GeoVerra)

GeoVerra

Imperial Oil Resources Ltd.

Norman Wells Bathymetric Survey

December / 2022 Rev 1

November / 2022 Rev 0

Project # 22-02273

Reference # 171-08147; 21-01940

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1. Introduction

Under license S03L1-001 issued by the Sahtu Land and Water Board, Imperial Oil Resources (IOR) has an annual requirement for a bathymetric survey at its Norman Wells facility. GeoVerra was tasked with completing the bathymetric survey for the year of 2022 and by using state of the art equipment could fulfill Imperial's requirements as regulated by the Sahtu Land and Water Board. This report is revision 1 to include updated drawing profiles. This report was revised as it came to light that the causeway and pipeline profiles between Goose and Bear Island had been switched between drawing # 096-0179-700-801 89 and # 096-0179-700-801 78. This has been corrected in the revised report

2. Field Methodology

2.1. Personnel

The following personnel were involved at various stages of the bathymetric survey (field and office):

- Alexandre Paradis, Hydrographer, Task Leader – WSP
- Cameron Welby, Hydrographer – WSP
- Jonathan Navas - IOR Boat Captain
- Kevin Laroche, Data Processor – WSP
- Alex LeBlanc, Data Processor – WSP
- Alex Morin, Bathymetric Lead – WSP
- Mark Hickaway, Project Manager – GeoVerra

2.2. Diary of Activities

The following is a summary of the daily activities during the field phase of the project:

1. September 15th (Thursday) – Mobilization of both WSP's crew members to Edmonton.
2. September 16th (Friday) – Mobilization from Edmonton to Norman Wells. Alexandre and Cameron went to pick up the survey gear at Canadian North Norman Wells and found out that one of the eight packages originally sent had been replaced by another box belonging to someone else: all the long equipment (survey poles, tripods, and GPS antennas) was not in Norman Wells. WSP's crew members also had their site orientation and talked with Travis Warren, of Imperial, about the zone between Bear and Goose islands which had to be done as quick as possible because Imperial suspected the pipe to be exposed. Finally, Alexandre and Cameron went to see the boat and began unpacking equipment while coordinating with GeoVerra crew on site to replace missing gear.
3. September 17th (Saturday) – Alexandre built another pole for the multibeam equipment and acquired replacement gear from the GeoVerra crews currently on site. Alexandre proceeded to link the gear with the GPS base station and surveyed the control point to validate the installation.

Alexandre and Cameron then conducted measurements of all the leaver arms for the multibeam gear in relation to its installation on the boat.

4. September 18th (Sunday) – The boat was put in the water and the crew proceeded with calibration of the multibeam system (GAMS test and Patch test) in the slope going from Island 3 to shore. The crew began surveying the Bear to Goose zone in the afternoon. The zone was nearly completed at the end of that day, with only minor data gaps needing to be filled the following day. Alexandre began cleaning the data and transferred the information to the processing team in Quebec to produce an image for the client as quick as possible.
5. September 19th (Monday) – The zone between Bear and Goose was completed in the morning before the crew moved to Island 5, beginning in the shallow area near Goose Island. The crew also attempted to access the smaller area of pipe from Goose Island to Island 4; it was deemed inaccessible due to shallow water levels. The processing team in Quebec continued processing the data from the 18th while Alexandre began cleaning the data obtained in the field on the 19th.
6. September 20th (Tuesday) – The zone around Island 5 was completed in the morning, before continuing with Island 4 in the afternoon.
7. September 21st (Wednesday) – The zone around Island 4 was completed in the morning, with the crew moving to the shallow portion of Island 3 in the afternoon. Images of the area between Bear and Goose islands were made in Quebec and sent to Imperial representatives for review. Additional follow up questions were answered by Alexandre on site.
8. September 22nd (Thursday) – The day started with the survey of the shallow portion of Island 3, before the crew moved on with the deeper zone along the alignment towards the mainland.
9. September 23rd (Friday) – Bad weather (high winds and waves) prevented the crew from finishing the shallow portion of Island 3 alignment near mainland The crew instead began the day in the zone close to the shore of Island 1. Once completed, they moved on to Island 2 and the additional zone requested in this year's survey to mitigate the poor weather by surveying near the shoreline.
10. September 24th (Saturday) – The crew completed Island 3 and spent the remainder of the day surveying around Island 1.
11. September 25th (Sunday) – The crew finished surveying around Island 1 in the morning and moved on to Island 2 and the additional zone in the afternoon. The crew was informed by the captain that he was only available until the following Thursday afternoon; no captain would be available for surveying afterwards.
12. September 26th (Monday) – The crew spent the entirety of the day surveying Island 2 and the additional area near the shore and existing dock. The water level was very shallow (around two meters everywhere), resulting in a smaller swath coverage than normal.
13. September 27th (Tuesday) – After consulting with Travis about area priority and the availability of the captain, it was agreed that the crew would focus on the remaining zones around Islands 2 and 6 and complete the additional zone with the remaining time. The crew went on to finish the zone around Island 2 that day.

14. **September 28th (Wednesday)** – The crew began the survey around Island 6 in the shallow waters but were unable to get as close as they have in past years as the water levels were quite low.
15. **September 29th (Thursday)** – The crew was able to finish the survey scope around Island 6 in the morning. Alexandre and Cameron then proceeded to remove all the survey equipment from the boat and prepare the shipping to Edmonton with Canadian North in the afternoon.
16. **September 30th (Friday)** – The crew travelled from Norman Wells to Edmonton. Cameron took a flight from Edmonton to Calgary the same day while Alexandre stayed in Edmonton.
17. **October 1st (Saturday)** – Alexandre travelled from Edmonton to Quebec City.

2.3. Water Level and Conditions

Figure 2.3.1 depicts the Mackenzie River water elevations as recorded during the survey.

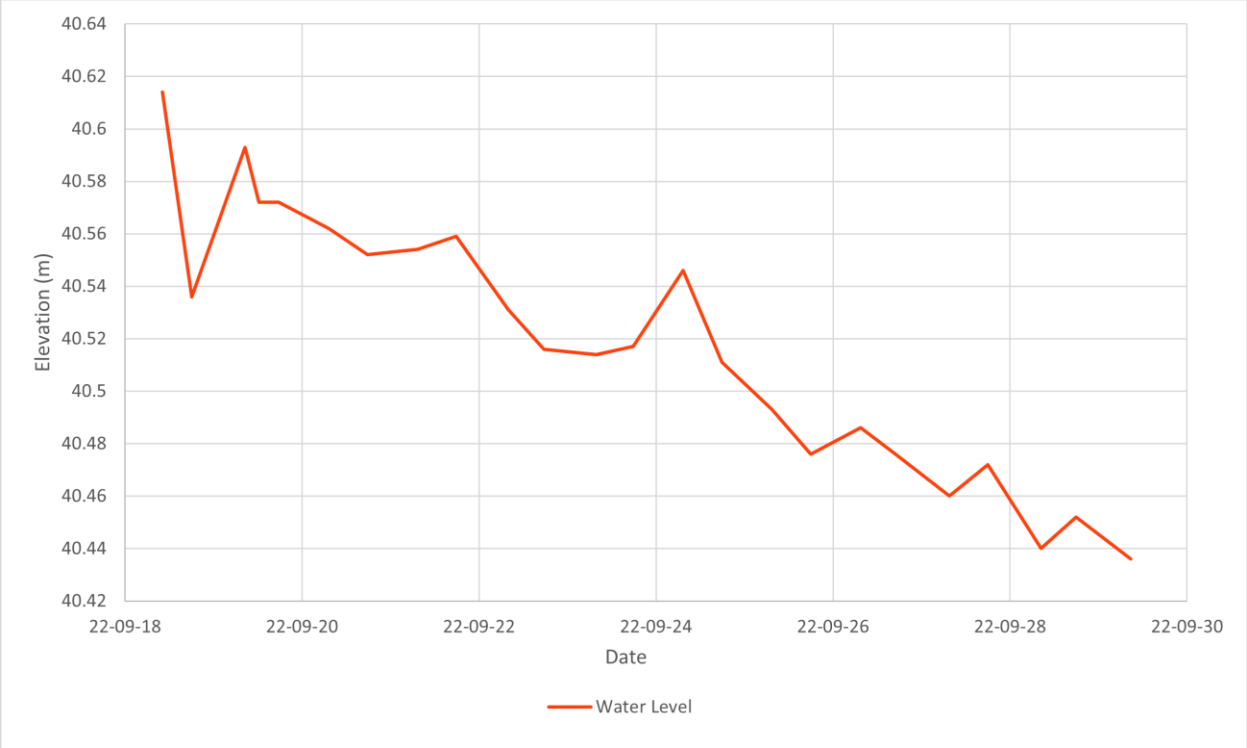


Figure 2.3.1 Mackenzie River water elevation (September 18th to September 29th, 2022)

The elevations shown on the chart were collected at the start and end of each day using a RTK GPS Leica GS-14 receiver.

The final elevations of the bottom were obtained during the bathymetric survey, using the correction sent by radio from the GPS base station to the multibeam system's GPS on the boat. Given the constant changes in the level of water, this method provides the best measurements to determine the true geodetic elevation of the bottom in real time while surveying.

For this project, the final river bottom elevations were determined in the manner described above, i.e., directly from the RTK GPS observations.

2.4. Horizontal Datum

The horizontal datum used for the 2022 bathymetric survey is derived from control point # WSP002 and its NAD83 UTM coordinates are as follows:

- Northing = 7,241,656.910
- Easting = 599,583.093
- Elevation (Geodetic) = 50.673m

To convert from NAD83 to NAD27, the following datum-shift parameters were used as provided by Imperial:

- dX= -13.445m
- dY= -144.355m
- dZ = -196.466m

By utilizing the same coordinate system and transformation between the various years of data collection, a more meaningful comparison of the river bottom can be achieved.

2.5. Vertical Datum

As with the horizontal datum, the vertical datum was provided by Imperial and is a Geodetic datum. The conversion from Site Elevation (1974 Adjustment) to Geodetic Elevation is as follows:

Geodetic Elevation = Site Elevation (1974 Adjustment) – 0.776 m.

2.5.1. Northern Loram Pipe ProFile Update

On several of the profile drawings that accompany this report, the note “Top of Pipe as per Northern Loram (August 1984 Survey)” appears on the plan. In using the documentation provided by Imperial as created by MMM Group Limited in 2014, GeoVerra has taken the following excerpt for this document which references the MMM report from 2007 regarding the vertical datum issue that appears to exist for this reference data.

“As explained previously, there is a 0.776m difference between the site vertical datum and the geodetic datum used for the bathymetry. This is important – if NL TOP data shown on the plan is actually referred to site vertical datum instead of the Geodetic datum, it is too high by 0.776 m. Therefore, the calculated DOC would be less by the same amount. There is a note on all the bathymetric pipeline plans concerning the Northern Loram data which reads “PIPE PROFILE AND CHAINAGES FROM ESSO DWG 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM”. During the preparation of this report a copy of this plan and others were obtained from IOR. The plan shows the bathymetric data for the years 1984 – 1990 for the buried pipelines across the Mackenzie at Norman Wells. There is a note on this plan (DWG 80054 REV.8) that reads “ELEVATIONS BASED ON GSC 747016 AT 60.93 m”. The number 747016 is incorrect and should read 74T016. Notwithstanding the error, the note confirms that Site (not Geodetic) vertical datum was

used for this plan. The Northern Loram TOP and CES 1983 bottom data is shown on these plans. It is shown at the same elevation as on the current version of the bathymetric plans – the plans provided to MMM Geomatics in 2004. Therefore, the Northern Loram and CES 1983 data must be shown incorrectly on one version of the plans. The opinion expressed here is that the IOR bathymetric survey work was originally referred to the Site vertical datum in 1984. That datum continued in use to at least 1990. Sometime thereafter the decision was made to shift the vertical datum to Geodetic. It is speculated that this may have been for government reporting purposes. It appears that when the vertical datum was changed that the Northern Loram and CES 1983 data was not shifted, i.e., the pipe profiles shown on the current version of the bathymetric plans is too high by 0.776 m."

As explained by MMM in their 2014 report, all Northern Loram and C.E.S 1983 were lowered on the 2008 drawing by the 0.776m that is mentioned above. It should be noted that all line work for 2014 and earlier was provided to GeoVerra from Imperial / MMM so therefore we are using the same data assumption as made by MMM in 2014.

2.6. Bathymetric Survey Equipment

2.6.1. Survey Launch

The survey launches and boat captains for this project were supplied by Imperial Oil Resources. The primary launch (Boat 1 – Figure 2.6.1.1) is a 7.3 m. aluminum vessel equipped with a 250 hp, 4 stroke Suzuki motor. The motor was equipped with a propeller.

Figure 2.6.1.1

The survey launch was equipped with the required survey equipment and all instruments were interfaced into a central control platform running Hypack navigation and control software

Figure 2.6.1.2

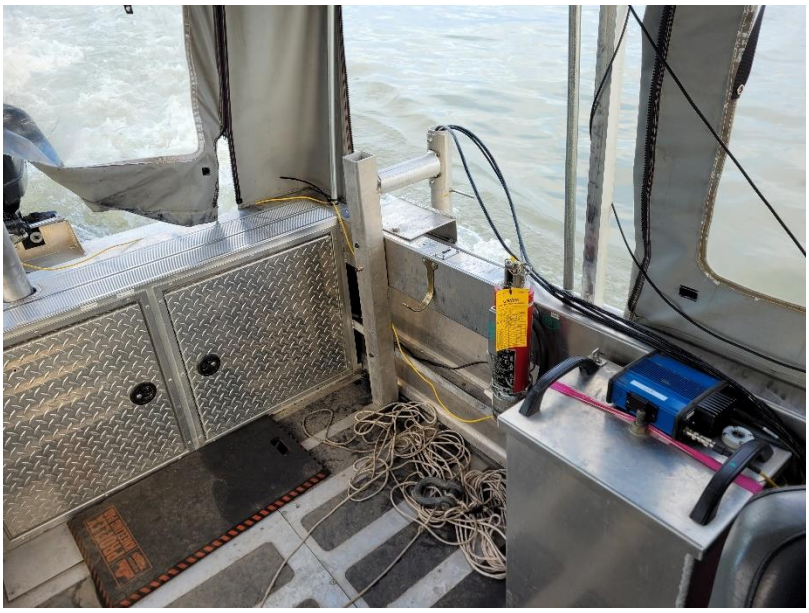


Figure 2.6.1.3

In 2022, a R2Sonic 2020 multibeam system was used for the bathymetric survey in Norman Wells. The high frequency of the R2Sonic 2020 allows to acquire accurate and clean data. To accomplish the multibeam system installation on the boat, a new survey pole was fabricated in the shop to replace the missing parts of equipment lost in the shipping form Quebec to Norman Wells. The new pole is shown in figure 2.6.1.2. Offsets for the bathymetric sensors including the multibeam, IMU, and GPS antennas were accurately measured using conventional survey and measurements methods. Prior equipment installations included a metal support that securely fixed the pole, as shown in figure 2.6.1.3.

2.7. Navigation and Positioning

The GPS RTK (Real Time Kinematic) system utilized for the survey consisted of two Leica dual frequency geodetic quality receivers. The system also included a Satel radio system consisting of a 35-watt base radio and a rover radio. The system provided real-time corrected horizontal and vertical positions through the course of the survey. The base receiver and radio equipment were set up on a known control point (control station WSP002) near the work area. The NAD83 UTM coordinates for station WSP002 are:

- Northing = 7,241,656.910
- Easting = 599,583.093
- Elevation (Geodetic) = 50.673m

2.8. Sonar System

The R2Sonic is a high quality multibeam sonar capable of acquiring very dense and accurate bathymetric data. Some of the key features of the R2Sonic 2020 are as follows:

- Over 20x user selectable frequencies from 200 to 400 kHz, selectable on the fly, in real-time during survey operations.
- Focused 1° x 1° beam widths
- 60kHz signal bandwidth over entire frequency range.
- True range resolution of 1.25 cm, all frequencies.
- Selectable swath coverage from 10° to 160°, selectable on the fly, in real-time during survey operations.
- 1 to 100 metre range.

The effective swath width of the R2Sonic system is approximately 2- or 3-times water depth. The deeper the water, the larger the footprint of the bottom covered during any one pass.

2.8.1. Motion Referencing Unit

The Applanix Pos MV is considered the highest rated MRU on the market today and it is for this reason that GeoVerra decided to utilize this unit for the survey. This motion reference unit is the 'benchmark' to which all MRU's are compared. The manufacturer's claimed accuracies are:

- Roll, Pitch Accuracy 0.02°
- Heading accuracy 0.02°
- Velocity accuracy 0.03m/sec

2.8.2. Calibration, Accuracy, and Data Validation

The sonar system must be calibrated for yaw, roll and pitch. The measured calibration values are entered in to the Hypack software. Prior to or during the bathymetric survey, the vessel proceeds to an area where there are both a flat seabed and a rapidly changing seabed to accommodate the 'patch' tests. A pre-configured set of procedures are conducted to gain the calibration values which are used for the remainder of the day.

The accuracy of the final elevations from sounding data is dependent on several factors including:

- the accuracy of the sounder hardware
- speed of the survey launch
- attitude of the survey launch
- river current at time of survey
- wind at time of survey

The digital data produced during the survey was reviewed and checked prior to leaving Norman Wells. It was important to confirm the quality and completeness of the sounding data before leaving the field in case of poor or missing data that would need to be re-surveyed.

3. Office Computations

3.1. Bathymetry

The 2022 bathymetric data was collected using an R2Sonic 2020 multibeam system. The entire survey was completed with the R2Sonic 2020 system; the crew did not use a single beam echo sounder for shallower areas because of safety concerns in those places. In addition to the usual survey areas around the islands, and additional zone was requested near Island 2. With the water levels being seasonably low during the 2022 survey, which took place in late September rather than June when water levels are optimal, the additional area stood in shallow water making it difficult to cover entirely as the swath was limited. Without a boat captain available past the 29 of September, crews were forced to limit their availability for the additional area and were unable to get as close as desired to the shoreline. The following images were extracted from the 2022 data set. The pictures are false color coded using a color temperature scale to represent depth, where dark blues indicate deep water and dark red indicates shallow water. For clarity, yellow indicates deeper water than orange on the elevation scale.

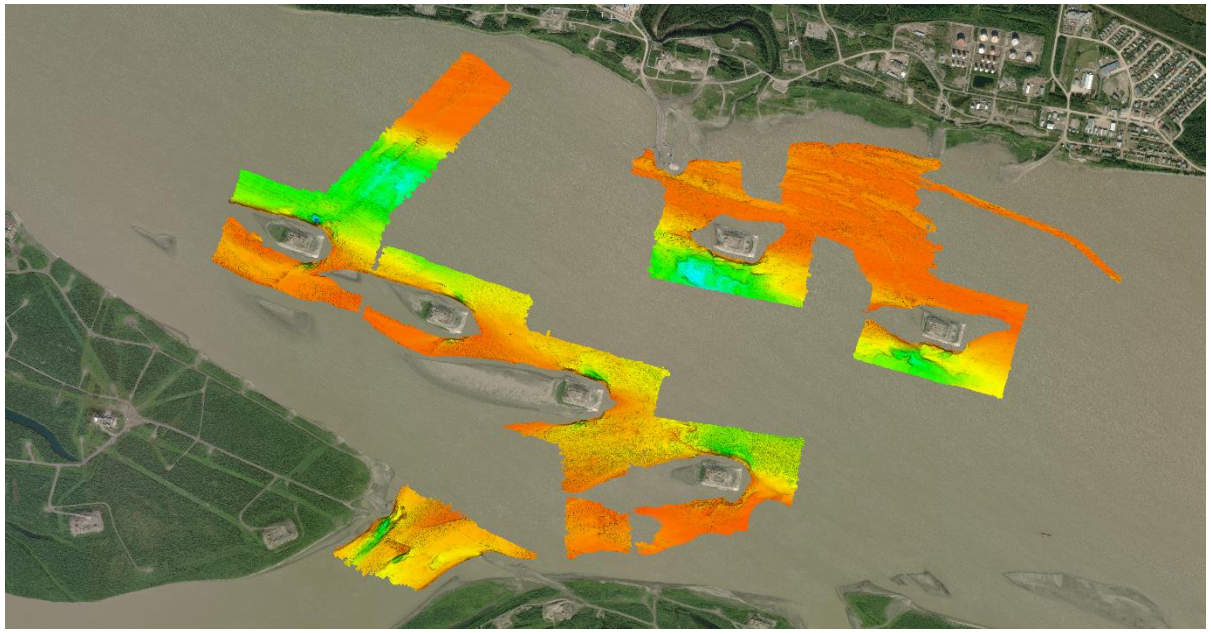


Figure 3.1.1: 2022 Overall Data Coverage

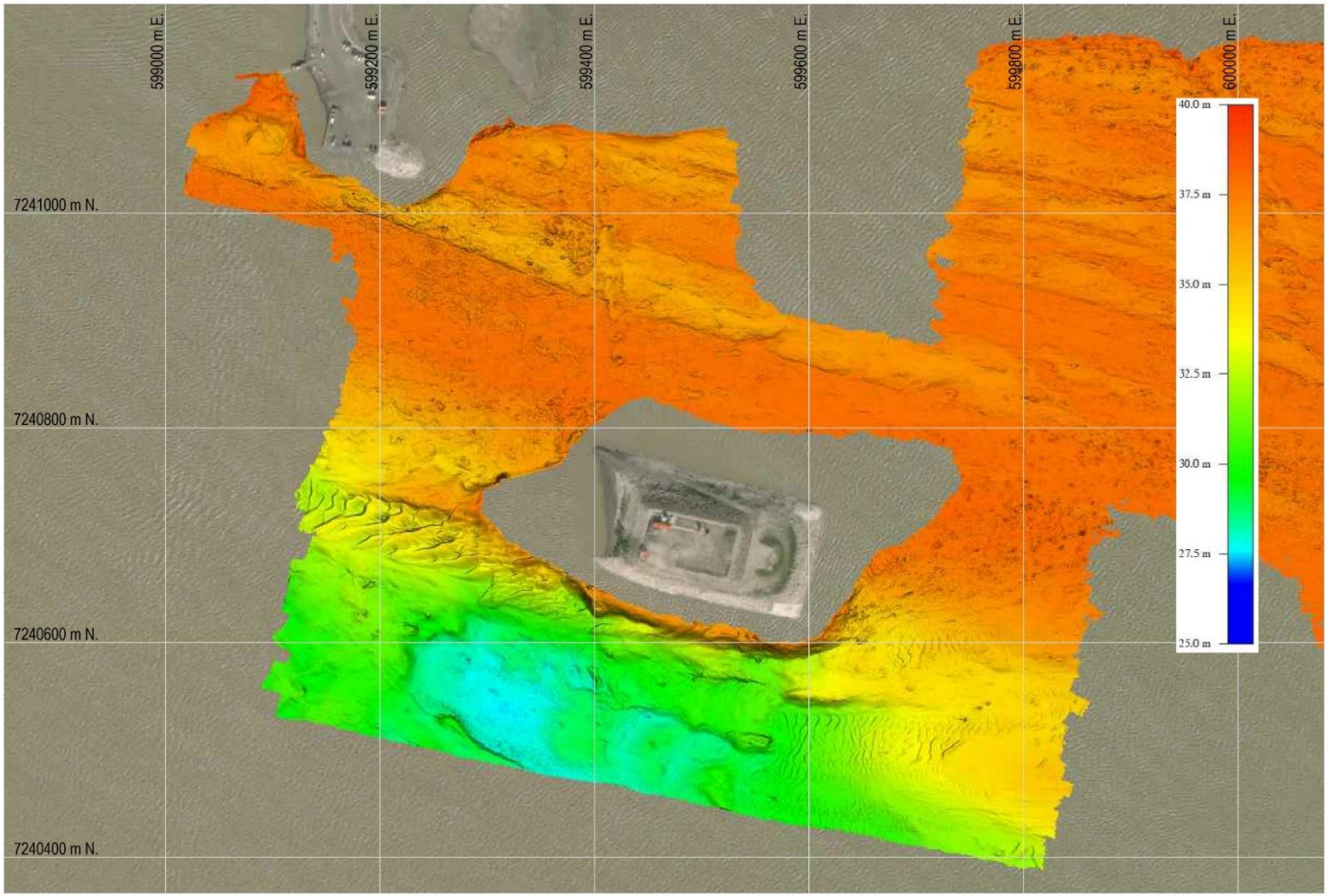


Figure 3.1.2: Island 1 to Mainland (2022 Bathymetric Survey Coverage)

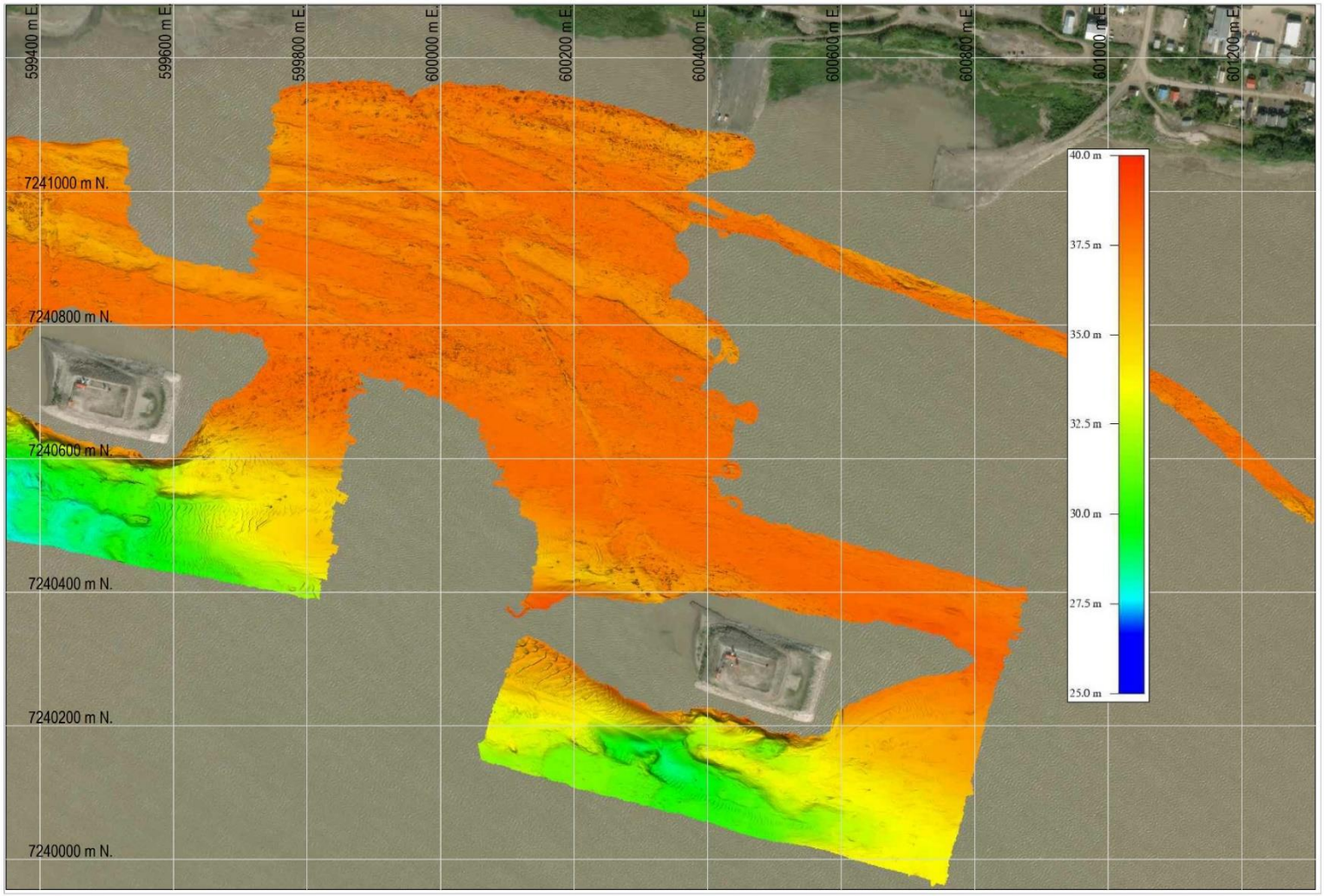


Figure 3.1.3: Island 2 to Mainland (2022 Bathymetric Survey Coverage)

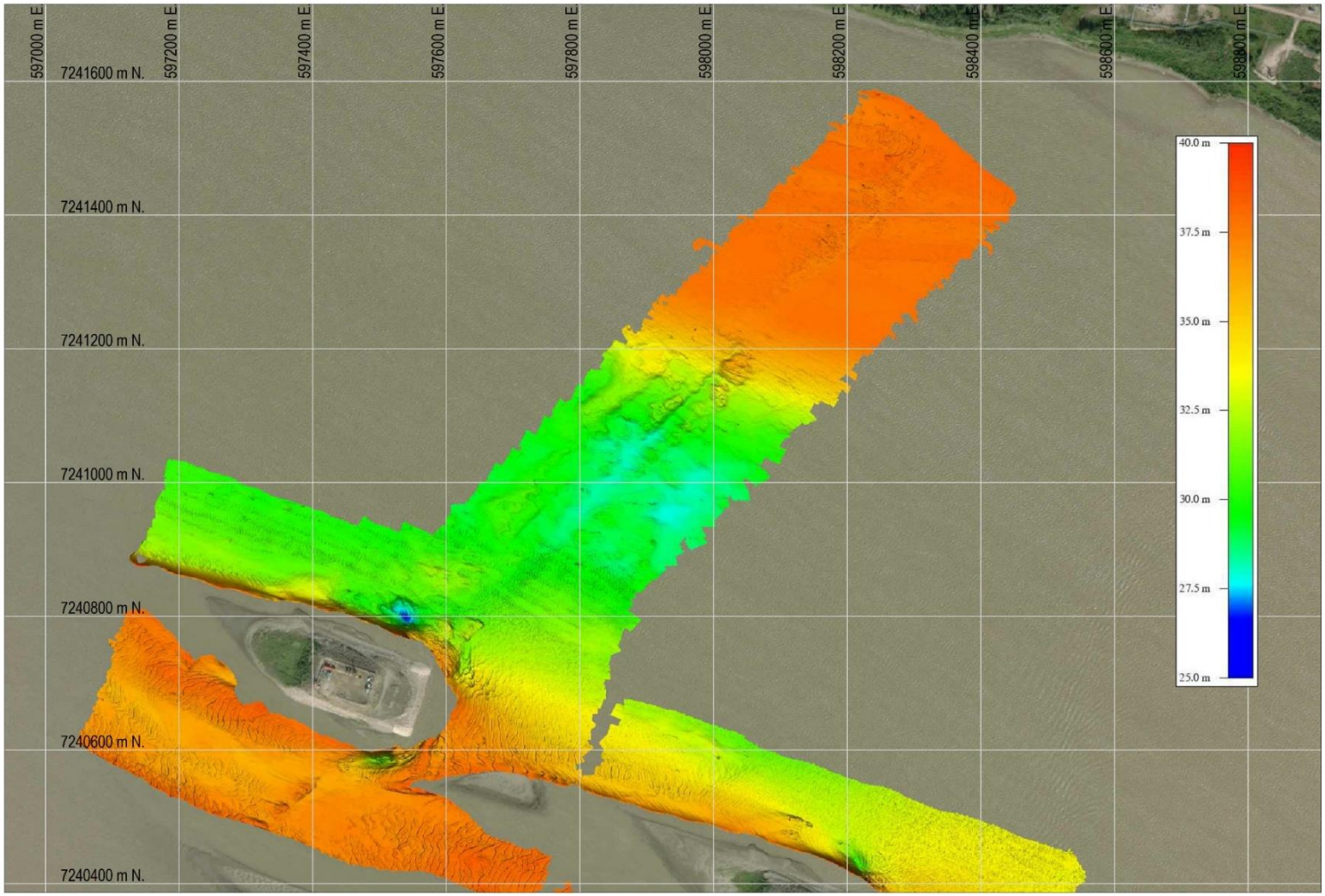


Figure 3.1.4: Island 3 to Mainland (2022 Bathymetric Survey Coverage)

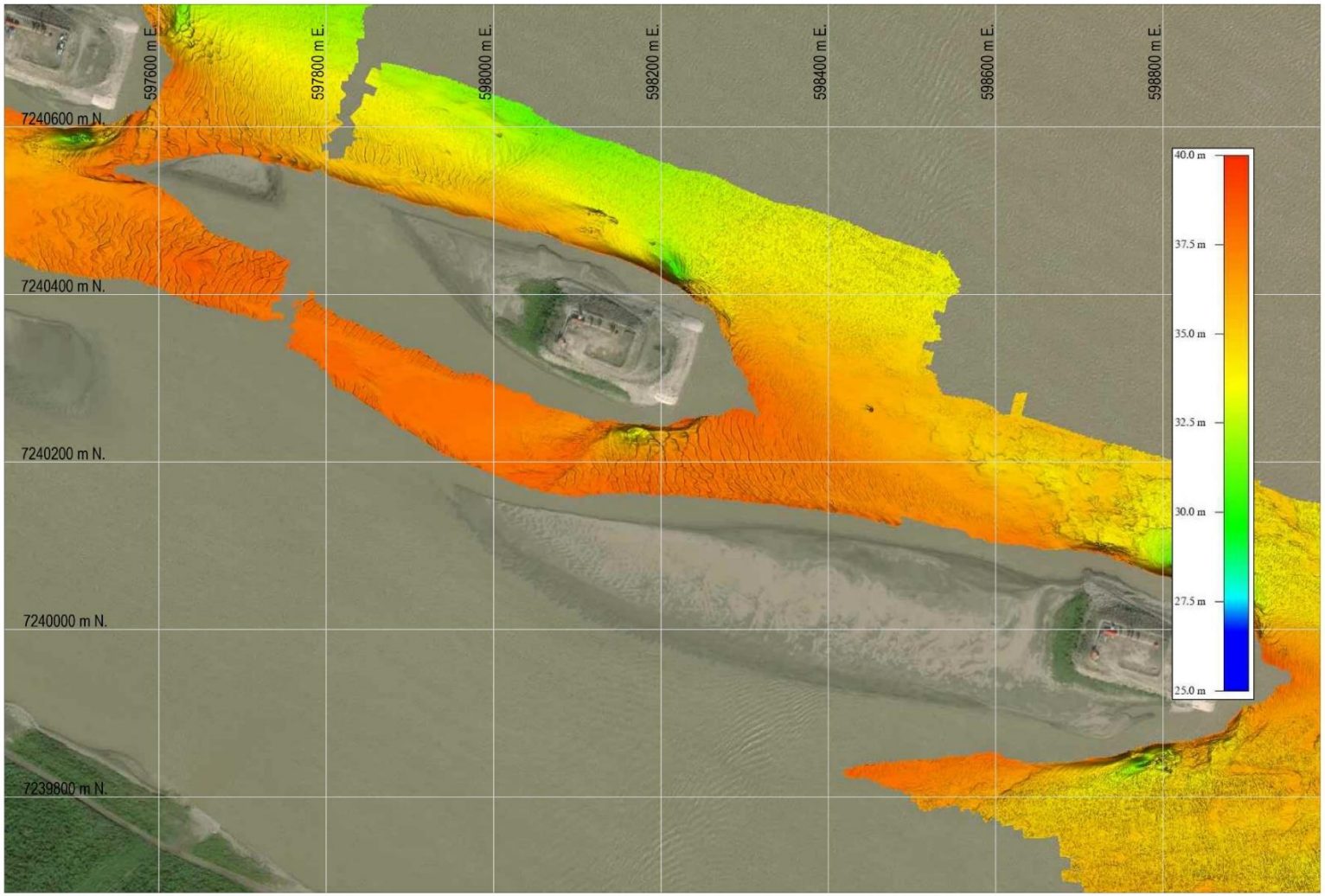


Figure 3.1.5: Island 4 (2022 Bathymetric Survey Coverage)

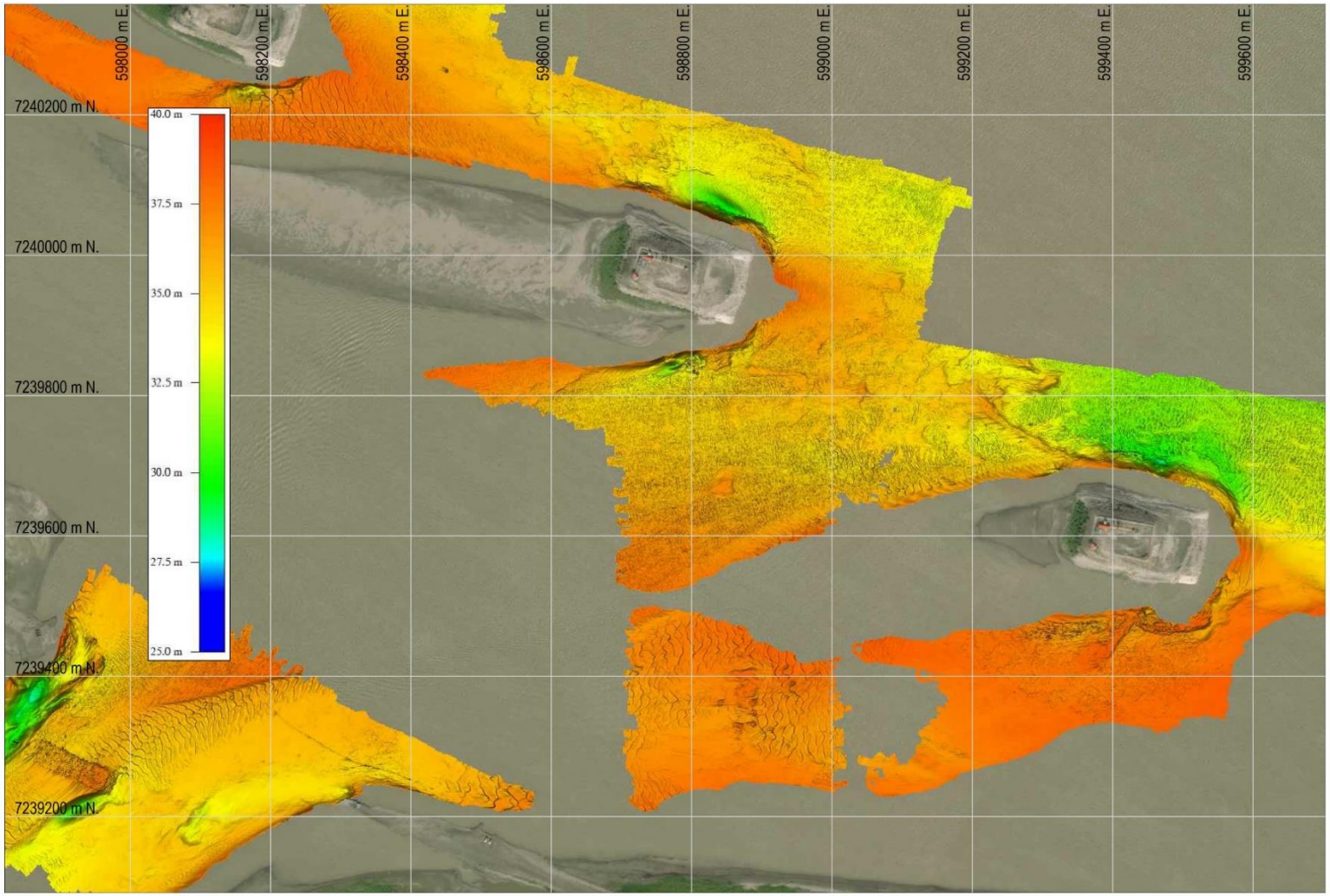


Figure 3.1.6: Island 5 (2022 Bathymetric Survey Coverage)

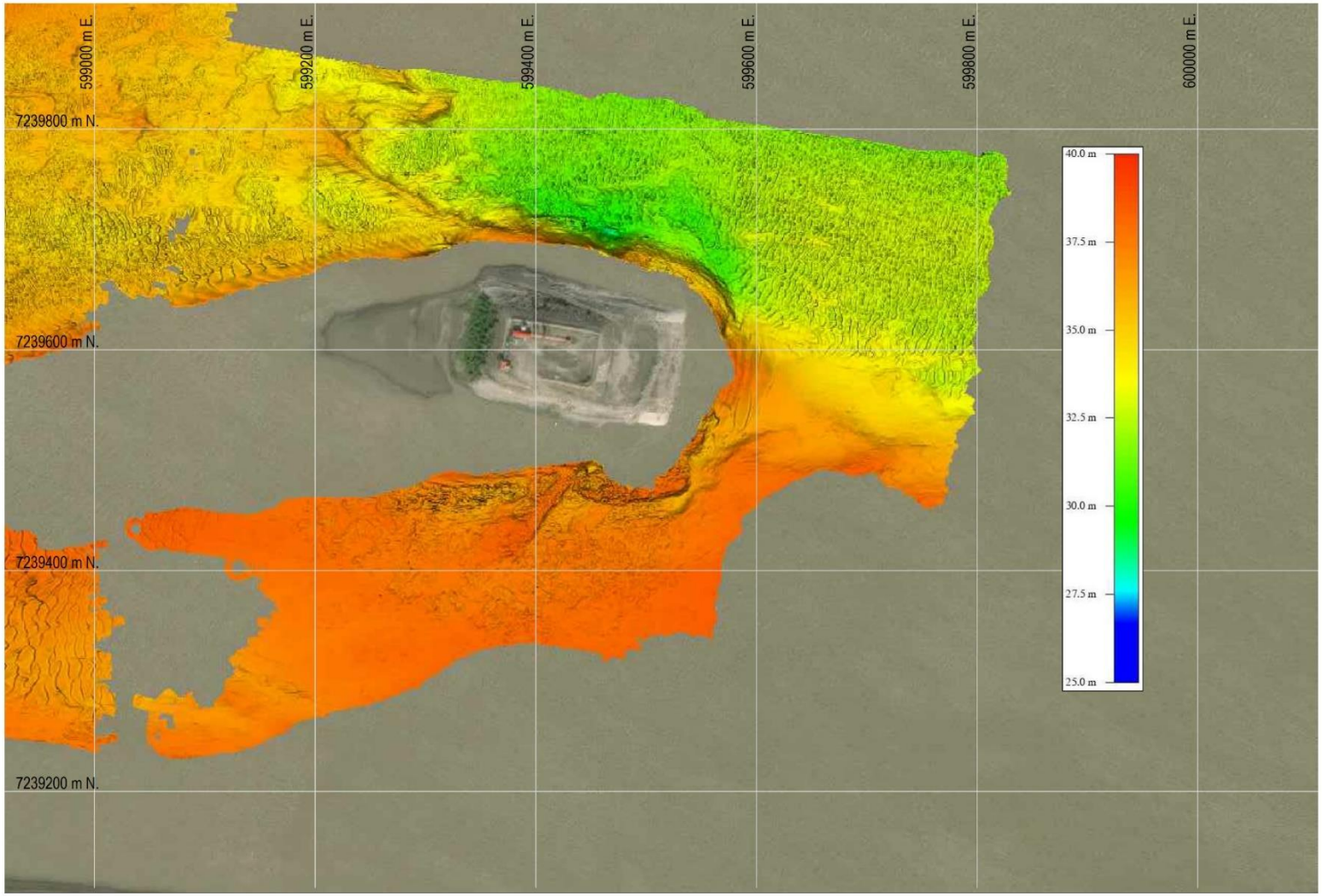


Figure 3.1.7: Island 6 to Bear Island (2022 Bathymetric Survey Coverage)

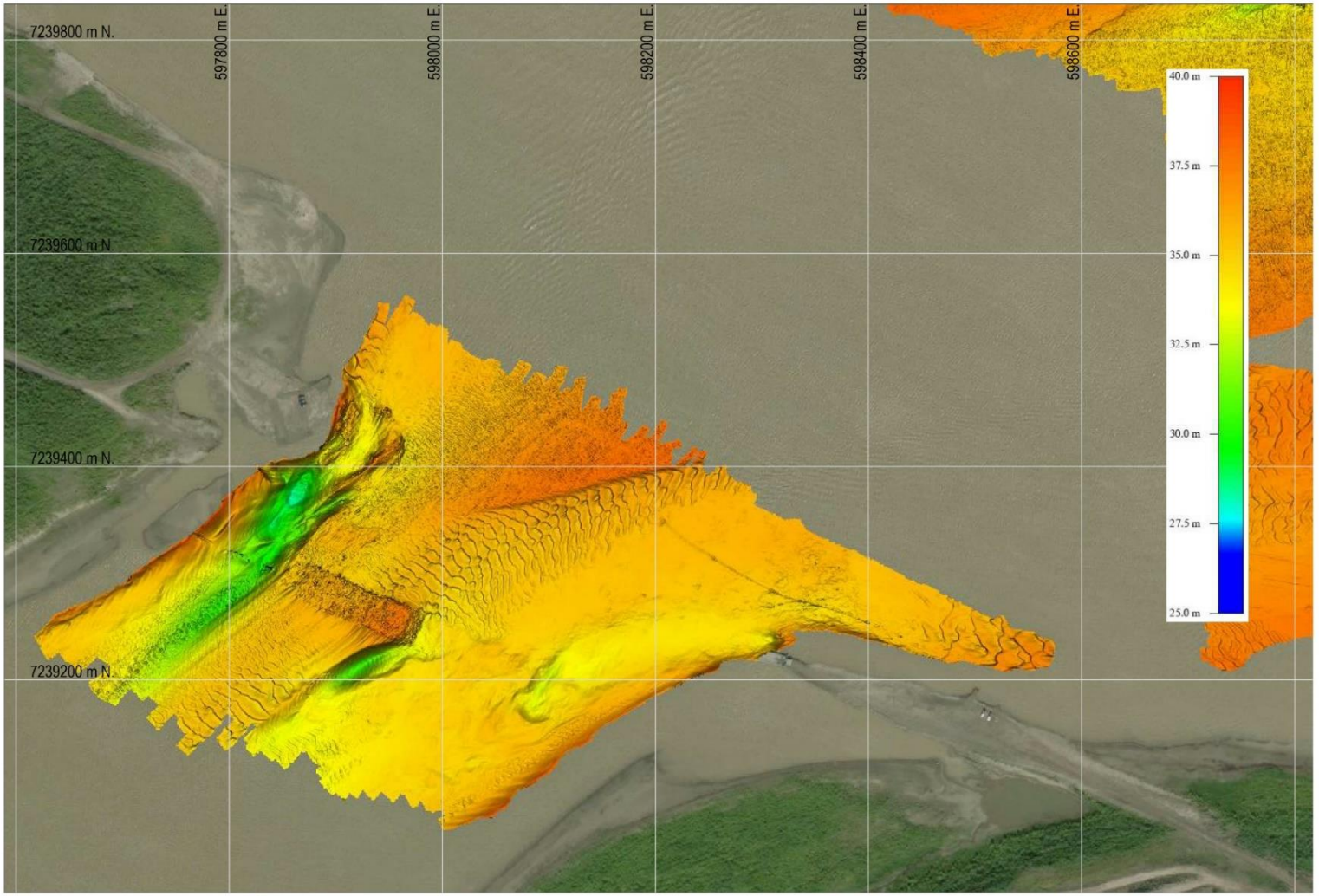


Figure 3.1.8: Bear Island to Goose Island (2022 Bathymetric Survey Coverage)

3.2. Final Bathymetric Plans

The following bathymetric survey plans were produced for this project:

Island 1 to Mainland Flowline	Dwg. No. 096-0179-700-801 71
Island 2 to Mainland Flowline	Dwg. No. 096-0179-700-801 72
Island 3 to Goose Island Flowline	Dwg. No. 096-0179-700-801-73
Island 3 to Mainland Flowline	Dwg. No. 096-0179-700-801 74
Island 4 to Goose Island Flowline	Dwg. No. 096-0179-700-801-75
Island 4 to Bear Island Flowline	Dwg. No. 096-0179-700-801 76
Island 6 to Bear Island Flowline	Dwg. No. 096-0179-700-801-77
Bear Island to Goose Island Flowline	Dwg. No. 096-0179-700-801 78
Island 1 and surrounding area	Dwg. No. 096-0179-700-801 79
Island 2 and surrounding area	Dwg. No. 096-0179-700-801 80
Island 3 and surrounding area	Dwg. No. 096-0179-700-801 81
Island 4 and surrounding area	Dwg. No. 096-0179-700-801 82
Island 5 and surrounding area	Dwg. No. 096-0179-700-801 83
Island 6 and surrounding area	Dwg. No. 096-0179-700-801 84
Riverbed and Island Contours	Dwg. No. 096-0179-700-801 86
Bear Island to Goose Island Causeway	Dwg. No. 096-0179-700-801 89

3.2.1. Mainland to Island 1 (Rayuka)

The 2022 bathymetric survey revealed little movement along the pipeline alignment and the surrounding area for Island 1 when compared to the 2021 data set. As shown in the comparison image below, the alignment experienced negligible movement this past year with the majority of change falling in the ~10cm range. This is also evident in the profile drawing # 096-0179-700-801 71 where the riverbed as determined in 2022 shows negligible change in the past 4 years.

Both areas of interest in the Mainland to Island 1 alignment showed consistent readings, with the low depth of cover remaining steadily at the ~1.3-1.4m range. These chainages of 1+492 and 1+620, although remaining consistent the last 5 years, are at a cover level that could prove to be concerning if any erosion occurs. It is recommended that these items remain monitored for sediment change in the case erosion is identified.

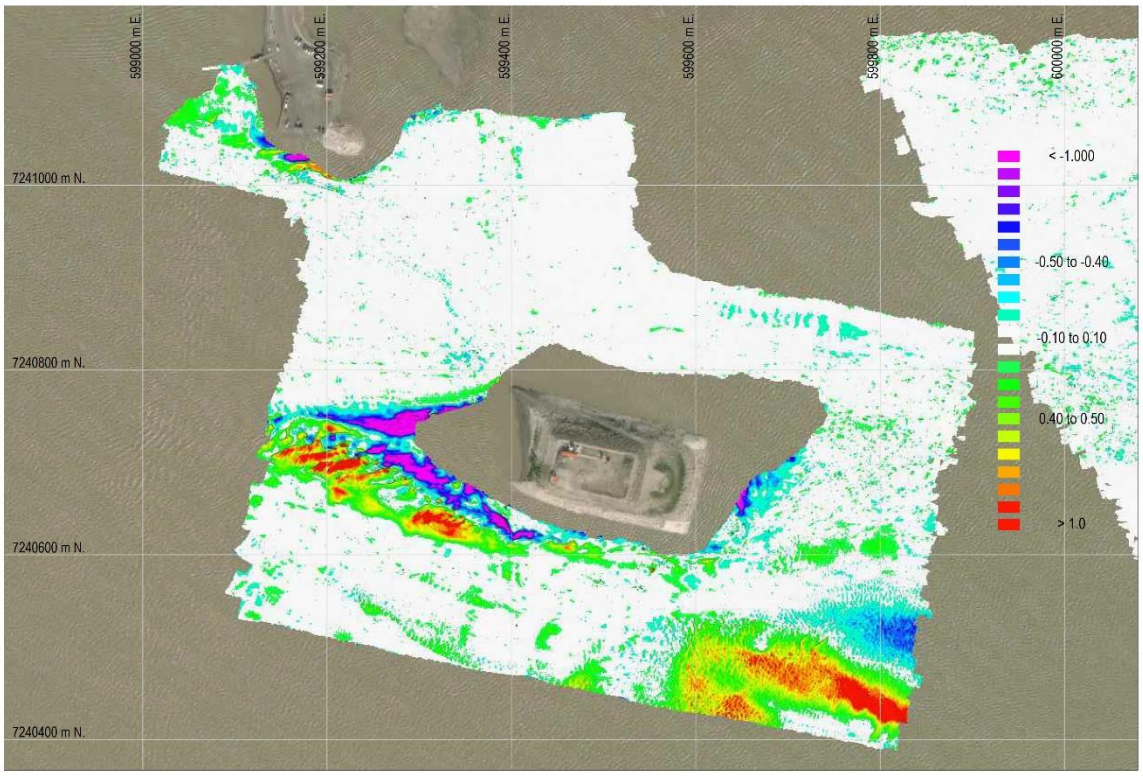


Figure 3.2.1.1: Mainland to Island 1 (2021-2022 Comparison Data)

3.2.2. Mainland to Island 2 (Ramport)

The 2022 bathymetric survey showed minimal sediment change along the pipeline route, with sporadic spacing of accretion and deposition in the ~20cm range. This is further identified in the profile shown on drawing # 096-0179-700-801 72.

The scour hole identified at Station 1+579 in 2016 has shown a slight increase in cover this year, moving from ~0.7m in 2021 to ~0.9m in 2022. Given the minimal cover and change in sediment in this location, it is recommended this area continue to be monitored for adequate cover. Similarly, Station 1+525 to 1+594 has experienced slight material movement, but ultimately remains consistent for the past 4 years with no other notable changes. It is however recommended for continued monitoring in 2023 as the depth of cover for this span of pipeline remains in the lower range of ~1m along the alignment.

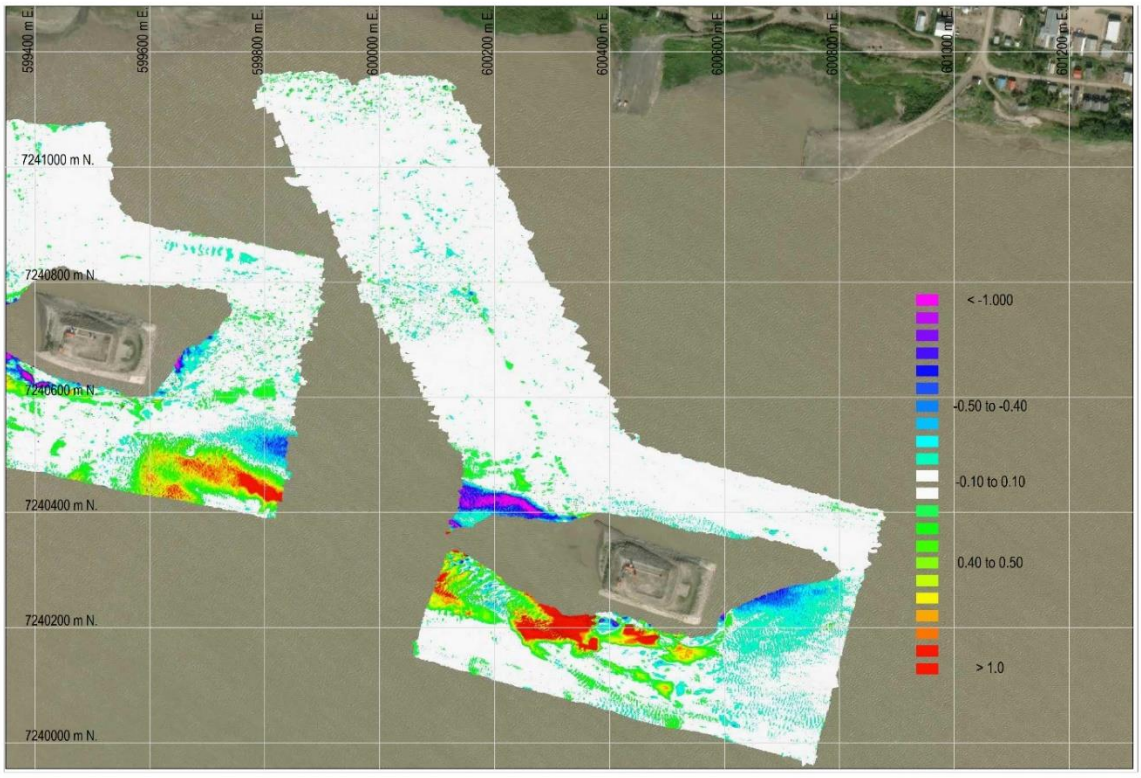


Figure 3.2.2.1: Mainland to Island 2 (2021-2022 Comparison Data)

3.2.3. Goose Island to Island 3 (Decho)

As the 2022 bathymetric survey was performed in late September this year, water levels were considerably lower than when conducted in June. This combined with the presence of a significant sandbar has limited our ability collect data prior to Station 0+950 for a number of years. As we cannot get near the shoreline by foot outside of winter months due to safety concerns, it is recommended to perform probing spot checks in the winter through select auger holes in the ice for depth verification. Station 0+500 to 0+700 will remain flagged until depth confirmation can be obtained.

Multibeam data was collected between the sandbar and Island 3 in 2022 and is reflected in both the below comparison image and drawing #096-0179-700-801 73. The data acquired begins at Station 0+935 and indicates significant sediment loss through to Station 1+050 when compared to the past two years. Depth of cover remains largely at an acceptable level of 2m throughout, with the exception of the scour hole at 0+950 which sits at ~1m. It is recommended that Station 0+935 to 0+970 be monitored in 2023 given the sediment volatility in the area.

Data obtained from Station 1+080 to 1+120 experienced a similar low depth of cover of 1m when compared to 2021, although the location of this scouring is now Station 1+090 rather than 1+124 in years past. It is recommended that this area remain flagged for monitoring in 2023 as scouring is becoming more prominent throughout, specifically at Station 1+090.

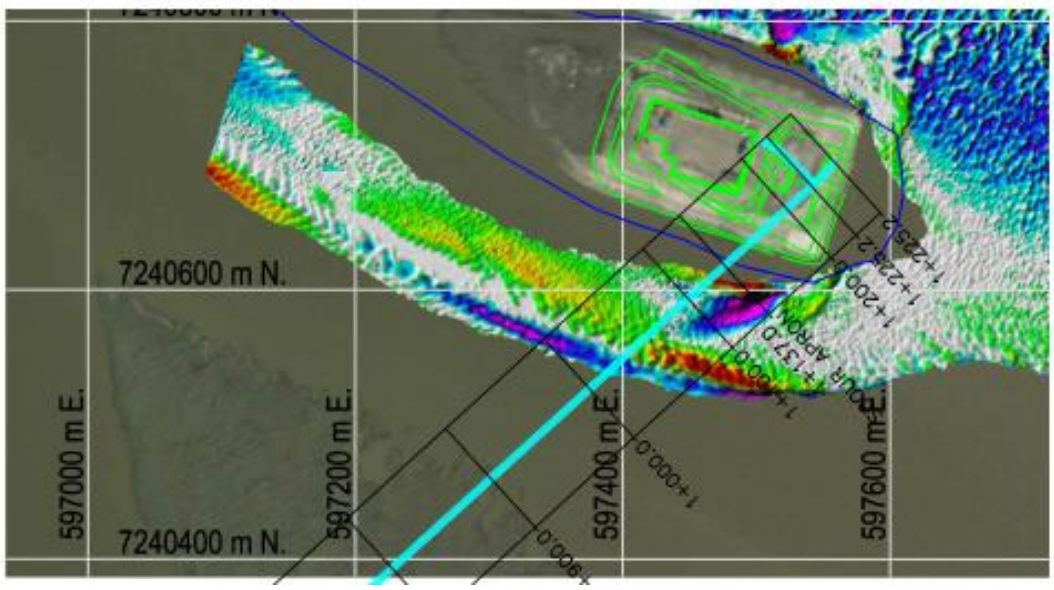


Figure 3.2.3.1: Goose to Island 3 (2021-2022 Comparison Data)

3.2.4. Mainland to Island 3 (Decho)

The depth of cover along the Mainland to Island 3 alignment has remained consistent in 2022, as it has for the previous 5 years with no areas of concern. These marginal changes are shown in drawing # 096-0179-700-801 74. The comparison image below does indicate sediment loss in the ~1m range surrounding Island 3, however this movement has not directly affected the depth of cover along this alignment. Water levels at the time of survey were low in comparison to year's past due to the survey being performed in September. As a result, there is a data gap between Station 0+630 to 0+715 which has been observed the previous 3 years. We will look to add to the data in this area and verify the depth of cover in the 2023 survey.

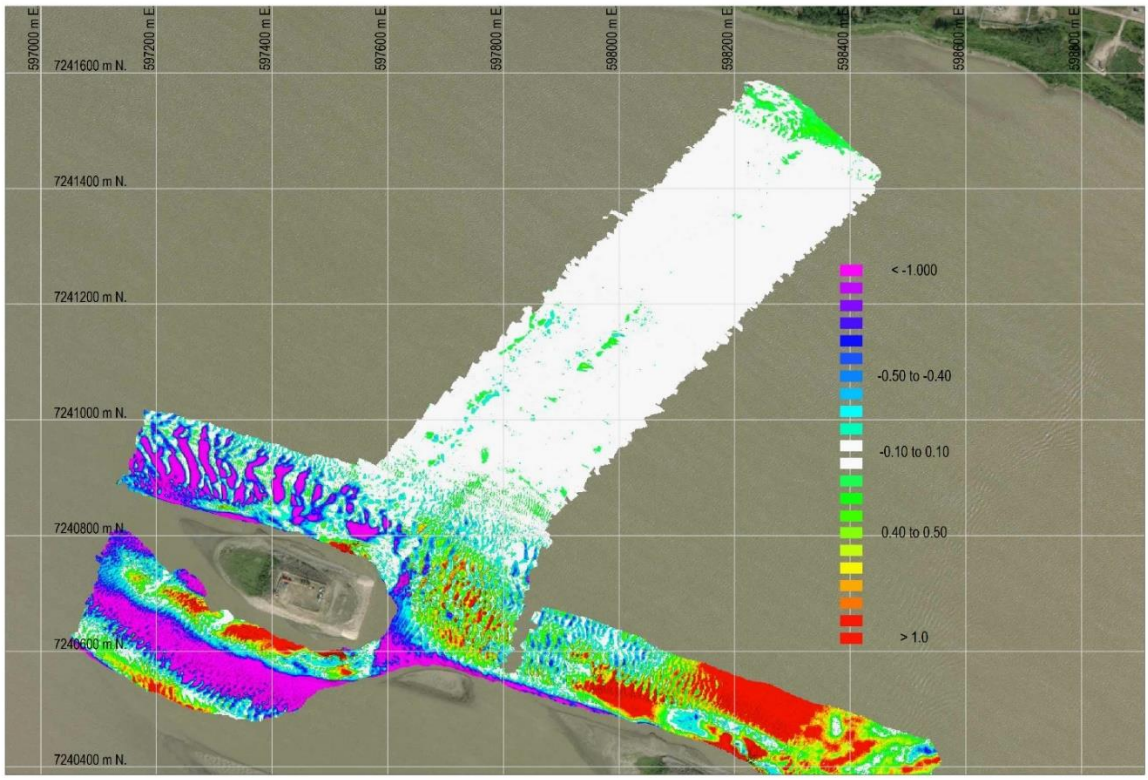


Figure 3.2.4.1: Mainland to Island 3 (2021-2022 Comparison Data)

3.2.5. Goose Island to Island 4 (Ekwe)

As the 2022 bathymetric survey was performed in September this year, the low water levels presented unsafe conditions to gather data in the Station 0+376 to 0+485 range, ahead of the sandbar. It is recommended to update probing readings in this area as pipe depths last confirmed in Jan 91 differ ~0.6m from the '84 survey. The annual surveys for this alignment can be viewed in profile drawing # 096-0179-700-801 75.

Station 0+900 and 1+025 data was observed in 2022 and identified no significant changes along the Goose Island to Island 4 alignment. As per last year's recommendation spreadsheet, this stationing was removed from the monitoring locations given its historic consistency. We will look to conduct the 2023 survey early in the summer season to supplement the sediment data between Goose Island and the sandbar.

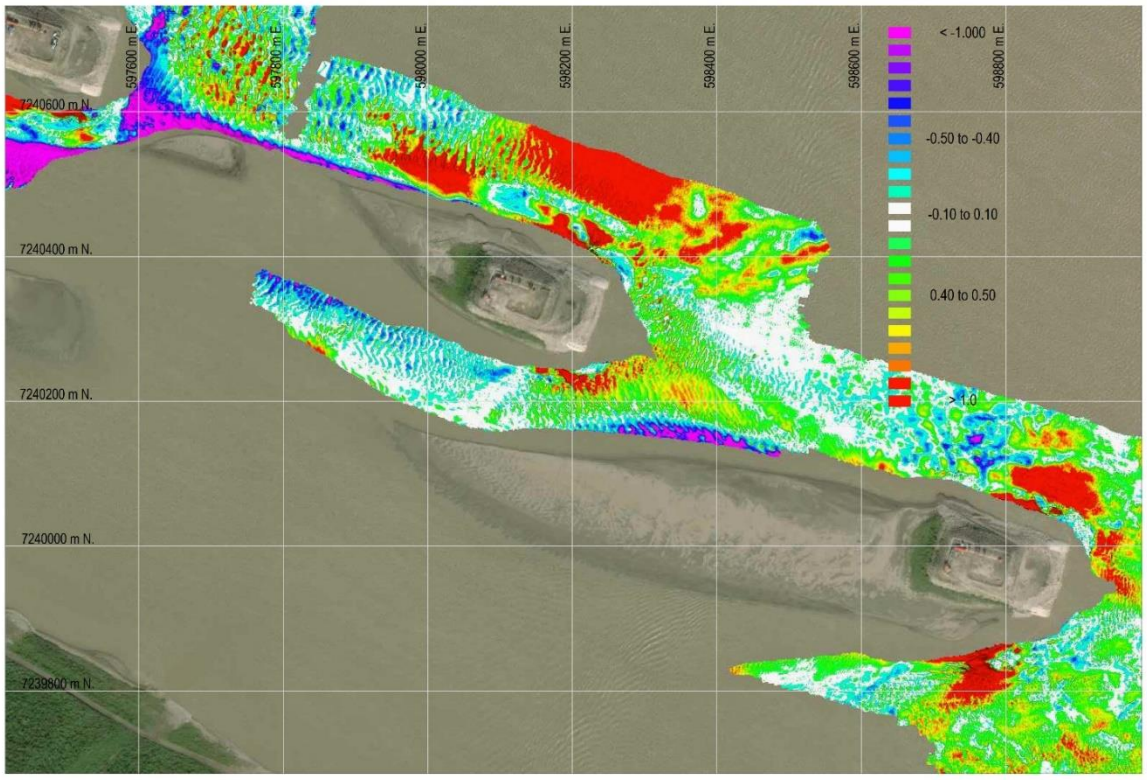


Figure 3.2.5.1: Island 4 (2021-2022 Comparison Data)

3.2.6. Bear Island to Island 5 (Iteh K'ee)

There are currently four areas identified for monitoring along the Bear Island to Island 5 alignment which can be observed when reviewing drawing # 096-0179-700-801 76. The four areas flagged for future monitoring along this alignment are as follows:

1. Station 0+148.2 and 0+233 was unsuitable for observation in the 2022 survey due to reduced water levels at the time of survey. It is recommended this area continue to be monitored as historic data in this area suggests a depth of cover just over 1m.
2. Station 0+334 to 0+350 was observed to be consistent with years past, showing minor sediment deposition. It is recommended to continue the monitoring throughout this area given the presence of the only scour hole along the alignment before the sandbar.
3. Station 0+628 to 0+675 showed a similar trending to the past 2 years, with no notable areas of scouring or sediment loss. Although the depth of cover does remain in the ~1.5m area throughout this span, it is recommended to continue to monitor this area in 2023 given the historic volatility which has brought the cover down to the ~1m range in years past.
4. Station 0+790 to 0+820 showed sediment movement in the ~40cm range but maintained a minimum cover of ~1.2m throughout. It is recommended to continue monitoring this area given the changes in riverbed on a yearly basis with a trending low point present at 0+815.

Station 0+493.6 to 0+537.1 was unsuitable for observation in 2022 due to low water levels, however this area can be omitted from the monitoring locations as historic data suggests a depth of cover in the area of ~3-4m.

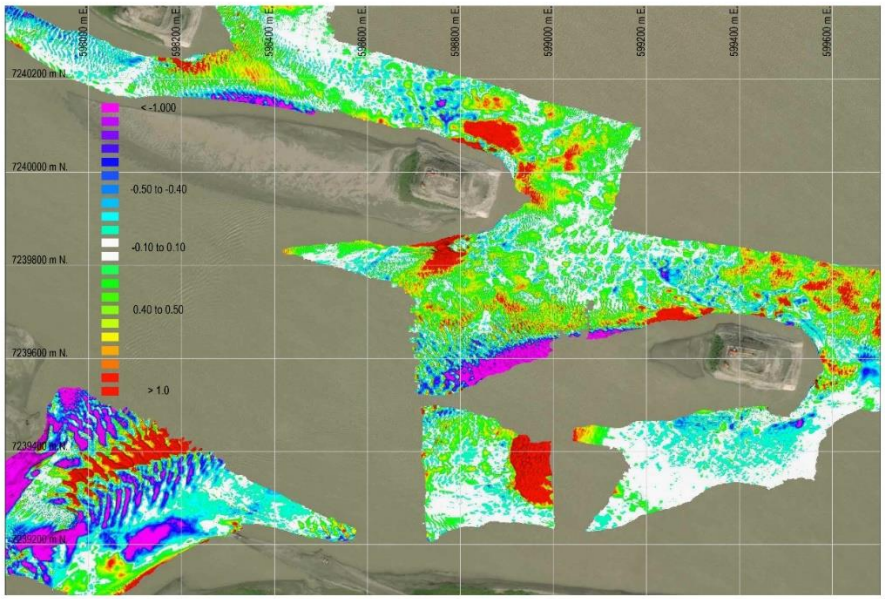


Figure 3.2.6.1: Bear Island to Island 5 (2021-2022 Comparison Data)

3.2.7. Bear Island to Island 6 (Little Bear)

The 2022 bathymetric survey was unable to collect data for the first area identified for monitoring along the Bear Island to Island 6 alignment due to lower water levels – Station 0+125 to 0+205. The 2022 data set begins at Station 0+250 which is reflected in drawing # 096-0179-700-801 77. At this stationing, the data begins with a depth of cover of 0.8m which trends lower towards as the alignment nears Bear Island. This area will want to be confirmed in the 2023 bathymetric survey as it could present issues if any scouring takes place. It is recommended this area be supplemented with probing data in a winter survey should it be safely achievable.

Station 0+560 to Island 6 was previously identified for monitoring due to concerning riverbed data gathered in 2019. This area was removed from monitoring in this year's review as per the 2021 recommendation, based on 2020 and 2021 data supporting a cover over 2m through this previously flagged area.

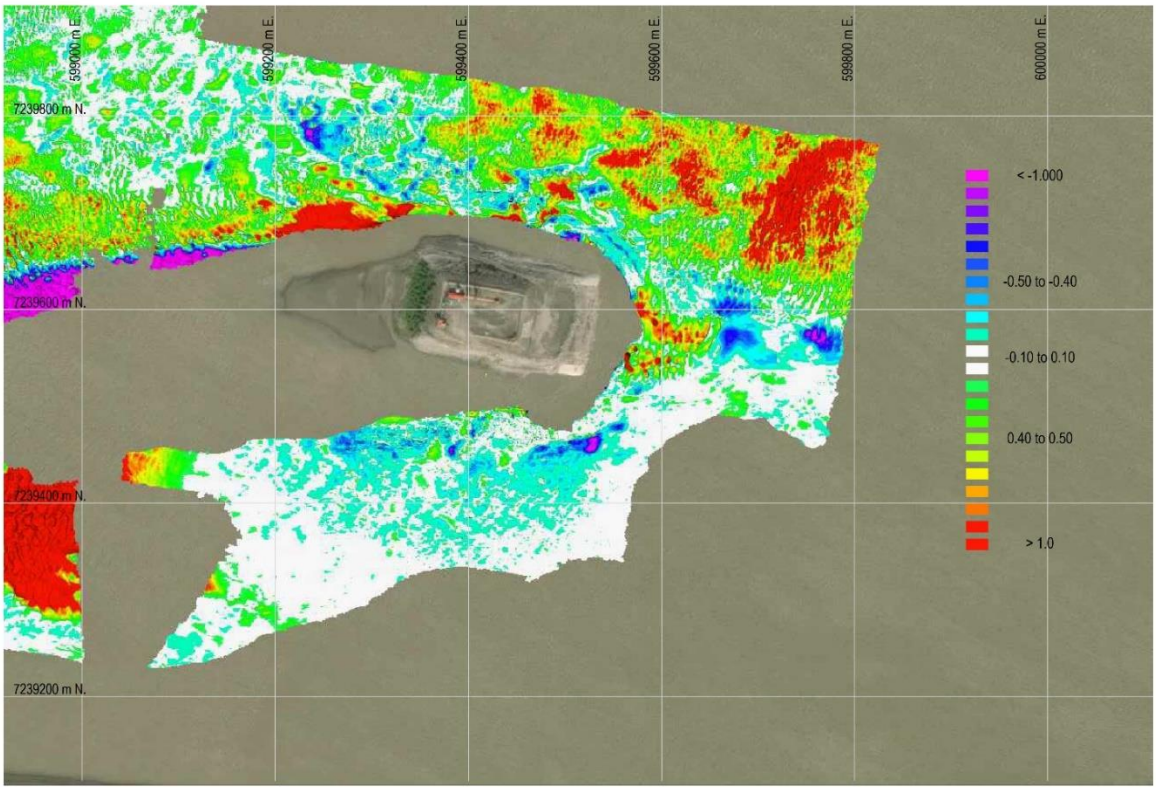


Figure 3.2.7.1: Bear Island to Island 6 (2021-2022 Comparison Data)

3.2.8. Goose Island to Bear Island

The 2022 bathymetric survey noted significant riverbed changes from Goose to Bear Island in the causeway, with an exposed pipe identified near the shore of Goose Island. These changes can be visualized in drawing # 096-0179-700-801 78, # 096-0179-700-801-89, Figure 3.1.7, and Figure 3.2.8.1. This section and associated plan were revised as it came to light that the causeway and pipeline profiles had been switched between drawing # 096-0179-700-801 89 and # 096-0179-700-801 78. This has been corrected in the revised plans.

Drawing # 096-0179-700-801-78 is the most effective drawing to illustrate the scouring that has taken place this past year. Station 0+179 to 0+210 has been updated to 0+127.5 to 0+232 to encapsulate the over 3m of sediment loss due to a scour hole with low point located at Station 0+198. This alignment has also seen sediment loss from Station 0+470 to 0+525, with an additional scour hole developing at Station 0+491 in the 2022 data set.

It is recommended that these areas remain monitored in the 2023 bathymetric survey.

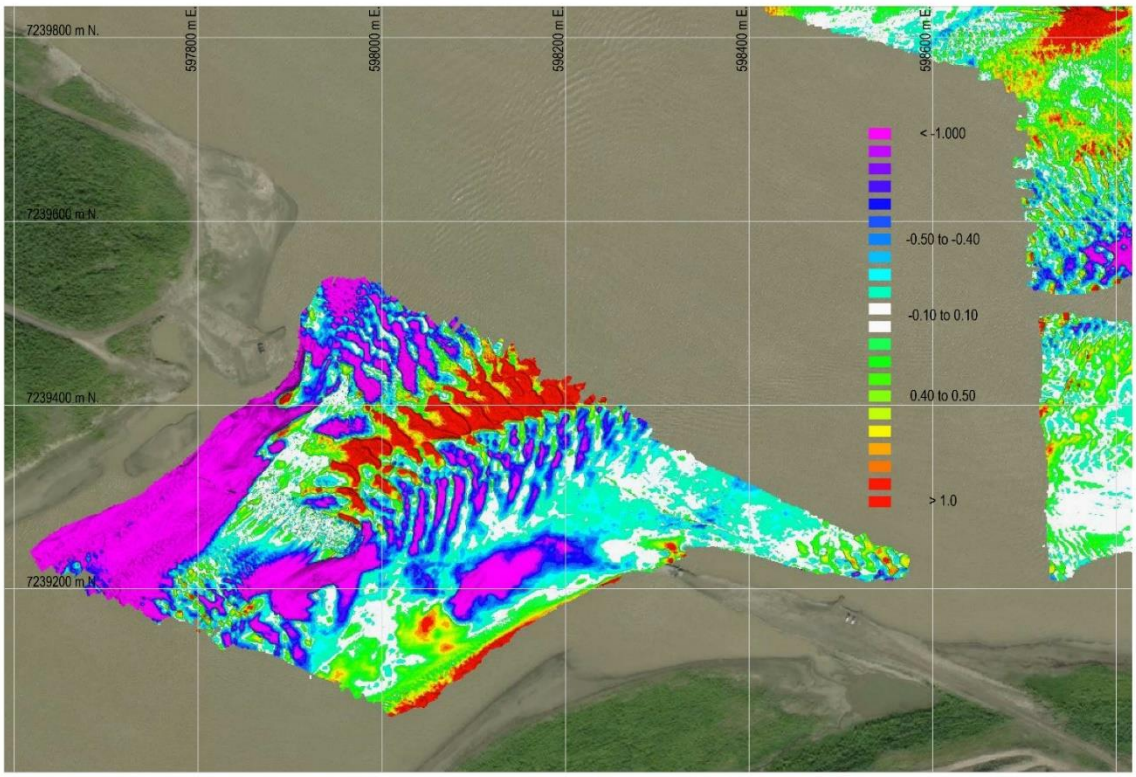


Figure 3.2.8.1: Goose Island to Bear Island (2021-2022 Comparison Data)

3.2.9. Island 1 (Rayuka) and Surrounding Area

Drawing # 096-0179-700-801 79 is a visual representation of Island 1 and the surrounding area contour lines. As evident in the comparison image shown in figure 3.2.1.1, the riverbed has remained quite consistent for the majority of the island area. There are select areas of deposition on the west side of the island neighbouring a comparable area of scouring closer to the island bank. The material change noted in these areas indicate a redistribution of material, as both the deposition and the scouring are of similar values in the ~50cm-1m range. There is an area of deposition further east of Island 1, nearing Island 2, which has accumulated material in the 50cm range, but has exceeded 1m in select areas.

3.2.10. Island 2 (Rampart) and Surrounding Area

Drawing # 096-0179-700-801 80 is a visual representation of Island 2 and the surrounding area contour lines. As evident in the comparison image shown in figure 3.2.2.1, there has been quite a bit of accumulation along the Southwesterly side of the Island similar which has been the trend the past two years. This is consistent with the moving channels towards the center of the river and can be expected on a yearly basis. Near the Northwest side of the Island there has been some scouring which aligns with the material movement from Island 1 to Island 2. Similar to 2021, there has been minor erosion on the East side of the island in the 0.5m range which aligns with the significant movement of the channel alongside this island.

3.2.11. Island 3 (Decho) and Surrounding Area

Drawing # 096-0179-700-801 81 is a visual representation of Island 3 and the surrounding area contour lines. As evident in the comparison image shown in figure 3.2.4.1, there have been fairly significant changes in the surrounding area of the Island which is characteristic as similar movement has been noted past years. The South side has seen a distinct area of deposition in the 1m range, followed by significant erosion further from the island and nearing the channel, indicated by the light purple streak further south of the island. The North side of the island experienced sporadic material loss in the 1m range which appears to have been reallocated directly to the East of Island 3. This trend continues on to the North side of Island 4.

3.2.12. Island 4 (Ekwe) and Surrounding Area

Drawing # 096-0179-700-801 82 is a visual representation of Island 4 and the surrounding area contour lines. As evident in the comparison image shown in figure 3.2.5.1, there has been significant deposition to the North of Island 4. Indicated by the dark red coloring, the North side of Island 4 has only seen material gain in the 1m range over the past year, while the South side has seen minor erosion in the 0.5m range. This material movement is in alignment with the heavy movement through the channel and river flow coming of the Westerly islands.

3.2.13. Island 5 (Iteh K'ee) and Surrounding Area

Drawing # 096-0179-700-801 83 is a visual representation of Island 5 and the surrounding area contour lines. As evident in the comparison image shown in figure 3.2.6.1, Island 5 has experienced deposition similar to Island 4. Directly North and South of the Island has seen distinct deposition in the 1m range, while deposition in the 0.5m range is spread across the neighboring areas of Island 5.

3.2.14. Island 6 (Little Bear) and Surrounding Area

Drawing # 096-0179-700-801 84 is a visual representation of Island 6 and the surrounding area contour lines. As evident in the comparison image shown in figure 3.2.7.1, there has been deposition directly to the Northwest of Island 6 in the 1m range, with material reallocation further Northwest indicated by the multispectral coloring. Although immediately to the Northeast of Island 6 has seen slight erosion in the 0.5m range, further Northeast from the Island has seen significant material gain in the range of 0.5 to 1m range which stretches to the limits of the data set. The East side of Island 6 has seen a small pocket of deposition while the South side of the Island indicates slight material loss in the 0.5 range for the surrounding area.

3.2.15. Mainland Dock

The mainland dock drawing was not included this season due to no electronic locate information having been obtained. This will look to be included in the 2023 bathymetric report.

3.2.16. Goose Island to Bear Island Causeway

Drawing # 096-0179-700-801 89 is a visual representation of the contours generated for the area between Goose Island and Bear Island. This plan was revised as it came to light that the causeway and pipeline profiles had been switched between drawing # 096-0179-700-801 89 and # 096-0179-700-801 78. This has been corrected in the revised plans. When the 2022 data is compared to the 2021 data as shown on figure 3.2.8.1, it is evident this area has experienced significant erosion from the Goose Island bank stretching into the channel. As discussed in 3.2.8, the material loss is upwards of 3m in this area. Although there has been deposition over 1m to the North area of the Causeway, there is further erosion evident as the area spans East to the Bear Island shore. There appears to be two distinct scour holes present in the channel on the East and South ends of substantial size with material loss in the 2m range. Historically there has not been significant material movement throughout the area.

4. Conclusions and Recommendations

The field survey was completed between September 18th and September 29th, 2022. The survey data was collected using an R2Sonic multibeam sonar which provided a complete river bottom coverage for all areas navigable by the vessel. Due to low water levels, many areas were inaccessible during the 2022 survey and will need to be revisited in 2023.

From the analysis of the 2022 Bathymetric Survey data, the following are recommended:

- Mainland to Island 1 – Monitoring locations at 1+498 and 1+620 have remained consistent for the past 5 years and currently sit at a depth of cover of ~1.3-1.4m. These areas are historically the most susceptible to scouring, it is recommended that both locations remain monitored for evaluation in 2023.
- Mainland to Island 2 - The scour hole flagged as an area for future monitoring at 1+525 to 1+594 has experienced slight material gain in 2022 and currently sits at a depth of cover of ~0.9m. This area saw a material loss of 0.5m in 2021 and is recommended to remain monitored in 2023.
- Goose Island to Island 3 – The area for future monitoring from 0+550 to 0+700 was unable to be verified in 2022 due to unsuitable water levels with the survey being performed in late September. Station 0+935 to 0+970 maintained a minimum depth of cover of 1m but did experience significant material loss in the surrounding areas. Station 1+080 to 1+124 saw the emergence of a scour hole at Station 1+090 with a 0.7m material loss. Continued monitoring is recommended for all identified locations along this alignment to ensure current depth of cover is maintained.
- Goose Island to Island 4 – As 0+348.2 to 0+900 was unsuitable for data collection during the 2022 survey, it is recommended these areas remain monitored for 2023 verification. Alternate survey methods are recommended due to the extended period of unsafe bathymetric survey conditions. Station 1+000 to 1+025 was removed from future monitoring as it has consistently shown no movement for the past 5 years.
- Bear Island to Island 5 – Station 0+148.2 to 0+233 was unsuitable for observation in 2022 due to low water levels. Station 0+334 to 0+350 showed slight deposition but still poses the highest risk for scouring in the future. Station 0+628 to 0+675 & Station 0+790 to 0+820 showed material movement and remain quite volatile. It is recommended all 4 locations remain monitored for erosion in 2023.
- Bear Island to Island 6 – The area for future monitoring from Station 0+125 to 0+205 was unsuitable for survey in 2022. It is recommended that until cover can be verified in this area that this location remain flagged for monitoring. 2022 data began at Station 0+250 within monitoring range Station 0+237 to 0+273. The riverbed remains low, with a depth of cover of 0.8m in this area. It is recommended this location also remain for future monitoring in 2023.
- Goose Island to Bear Island – Significant scouring in the 3m range has been noted within the pipe alignment at Station 0+127.5 to 0+232. Station 0+470 to 0+525 also has shown the emergence of a scour hole in the 2m range in 2022. Both locations will need to be monitored for improvement in 2023.

Low water levels provided challenging conditions for the 2022 Norman Wells Bathymetric Survey. The bathymetric crew and the IOR boat captain were able to complete the bathymetric survey safely, although more data gaps exist this year than years past due to the survey being conducted in late September. It is suggested that the 2023 bathymetric survey be conducted in the middle of June, while high water levels are still present, but winter runoff has subsided and eliminated the majority of the debris from the water. The additional area requested in this year's survey was left incomplete due to availability of a boat captain on site. This area can be completed in next year's survey which will also yield data closer to the shoreline with the survey being performed with higher water levels. Areas that require a Zodiac to be surveyed were not completed due to floating debris and would require the presence of a security boat on the water able to access these areas in case of an emergency. It should also be noted that even with the presence of a safety boat, the crew and captain would need to evaluate environmental conditions at the time of survey to determine if it could be completed safely. It is recommended that areas closer to shore could potentially be completed on foot in the early winter if probing is possible with the ground conditions and the proper safety constraints can be put in place. Alternatively, these areas close to the shoreline could be surveyed with a vessel larger than the Zodiac with a low draught.

Overall, the 2022 bathymetric survey was successful in gaining data in all available areas and providing insight on areas of concern within the Bear to Goose Causeway. Alternate survey methods nearing shorelines and sandbars, along with updated pipe elevation information is recommended for the 2023 bathymetric survey to ensure the most complete data sets.

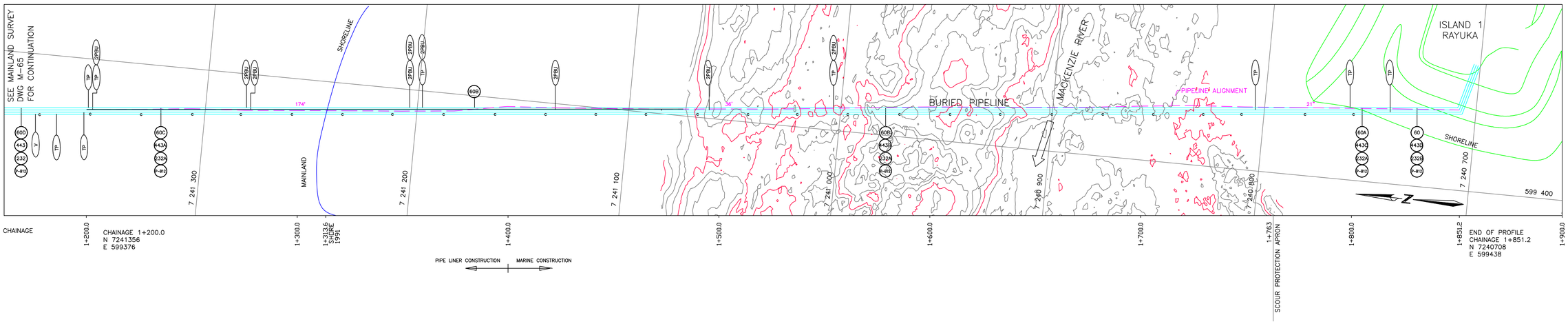
Appendix A
Drawings

The following drawings have been created for the 2022 Bathymetric Survey and are included in the Appendix.

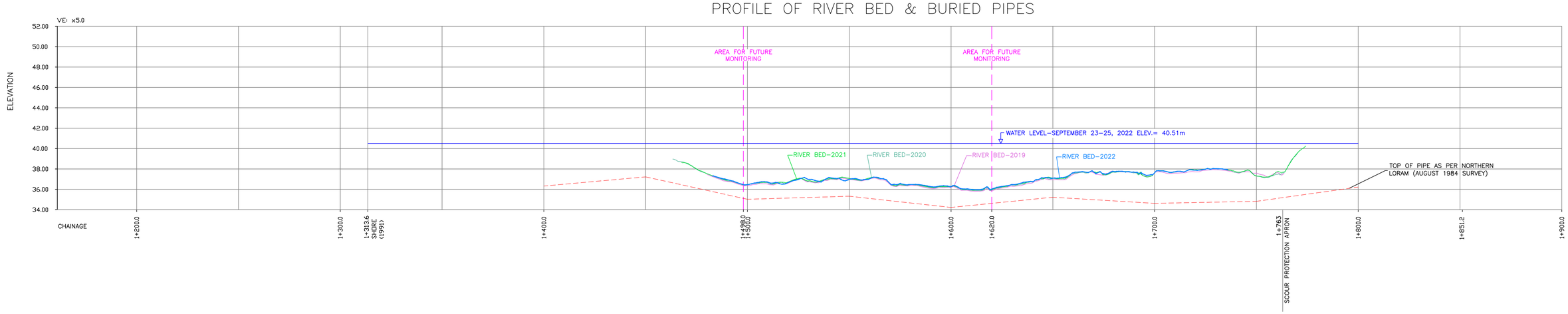
Island 1 to Mainland Flowline	Dwg. No. 096-0179-700-801 71
Island 2 to Mainland Flowline	Dwg. No. 096-0179-700-801 72
Island 3 to Goose Island Flowline	Dwg. No. 096-0179-700-801-73
Island 3 to Mainland Flowline	Dwg. No. 096-0179-700-801 74
Island 4 to Goose Island Flowline	Dwg. No. 096-0179-700-801-75
Island 4 to Bear Island Flowline	Dwg. No. 096-0179-700-801 76
Island 6 to Bear Island Flowline	Dwg. No. 096-0179-700-801-77
Bear Island to Goose Island Flowline	Dwg. No. 096-0179-700-801 78
Island 1 and surrounding area	Dwg. No. 096-0179-700-801 79
Island 2 and surrounding area	Dwg. No. 096-0179-700-801 80
Island 3 and surrounding area	Dwg. No. 096-0179-700-801 81
Island 4 and surrounding area	Dwg. No. 096-0179-700-801 82
Island 5 and surrounding area	Dwg. No. 096-0179-700-801 83
Island 6 and surrounding area	Dwg. No. 096-0179-700-801 84
Riverbed and Island Contours	Dwg. No. 096-0179-700-801 86
Bear Island to Goose Island Causeway	Dwg. No. 096-0179-700-801 89

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 71

PIPELINE ALIGNMENT



PROFILE OF RIVER BED & BURIED PIPES



SURVEY CONTROL

No.	DESCRIPTION	NORTHING	EASTING	ELEV.
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89	
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90	
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43	
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97	
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38	
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36	
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08	
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94	
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63	
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14	
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56	
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79	

No.	SUBSTANCE DESCRIPTION
	MULTIPHASE LIQUIDS
60	168.3 OE ls.1 to L.P.T.1, Glycol H.T. 60-60A
60A	168.3 OE ls.1 to L.P.T.1, Glycol H.T., Conc Coated 60-60A-60B
60B	168.3 OE ls.1 to L.P.T.1, Conc Coated 60-60A-60B-60C
60C	168.3 OE ls.1 to L.P.T.1, Dbl Sect H.T., Conc Coated 60-60A-60B-60C-60D M-75,65,55 H.T.261
60D	168.3 OE ls.1 to L.P.T.1, Sng Sect H.T. 60-60A-60B-60C-60D-L.P.T.1 M-75,65,55 H.T.261
	GASLIFT
232	88.9 NG (Gas Lift) L.P.T.1 to ls.1 (Buried) 232-232A M-55,65,64
232A	88.9 NG (Gas Lift) L.P.T.1 to ls.1 (Conc Coated) 232-232A-232B M-55,65,64
232B	88.9 NG (Gas Lift) L.P.T.1 to ls.1 (Buried) 232-232A-232B-L.P.T.1
	INJECTION WATER
443	88.9 INJ-SW L.P.T.1 to ls.1, Sng Sect H.T., Liner 443-443A M-55,65,75 H.T.262
443A	88.9 INJ-SW L.P.T.1 to ls.1, Dbl Sect H.T., Conc Coated, Liner 443-443A-443B M-55,65,75 H.T.262
443B	88.9 INJ-SW L.P.T.1 to ls.1, Conc Coated, Liner 443-443A-443B-443C
443C	88.9 INJ-SW L.P.T.1 to ls.1, Glycol H.T., Conc Coated, Liner 443-443A-443B-443C-443D
443D	88.9 INJ-SW L.P.T.1 to ls.1, Glycol H.T., Liner 443-443A-443B-443C-443D-L.P.T.1
	ELECTRICAL DESCRIPTION
P-B12	4160 H.V. From FS-15KV Switch Gear to ls.1 TR-B7 M-55,65,75

No.	SUBSTANCE DESCRIPTION

PROFILE ALIGNMENT COORDINATES

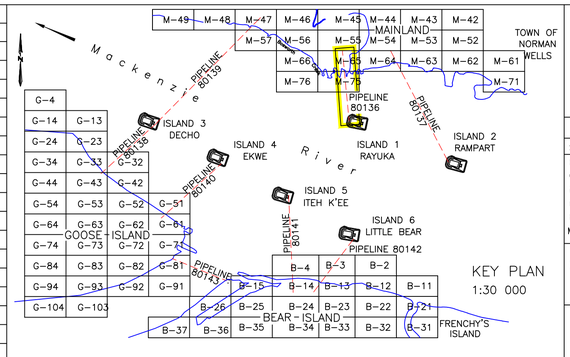
EASTING	NORTHING	
599376.000	7241356.000	START CHAINAGE 1+200.000
599378.450	7241330.830	
599381.120	7241306.470	
599382.783	7241280.956	
599385.000	7241256.880	
599387.300	7241231.860	
599389.510	7241207.170	
599391.970	7241182.390	
599396.470	7241157.620	
599398.220	7241132.800	
599402.340	7241083.120	
599404.860	7241058.020	
599407.190	7241033.180	
599409.890	7241008.400	
599415.390	7240958.570	
599417.640	7240933.640	
599419.980	7240908.890	
599422.370	7240884.060	
599425.310	7240858.970	
599428.020	7240833.790	
599429.700	7240809.420	
599431.820	7240784.450	
599435.910	7240734.650	
599438.000	7240708.000	END CHAINAGE 1+851.2

Alignment includes Winter 1997 pipe locating data.

NOTES

1. RIVER BOTTOM PROFILE FROM 2022 BATHYMETRIC SURVEY PERFORMED SEPTEMBER 18 TO SEPTEMBER 29, 2022.
2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM (TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)
3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129°
4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189
5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL
6. CONTOUR INTERVAL = 0.25 METRES.

2019 RIVER BED PROFILE SHOWN AS
2020 RIVER BED PROFILE SHOWN AS
2021 RIVER BED PROFILE SHOWN AS
2022 RIVER BED PROFILE SHOWN AS



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1	ADDED FUTURE MONITORING DEC. 2019: WSP	1	ADDED 2001 BOTTOM PROFILE AUG 2001: UMA GEOMATICS	1	ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics	1	ADDED 2014 BOTTOM PROFILE AUGUST 2014: MMM Geomatics
1	ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP	1	ADDED 2000 BOTTOM PROFILE AUG 2000: UMA GEOMATICS	1	ADDED 2006 BOTTOM PROFILE JUNE 2006: USHER CANADA LTD	1	ADDED 2013 BOTTOM PROFILE AUGUST 2013: MMM Geomatics
1	ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP	1	ADDED 1999 BOTTOM PROFILE AUG 1999: UMA GEOMATICS	1	ADDED 2005 BOTTOM PROFILE JUNE 2005: USHER CANADA LTD	1	ADDED 2012 BOTTOM PROFILE AUGUST 2012: MMM Geomatics
1	ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP	1	ADDED 2022 BOTTOM PROFILE NOV 2022: GEOVERRA	1	ADDED 2004 BOTTOM PROFILE AUG 2004: USHER CANADA LTD	1	ADDED 2011 BOTTOM PROFILE AUGUST 2011: MMM Geomatics
1	ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP	1	ADDED 2021 BOTTOM PROFILE SEP 2021: GEOVERRA	1	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS	1	ADDED 2010 BOTTOM PROFILE JULY 2010: MMM Geomatics
No.	REVISION	No.	REVISION	No.	REVISION	No.	REVISION

LEGEND

UTILIDORS SHOWN
ROADS SHOWN
BURIED PIPES SHOWN
BELOW GROUND POWER,TELEPHONE, & COMMUNICATION SHOWN
VENT SHOWN
TRANSITION POINT
PULL BOX SHOWN
PULL POINT SHOWN
PIPE O/S DIA.'S ARE IN MILLIMETERS AND DECIMALS THEREOF

V, TP, PBU, P.P.

SUBSTANCE/CATEGORY CROSS REFERENCE

SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ-SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ-FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Esso Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

MAINLAND TO ISLAND 1 SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA

DATE: 22-11-01

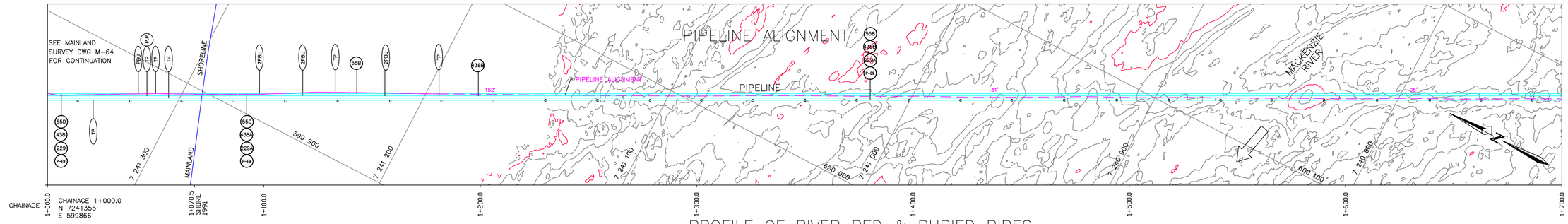
SCALE: H 1:1000 V 1:200

CONTRACTOR DWG NO. : 1196-C

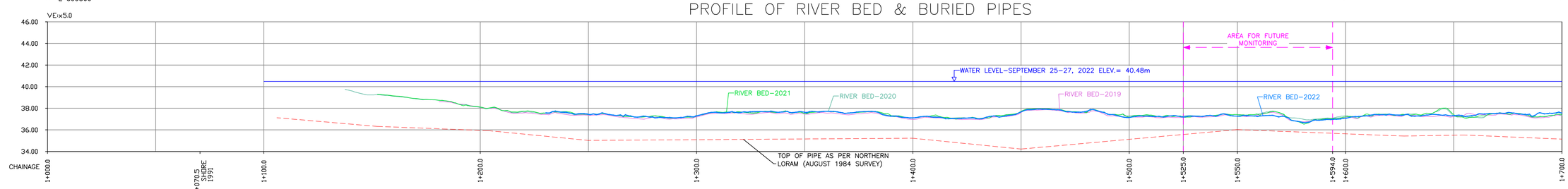
ESSO FILE No.

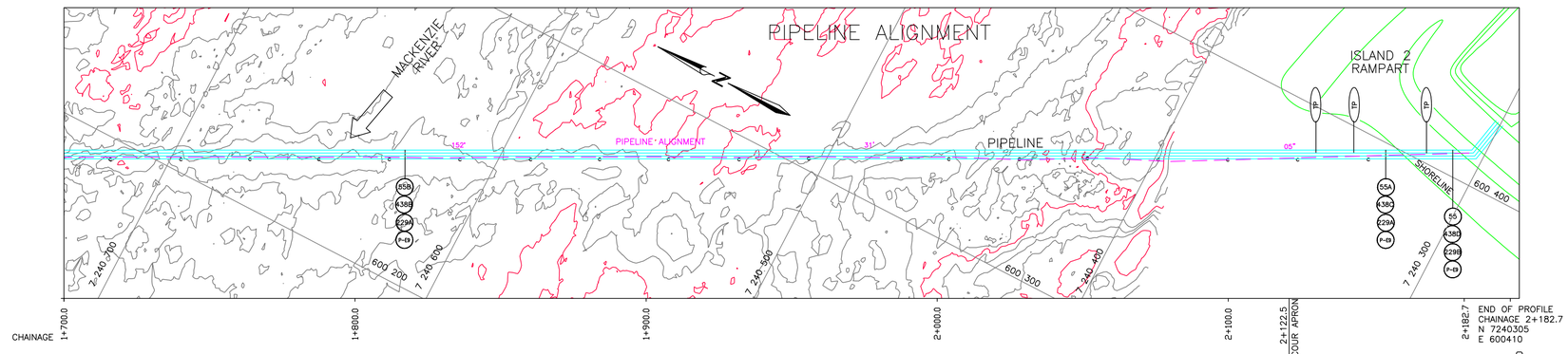
096-0179-700-801 71

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 72

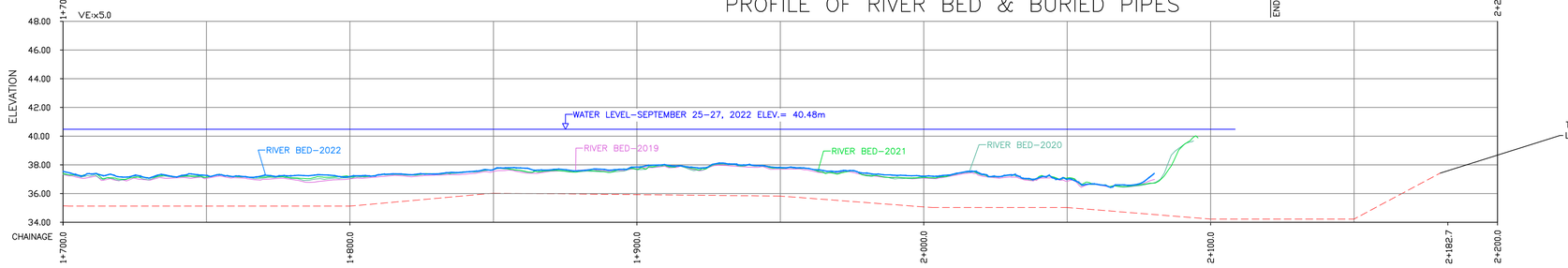


PROFILE OF RIVER BED & BURIED PIPES





PROFILE OF RIVER BED & BURIED PIPES



SURVEY CONTROL

No.	DESCRIPTION	NORTHING	EASTING	ELEV.
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89	
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90	
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43	
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97	
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38	
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36	
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08	
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94	
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63	
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14	
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56	
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79	

No.	SUBSTANCE DESCRIPTION
	MULTIPHASE LIQUIDS
55	219.1 OE ls.2 to L.P.T.1, Glycol H.T. 55-55A
55A	219.1 OE ls.2 to L.P.T.1, Glycol H.T., Conc Coated 55-55A-55B
55B	219.1 OE ls.2 to L.P.T.1, Conc Coated 55-55A-55B-55C M-64,65,55
55C	219.1 OE ls.2 to L.P.T.1, Dbl Sect H.T., Conc Coated 55-55A-55B-55C-55D M-64,65,55 H.T.263
55D	219.1 OE ls.2 to L.P.T.1, Sng Sect H.T. 55-55A-55B-55C-55D-L.P.T.1 M-64,65,55 H.T.263
	GASLIFT
229	114.3 NG (Gas Lift) L.P.T.1 to ls.2 (Buried) 229-229A M-55,65,64
229A	114.3 NG (Gas Lift) L.P.T.1 to ls.2 (Conc Coated) 229-229A-229B M-55,65,64
229B	114.3 NG (Gas Lift) L.P.T.1 to ls.2 (Buried) 229-229A-229B-L.P.T.1
	INJECTION WATER
438	114.3 INJ-SW L.P.T.1 to ls.2, Sng Sect H.T., Liner 438-438A M-55,65,64 H.T.264
438A	114.3 INJ-SW L.P.T.1 to ls.2, Dbl Sect H.T., Conc Coated, Liner 438-438A-438B M-55,65,64 H.T.264
438B	114.3 INJ-SW L.P.T.1 to ls.2, Conc Coated, Liner 438-438A-438B-438C
438C	114.3 INJ-SW L.P.T.1 to ls.2, Glycol H.T., Conc Coated, Liner 438-438A-438B-438C-438D
438D	114.3 INJ-SW L.P.T.1 to ls.2, Glycol H.T., Liner 438-438A-438B-438C-438D-L.P.T.1
	ELECTRICAL DESCRIPTION
P-E9	4160 H.V. From FS-25KV Switch Gear to ls.2 TR-E5 M-54,64

PROFILE ALIGNMENT COORDINATES

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599866.000	7241355.000	START CHAINAGE 1+000.000
599867.750	7241350.020	
599877.070	7241332.840	
599888.830	7241311.060	
599900.050	7241288.670	
599911.540	7241266.730	
599923.760	7241245.240	
599935.170	7241222.640	
599946.190	7241200.430	
599957.710	7241177.750	
599968.910	7241155.590	
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599991.630	7241110.940	
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600014.910	7241066.250	
600026.790	7241043.290	
600038.900	7241019.240	
600050.790	7240996.510	
600062.340	7240973.070	
600073.970	7240950.940	
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600188.291	7240728.880	
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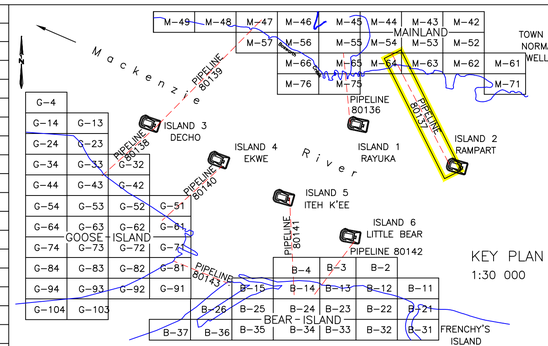
600337.481	7240439.550	
600349.651	7240417.660	
600359.971	7240395.040	
600410.000	7240305.0004	END CHAINAGE 2+182.7

Alignment includes Winter 1997 pipe locating data.

NOTES

1. RIVER BOTTOM PROFILE FROM 2022 BATHYMETRIC SURVEY PERFORMED SEPTEMBER 18 TO SEPTEMBER 29, 2022.
2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM (TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)
3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129°
4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189
5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL
6. CONTOUR INTERVAL = 0.25 METRES.

2019 RIVER BED PROFILE SHOWN AS
2020 RIVER BED PROFILE SHOWN AS
2021 RIVER BED PROFILE SHOWN AS
2022 RIVER BED PROFILE SHOWN AS



ADDED 2020 BOTTOM PROFILE JULY 2020: GEOVERRA	ADDED 2002 BOTTOM PROFILE AUG 2002: UMA GEOMATICS	ADDED 2009 BOTTOM PROFILE JUNE 2009: MMM Geomatics	ADDED 2015 BOTTOM PROFILE AUG. 2015: WSP
ADDED FUTURE MONITORING DEC. 2019: WSP	ADDED 2001 BOTTOM PROFILE AUG. 2001: UMA GEOMATICS	ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics	ADDED 2014 BOTTOM PROFILE AUG 2014: MMM Geomatics
ADDED 2019 BOTTOM PROFILE SEP. 2018: WSP	ADDED 2000 BOTTOM PROFILE AUG 2000: UMA GEOMATICS	ADDED 2006 BOTTOM PROFILE JUNE 2006: USHER CANADA LIMITED	ADDED 2013 BOTTOM PROFILE AUG 2013: MMM Geomatics
ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP	ADDED 1999 BOTTOM PROFILE AUG 1999: UMA GEOMATICS	ADDED 2005 BOTTOM PROFILE JUNE 2005: USHER CANADA LIMITED	ADDED 2012 BOTTOM PROFILE AUG 2012: MMM Geomatics
ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP	ADDED 2022 BOTTOM PROFILE NOV 2022: GEOVERRA	ADDED 2004 BOTTOM PROFILE AUG 2004: USHER CANADA LIMITED	ADDED 2011 BOTTOM PROFILE AUG 2011: MMM Geomatics
ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP	ADDED 2021 BOTTOM PROFILE SEP 2021: GEOVERRA	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS	ADDED 2010 BOTTOM PROFILE JULY 2010: MMM Geomatics
No. REVISION	No. REVISION	No. REVISION	No. REVISION

LEGEND

UTILIDORS SHOWN
ROADS SHOWN
BURIED PIPES SHOWN
BELOW GROUND POWER,TELEPHONE, & COMMUNICATION SHOWN
VENT SHOWN
TRANSITION POINT
PULL BOX SHOWN
PULL POINT SHOWN
PIPE O/S DIA.'S ARE IN MILLIMETERS AND DECIMALS THEREOF

V, TP, PBU, PJP

SUBSTANCE/CATEGORY CROSS REFERENCE

SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ-SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ-FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Esso Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

MAINLAND TO ISLAND 2 SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA

CONTRACTOR DWG NO. : 1197-C

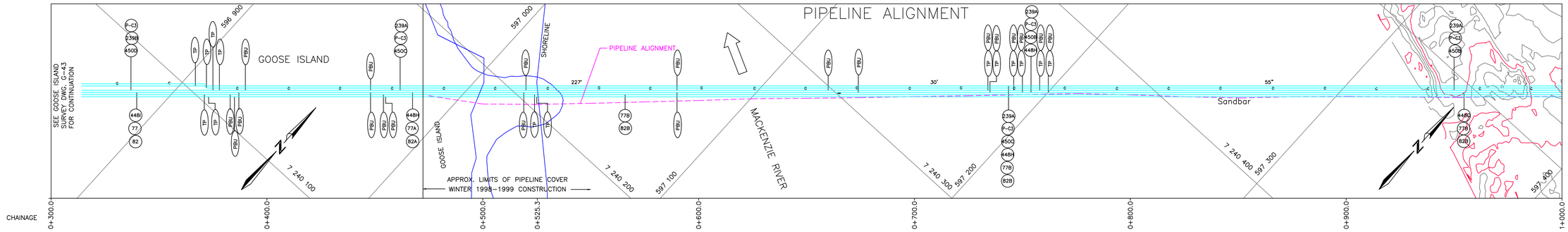
DATE: 22-11-01

SCALE: H 1:1000 V 1:200

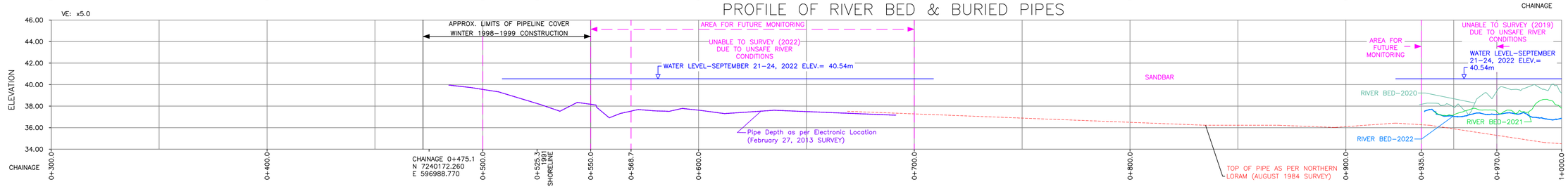
ESSO FILE No. 096-0179-700-801 72

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 73

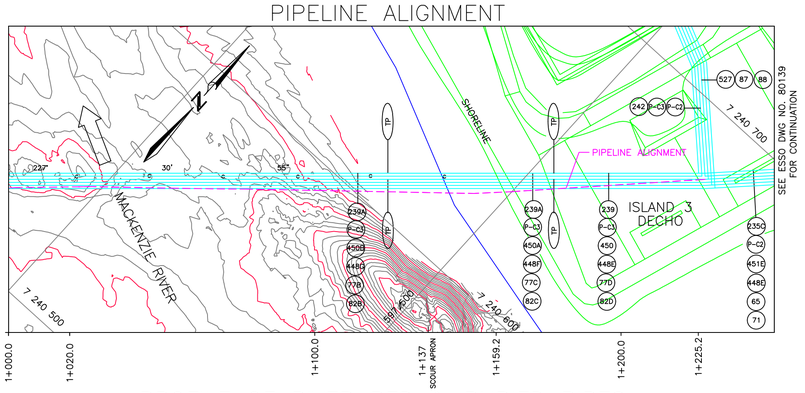
PIPELINE ALIGNMENT



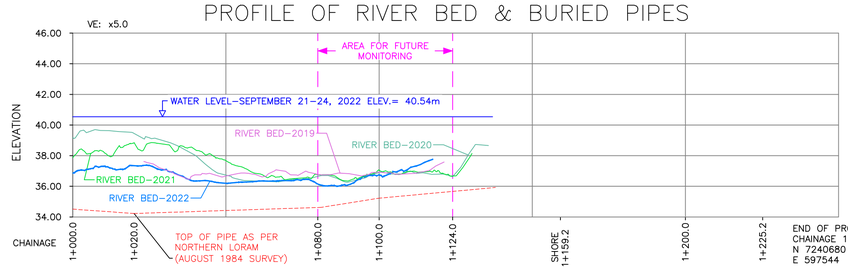
PROFILE OF RIVER BED & BURIED PIPES



PIPELINE ALIGNMENT



PROFILE OF RIVER BED & BURIED PIPES



PROFILE ALIGNMENT COORDINATES

EASTING	NORTHING	
596988.770	7240172.260	START CHAINAGE 0+475.1
597009.800	7240186.220	
597028.480	7240202.910	
597046.630	7240220.110	
597064.660	7240237.340	
597082.730	7240254.650	
597100.670	7240272.040	
597118.990	7240288.930	
597137.310	7240306.010	
597155.620	7240323.290	
597173.860	7240340.390	
597210.560	7240375.130	
597229.770	7240391.670	
597248.970	7240407.940	
597267.960	7240424.470	
597286.110	7240441.770	
597304.600	7240458.730	
597323.320	7240475.370	
597342.080	7240492.060	
597360.360	7240509.380	
597377.592	7240524.939	
597378.820	7240526.320	
597397.380	7240543.600	
597417.410	7240561.070	
597435.040	7240576.720	
597453.610	7240592.970	
597491.220	7240625.820	
597499.670	7240634.250	
597544.000	7240680.000	END CHAINAGE 1+225.1

Alignment includes Winter 1997 pipe locating data.

SURVEY CONTROL

No.	DESCRIPTION	NORTHING	EASTING	ELEV.
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89	
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90	
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43	
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97	
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38	
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36	
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08	
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94	
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63	
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14	
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56	
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79	

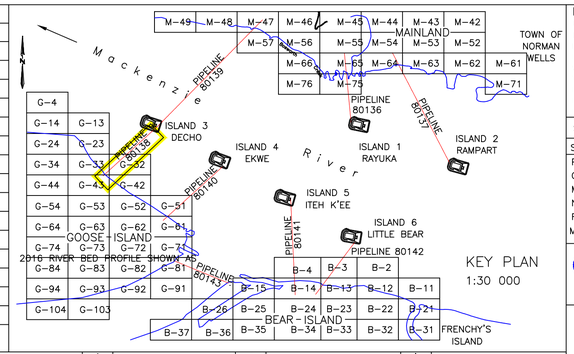
No.	SUBSTANCE DESCRIPTION
	MULTIPHASE LIQUIDS
65	273.1 OE ls.3 to C.P.F. Glycol H.T. 87–65–65A
71	355.6 OE ls.3 to C.P.F. Glycol H.T. 88–71–71A
77	273.1 OE GIT 4 to ls.3 Single Sect H.T. 77A–77B G–54,43,33,32 H.T.354
77A	273.1 OE GIT 4 to ls.3 Single Sect H.T., Conc Coated, 77A–77B–77C G–54,43,33,32 H.T.354
77B	273.1 OE GIT 4 to ls.3 Conc Coated, 77A–77B–77C–77D G–54,43,33,32
77C	273.1 OE GIT 4 to ls.3 Conc Coated, Glycol H.T. 77A–77B–77C–77D
77D	273.1 OE GIT 4 to ls.3 Glycol H.T. 77C–77D–65
82	355.6 OE GIT 4 to ls.3 Single Sect H.T. 82A–82B G–54,43,33,32 H.T.353
82A	355.6 OE GIT 4 to ls.3 Single Sect H.T., Conc Coated, 82A–82B–82C G–54,43,33,32 H.T.353
82B	355.6 OE GIT 4 to ls.3 Conc Coated, 82A–82B–82C–82D G–54,43,33,32
82C	355.6 OE GIT 4 to ls.3 Conc Coated, Glycol H.T. 82A–82B–82C–82D
82D	355.6 OE GIT 4 to ls.3 Glycol H.T. 82C–82D–71
87	168.3 OE ls.3 to C.P.F. Glycol H.T. 87–65–65A
88	168.3 OE ls.3 to C.P.F. Glycol H.T. 88–71–71A
	GASLIFT
235C	168.3 NG (Gas Lift) C.P.F. to ls.3 (Conc Coated) 235–235A–235B–235C–ls.3
239	168.3 NG (Gas Lift) ls.3 to GIT 4 (Buried) 235C–239–239A
239A	168.3 NG (Gas Lift) ls.3 to GIT 4 (Conc Coated) 239–239A–239B
239B	168.3 NG (Gas Lift) ls.3 to GIT 4 (Buried) 239A–239B–GIT 4 G–54,43,33,32
242	88.9 NG (Gas Lift) C.P.F. to ls.3 (Buried) 235C–242–ls.3

No.	SUBSTANCE DESCRIPTION
	INJECTION WATER
448E	219.1 INJ–FW C.P.F. to G.I.T.4, Gly H.T. 448 to 448F
448F	219.1 INJ–FW C.P.F. to G.I.T.4, Gly H.T., Conc Coated 448 to 448G
448G	219.1 INJ–FW C.P.F. to G.I.T.4, Conc Coated 448 to 448H G–32,33,43,54
448H	219.1 INJ–FW C.P.F. to G.I.T.4, Dbl Sect H.T., Conc Coated 448 to 448I G–32,33,43,54 H.T.352
448I	219.1 INJ–FW C.P.F. to G.I.T.4, Sng Sect H.T. 448 to 448I–G.I.T.4 G–32,33,43,54 H.T.352
450	168.3 INJ–SW ls.3 to G.I.T.4, Gly H.T. 451E–450–450A
450A	168.3 INJ–SW ls.3 to G.I.T.4, Gly H.T., Conc Coated 450–450A–450B
450B	168.3 INJ–SW ls.3 to G.I.T.4, Conc Coated 450–450A–450B–450C G–32,33,43,54
450C	168.3 INJ–SW ls.3 to G.I.T.4, Dbl Sect H.T., Conc Coated 450–450A–450B–450C–450D G–32,33,43,54 H.T.351
450D	168.3 INJ–SW ls.3 to G.I.T.4, Sng Sect H.T. 450–450A–450B–450C–450D–G.I.T.4 G–32,33,43,54 H.T.351
451E	168.3 INJ–SW C.P.F. to ls.3, Gly H.T. 451–451A–451B–451C–451D–451E–450
527	88.9 INJ–SW 451E Tee to ls.3, Gly H.T. 451E–527–ls.3
	ELECTRICAL DESCRIPTION
P–C2	4160 H.V. From SB–C1 to SB–C2 (ls.3) M–47,57 Refer to Dwg 096–0100–100–006
P–C3	4160 H.V. From SB–C2 (ls.3) to GIT 4 Trans TR–C1B G–54,43,33,32

NOTES

1. RIVER BOTTOM PROFILE FROM 2022 BATHYMETRIC SURVEY PERFORMED SEPTEMBER 18 TO SEPTEMBER 29, 2022.
2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM
   (TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)
3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129°
4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189
5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL
6. CONTOUR INTERVAL = 0.25 METRES.

2019 RIVER BED PROFILE SHOWN AS
2020 RIVER BED PROFILE SHOWN AS
2021 RIVER BED PROFILE SHOWN AS
2022 RIVER BED PROFILE SHOWN AS



No.	REVISION	No.	REVISION	No.	REVISION	No.	REVISION
30	ADDED 2021 BOTTOM PROFILE SEP. 2021: GEOVERRA	12	ADDED 2002 BOTTOM PROFILE AUG 2002: UMA GEOMATICS	18	ADDED 2010 BOTTOM PROFILE JULY 2010: MMM Geomatics	24	ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP
29	ADDED 2020 BOTTOM PROFILE JULY 2020: GEOVERRA	11	ADDED 2001 BOTTOM PROFILE AUG 2001: UMA GEOMATICS	17	ADDED 2009 BOTTOM PROFILE JUNE 2009: MMM Geomatics	23	ADDED 2015 BOTTOM PROFILE AUG. 2015: WSP
28	ADDED FUTURE MONITORING DEC. 2019: WSP	10	ADDED 2000 BOTTOM PROFILE AUG 2000: UMA GEOMATICS	16	ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics	22	ADDED 2014 BOTTOM PROFILE AUGUST 2014: MMM Geomatics
27	ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP	9	ADDED 1999 BOTTOM PROFILE AUG 1999: UMA GEOMATICS	15	ADDED 2006 BOTTOM PROFILE AUG 2006: USHER CANADA LIMITED	21	ADDED 2013 BOTTOM PROFILE AUGUST 2013: MMM Geomatics
26	ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP	32	REVIEW OF BOTTOM PROFILES DEC 2022: GEOVERRA	14	ADDED 2005 BOTTOM PROFILE AUG 2005: USHER CANADA LIMITED	20	ADDED 2012 BOTTOM PROFILE AUGUST 2012: MMM Geomatics
25	ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP	31	ADDED 2022 BOTTOM PROFILE NOV 2022: GEOVERRA	13	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS	19	ADDED 2011 BOTTOM PROFILE AUGUST 2011: MMM Geomatics

LEGEND

UTILIDORS SHOWN
ROADS SHOWN
BURIED PIPES SHOWN
BELOW GROUND POWER,TELEPHONE, & COMMUNICATION SHOWN (C C)
VENT SHOWN (V)
TRANSITION POINT (TP)
PULL BOX SHOWN (PBU)
PULL POINT SHOWN (P.P)
PIPE O/S DIA.'S ARE IN MILLIMETERS AND DECIMALS THEREOF

SUBSTANCE/CATEGORY CROSS REFERENCE

SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ–SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ–FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Esso Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

GOOSE TO ISLAND 3 SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA

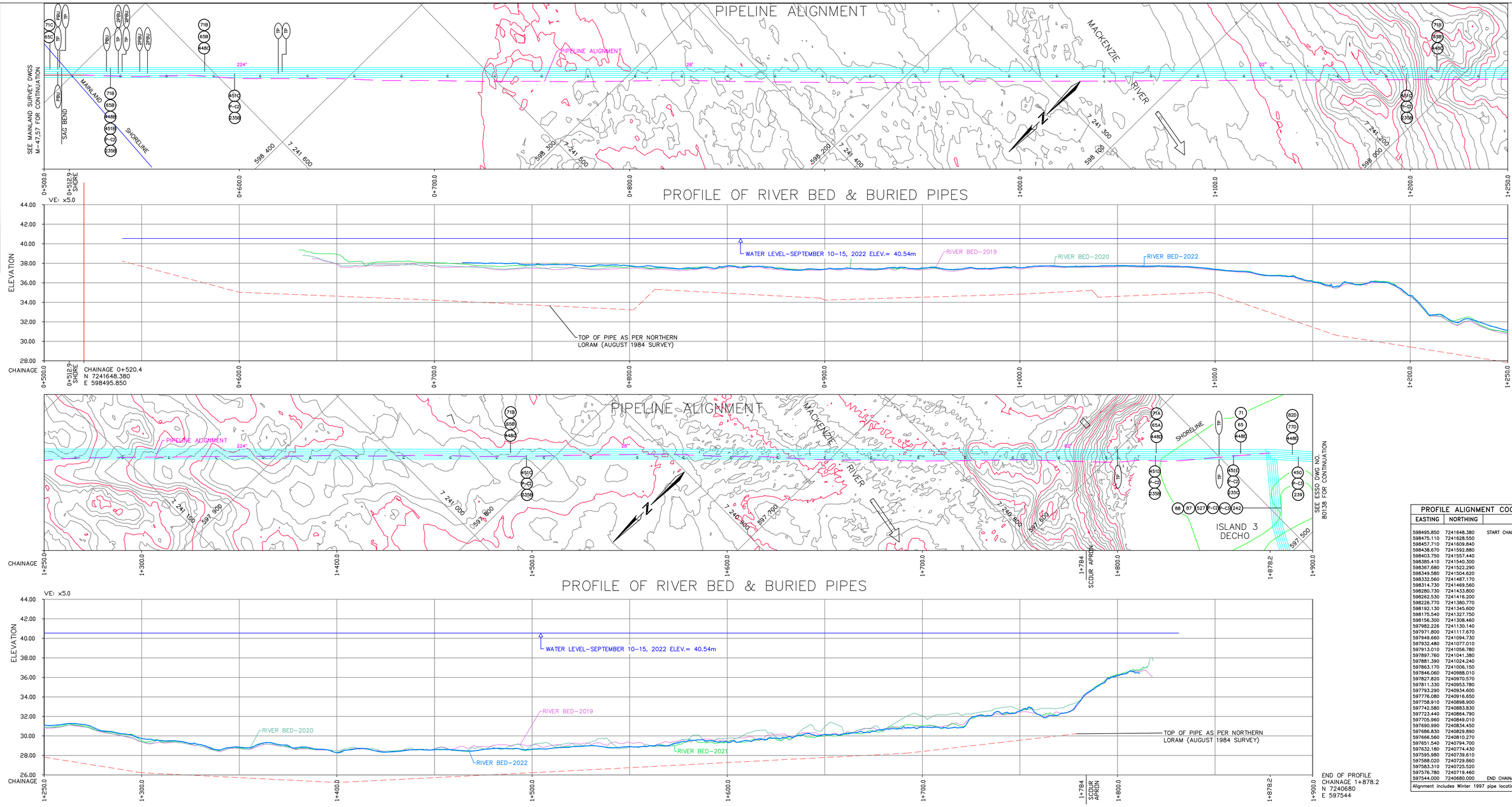
CONTRACTOR DWG NO. : 1198–C

ESSO FILE No. 096–0179–700–801 73

DATE: 22–12–05

SCALE: H 1:1000 V 1:200

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 74



PROFILE ALIGNMENT COORDINATES		
EASTING	NORTHING	
598495.850	7241648.380	START CHAINAGE 0+520.4
598475.110	7241628.550	
598457.710	7241609.840	
598438.670	7241592.880	
598403.750	7241557.440	
598385.410	7241540.300	
598367.680	7241522.290	
598349.580	7241504.620	
598332.560	7241487.170	
598314.730	7241469.560	
598280.730	7241433.800	
598262.530	7241416.200	
598226.770	7241380.770	
598192.130	7241345.600	
598175.540	7241327.750	
598156.300	7241308.460	
597982.226	7241130.140	
597971.800	7241117.670	
597949.660	7241094.730	
597932.480	7241077.010	
597913.010	7241056.780	
597897.760	7241041.380	
597881.390	7241024.240	
597863.170	7241006.150	
597846.060	7240988.010	
597827.820	7240970.570	
597811.330	7240953.780	
597793.290	7240934.600	
597776.080	7240916.650	
597758.910	7240898.900	
597742.580	7240883.830	
597723.440	7240864.790	
597705.960	7240849.010	
597690.990	7240834.450	
597686.830	7240829.890	
597666.560	7240810.270	
597651.540	7240794.700	
597632.180	7240774.430	
597595.980	7240739.610	
597588.020	7240729.860	
597583.310	7240725.520	
597576.780	7240719.460	
597544.000	7240680.000	END CHAINAGE 1+878.2

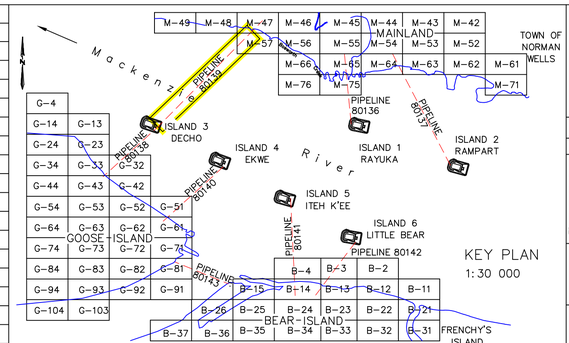
Alignment includes Winter 1997 pipe locating data.

SURVEY CONTROL				
No.	DESCRIPTION	NORTHING	EASTING	ELEV.
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89	
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90	
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43	
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97	
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38	
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36	
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08	
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94	
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63	
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14	
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56	
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79	

No.	SUBSTANCE DESCRIPTION
	MULTIPHASE LIQUIDS
65	273.1 OE ls.3 to C.P.F. Glycol H.T. 87–65–65A
65A	273.1 OE ls.3 to C.P.F. Glycol H.T., Conc Coated 65–65A–65B
65B	273.1 OE ls.3 to C.P.F. Conc Coated 65–65A–65B–65C M–57,47,46
65C	273.1 OE ls.3 to C.P.F. Sng Sect. H.T. Conc Coated 65–65A–65B–65C–65D M–57,47,46 H.T.224
71	355.6 OE ls.3 to C.P.F. Glycol H.T. 88–71–71A
71A	355.6 OE ls.3 to C.P.F. Glycol H.T., Conc Coated 71–71A–71B
71B	355.6 OE ls.3 to C.P.F. Conc Coated 71–71A–71B–71C M–57,47,46
71C	355.6 OE ls.3 to C.P.F. Dbl Sect. H.T. Conc Coated 71–71A–71B–71C–71D M–57,47,46 H.T.223
77D	273.1 OE GIT 4 to ls.3 Glycol H.T. 77C–77D–65
82D	355.6 OE GIT 4 to ls.3 Glycol H.T. 82C–82D–71
87	168.3 OE ls.3 to C.P.F. Glycol H.T. 87–65–65A
88	168.3 OE ls.3 to C.P.F. Glycol H.T. 88–71–71A
	GASLIFT
235B	168.3 NG (Gas Lift) C.P.F. to ls.3 (Conc Coated) 235–235A–235B–235C M–46,47,57
235C	168.3 NG (Gas Lift) C.P.F. to ls.3 (Conc Coated) 235–235A–235B–235C–ls.3
239	168.3 NG (Gas Lift) ls.3 to GIT 4 (Conc Coated) 235C–239–239A
242	88.9 NG (Gas Lift) C.P.F. to ls.3 (Buried) 235C–242–ls.3
	INJECTION WATER
448B	219.1 INJ–FW C.P.F to G.I.T. 4, Dbl Sect H.T., Conc Coated 448–448A–448B–448C M–46,47,57
448C	219.1 INJ–FW C.P.F. to G.I.T. 4, Conc Coated 448–448A–448B–448C–448D M–46,47
448D	219.1 INJ–FW C.P.F. to G.I.T. 4, Conc Coated, Gly H.T., 448–448A–448B–448C–448D–448E
448E	219.1 INJ–FW C.P.F. to G.I.T. 4, Glycol H.T., 448–448A–448B–448C–448D–448E–527

No.	SUBSTANCE DESCRIPTION
	INJECTION WATER
448E	219.1 INJ–FW C.P.F. to G.I.T. 4, Glycol H.T., 448–448A–448B–448C–448D–448E–448F
451B	168.3 INJ–SW C.P.F. to ls. 3, Dbl Sect H.T., Conc Coated, Liner 451–451A–451B–451C Converted Spare Line H.T.226
451C	168.3 INJ–SW C.P.F. to ls. 3, Conc Coated Liner 451–451A–451B–451C–451D M–46,47,57 Converted Spare Line
451D	168.3 INJ–SW C.P.F. to ls. 3, Conc Coated, Gly H.T., Liner 451–451A–451B–451C–451D–451E Converted Spare Line
451E	168.3 INJ–SW C.P.F. to ls. 3, Glycol H.T., Liner 451–451A–451B–451C–451D–451E–450 Converted Spare Line
450	168.3 INJ–SW ls.3 to GIT 4, Glycol H.T. 451E–450–450A Converted Spare Line
527	88.9 INJ–SW 451E Tee to ls.3, Glycol H.T. 451E–527–ls.3
	ELECTRICAL DESCRIPTION
P–C2	4160 H.V. From SB–C1 to SB–C2 (ls.3) M–47,57 Refer to Dwg 096–0100–100–006
P–C3	4160 H.V. From SB–C2 (ls.3) to GIT 4 Trans TR–C18 G–54,43,33,32

NOTES
1. RIVER BOTTOM PROFILE FROM 2022 BATHYMETRIC SURVEY PERFORMED SEPTEMBER 18 TO SEPTEMBER 29, 2022.
2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM (TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)
3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129°
4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189
5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL
6. CONTOUR INTERVAL = 0.25 METRES.
2019 RIVER BED PROFILE SHOWN AS
2020 RIVER BED PROFILE SHOWN AS
2021 RIVER BED PROFILE SHOWN AS
2022 RIVER BED PROFILE SHOWN AS



LEGEND	
UTILIDORS SHOWN	
ROADS SHOWN	
BURIED PIPES SHOWN	
BELOW GROUND POWER,TELEPHONE, & COMMUNICATION SHOWN	C C
VENT SHOWN	V
TRANSITION POINT	TP
PULL BOX SHOWN	PBU
PULL POINT SHOWN	P.P.
PIPE O/S DIA.'S ARE IN MILLIMETERS AND DECIMALS THEREOF	

SUBSTANCE/CATEGORY CROSS REFERENCE			
SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ–SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ–FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Esso Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

MAINLAND TO ISLAND 3 SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA	CONTRACTOR DWG NO. : 1199–C
DATE: 22–11–01	ESSO FILE No. 096–0179–700–801 74
SCALE: H 1:1000 V 1:200	

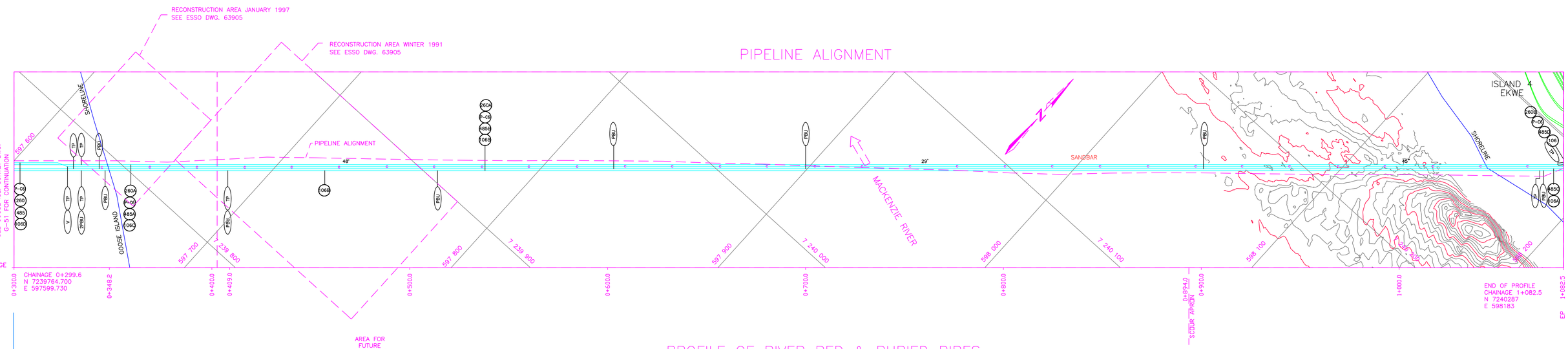
No.	REVISION	No.	REVISION	No.	REVISION	No.	REVISION
1	ADDED 2021 BOTTOM PROFILE SEP. 2021: GEOVERRA	1	ADDED 2002 BOTTOM PROFILE AUG. 2002: UMA GEOMATICS	1	ADDED 2009 BOTTOM PROFILE JUNE 2009: MMM Geomatics	1	ADDED 2015 BOTTOM PROFILE AUG. 2015: WSP
1	ADDED 2020 BOTTOM PROFILE JULY 2020: GEOVERRA	1	ADDED 2001 BOTTOM PROFILE AUG. 2001: UMA GEOMATICS	1	ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics	1	ADDED 2014 BOTTOM PROFILE AUG 2014: MMM GEOMATICS
1	ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP	1	ADDED 2000 BOTTOM PROFILE AUG 2000: UMA GEOMATICS	1	ADDED 2006 BOTTOM PROFILE JUNE 2006: USHER CANADA LIMITED	1	ADDED 2013 BOTTOM PROFILE AUG 2013: MMM GEOMATICS
1	ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP	1	ADDED 1999 BOTTOM PROFILE AUG 1999: UMA GEOMATICS	1	ADDED 2005 BOTTOM PROFILE JUNE 2005: USHER CANADA LIMITED	1	ADDED 2012 BOTTOM PROFILE AUG 2012: MMM GEOMATICS
1	ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP	1	ADDED 1998 BOTTOM PROFILE JUNE, 1998: UMA GEOMATICS	1	ADDED 2004 BOTTOM PROFILE AUG 2004: USHER CANADA LIMITED	1	ADDED 2011 BOTTOM PROFILE AUG 2011: MMM GEOMATICS
1	ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP	1	ADDED 2022 BOTTOM PROFILE NOV 2022: GEOVERRA	1	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS	1	ADDED 2010 BOTTOM PROFILE JULY 2010: MMM GEOMATICS

096-0179-700-801 75

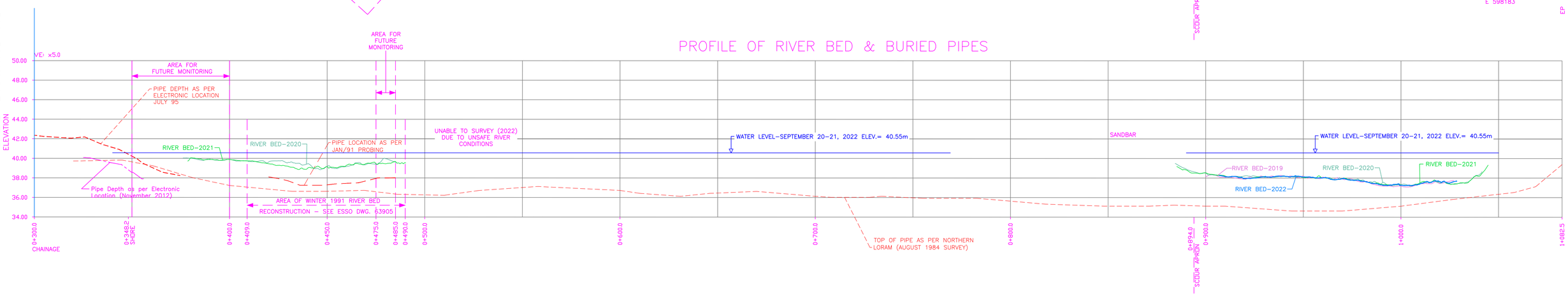
AutoCAD

NO MANUAL CHANGES

CADD DRAWING



PROFILE OF RIVER BED & BURIED PIPES



SURVEY CONTROL

No.	DESCRIPTION	NORTHING	EASTING	ELEV.
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89	
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90	
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43	
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97	
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38	
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36	
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08	
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94	
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63	
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14	
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56	
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79	

No.	SUBSTANCE DESCRIPTION	
	MULTIPHASE LIQUIDS	
106	219.1 OE ls.4 to GIT 4, Glycol H.T. 106–106A	
106A	219.1 OE ls.4 to GIT 4, Glycol H.T., Conc Coated 106–106A–106B	
106B	219.1 OE ls.4 to GIT 4, Conc Coated 106–106A–106B–106C	
106C	219.1 OE ls.4 to GIT 4, Sng Sect H.T., Conc Coated 106–106A–106B–106C–106D G–51,61,62,72,63,64,54 H.T.356	
106D	219.1 OE ls.4 to GIT 4, Sng Sect H.T. 106–106A–106B–106C–106D–GIT 4 G–51,61,62,72,63,64,54 H.T.356	
	GASLIFT	
260	88.9 NG (Gas Lift) GIT 4 to ls.4 (Buried) 260–260A G–51,62,72,63,64,54	
260A	88.9 NG (Gas Lift) GIT 4 to ls.4 (Conc Coated) 260–260A–260B G–51,62,72,63,64,54	
260B	88.9 NG (Gas Lift) GIT 4 to ls.4 (Buried) 260–260A–260B–ls.4	
	INJECTION WATER	
485	88.9 INJ–SW GIT 4 to ls.4, Sng Sect H.T., Liner 485–485A G–51,62,72,63,64,54 H.T.355	
485A	88.9 INJ–SW GIT 4 to ls.4, Sng Sect H.T., Conc Coated, Liner G–51,62,72,63,64,54 H.T.355	
485B	88.9 INJ–SW GIT 4 to ls.4, Conc Coated, Liner 485–485A–485B–485C G–51,62,72,63,64,54	
485C	88.9 INJ–SW GIT 4 to ls.4, Glycol H.T., Conc Coated, Liner 485–485A–485B–485C–485D	
485D	88.9 INJ–SW ls.4 ls.4, Glycol H.T., Liner 485–485A–485B–485C–485D–ls. 4	
	ELECTRICAL DESCRIPTION	
P–C6	4160 H.V. GIT 4 5Kv Switch Gear ls.4 Tr–C3 G–51,62,72,63,64,54	

PROFILE ALIGNMENT COORDINATES

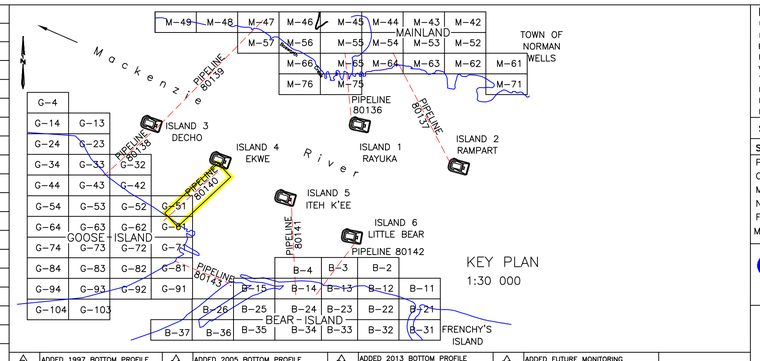
EASTING	NORTHING	
597599.730	7239764.700	START CHAINAGE 0+299.6
597620.330	7239783.340	
597638.850	7239800.100	
597657.950	7239816.460	
597675.810	7239834.160	
597693.470	7239852.120	
597712.360	7239868.620	
597750.070	7239901.480	
597768.890	7239918.080	
597787.670	7239934.740	
597806.100	7239951.640	
597843.510	7239984.930	
597862.720	7240001.070	
597881.690	7240017.520	
597900.880	7240033.650	
597919.950	7240049.830	
597939.050	7240066.100	
597958.080	7240082.260	
597977.390	7240098.090	
597996.440	7240114.330	
598014.690	7240131.690	
598033.130	7240148.630	
598051.700	7240165.310	
598070.430	7240181.730	
598089.120	7240198.220	
598098.390	7240206.570	
598107.670	7240214.920	
598126.290	7240231.630	
598144.980	7240248.190	
598163.770	7240264.700	
598178.650	7240277.920	
598183.000	7240287.000	END CHAINAGE 1+082.5

Alignment includes Winter 1997 pipe locating data.

NOTES

1. RIVER BOTTOM PROFILE FROM 2022 BATHYMETRIC SURVEY PERFORMED SEPTEMBER 18 TO SEPTEMBER 29, 2022.
2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM (TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)
3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129°
4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189
5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL
6. CONTOUR INTERVAL = 0.25 METRES.

2019 RIVER BED PROFILE SHOWN AS
2020 RIVER BED PROFILE SHOWN AS
2021 RIVER BED PROFILE SHOWN AS
2022 RIVER BED PROFILE SHOWN AS



No.	REVISION	No.	REVISION	No.	REVISION	No.	REVISION
7	ADDED 1997 BOTTOM PROFILE JULY, 1997: UMA GEOMATICS	14	ADDED 2005 BOTTOM PROFILE AUG 2005: USHER CANADA LIMITED	21	ADDED 2013 BOTTOM PROFILE AUGUST 2013: MMM Geomatics	28	ADDED FUTURE MONITORING DEC. 2019: WSP
6	ADDED 1996 BOTTOM PROFILE JULY, 1996: UMA GEOMATICS	13	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS	20	ADDED 2012 BOTTOM PROFILE AUGUST 2012: MMM Geomatics	27	ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP
5	ADDED 1995 BOTTOM PROFILE JULY, 1995: UMA GEOMATICS	12	ADDED 2002 BOTTOM PROFILE AUG 2002: UMA GEOMATICS	19	ADDED 2011 BOTTOM PROFILE AUGUST 2011: MMM Geomatics	26	ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP
4	ADDED 1994 BOTTOM PROFILE NOV 2022: GEOVERRA	11	ADDED 2001 BOTTOM PROFILE AUG 2001: UMA GEOMATICS	18	ADDED 2010 BOTTOM PROFILE JULY 2010: MMM Geomatics	25	ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP
3	ADDED 2022 BOTTOM PROFILE NOV 2022: GEOVERRA	10	ADDED 2000 BOTTOM PROFILE AUG 2000: UMA GEOMATICS	17	ADDED 2009 BOTTOM PROFILE JUNE 2009: MMM Geomatics	24	ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP
2	ADDED 2021 BOTTOM PROFILE SEP 2021: GEOVERRA	9	ADDED 1999 BOTTOM PROFILE AUG, 1999: UMA GEOMATICS	16	ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics	23	ADDED 2015 BOTTOM PROFILE AUG. 2015: WSP
1	ADDED 2020 BOTTOM PROFILE JULY 2020: GEOVERRA	8	ADDED 1998 BOTTOM PROFILE JUNE, 1998: UMA GEOMATICS	15	ADDED 2006 BOTTOM PROFILE AUG 2006: USHER CANADA LIMITED	22	ADDED 2014 BOTTOM PROFILE AUG 2014: MMM Geomatics

LEGEND

UTILIDORS SHOWN
ROADS SHOWN
BURIED PIPES SHOWN
BELOW GROUND POWER,TELEPHONE, & COMMUNICATION SHOWN (C C)
VENT SHOWN (V)
TRANSITION POINT (TP)
PULL BOX SHOWN (PBU)
PULL POINT SHOWN (P.P)
PIPE O/S DIA.'S ARE IN MILLIMETERS AND DECIMALS THEREOF

SUBSTANCE/CATEGORY CROSS REFERENCE

SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ–SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ–FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Esso Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

GOOSE TO ISLAND 4 SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA

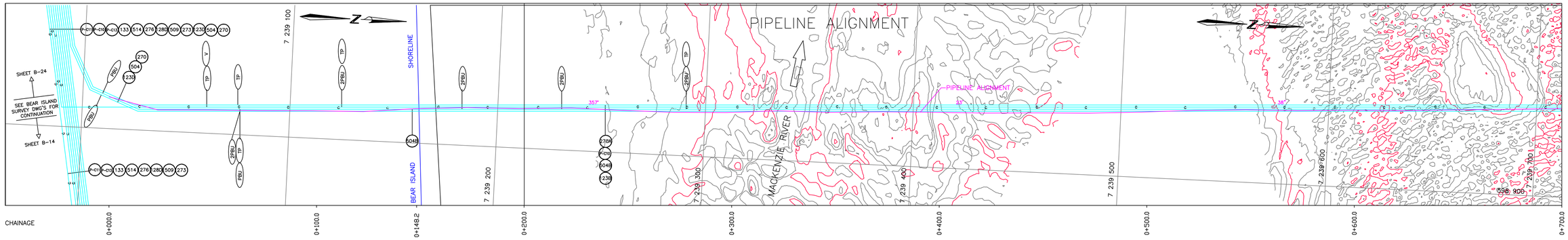
CONTRACTOR DWG NO. : 1200–C

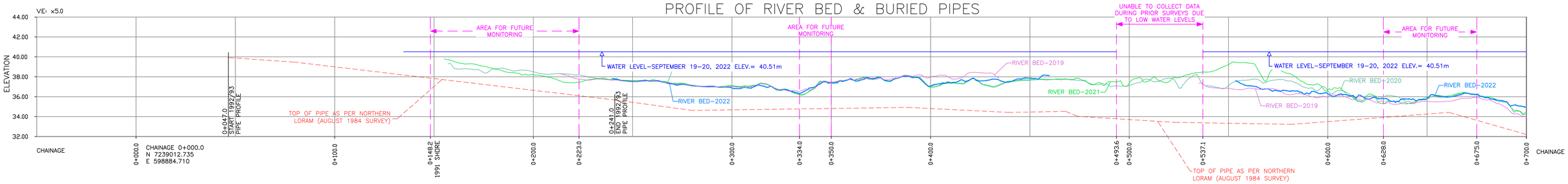
DATE: 22–11–25

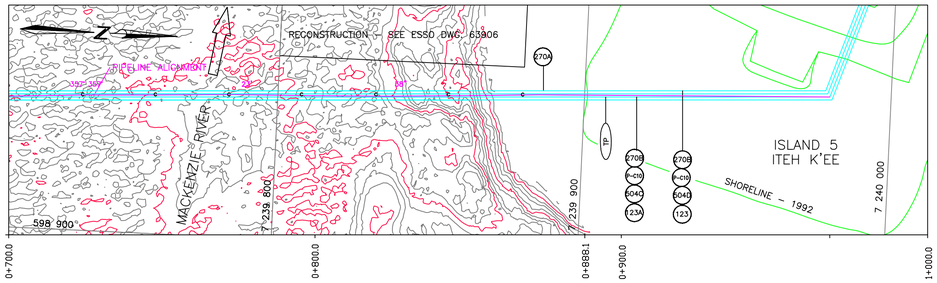
SCALE: H 1:1000 V 1:200

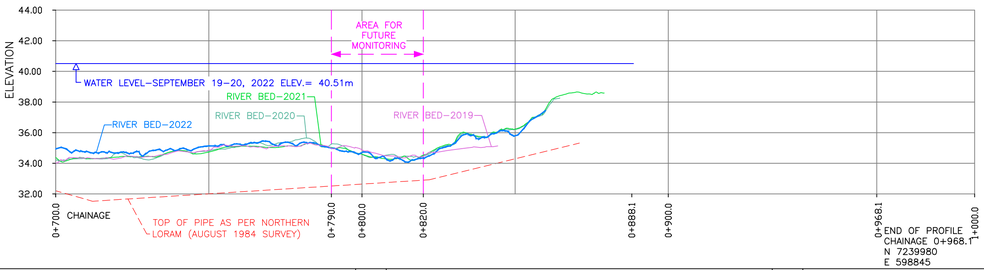
ESSO FILE No. 096–0179–700–801 75

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 76









PROFILE ALIGNMENT COORDINATES		
EASTING	NORTHING	
598884.710	7239012.735	START CHAINAGE 0+000.000
598889.860	7239036.320	
598888.710	7239061.550	
598887.910	7239085.780	
598886.820	7239110.580	
598886.050	7239135.440	
598883.480	7239160.310	
598881.680	7239185.260	
598881.060	7239210.410	
598879.520	7239235.430	
598879.560	7239259.790	
598879.320	7239284.800	
598878.200	7239310.010	
598876.280	7239334.880	
598875.790	7239359.970	
598874.330	7239384.860	
598873.360	7239409.840	
598872.610	7239434.770	
598871.350	7239459.860	
598870.310	7239484.780	
598868.570	7239509.940	
598866.610	7239535.040	
598865.090	7239560.020	
598864.320	7239585.090	
598862.850	7239610.190	
598861.950	7239635.260	
598860.400	7239660.400	
598859.020	7239685.300	
598857.480	7239710.330	
598857.363	7239712.223	
598855.944	7239735.330	
598854.714	7239760.360	
598853.404	7239785.410	
598852.614	7239810.250	
598851.594	7239835.450	
598850.244	7239860.180	
598848.764	7239885.080	
598845.000	7239980.000	END CHAINAGE 0+968.1

Alignment includes Winter 1997 pipe locating data.

SURVEY CONTROL				
No.	DESCRIPTION	NORTHING	EASTING	ELEV.
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89	
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90	
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43	
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97	
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38	
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36	
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08	
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94	
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63	
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14	
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56	
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79	

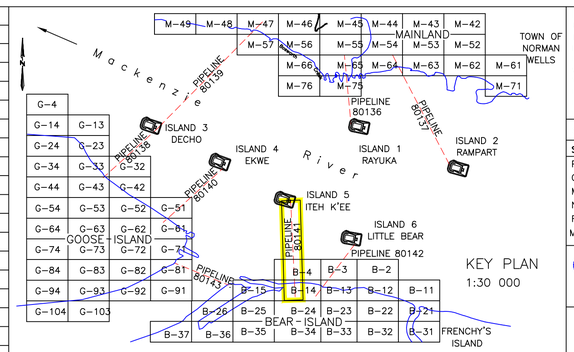
No.	SUBSTANCE DESCRIPTION
	MULTIPHASE LIQUIDS
123	219.1 OE Is.5 to BIT 4, Glycol H.T. 123–123A
123A	219.1 OE Is.5 to BIT 4, Glycol H.T., Conc Coated 123–123A–123B
123B	219.1 OE Is.5 to BIT 4, Conc Coated 123–123A–123B–123C B–14,24,25
123C	219.1 OE Is.5 to BIT 4, Dbl Sect H.T., Conc Coated 123–123A–123B–123C–123D B–14,24,25 H.T.443
123D	219.1 OE Is.5 to BIT 4, Sng Sect H.T. 123–123A–123B–123C–123D–BIT 4 B–14,24,25 H.T.443
128D	168.3 OE Is.6 to BIT 4, Sng Sect H.T. 128–128A–128B–128C–128D–BIT 4 B–3,13,14,24,25 H.T.441
133	219.1 OE BIT 3 to BIT 4, Sng Thermon H.T. B–22,23,13,14,24,25 H.T.428
	GASLIFT
270	88.9 NG (Gas Lift) BIT 4 to Is.5 (Buried) 270–270A B–14,24
270A	88.9 NG (Gas Lift) BIT 4 to Is.5 (Conc Coated) 270–270A–270B B–14,24
270B	88.9 NG (Gas Lift) BIT 4 to Is.5 (Buried) 270–270A–270B–Is.5
273	88.9 NG (Gas Lift) BIT 4 to Is.6 (Buried) 273–273A B–25,24,14,13,3
276	88.9 NG (Gas Lift) BIT 4 to BIT 3, (Buried) B–22,23,13,14,24,25
	INJECTION WATER
504	88.9 INJ–FW BIT 4 to Is.5, Sng Sect H.T. 504–504A B–14,24 H.T.444
504A	88.9 INJ–FW BIT 4 to Is.5, Dbl Sect H.T., Conc Coated 504–504A–504B B–14,24 H.T.444
504B	88.9 INJ–FW BIT 4 to Is.5, Conc Coated 504–504A–504B–504C B–14,24
504C	88.9 INJ–FW BIT 4 to Is.5, Glycol H.T., Conc Coated 504–504A–504B–504C–504D
504D	88.9 INJ–FW Is.5 Is.5, Glycol H.T. 504–504A–504B–504C–504D–Is.5
509	88.9 INJ–FW BIT 4 to Is.6, Sng Sect H.T. 509–509A B–25,24,14,13,3 H.T.442
514	88.9 INJ–FW BIT4 to BIT 3, Sng Thermon H.T. B–22,23,13,14,24,25 H.T.429

No.	SUBSTANCE DESCRIPTION
	ELECTRICAL DESCRIPTION
P–C10	4160 H.V. BIT 4 5Kv Switch Gear Is.5 Tr–C5 B–14,24
P–C11	4160 H.V. BIT 4 5Kv Switch Gear Is.6 Tr–C6 B–25,24,1413,3
P–C13	4160 H.V. BIT 4 5Kv Switch Gear BIT 3 5Kv Switch Gear B–25,24,23,22,13

NOTES

1. RIVER BOTTOM PROFILE FROM 2022 BATHYMETRIC SURVEY PERFORMED SEPTEMBER 18 TO SEPTEMBER 29, 2022.
2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM (TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)
3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129°
4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189
5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL
6. CONTOUR INTERVAL = 0.25 METRES.

2019 RIVER BED PROFILE SHOWN AS
2020 RIVER BED PROFILE SHOWN AS
2021 RIVER BED PROFILE SHOWN AS
2022 RIVER BED PROFILE SHOWN AS



ADDED 2020 BOTTOM PROFILE JULY 2020: GEOVERRA	ADDED 2003 BOTTOM PROFILE AUG 2002: UMA GEOMATICS	ADDED 2009 BOTTOM PROFILE JUNE 2009: MMM Geomatics	ADDED 2015 BOTTOM PROFILE AUG. 2015: WSP
ADDED FUTURE MONITORING DEC. 2018: WSP	ADDED 2001 BOTTOM PROFILE AUG 2001: UMA GEOMATICS	ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics	ADDED 2014 BOTTOM PROFILE AUG 2014: MMM Geomatics
ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP	ADDED 2000 BOTTOM PROFILE AUG 2000: UMA GEOMATICS	ADDED 2006 BOTTOM PROFILE JUNE 2006: USHER CANADA LIMITED	ADDED 2013 BOTTOM PROFILE AUG 2013: MMM Geomatics
ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP	CHANGE TO THE 2019 BOTTOM DEC 2022: GEOVERRA	ADDED 2005 BOTTOM PROFILE JUNE 2005: USHER CANADA LIMITED	ADDED 2012 BOTTOM PROFILE AUG 2012: MMM Geomatics
ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP	ADDED 2022 BOTTOM PROFILE NOV 2022: GEOVERRA	ADDED 2004 BOTTOM PROFILE AUG 2004: USHER CANADA LIMITED	ADDED 2011BOTTOM PROFILE AUG 2011: MMM Geomatics
ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP	ADDED 2021 BOTTOM PROFILE SEP 2021: GEOVERRA	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS	ADDED 2010 BOTTOM PROFILE JULY 2010: MMM Geomatics
No. REVISION	No. REVISION	No. REVISION	No. REVISION

LEGEND

UTILIDORS SHOWN
ROADS SHOWN
BURIED PIPES SHOWN
BELOW GROUND POWER,TELEPHONE, & COMMUNICATION SHOWN
VENT SHOWN
TRANSITION POINT
PULL BOX SHOWN
PULL POINT SHOWN
PIPE O/S DIA'S ARE IN MILLIMETERS AND DECIMALS THEREOF

SUBSTANCE/CATEGORY CROSS REFERENCE

SUBSTANCE	CODE	SUBSTANCE	CODE
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NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ–FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Esso Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

BEAR TO ISLAND 5 SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA

CONTRACTOR DWG NO. : 1201–C

DATE: 22–12–05

SCALE: H 1:1000 V 1:200

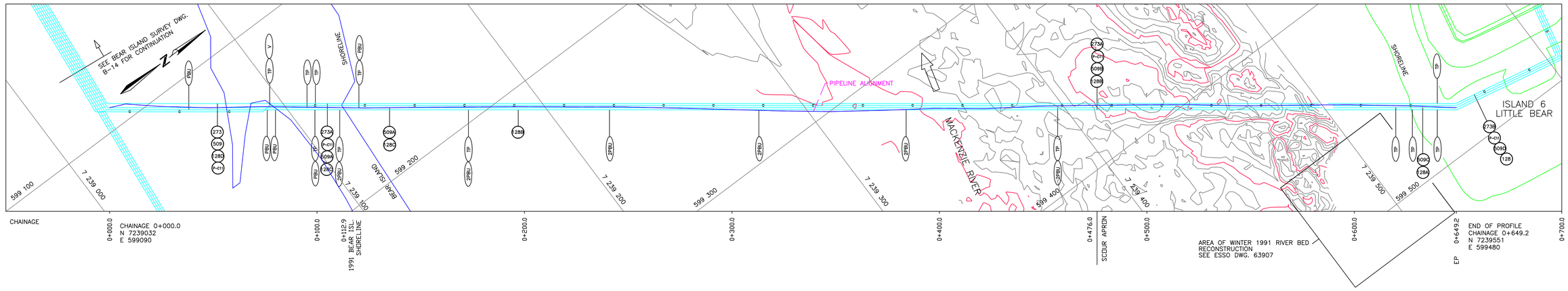
ESSO FILE No. 096–0179–700–801 76

096-0179-700-801 77

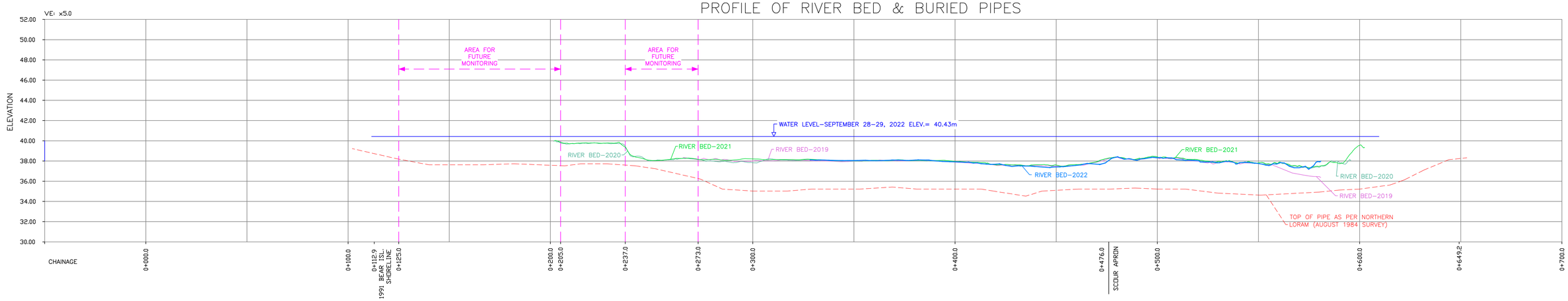
AutoCAD

NO MANUAL CHANGES

CADD DRAWING



PROFILE OF RIVER BED & BURIED PIPES



SURVEY CONTROL

No.	DESCRIPTION	NORTHING	EASTING	ELEV.
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89	
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90	
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43	
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97	
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38	
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36	
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08	
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94	
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63	
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14	
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56	
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79	

SUBSTANCE DESCRIPTION

No.	SUBSTANCE DESCRIPTION
	MULTIPHASE LIQUIDS
128	168.3 OE Is.6 to BIT 4, Glycol H.T. 128-128A
128A	168.3 OE Is.6 to BIT 4, Glycol H.T., Conc Coated 128-128A-128B
128B	168.3 OE Is.6 to BIT 4, Conc Coated 128-128A-128B-128C B-3,13,14,24,25
128C	168.3 OE Is.6 to BIT 4, Dbl Sect H.T., Conc Coated 128-128A-128B-128C-128D B-3,13,14,24,25 H.T.441
128D	168.3 OE Is.6 to BIT 4, Sng Sect H.T. 128-128A-128B-128C-128D-BIT 4 B-3,13,14,24,25 H.T.441
	GASLIFT
273	88.9 NG (Gas Lift) BIT 4 to Is.6 (Buried) 273-273A B-25,24,14,13,3
273A	88.9 NG (Gas Lift) BIT 4 to Is.6 (Conc Coated) 273-273A-273B B-25,24,14,13,3
273B	88.9 NG (Gas Lift) BIT 4 to Is.6 (Buried) 273-273A-273B-Is.6
	INJECTION WATER
509	88.9 INJ-FW BIT 4 to Is.6, Sng Sect H.T. 509-509A B-25,24,14,13,3 H.T.442
509A	88.9 INJ-FW BIT 4 to Is.6, Dbl Sect H.T., Conc Coated 504-504A-504B B-25,24,14,13,3 H.T.442
509B	88.9 INJ-FW BIT 4 to Is.6, Conc Coated 509-509A-509B-509C B-25,24,14,13,3
509C	88.9 INJ-FW BIT 4 to Is.6, Glycol H.T., Conc Coated 509-509A-509B-509C-509D
509D	88.9 INJ-FW BIT 4 to Is.6, Glycol H.T. 509-509A-509B-509C-509D-Is.6
	ELECTRICAL DESCRIPTION
P-C11	4160 H.V. BIT 4 5Kv Switch Gear Is.6 Tr-C6 B-25,24,1413,3

PROFILE ALIGNMENT COORDINATES

EASTING	NORTHING	
599090.000	7239032.000	START CHAINAGE 0+000.000
599093.250	7239039.250	
599103.320	7239050.850	
599118.870	7239070.340	
599133.430	7239090.700	
599149.930	7239112.080	
599163.950	7239130.100	
599178.670	7239150.250	
599193.510	7239170.290	
599208.340	7239190.310	
599223.420	7239210.200	
599238.330	7239230.020	
599253.750	7239249.580	
599269.330	7239269.230	
599285.010	7239288.900	
599290.520	7239296.040	
599294.190	7239300.800	
599300.310	7239308.730	
599314.720	7239328.900	
599329.050	7239349.520	
599344.090	7239369.280	
599358.010	7239389.800	
599372.550	7239409.930	
599387.300	7239429.980	
599402.270	7239450.020	
599417.930	7239469.890	
599432.740	7239490.140	
599447.530	7239510.210	
599462.960	7239529.870	
599468.430	7239536.780	
599480.000	7239551.000	END CHAINAGE 0+649.2

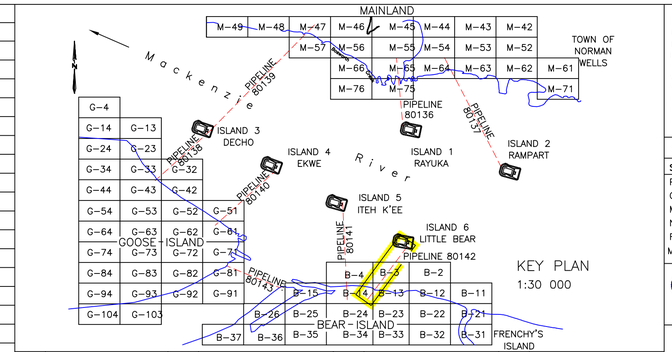
Alignment includes Winter 1997 pipe locating data.

NOTES

1. RIVER BOTTOM PROFILE FROM 2022 BATHYMETRIC SURVEY PERFORMED SEPTEMBER 18 TO SEPTEMBER 29, 2022.
2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80054 REV. 8 – TOP OF PIPE AS PER NORTHERN LORAM (TOP OF PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)
3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129°
4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189
5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL
6. CONTOUR INTERVAL = 0.25 METRES.

LEGEND

- 2019 RIVER BED PROFILE SHOWN AS
- 2020 RIVER BED PROFILE SHOWN AS
- 2021 RIVER BED PROFILE SHOWN AS
- 2022 RIVER BED PROFILE SHOWN AS



No.	REVISION	No.	REVISION	No.	REVISION		
7	ADDED 1997 BOTTOM PROFILE JULY, 1997: UMA GEOMATICS	14	ADDED 2005 BOTTOM PROFILE JUNE 2005: USHER CANADA LIMITED	21	ADDED 2013 BOTTOM PROFILE AUG 2013: MMM Geomatics	28	ADDED FUTURE MONITORING DEC. 2019: WSP
6	ADDED 1998 BOTTOM PROFILE JULY, 1998: UMA GEOMATICS	13	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS	20	ADDED 2012 BOTTOM PROFILE AUG 2012: MMM Geomatics	27	ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP
5	ADDED 1995 BOTTOM PROFILE JULY, 1995: UMA GEOMATICS	12	ADDED 2002 BOTTOM PROFILE AUG 2002: UMA GEOMATICS	19	ADDED 2011 BOTTOM PROFILE AUG 2011: MMM Geomatics	26	ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP
22	2022 BOTTOM PROFILE CHANGED NOV 2022: GEOVERRA	11	ADDED 2001 BOTTOM PROFILE AUG 2001: UMA GEOMATICS	18	ADDED 2010 BOTTOM PROFILE JULY 2010: MMM Geomatics	25	ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP
23	ADDED 2022 BOTTOM PROFILE NOV 2022: GEOVERRA	10	ADDED 2000 BOTTOM PROFILE AUG 2000: UMA GEOMATICS	17	ADDED 2009 BOTTOM PROFILE JUNE 2009: MMM Geomatics	24	ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP
24	ADDED 2021 BOTTOM PROFILE SEP 2021: GEOVERRA	9	ADDED 1999 BOTTOM PROFILE AUG 1999: UMA GEOMATICS	16	ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics	23	ADDED 2015 BOTTOM PROFILE AUG. 2015: WSP
25	ADDED 2020 BOTTOM PROFILE JULY 2020: GEOVERRA	8	ADDED 1998 BOTTOM PROFILE JUNE, 1998: UMA GEOMATICS	15	ADDED 2006 BOTTOM PROFILE JUNE 2006: USHER CANADA LIMITED	22	ADDED 2014 BOTTOM PROFILE AUG 2014: MMM Geomatics

LEGEND

UTILIDORS SHOWN
ROADS SHOWN
BURIED PIPES SHOWN
BELOW GROUND POWER,TELEPHONE, & COMMUNICATION SHOWN
VENT SHOWN (V)
TRANSITION POINT (TP)
PULL BOX SHOWN (PBU)
PULL POINT SHOWN (P.P)
PIPE O/S DIA.'S ARE IN MILLIMETERS AND DECIMALS THEREOF

SUBSTANCE/CATEGORY CROSS REFERENCE

SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ-SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ-FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Esso Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

BEAR TO ISLAND 6 SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA

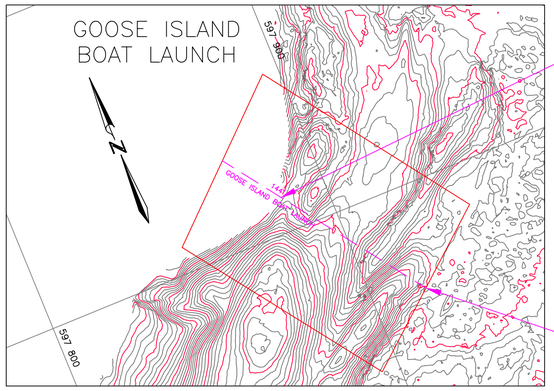
CONTRACTOR DWG NO. : 1202-C

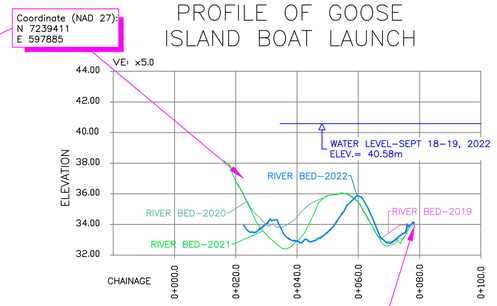
DATE: 22-11-24

SCALE: H 1:1000 V 1:200

ESSO FILE No. 096-0179-700-801 77

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 78





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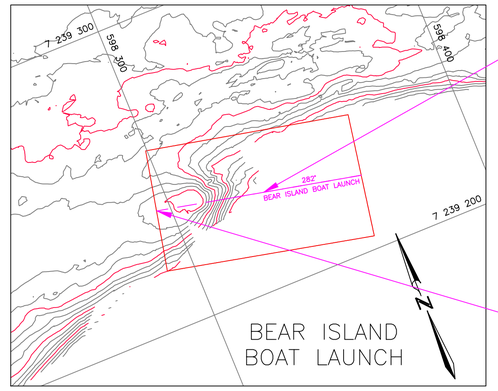
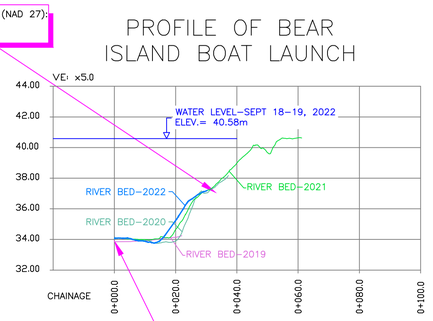
E 597885

Coordinate (NAD 27):
N 7239366
E 597918





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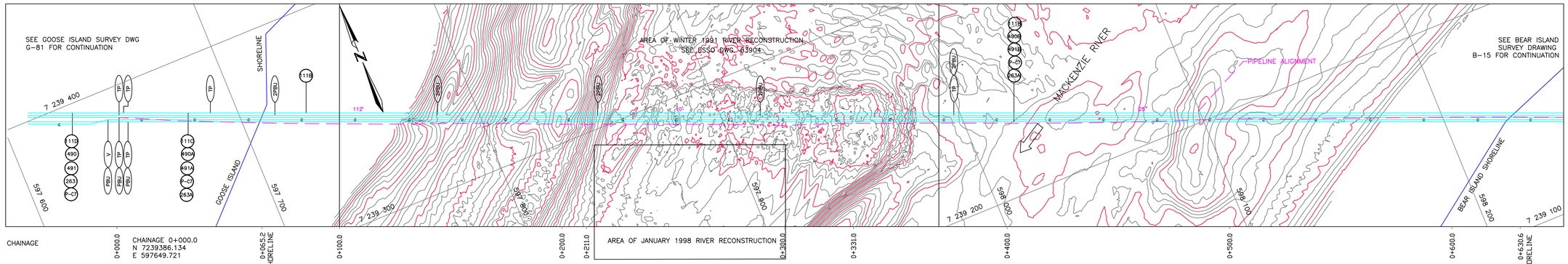
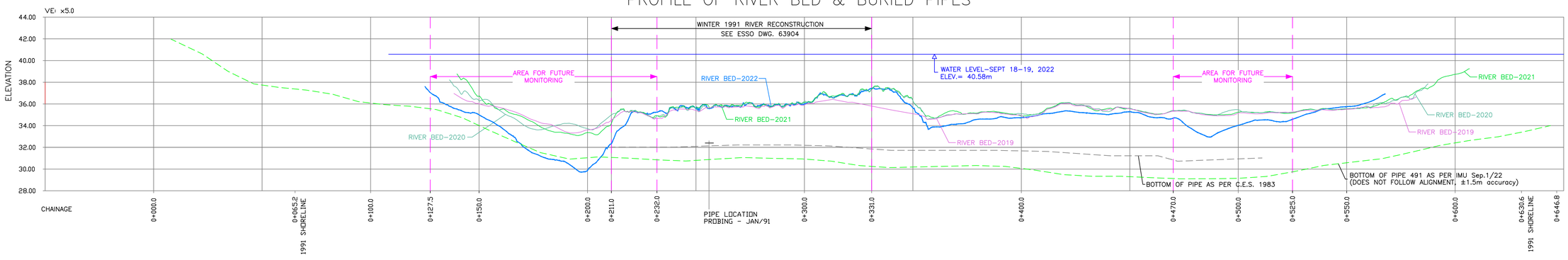
E 598295

PIPELINE ALIGNMENT



PROFILE OF RIVER BED & BURIED PIPES



SURVEY CONTROL

No.	DESCRIPTION	NORTHING	EASTING	ELEV.
1000	REBAR @ N.E. OF ISL. 1	7240711.75	599540.89	
1004	REBAR @ N.W. OF ISL. 1	7240729.21	599459.90	
2	REBAR @ N.E. OF ISL. 2	7240301.75	600511.43	
2001	REBAR @ N.W. OF ISL. 2	7240324.34	600431.97	
27	REBAR @ N.W. OF ISL. 3	7240741.90	597423.38	
3000	REBAR @ N.E. OF ISL.3	7240716.18	597500.36	
26	REBAR @ N.W. OF ISL. 4	7240387.54	598100.08	
4000	REBAR @ N.E. OF ISL. 4	7240361.98	598175.94	
22	REBAR @ N.W. OF ISL. 5	7240016.98	598734.63	
5000	REBAR @ N.E. OF ISL. 5	7239993.12	598815.14	
21	REBAR @ N.W. OF ISL. 6	7239631.84	599382.56	
6000	REBAR @ N.E. OF ISL. 6	7239616.68	599465.79	

No.	SUBSTANCE DESCRIPTION
	MULTIPHASE LIQUIDS
111B	273.1 OE BIT 4 TO GIT 4, Conc Coated 111A–111B–111C B–25,15,80143,G–81,72,73,63,53,54
111C	273.1 OE BIT 4 TO GIT 4, Conc Coated, Dbl Sect H.T. 111A–111B–111C–111D H.T.358 B–25,15,80143,G–81,72,73,63,53,54
111D	273.1 OE BIT 4 TO GIT 4, Sng Sect H.T. 111A–111B–111C–111D–GIT 4 H.T.358 B–25,15,80143,G–81,72,73,63,53,54
	GAS LIFT
263	114.3 NG (Gas Lift) GIT 4 to BIT 4, (Buried) 263–263A G–54,53,63,73,72,81,80143, B–15,25
263A	114.3 NG (Gas Lift) GIT 4 to BIT 4, (Conc Coated) 263–263A–263B G–54,53,63,73,72,81,80143, B–15,25
	INJECTION WATER
490	168.3 INJ–FW GIT 4 to BIT 4, Sng Sect H.T. 490–490A G–54,53,63,73,72,81,80143, B–15,25
490A	168.3 INJ–FW GIT 4 to BIT 4, Dbl Sect H.T., Conc Coated 490–490A–490B G–54,53,63,73,72,81,80143, B–15,25
490B	168.3 INJ–FW GIT 4 to BIT 4, Conc Coated 490–490A–490B–490C G–54,53,63,73,72,81,80143, B–15,25
491	168.3 INJ–FW GIT 4 to BIT 4, Sng Sect H.T. 491–491A H.T.359 G–54,53,63,73,72,81, 80143,B–15,25
491A	168.3 INJ–FW GIT 4 to BIT 4, Dbl Sect H.T., Conc Coated 491–491A–491B B–15,25 H.T.359 G–54,53,63,73,72,81, 80143,
491B	168.3 INJ–FW GIT 4 to BIT 4, Conc Coated 491–491A–491B–491C G–54,53,63,73,72,81,80143, B–15,25
	ELECTRICAL DESCRIPTION
P–C7	From GIT 4 5 Kv Switch Gear to Bit 4 5 Kv Switch Gear G–54,53,63,73,72,81,80143, B–15,25

PROFILE ALIGNMENT COORDINATES

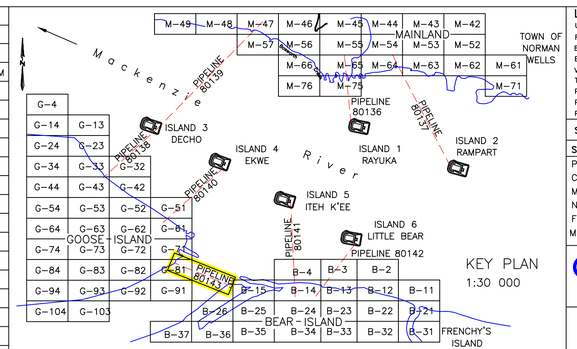
EASTING	NORTHING	
597649.721	7239386.134	START CHAINAGE 0+000.000
597671.510	7239375.720	
597694.360	7239365.650	
597717.320	7239355.580	
597740.330	7239346.000	
597763.530	7239336.350	
597786.920	7239327.070	
597809.940	7239317.690	
597832.860	7239307.890	
597856.150	7239298.350	
597879.180	7239288.940	
597902.340	7239279.360	
597925.180	7239269.500	
597948.810	7239260.830	
597971.850	7239251.360	
597995.020	7239242.080	
598018.150	7239232.440	
598041.300	7239223.030	
598064.660	7239213.950	
598088.100	7239205.000	
598111.620	7239196.410	
598134.900	7239186.640	
598158.230	7239177.540	
598181.400	7239168.400	
598204.620	7239159.090	
598227.940	7239149.630	
598250.780	7239140.080	END CHAINAGE 0+650.0

Alignment includes Winter 1997 pipe locating data.

NOTES

1. RIVER BOTTOM PROFILE FROM 2022 BATHYMETRIC SURVEY PERFORMED SEPTEMBER 18 TO SEPTEMBER 29, 2022.
2. PIPE PROFILE AND CHAINAGES FROM ESSO DWG. 80056 REV. 8 – BOTTOM OF PIPE AS PER CANADIAN ENG. SURVEYS DRAWINGS OF 1983 (PIPE PROFILE ELEVATION REDUCED 0.776m IN 2008)
3. HORIZONTAL DATUM : NAD27 (SHORAN) – UTM GRID/CM = 129°
4. VERTICAL DATUM – GEODETIC BM 74T016 ELEVATION 60.189
5. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL
6. CONTOUR INTERVAL = 0.25 METRES.

2019 RIVER BED PROFILE SHOWN AS
2020 RIVER BED PROFILE SHOWN AS
2021 RIVER BED PROFILE SHOWN AS
2022 RIVER BED PROFILE SHOWN AS



No.	REVISION
7	ADDED 2020 BOTTOM PROFILE JULY 2020: GEOVERRA
6	ADDED FUTURE MONITORING DEC. 2019: WSP
5	ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP
4	ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP
3	ADDED 2017 BOTTOM PROFILE SEP 2017: WSP
2	ADDED 2016 BOTTOM PROFILE SEP 2016: WSP
1	ADDED 2003 BOTTOM PROFILE AUG 2002: UMA GEOMATICS
1	ADDED 2001 BOTTOM PROFILE AUG 2001: UMA GEOMATICS
1	REVIEW PROFILES 2019–2022 DEC 2022: GEOVERRA
1	UPDATED LINE 111 MFL ILI PIPELINE NOV 2022: GEOVERRA
1	ADDED 2022 BOTTOM PROFILE NOV 2022: GEOVERRA
1	ADDED 2021 BOTTOM PROFILE SEP 2021: GEOVERRA
1	ADDED 2009 BOTTOM PROFILE JUNE 2009: MMM Geomatics
1	ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics
1	ADDED 2006 BOTTOM PROFILE JUNE 2006: USHER CANADA LIMITED
1	ADDED 2005 BOTTOM PROFILE JUNE 2005: USHER CANADA LIMITED
1	ADDED 2004 BOTTOM PROFILE AUG 2004: USHER CANADA LIMITED
1	ADDED 2003 BOTTOM PROFILE AUG 2003: UMA GEOMATICS
1	ADDED 2015 BOTTOM PROFILE, GOOSE ISLAND BOAT LAUNCH & BEAR ISLAND PROFILE AUG 2015: WSP
1	ADDED 2014 BOTTOM PROFILE AUG 2014: MMM Geomatics
1	ADDED 2013 BOTTOM PROFILE AUG 2013: MMM Geomatics
1	ADDED 2012 BOTTOM PROFILE AUG 2012: MMM Geomatics
1	ADDED 2011 BOTTOM PROFILE AUG 2011: MMM Geomatics
1	ADDED 2010 BOTTOM PROFILE JULY 2010: MMM Geomatics

LEGEND

UTILIDORS SHOWN
ROADS SHOWN
BURIED PIPES SHOWN
BELOW GROUND POWER,TELEPHONE, & COMMUNICATION SHOWN
VENT SHOWN
TRANSITION POINT
PULL BOX SHOWN
PULL POINT SHOWN
PIPE O/S DIA'S ARE IN MILLIMETERS AND DECIMALS THEREOF

SUBSTANCE/CATEGORY CROSS REFERENCE

SUBSTANCE	CODE	SUBSTANCE	CODE
PROPANE/BUTANE	HV	PRODUCED WATER	SW
CRUDE OIL	CO	FRESH WATER	FW
MULTIPHASE FLUIDS	OE	INJECTION (SW)	INJ–SW
NATURAL/LIFT GAS	NG	INJECTION (FW)	INJ–FW
FUEL GAS	FG	ABANDONED	ABAN
MISCELLANEOUS LIQUIDS	ML	MISCELLANEOUS GASES	MG

Esso Imperial Oil

IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

GOOSE TO BEAR SURVEY PLAN

CONTRACTOR NAME: GEOVERRA

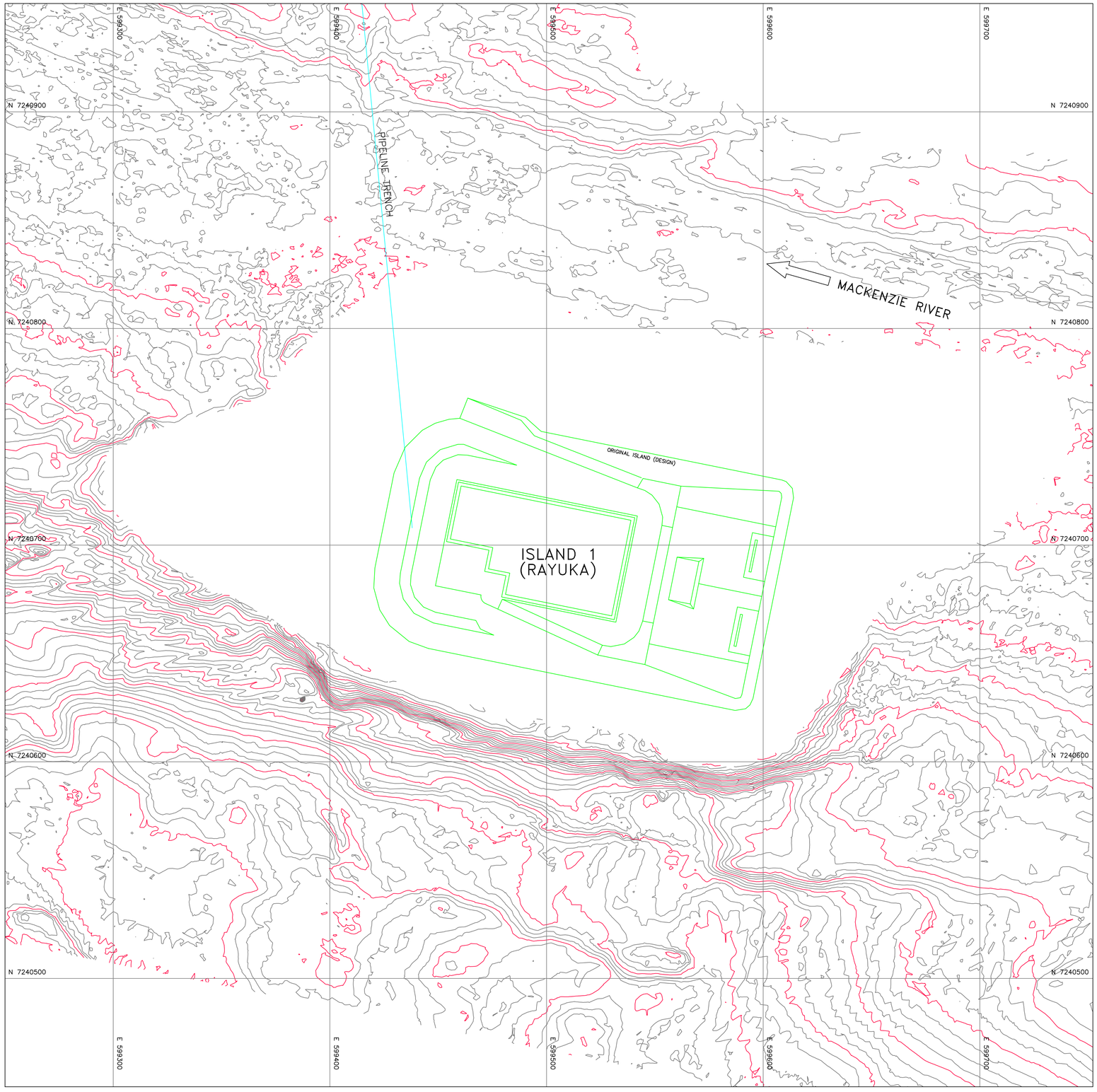
DATE: 23–01–25

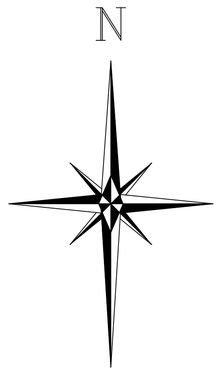
SCALE: H 1:1000 V 1:200

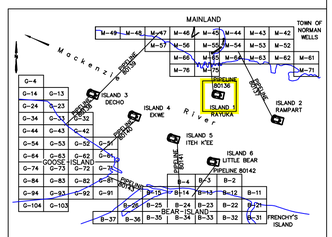
CONTRACTOR DWG NO. : 1203–C

ESSO FILE No. 096–0179–700–801 78

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 79







KEY PLAN
1:50 000

NOTES

1. CONTOUR INTERVAL = 0.25 METRES.
2. BATHYMETRIC SURVEY PERFORMED BETWEEN SEPTEMBER 18 TO SEPTEMBER 29, 2022.
3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
4. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/CM = 129°
5. VERTICAL DATUM: GEODETIC BM 74T016 ELEVATION = 60.189m

LEGEND

1	2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS	15	2015 SURVEY CONTOURS AUG. 2015: WSP
2	2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS	14	2014 SURVEY CONTOURS AUGUST 2014: MMM Geomatics
3	2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS	13	2013 SURVEY CONTOURS AUGUST 2013: MMM Geomatics
4	2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS	12	2012 SURVEY CONTOURS AUGUST 2012: MMM Geomatics
22	2022 SURVEY CONTOURS NOV 2022: GEOVERRA	11	2011 SURVEY CONTOURS AUGUST 2011: MMM Geomatics
21	2021 SURVEY CONTOURS SEP 2021: GEOVERRA	10	2010 SURVEY CONTOURS JULY 2010: MMM Geomatics
20	2020 SURVEY CONTOURS JULY 2020: GEOVERRA	9	2009 SURVEY CONTOURS JUNE 2009: MMM Geomatics
19	2019 SURVEY CONTOURS SEP. 2019: WSP	8	2008 SURVEY CONTOURS JUNE 2008: MMM Geomatics
18	2018 SURVEY CONTOURS NOV. 2018: WSP	6	2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
17	2017 SURVEY CONTOURS SEP. 2017: WSP	5	2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED
16	2016 SURVEY CONTOURS SEP. 2016: WSP	4	2004 SURVEY CONTOURS AUG.2004:USHER CANADA LIMITED
No.	REVISION	No.	REVISION

Esso Imperial Oil

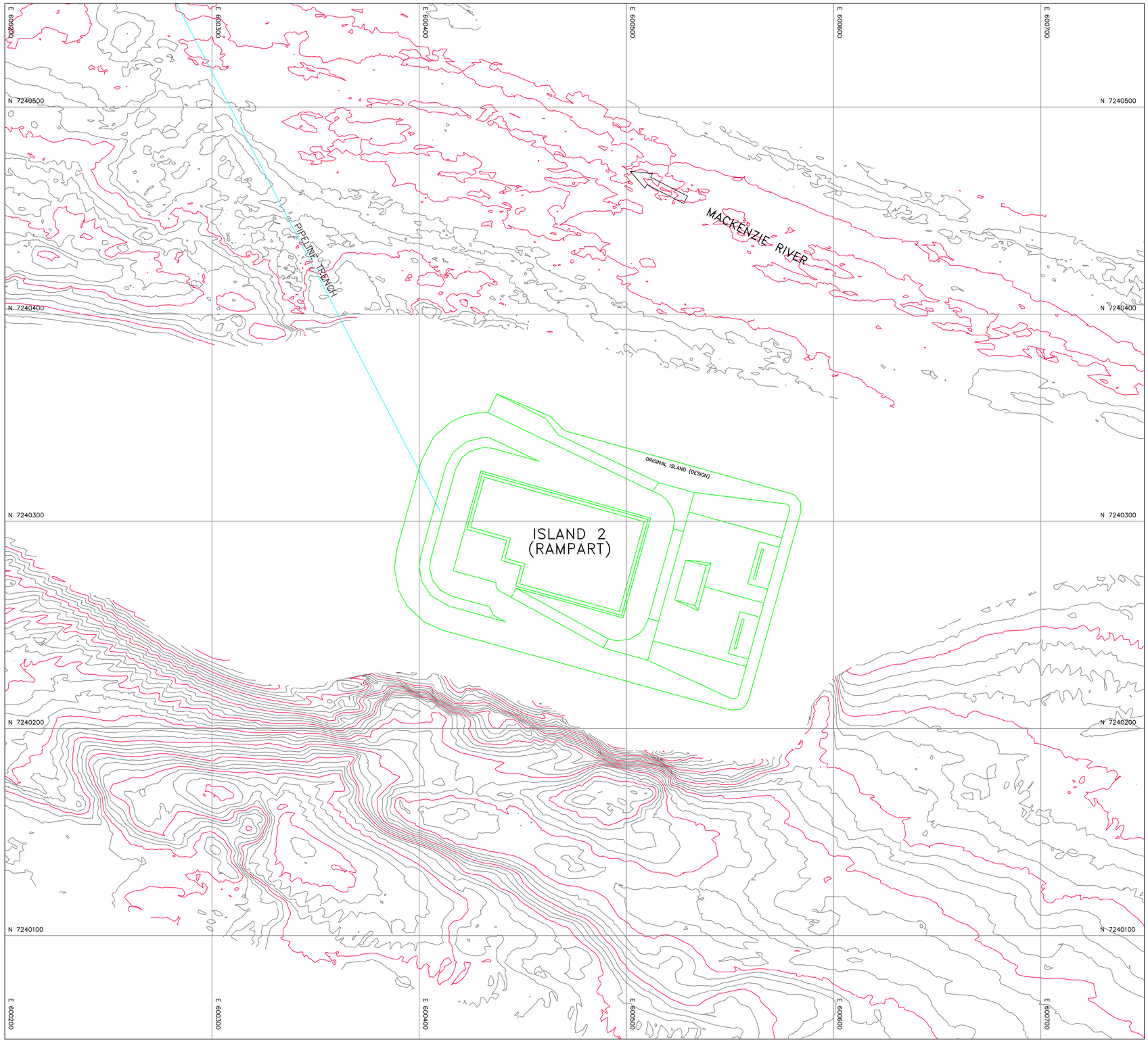
IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

ISLAND 1 & SURROUNDING AREA SURVEY PLAN

CONTRACTOR NAME: GEOVERRA	CONTRACTOR DWG NO. : 1204-C
DATE: 22-11-01	ESSO FILE No. 096-0179-700-801 79
SCALE: 1:1000	

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 80



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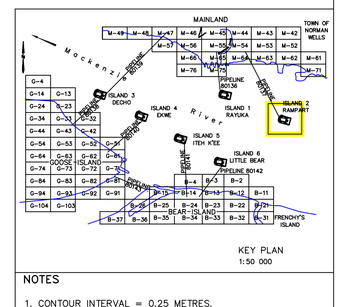

KEY PLAN
1:50 000

NOTES

1. CONTOUR INTERVAL = 0,25 METRES.
2. BATHYMETRIC SURVEY PERFORMED BETWEEN SEPTEMBER 18 TO SEPTEMBER 29, 2022.
3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
4. HORIZONTAL DATUM: NAD27(SHORAN)–UTM GRID/CM = 129°
5. VERTICAL DATUM: GEODETIC BM 74T016 ELEVATION = 60.189m

LEGEND

1 2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS	15 2015 SURVEY CONTOURS AUG. 2015: WSP
2 2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS	14 2014 SURVEY CONTOURS AUGUST 2014: MMM Geomatics
3 2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS	13 2013 SURVEY CONTOURS AUGUST 2013: MMM Geomatics
4 2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS	12 2012 SURVEY CONTOURS AUGUST 2012: MMM Geomatics
22 2022 SURVEY CONTOURS NOV 2022: GEOVERRA	11 2011 SURVEY CONTOURS AUGUST 2011: MMM Geomatics
21 2021 SURVEY CONTOURS SEP. 2021: GEOVERRA	10 2010 SURVEY CONTOURS JULY 2010: MMM Geomatics
20 2020 SURVEY CONTOURS JULY 2020: GEOVERRA	09 2009 SURVEY CONTOURS JUNE 2009: MMM Geomatics
19 2019 SURVEY CONTOURS SEP. 2019: WSP	08 2008 SURVEY CONTOURS JUNE 2008: MMM Geomatics
18 2018 SURVEY CONTOURS NOV. 2018: WSP	06 2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
17 2017 SURVEY CONTOURS SEP. 2017: WSP	05 2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED
16 2016 SURVEY CONTOURS SEP. 2016: WSP	04 2004 SURVEY CONTOURS AUG 2004:USHER CANADA LIMITED
No. REVISION	No. REVISION

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IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

ISLAND 2 & SURROUNDING AREA

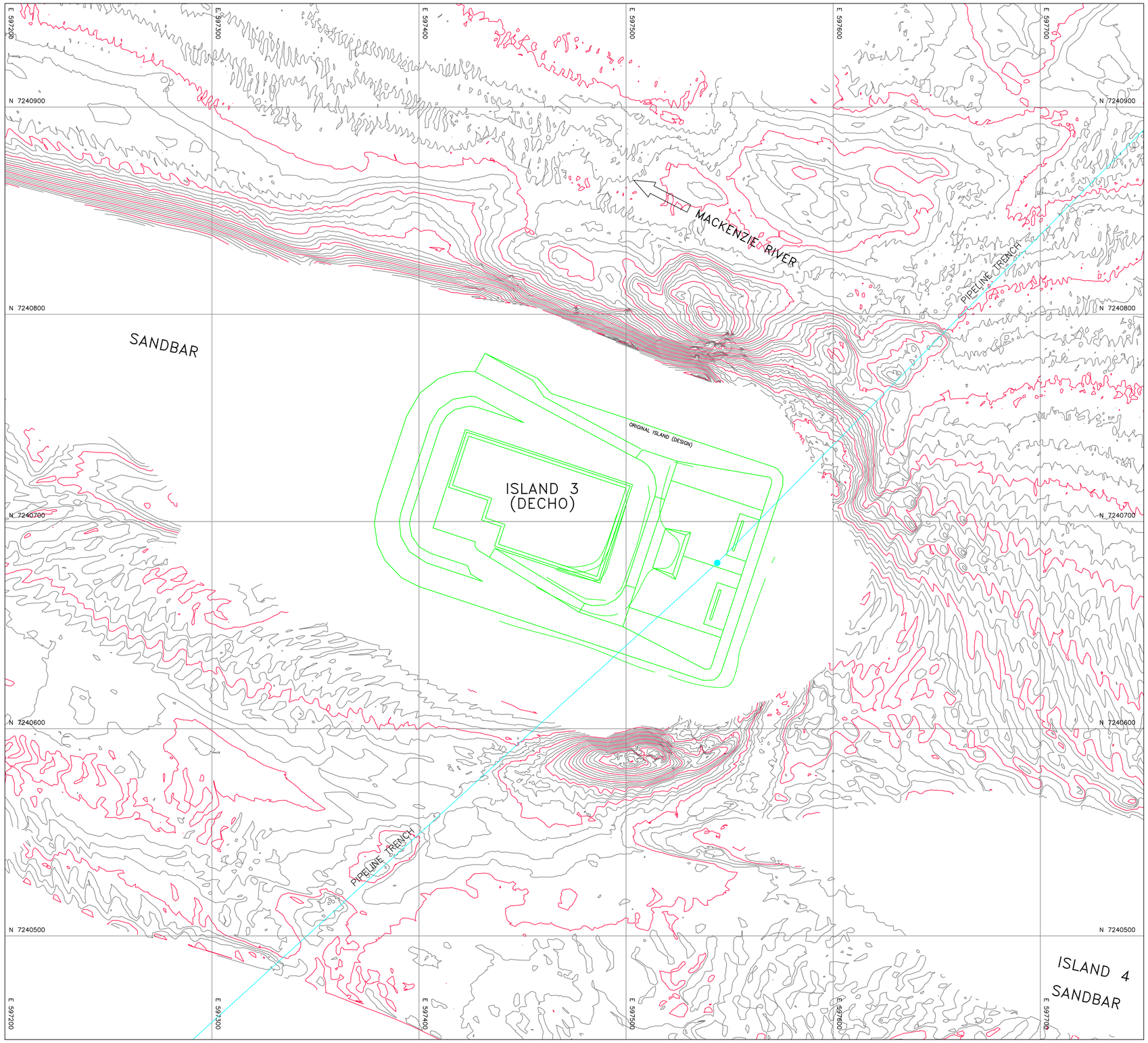
SURVEY DRAWING

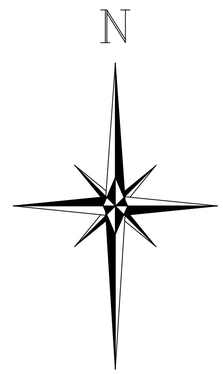
CONTRACTOR NAME: GEOVERRA	CONTRACTOR DWG NO. : 1205–C
DATE: 22–11–01	ESSO FILE No. 096–0179–700–801 80
SCALE: 1:1000	

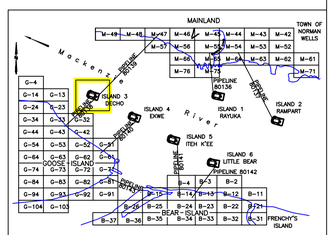
096-0179-700-801 81

AutoCAD

CADD DRAWING NO MANUAL CHANGES







KEY PLAN
1:50 000

NOTES

1. CONTOUR INTERVAL = 0.25 METRES.
2. BATHYMETRIC SURVEY PERFORMED BETWEEN SEPTEMBER 18 TO SEPTEMBER 29, 2022.
3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
4. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/cm = 129°
5. VERTICAL DATUM: GEODETIC BM 74T016 ELEVATION = 60.189m

LEGEND

1	2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS	15	2015 SURVEY CONTOURS AUG. 2015: WSP
14	2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS	14	2014 SURVEY CONTOURS AUGUST 2014: MMM Geomatics
13	2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS	13	2013 SURVEY CONTOURS AUGUST 2013: MMM Geomatics
12	2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS	12	2012 SURVEY CONTOURS AUGUST 2012: MMM Geomatics
22	2022 SURVEY CONTOURS NOV. 2022: GEOVERRA	11	2011 SURVEY CONTOURS AUGUST 2011: MMM Geomatics
21	2021 SURVEY CONTOURS SEP. 2021: GEOVERRA	10	2010 SURVEY CONTOURS JULY 2010: MMM Geomatics
20	2020 SURVEY CONTOURS JULY 2020: GEOVERRA	09	2009 SURVEY CONTOURS JUNE 2009: MMM Geomatics
19	2019 SURVEY CONTOURS SEP. 2019: WSP	08	2008 SURVEY CONTOURS JUNE 2008: MMM Geomatics
18	2018 SURVEY CONTOURS NOV. 2018: WSP	06	2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
17	2017 SURVEY CONTOURS SEP. 2017: WSP	05	2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED
16	2016 SURVEY CONTOURS SEP. 2016: WSP	04	2004 SURVEY CONTOURS AUG 2004:USHER CANADA LIMITED
No.	REVISION	No.	REVISION

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IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

ISLAND 3 & SURROUNDING AREA

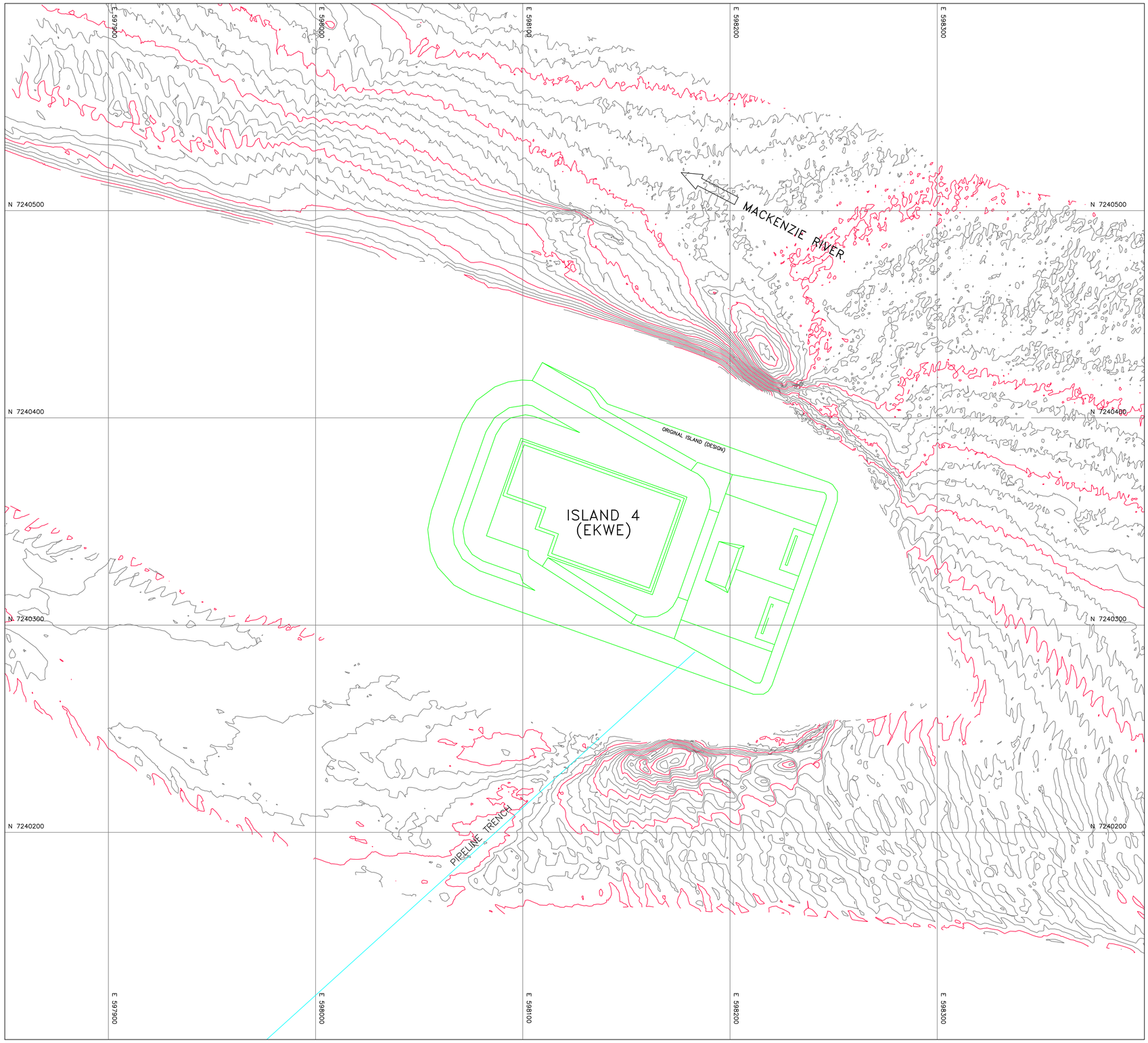
SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA	CONTRACTOR DWG NO. : 1206-C
DATE: 22-11-01	ESSO FILE No.
SCALE: 1:1000	096-0179-700-801 81

096-0179-700-801 82

AutoCAD

CADD DRAWING NO MANUAL CHANGES



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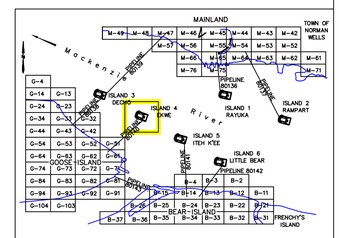

KEY PLAN
1:50 000

NOTES

1. CONTOUR INTERVAL = 0,25 METRES.
2. BATHYMETRIC SURVEY PERFORMED BETWEEN SEPTEMBER 18 TO SEPTEMBER 29, 2022.
3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
4. HORIZONTAL DATUM: NAD27(SHORAN)–UTM GRID/CM = 129°
5. VERTICAL DATUM: GEODETIC BM 74T016 ELEVATION = 60.189m

LEGEND

1	2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS	15	2015 SURVEY CONTOURS AUG. 2015: WSP
14	2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS	14	2014 SURVEY CONTOURS AUGUST 2014: MMM Geomatics
13	2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS	13	2013 SURVEY CONTOURS AUGUST 2013: MMM Geomatics
12	2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS	12	2012 SURVEY CONTOURS AUGUST 2012: MMM Geomatics
22	2022 SURVEY CONTOURS NOV 2022: GEOVERRA	11	2011 SURVEY CONTOURS AUGUST 2011: MMM Geomatics
21	2021 SURVEY CONTOURS SEP. 2021: GEOVERRA	10	2010 SURVEY CONTOURS JULY 2010: MMM Geomatics
20	2020 SURVEY CONTOURS JULY 2020: GEOVERRA	09	2009 SURVEY CONTOURS JUNE 2009: MMM Geomatics
19	2019 SURVEY CONTOURS SEP. 2019: WSP	08	2008 SURVEY CONTOURS JUNE 2008: MMM Geomatics
18	2018 SURVEY CONTOURS NOV. 2018: WSP	06	2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
17	2017 SURVEY CONTOURS SEP. 2017: WSP	05	2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED
16	2016 SURVEY CONTOURS SEP. 2016: WSP	04	2004 SURVEY CONTOURS AUG 2004:USHER CANADA LIMITED

No.	REVISION	No.	REVISION

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IMPERIAL OIL RESOURCES

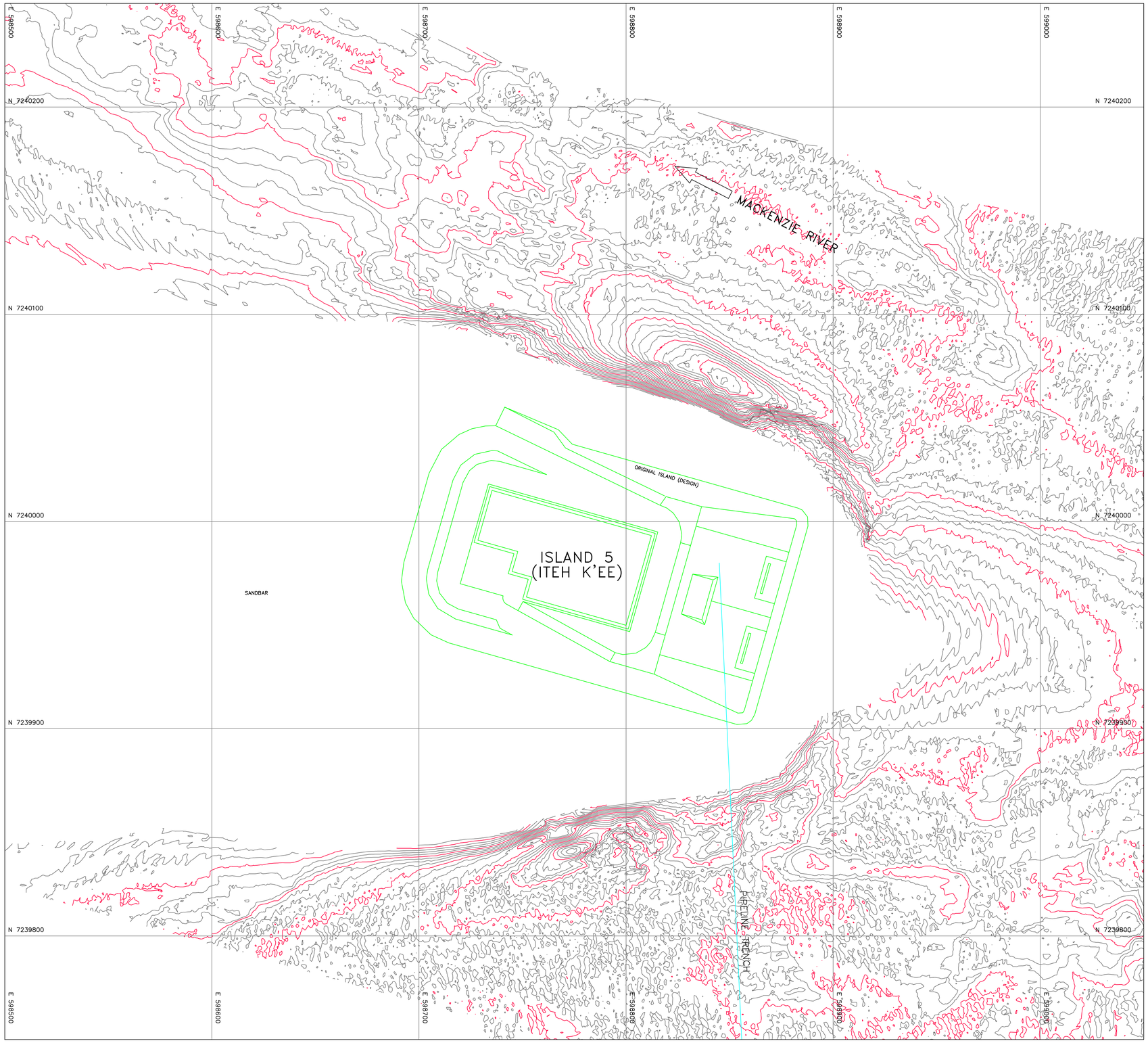
NORMAN WELLS FACILITIES

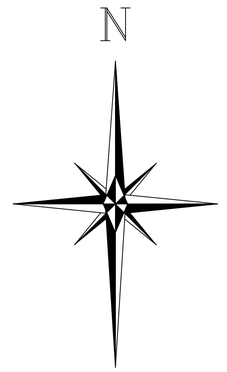
ISLAND 4 & SURROUNDING AREA

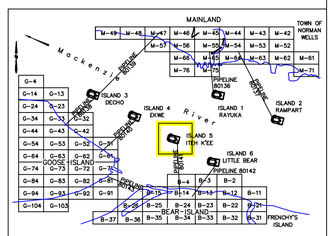
SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA	CONTRACTOR DWG NO. : 1207–C
DATE: 22–11–01	ESSO FILE No. 096–0179–700–801 82
SCALE: 1:1000	

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 83







KEY PLAN
1:50 000

NOTES

1. CONTOUR INTERVAL = 0,25 METRES.
2. BATHYMETRIC SURVEY PERFORMED BETWEEN SEPTEMBER 18 TO SEPTEMBER 29, 2022.
3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
4. HORIZONTAL DATUM: NAD27 SHORAN-UTM GRID/CM = 129°
5. VERTICAL DATUM: GEODETIC BM 74T016 ELEVATION = 60.189m

LEGEND

1	2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS	15	2015 SURVEY CONTOURS AUG. 2015: WSP
2	2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS	14	2014 SURVEY CONTOURS AUGUST 2014: MMM Geomatics
3	2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS	13	2013 SURVEY CONTOURS AUGUST 2013: MMM Geomatics
4	2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS	12	2012 SURVEY CONTOURS AUGUST 2012: MMM Geomatics
5	2022 SURVEY CONTOURS NOV 2022: GEOVERRA	11	2011 SURVEY CONTOURS AUGUST 2011: MMM Geomatics
6	2021 SURVEY CONTOURS SEP. 2021: GEOVERRA	10	2010 SURVEY CONTOURS JULY 2010: MMM Geomatics
7	2020 SURVEY CONTOURS JULY 2020: GEOVERRA	09	2009 SURVEY CONTOURS JUNE 2009: MMM Geomatics
8	2019 SURVEY CONTOURS SEP. 2019: WSP	08	2008 SURVEY CONTOURS JUNE 2008: MMM Geomatics
9	2018 SURVEY CONTOURS NOV. 2018: WSP	06	2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
10	2017 SURVEY CONTOURS SEP. 2017: WSP	05	2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED
11	2016 SURVEY CONTOURS SEP. 2016: WSP	04	2004 SURVEY CONTOURS AUG 2004:USHER CANADA LIMITED

No.	REVISION	No.	REVISION

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IMPERIAL OIL RESOURCES

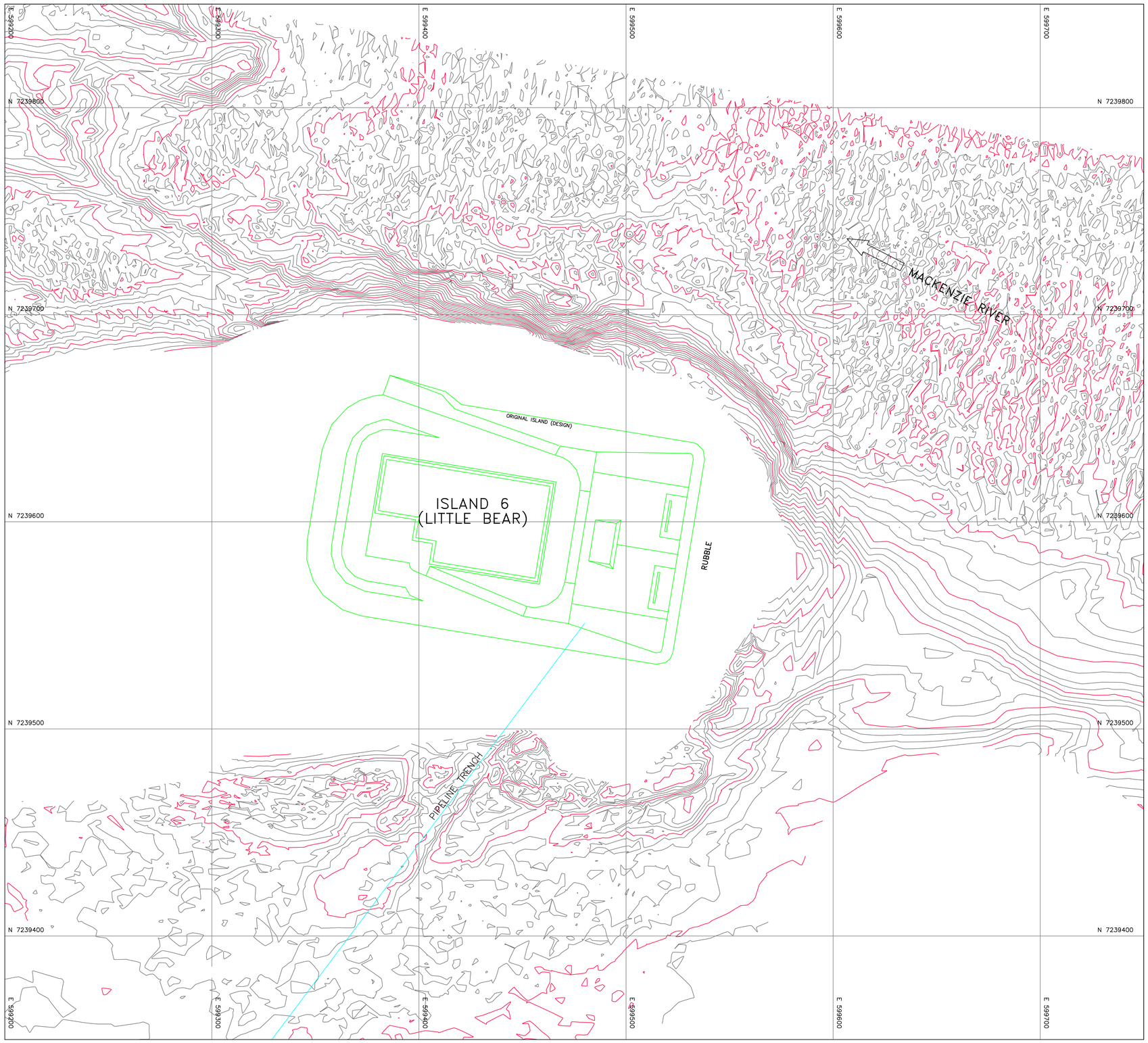
NORMAN WELLS FACILITIES

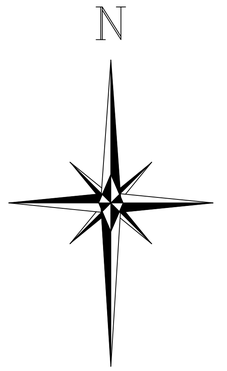
ISLAND 5 & SURROUNDING AREA

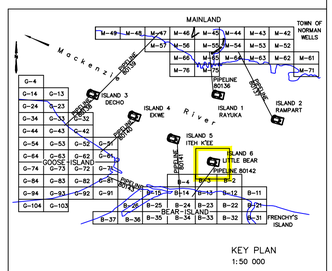
SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA	CONTRACTOR DWG NO. : 1208-C
DATE: 22-11-01	ESSO FILE No. 096-0179-700-801 83
SCALE: 1:1000	

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 84







KEY PLAN
1:50 000

NOTES

1. CONTOUR INTERVAL = 0.25 METRES.
2. BATHYMETRIC SURVEY PERFORMED BETWEEN SEPTEMBER 18 TO SEPTEMBER 29, 2022.
3. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
4. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/CM = 129°
5. VERTICAL DATUM: GEODETIC BM 74T016 ELEVATION = 60.189m

LEGEND

1	2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS	15	2015 SURVEY CONTOURS AUG. 2015: WSP
2	2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS	14	2014 SURVEY CONTOURS AUGUST 2014: MMM Geomatics
3	2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS	13	2013 SURVEY CONTOURS AUGUST 2013: MMM Geomatics
4	2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS	12	2012 SURVEY CONTOURS AUGUST 2012: MMM Geomatics
22	2022 SURVEY CONTOURS NOV 2022: GEOVERRA	11	2011 SURVEY CONTOURS AUGUST 2011: MMM Geomatics
21	2021 SURVEY CONTOURS SEP. 2021: GEOVERRA	10	2010 SURVEY CONTOURS JULY 2010: MMM Geomatics
20	2020 SURVEY CONTOURS JULY 2020: GEOVERRA	09	2009 SURVEY CONTOURS JUNE 2009: MMM Geomatics
19	2019 SURVEY CONTOURS SEP. 2019: WSP	08	2008 SURVEY CONTOURS JUNE 2008: MMM Geomatics
18	2018 SURVEY CONTOURS NOV. 2018: WSP	06	2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
17	2017 SURVEY CONTOURS SEP. 2017: WSP	05	2005 SURVEY CONTOURS JULY 2005: USHER CANADA LIMITED
16	2016 SURVEY CONTOURS SEP. 2016: WSP	04	2004 SURVEY CONTOURS AUG 2004:USHER CANADA LIMITED
No.	REVISION	No.	REVISION

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IMPERIAL OIL RESOURCES

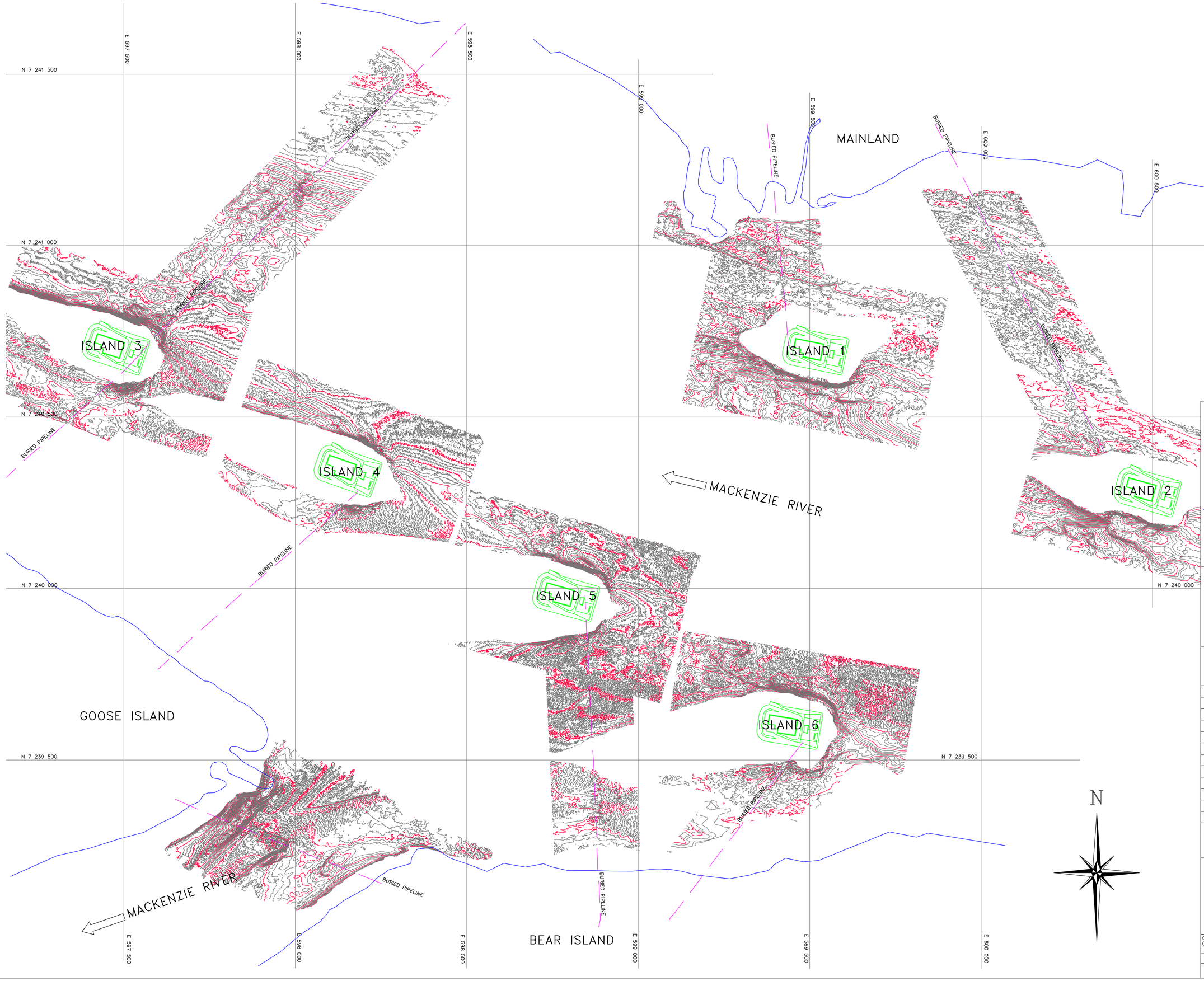
NORMAN WELLS FACILITIES

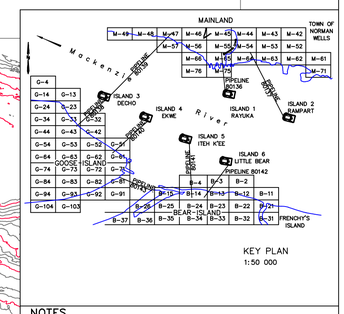
ISLAND 6 & SURROUNDING AREA

SURVEY DRAWING

CONTRACTOR NAME: GEOVERRA	CONTRACTOR DWG NO. : 1209-C
DATE: 22-11-01	ESSO FILE No.
SCALE: 1:1000	096-0179-700-801 84

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 86





KEY PLAN
1:50 000

NOTES

1. BATHYMETRIC SURVEY PERFORMED BETWEEN SEPTEMBER 18 TO SEPTEMBER 29, 2022.
2. WATER LEVEL DETERMINED DIRECTLY FROM RTK OBSERVATIONS ON SURVEY VESSELL.
3. HORIZONTAL DATUM: NAD 27(SHORAN)-UTM GRID/cm=129'
4. VERTICAL DATUM: GEODETIC BM 741016 ELEVATION = 60.189

LEGEND

1	2003 SURVEY POINTS AUG 2003: UMA GEOMATICS	16	2016 SURVEY POINTS SEP. 2016: WSP
0	2002 SURVEY POINTS AUG 2002: UMA GEOMATICS	15	2015 SURVEY POINTS AUG. 2015: WSP
1	2001 SURVEY POINTS AUG 2001: UMA GEOMATICS	14	2014 SURVEY POINTS AUGUST 2014: MMM GEOMATICS
0	2000 SURVEY POINTS AUG 2000: UMA GEOMATICS	13	2013 SURVEY POINTS AUGUST 2013: MMM GEOMATICS
9	1999 SURVEY POINTS AUG 1999: UMA GEOMATICS	12	2012 SURVEY POINTS AUGUST 2012: MMM GEOMATICS
8	1998 SURVEY POINTS JUNE 1998: UMA GEOMATICS	11	2011 SURVEY POINTS AUGUST 2011: MMM GEOMATICS
22	2022 SURVEY POINTS NOV 2022: GEOVERRA	10	2010 SURVEY POINTS JULY 2010: MMM GEOMATICS
21	2021 SURVEY POINTS SEP 2021: GEOVERRA	09	2009 SURVEY POINTS JUNE 2009: MMM GEOMATICS
19	2019 SURVEY POINTS SEP. 2019: WSP	08	2008 SURVEY POINTS JUNE 2008: MMM GEOMATICS
18	2018 SURVEY POINTS NOV. 2018: WSP	06	2006 SURVEY POINTS JUNE 2006: USHER CANADA LIMITED
17	2017 SURVEY POINTS SEP. 2017: WSP	05	2005 SURVEY POINTS JUNE 2005: USHER CANADA LIMITED
No.	REVISION	No.	REVISION

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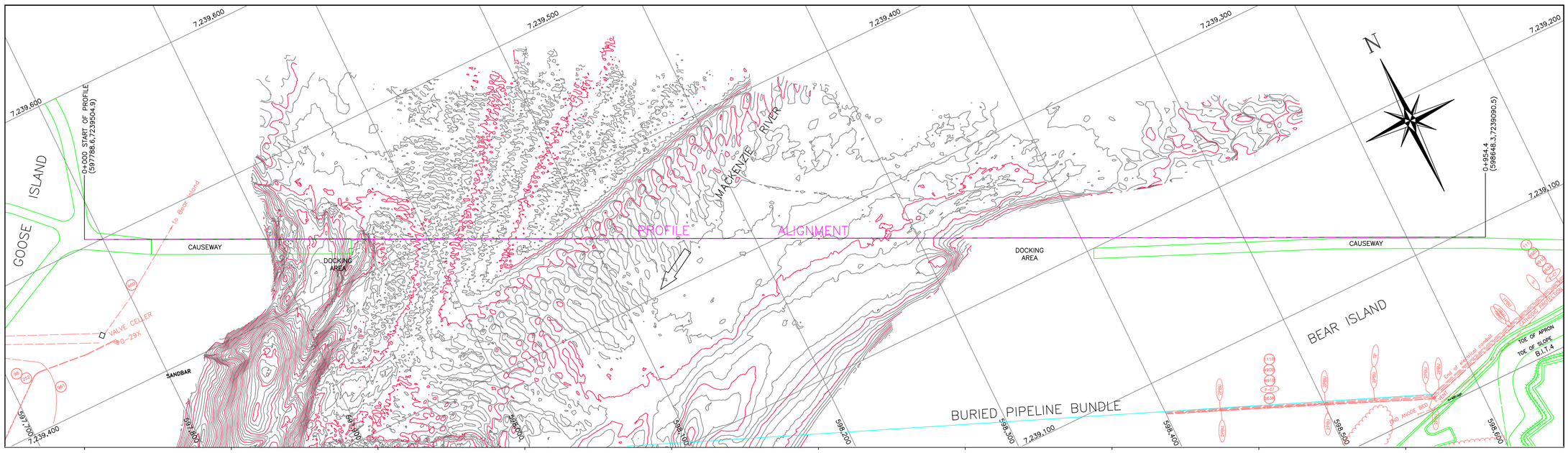
IMPERIAL OIL RESOURCES

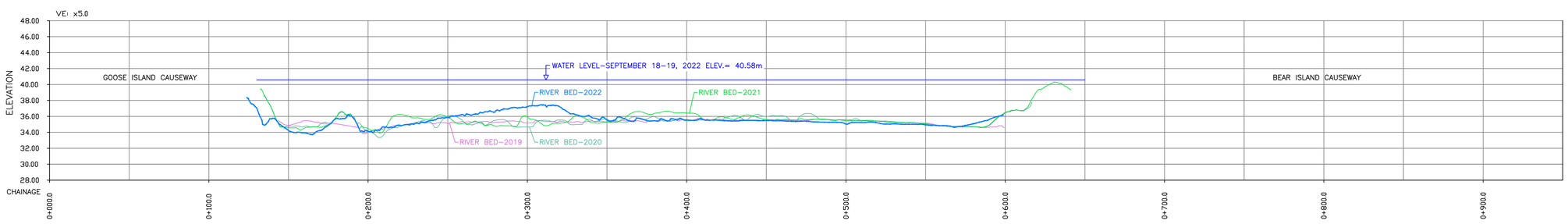
NORMAN WELLS FACILITIES

RIVER BED AND ISLAND CONTOURS SURVEY DRAWING

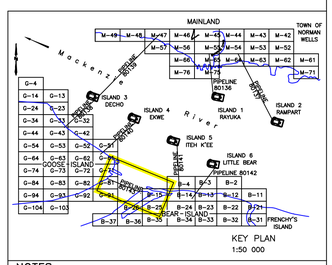
CONTRACTOR NAME: GEOVERRA	CONTRACTOR DWG NO. : 1213-C
DATE: 22-11-01	ESSO FILE No. 096-0179-700-801 86
SCALE: 1:5000	

CADD DRAWING NO MANUAL CHANGES | AutoCAD | 096-0179-700-801 89





PROFILE OF RIVER BED



KEY PLAN
1:50 000

NOTES
1. CONTOUR INTERVAL = 0.25 METRES.
2. BATHYMETRIC SURVEY PERFORMED BETWEEN SEPTEMBER 18 TO SEPTEMBER 29, 2022.
3. WATER LEVEL = 43.03 m (JUNE 18, 2020)
4. WATER LEVEL DETERMINED DIRECTLY FROM RTK GPS OBSERVATIONS ON SURVEY VESSEL.
5. HORIZONTAL DATUM: NAD27(SHORAN)-UTM GRID/CM = 129°
6. VERTICAL DATUM: GEODETIC BM 74T016 ELEVATION = 60.189m

No.	REVISION	No.	REVISION
1	2003 SURVEY CONTOURS AUG 2003: UMA GEOMATICS	22	ADDED 2015 BOTTOM PROFILE AUG. 2015: WSP
1	2002 SURVEY CONTOURS AUG 2002: UMA GEOMATICS	21	ADDED 2014 BOTTOM PROFILE AUG 2014: MMM Geomatics
1	2001 SURVEY CONTOURS AUG 2001: UMA GEOMATICS	20	ADDED 2013 BOTTOM PROFILE AUG 2013: MMM Geomatics
1	2000 SURVEY CONTOURS AUG 2000: UMA GEOMATICS	19	ADDED 2012 BOTTOM PROFILE AUG 2012: MMM Geomatics
25	ADDED 2022 BOTTOM PROFILE NOV 2022: GEOVERRA	18	ADDED 2011 BOTTOM PROFILE AUG 2011: MMM Geomatics
24	ADDED 2021 BOTTOM PROFILE SEP. 2021: GEOVERRA	17	ADDED 2010 BOTTOM PROFILE JULY 2010: MMM Geomatics
23	ADDED 2020 BOTTOM PROFILE JULY 2020: GEOVERRA	16	ADDED 2009 BOTTOM PROFILE JUNE 2009: MMM Geomatics
22	ADDED 2019 BOTTOM PROFILE SEP. 2019: WSP	15	ADDED 2008 BOTTOM PROFILE JUNE 2008: MMM Geomatics
21	ADDED 2018 BOTTOM PROFILE NOV. 2018: WSP	14	2006 SURVEY CONTOURS JUNE 2006: USHER CANADA LIMITED
20	ADDED 2017 BOTTOM PROFILE SEP. 2017: WSP	13	2005 SURVEY CONTOURS JUNE 2005: USHER CANADA LIMITED
19	ADDED 2016 BOTTOM PROFILE SEP. 2016: WSP	12	2004 SURVEY CONTOURS AUG 2004:USHER CANADA LIMITED

Imperial Oil
IMPERIAL OIL RESOURCES

NORMAN WELLS FACILITIES

GOOSE TO BEAR CAUSEWAY

SURVEY DRAWING

LEGEND
- 2019 RIVER BED PROFILE
- 2020 RIVER BED PROFILE
- 2021 RIVER BED PROFILE
- 2022 RIVER BED PROFILE

CONTRACTOR NAME: GEOVERRA	CONTRACTOR DWG NO. : 1215-C
DATE: 22-12-02	ESSO FILE No. 096-0179-700-801 89
SCALE: H 1:1500 V 1:300	