2023 Annual Report for CFS Alert, Nunavut

In support of the
Nunavut Water Board Licence
No. 8AC-ALT1929

March 2024

Prepared for:
Nunavut Water Board

Licensee:
RP Ops Group North
Department of National Defence

Prepared & Submitted by:
8 Wing Environmental Management,
8 Wing Trenton,
Department of National Defence

31 March 2024

Nunavut Water Board
P.O. Box 119
Gjoa Haven, Nunavut, X0B 1J0

Attention: Manager of Licensing

Subject: 2023 Annual Report for CFS Alert, Nunavut

Please find enclosed a copy of the 2023 Annual Report to the Nunavut Water Board and Executive Summary in English and Inuktitut for the following site:

1. Canadian Forces Station (CFS) Alert – 8AC-ALT1929 Type "A"

The Annual Report is being submitted by the Department of National Defence at 8 Wing/Canadian Forces Base Trenton on behalf of the licensee, the Department of National Defence at RP Ops N- ADM (IE).

Should the Nunavut Water Board have comments or require additional information regarding the Annual Report, please contact Mr. Nathan Koutroulides, 8 Wing Deputy Environment Officer, 8 Wing Environmental Management at (613) 392-2811 x4821 or by e-mail at: Nathan.Koutroulides@forces.gc.ca.

Sincerely,

Nathan Koutroulides, B.Sc, CD, PMP.
8 Wing Deputy Environment Officer, Environmental Management
Department of National Defence / Government of Canada
Nathan.Koutroulides@forces.gc.ca / Tel: 613-392-2811 Ext. 4821

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8 Wing Environmental Management, Room 305, 74 Polaris Avenue, Box 1000 Stn Forces, Astra, Ontario, K0K 3W0
Tel: 613-392-2811 x4821 Fax: 613-965-3368

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2023 Annual Report to the Nunavut Water Board

Licensee: Department of National Defence – RP Ops - ADM (IE)
Licence: 8AC-ALT1929 Type "A",
Location: Canadian Forces Station Alert, Ellesmere Island, Qikiqtani Region, Nunavut.

Report submitted by: Department of National Defence –
8 Wing/Canadian Forces Base Trenton –
8 Wing Environmental Management,
31 March 2024

Executive Summary

The 2023 annual report to the Nunavut Water Board (NWB) is a requirement under Licence Number 8AC-ALT1929 Type "A", Part B, Paragraph 1. This annual report is for Canadian Forces Station (CFS) Alert, Nunavut. The Licence was issued on November 1st, 2019, to the Department of National Defence (DND) Real Property Operations North (RP Ops N) - Assistant Deputy Minister of Infrastructure & Environment (ADM(IE)). As 8 Wing – Canadian Forces Base (CFB) Trenton, Ontario, oversees CFS Alert, 8 Wing Trenton is filing the annual report on behalf of the DND licensee, Real Property Operations North (RP Ops N) - Assistant Deputy Minister of Infrastructure & Environment (ADM(IE)).

For 2023, the average daily water usage at CFS Alert was 609 m^3. This usage is below the 875 cubic meters daily water usage allowed by the NWB Licence. The daily water usage amount being reported is less than the daily intake amount of raw water from the source at Upper Dumbell Lake. A large portion of this usage water is directly returned (raw and untreated) to the source concurrently to the intake process, the average return amount was 516 m^3/day. This constant circulatory (return) flow of the raw water prevents freezing damages to the water pipelines. The average daily water consumption amount was 92 m^3. The total annual quantity of water used in 2023 was 221,517 m^3.

Hazardous wastes (Glycol, hazardous liquids) were backhauled from CFS Alert in 2023 for disposal outside of Nunavut in Ontario, by external contractors. Non-hazardous domestic wastes produced from CFS Alert were directed to the designated Main Station Landfill. Repairs to the sewage terrace system completed in 2022 were inspected and were successful for 2023. DND will continue to monitor and repair as required until the new sewage treatment plant is constructed. All sewage was directed to the Sewage Terrace System.

DND maintains a positive commitment to demonstrating compliance to the NWB Licence and is planning to continue the CFS Alert Surveillance Network Program capabilities in Summer 2024.

2023 ᐊᖏᕐᕕᒍᒪᔪᑦ ᐅᓂᒃᑲᖅ ᓄᓇᕗᑦ ᐃᒪᖏᑦ ᑲᑎᒪᔨᖏᑐᓂ

ᓯᐃᓐᓴᓂᓗᓴ: ᑲᓇᑕᒥ ᐅᓇᑕᖅᑐᐊᓕᓚᐅᔨᓐᔪᑦ – RP Ops - ADM (IE)
ᓯᐃᓐᓴ: 8AC-ALT1929 Type “A”,
ᓇᒧᐧᓂᖏᓐᓄ: ᑲᓇᑕᒥ ᐅᓇᓂᑕᓂᒃ ᐊᔪᑦ (Alert), ᐊᐅᓯᐃᓂᑐᐸ ᖃᑭᖅᑕᓗᐊᖅ, ᖃᑭᖅᑕᓗᓚᒥ, ᓄᓇᕗᑦ.

ᑐᓂᓯᓯᒪᔪᑦ: ᑲᓇᑕᒥ ᐅᓇᑕᖅᑐᐊᓕᓚᐅᔨᓐᔪᑦ –
8–ᖃᓚᓄᓂᑐᑦ/ᑲᓇᑕᒥ ᐅᓇᓂᔨᓂᑦ ᐊᓪᓚᕐᓚᖃᓄᓂ ᑐᕆᑕᓂ –
8–ᖃᓚᓄᓂᑐᖅ ᐊᐸᑎᓂᓚᐅᔨᓐᔪᑦ ᐊᐅᓪᓚᑎᐅᓕᖏᑦ,
ᒧᐃᖅ 31, 2024

ᓯᓚᓂᖅᑏᑦ ᐅᓂᒃᑲᖏᑦ ᓇᐃᓇᖅᓯᒪᔪᑦ

2023 ᐊᖏᕐᕕᒍᒪᔪᑦ ᐅᓂᒃᑲᖅ ᓄᓇᕗᑦ ᐃᒪᖏᑦ ᑲᑎᒪᔨᖏᑐᓂ (NWB) ᓄᑖᑭᖅᑎᑎᖅᑕᒥᕆᖅᖏᓪᓕ ᓯᐃᒪᔨᓯᓂᒃ ᐁᕼᐅᑎᓕᒥᑦ 8AC-ALT1929 ᓇᓗᓇᐃᒃᓯᑎᖓ “A”, ᐃᓕᖓ B, ᑎᑎᕆᖅᓯᒪᔪᖅ 1–ᒥ. ᑖᒃᓇ ᐊᖏᕐᕕᒍᒪᖅ ᐅᓂᒃᑲᖅ ᑖᒃᓯᓄᖓᓂᖓᔪᓂ ᑲᓇᑕᒥ ᐅᓇᑕᒃᓯᑦ (CFS) ᐊᔪᑦ (Alert), ᓄᓇᕗᑦ. ᓯᐃᓐᓴᓂ ᑐᓂᔨᐅᓯᐅᑦᓯᓯᒪᔪᖅ ᓄᓐᓇᐸᐃᑦ 1, 2019, ᑲᓇᑕᒥ ᐅᓇᑕᓴᓚᓄᓂᒃᓯᓯᒪᓂᓄᑦ (DND) – ᑲᓇᑕᒥ ᐃᓕᓴᐊᓗᓂᑦ ᐊᐅᓯᕆᑎᓂᖓᓂᑐᓂ ᐅᑭᐅᖅᑕᖅᑐᒥ (RP Ops N) - ᒥᓂᑕᐅᐸ ᑐᖓᓕᖓᖏᓕᑕ ᐃᑲᔪᖅᑎᖓ ᐃᓕᓴᕐᐊᓕᓚᓂᖓᓂᑦ ᐊᐸᑎᓕᓚᓂᖓᓂᑦᓴᓕᓴ (ADM(IE)). 8–ᒥᑦ ᓇᓗᓇᐃᒃᓯᑎᓕᐳᒃ – ᑲᓇᑕᒥ ᐅᓇᓕᑦ ᐊᑦᓚᕆᖓ (CFB) ᑐᕆᑕᓕᓵ, ᐊᓵᑎᐅᓚᔪ, ᑲᒪᖃᑦᑕᕐᖓᑕ ᑲᓇᑕᒥ ᐅᓇᓕᒃᓯᑦ (CFS) ᐊᔪᑦ (Alert), 8–ᒥᑦ ᓇᓗᓇᐃᒃᓯᑎᓕᓚᒥᑦ ᑐᕆᑕᑕᒥ ᑐᓂᓯᒥᒪᑕ ᐊᖏᕐᕕᒍᒪᔪᑦ ᐅᓂᒃᑲᖏᑦ ᐱᔨᔪᑎᖃᖅᑐᑎᑦ ᑲᓇᑕᒥ ᐅᓇᓂᑦᓴᓚᓄᓂᒃᓯᑦ ᓴᐅᑎᖃᖅᑐᑎᑦ ᑕᐃᒪᓐᓇᐅᑎᓂᒃᓯᑦ ᐅᑭᐅᖅᑕᖅᑐᒥ (RP Ops N) - ᒥᓂᑕᐅᐸ ᑐᖓᓕᖓᖏᓕᑕ ᐃᑲᔪᖅᑎᖓ ᐃᓕᓴᕐᐊᓕᓚᓂᖓᓂᑦᓴᓕᓴ ᐊᐸᑎᓕᓚᓂᖓᓂᑦᓴᓕᓴ (ADM(IE)).

2023–ᒥ, ᐃᒥᖏ ᖃᐅᑕᒪᒃᑯ ᐊᑐᖃᑦᑕᓕᐅᕐᖓᑕ ᑲᓇᑕᒥ ᐅᓇᓂᑦᓯᒥ (CFS) ᐊᔪᑎᒥ (Alert) ᑕᒪᓂ 609 m^3. ᐊᑐᖃᑕᐅᓂᖓ ᐊᑦᑕᓂᓕᐅᖅᑐᑦ 875 (cubic meters) ᓯᓚᑭᑕᑲᓪᓕᓂᓂᓂᓂᑦ ᑭᑕᓂᓵ ᖃᐅᑕᒪᒃᑯ ᐱᓯᓂᓇᐅᖅᑎᑕᐅᓪᓗᑎᑦ ᓄᓇᕗᑦ ᐃᒪᖏᑦ ᑲᑎᒪᔨᖏᑐᓄᑦ (NWB) ᓯᐃᓐᓴᖓᔪᑦ. ᐃᒪᖏᑦ ᐊᑐᑭᓇᖃᑕᖏᑐᓂ ᐅᓂᒃᑲᓕᐅᓂᖅᓴᐅᓯᒪᓂᑐᑎᑦ ᖃᑦᑎᓇᐅᓂᖅᓴᐅᓯᒪᓂᑐᑎᑦ ᐃᒥᑐᐃᓇᖃᖅᑐᑎᑦ ᑕᐃᑲᓐᓇᖅᑐᑦ (Upper Dumbell Lake). ᐃᒪᖅ ᐊᑐᖅᑕᖓ ᐅᑎᖅᓯᑦᑐᑎ ᐊᖏᓂᖅᓴᖅ (ᑭᓯᓚᖅᓯᒪᓂᖏᑦᑐᖅ) ᐊᓂᓇᐅᔨᖅ ᐱᔪᐅᓂᖅᑐᓂᒃ, ᑕᒪᓂᖃᐃ ᐅᑎᖅᓯᑦᑐᑦ 516 m^3/ᖃᐅᑕᒪᒃᑯ. ᑕᒪᓇᓇ ᐃᖏᕐᕋᐃᓇᓇᖅᑐᖅ ᐅᑎᖅᑕᖅᑐᒥ ᐃᒪᐅᐸᓚᒪᑦ ᕿᑐᓇᓇᖏᑦᑕᖅᑐᖅ ᓯᓂᓗᓂᓴᐅᑦ. ᖃᐅᑕᒪᒃᑯ ᐃᒥᖅᑐᓯᑦᑐᑦ ᑕᒪᓂ 92 m^3. ᑲᑎᑦᑐᑎᑦ ᐊᖏᕐᕕᒍᒪᒃᑯ ᐃᒥᖅᑐᖃᑦᑕᖅᑐᑦ 2023 ᑕᒪᐃᓕᓴᐅᖅᑐᖅ 221,517 m^3.

ᐅᓗᓇᐊᓇᖅᑐᑦ (ᐃᓕᓴᕕᑦ (Glycol), ᐅᓗᓇᐊᓇᖅᑐᖅ ᐃᒥᕐᓗᐃᑦ (hazardous liquids)) ᐅᓯᕆᐅᓕᓗᑎᑦ ᑕᐃᑲᓴᖓᑦ ᑲᓇᑕᒥ ᐅᓇᓂᔨᓂᑦ (ᐊᓵᑎᐅᓚᔪ) 2023–ᒥ ᐃᒥᑕᐅᓂᐊᖅᑐᑎᑦ ᓄᓇᕗᑦ ᓯᓓᑕᓂ ᐊᓵᑎᐅᓚᔪᒧᑦ, ᓯᓓᑕᓂ ᑲᑎᒪᔨᖏᑐᓂᒃ ᑲᓇᑕᒥ ᐅᓇᓂᔨᓂᑦ (CFS) ᐊᔪᑎᒥ (Alert) ᐃᓯᖅᓴᓂᐊᖅᑐᓂᓕᓂᓂᑦ ᑲᓇᑕᒥ ᐅᓇᓂᔨᓂᑦ (CFS) ᐊᔪᑎᒥ (Alert) 2022–ᒥ ᖃᐅᔨᓴᖅᑕᐅᓂᓕᓂᑐᐸᓗᖅᑐᓂ 2023–ᒥ. ᑲᓇᑕᒥ ᐅᓇᑕᖅᑐᐊᓕᓚᐅᔨᓐᔪᑦ (DND) ᐅᓱᐊᖅᓯᐃᓐᓇᖃᑦᑕᓂᐅᔪᖅᑐᑦ ᓴᓇᕐᐊᓂᓂᓕᓂᑐᓂᒃ ᓄᓇᕗᑦ ᐃᒪᖏᑦ ᑲᑎᒪᔨᖏᑐᓂᖓᓂᑐᓂ. ᑭᓇᓗᐃᑦ ᐃᑯᓐᖓᑦᑐᓂᒃᓯᑦᑐᓂᒃ ᑲᓇᑕᒥ ᐅᓇᓂᔨᓂᑦ (CFS) ᐊᔪᑎᒥ (Alert)

ᑲᓇᑕᒥ ᐅᓇᑕᖅᑐᐊᓕᓚᐅᔨᓐᔪᑦ (DND) ᑲᒪᐃᓐᓇᖅᓯᐊᖅᑐᓂ ᒪᓕᓪᓗᓂᑦ ᓄᓇᕗᑦ ᐃᒪᖏᑦ ᑲᑎᒪᔨᑦ (NWB) ᓯᐃᓐᓴᖓᔪᓂᒃ ᐸᖃᐅᑎᖓᓂᓪᓗ ᑲᓇᑕᒥ ᐅᓇᓂᔨᓂᑦ (CFS) ᐊᔪᑎᒥ (Alert) ᖃᐅᔨᓴᖅᓂᖏᑦ ᖃᕆᓴᐅᑦᑦᔨᓂᑦ ᐃᑲᔪᖅᑎᖓ ᐱᓕᕆᔨᓂᖅᓯᒪᓂᖅ 2024–ᒥ.

Rapport annuel 2023 à l'Office des eaux du Nuavut

Détenteur du permis : Ministère de la Défense nationale – Ops Imm – SMA(IE)
Permis : 8AC-ALT1929 Type "A",
Lieu : Station des Forces canadiennes Alert, île d'Ellesmere, région de Qikiqtani, Nunavut.

Rapport présenté par : Ministère de la Défense nationale –
8e Escadre/Base des forces canadiennes Trenton –
Gestion environnementale de la 8e Escadre,
31 mars 2024

Sommaire

Le rapport annuel 2023 présenté à l'office des eaux du Nunavut (OEN) constitue une exigence aux termes du permis no 8AC-ALT1929 Type « A », partie B, paragraphe 1. Le présent rapport annuel vise la Station des Forces canadiennes (SFC) Alert, au Nunavut. Le permis a été délivré le 1er novembre 2019 au ministère de la Défense nationale (MDN) – Opérations immobilières (Nord) [Ops Imm (Nord)] du sous-ministre adjoint (Infrastructure et environnement) [SMA(IE)]. Comme la 8e Escadre/Base des Forces canadiennes (BFC) Trenton, en Ontario, supervise la SFC Alert, la 8e Escadre Trenton présente le rapport annuel au nom du nouveau détenteur de permis du MDN, les Ops Imm (Nord) du SMA(IE).

En 2023, l'utilisation quotidienne moyenne d'eau à la SFC Alert était de 609 m^3, ce qui est inférieur à la consommation quotidienne de 875 m^3 d'eau autorisée par le permis de l'OEN. La quantité d'eau utilisée quotidiennement qui est déclarée est inférieure à la quantité d'eau brute puisée quotidiennement de la source du lac Upper Dumbell. Une grande partie de l'eau utilisée est retournée directement (brute et non traitée) à la source en même temps qu'elle est puisée, et la quantité moyenne d'eau retournée s'élève à 516 m^3 par jour. Cette circulation constante de l'écoulement (restitué de l'eau brute) empêche le gel d'endommager les canalisations d'eau. La quantité moyenne d'eau consommée quotidiennement était de 92 m^3. La quantité annuelle totale d'eau utilisée en 2023 était de 221,517 m^3.

En 2023, les déchets dangereux (glycol et liquides dangereux) ont été réacheminés de la SFC Alert vers l'Ontario pour être éliminés à l'extérieur du Nunavut par des entrepreneurs externes. Les déchets ménagers non dangereux produits par la SFC Alert ont été acheminés à la décharge principale désignée. Les réparations du système de traitement des eaux usées à paliers effectuées en 2022 ont fait l'objet d'une inspection, qui a révélé leur conformité pour 2023. Le MDN continuera d'assurer la surveillance et la réparation de ce système jusqu'à ce qu'un nouveau système de traitement des eaux usées soit mis en place. Toutes les eaux usées ont été rejetées dans le système de traitement des eaux usées à paliers.

Le MDN demeure résolu à démontrer sa conformité au permis de l'OEN et prévoit maintenir les capacités du programme du réseau de surveillance de la SFC Alert à l'été 2024.
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NWB Annual Report 2023

NWB Annual Report		**Year being reported:**	2023
License No:	8AC-ALT1926	**Issued Date:**	November 1, 2019
		Expiry Date:	October 31, 2029

Project Name: Canadian Forces Station (CFS) Alert, Nunavut

Licensee: Department of National Defence - Real Property Operations-ADM(IE)

Mailing Address:
Real Property Operations Group
Department of National Defence
Assistant Deputy Minister (Infrastructure & Environment)
101 Col By Drive, Ottawa, ON, K1A 0K2

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

8 Wing Environmental Management
Room 308, Building 22, 74 Polaris Ave.
Department of National Defence - 8 Wing/ CFB Trenton
Box 1000, Stn Forces
Astra, Ontario, K0K 3W0

General Background Information on the Project (*optional):

Formerly: 8AC-ALT---- Type A until Oct 31, 2019.
Formerly: 3BC-ALT1015 Type B.

Licence Requirements: the licensee must provide the following information in accodance with

Part B | Item 1

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s):	Upper Dumbell Lake, Nunavut.	
Water Quantity:	875	Quantity Allowable Domestic (cu.m)
	609	Actual Quantity Used Domestic (cu.m)
		Quantity Allowable Drilling (cu.m)

Total Quantity Used Drilling (cu.m)

Waste Management and/or Disposal

- [x] Solid Waste Disposal
- [x] Sewage
- [ ] Drill Waste
- [x] Greywater
- [x] Hazardous
- [x] Other:

Landfarms

Appendix A: Monitoring Program Station No. ALT-1
Appendix B: Monitoring Program Stations No. ALT-2-3-13
Appendix C: Monitoring Program Stations No. ALT-4-5-6-7
Appendix D: Monitoring Program Stations No. ALT-8-9-10-11
Appendix E: June/July Analysis Results for ALT-4-8-9-10
Appendix F: Aug/Sept Analysis Results for ALT-4
Appendix G: List of Waste Disposal Activities /
Appendix H: Progressive and Final Reclamation Work Undertaken

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: 2023-122 (as reported to the Spill Hot-line)
Date of Spill: March 29, 2023
Date of Notification to an Inspector: March 29, 2023
Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc)

Please see attached detailed spill report in Appendix I

Revisions to the Spill Contingency Plan

SCP submitted and approved - no revision required or proposed

Additional Details:

No revisions required.

Revisions to the Abandonment and Restoration Plan

Other: (see additional details)

Additional Details:

DND has retained a consultant to develop a reclamations options analysis for the historical waste deposits. DND expects to have a report in 2024/25.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

See Appendix H.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Details described below

Additional Details:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Details described below

Additional Details:

Results of any additional sampling and/or analysis that was requested by an Inspector

No additional sampling requested by an Inspector or the Board

Additional Details: (date of request, analysis of results, data attached, etc)

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

No additional sampling requested by an Inspector or the Board

Additional Details: (Attached or provided below)

Any responses or follow-up actions on inspection/compliance reports

No inspection and/or compliance report issued by INAC

Additional Details: (Dates of Report, Follow-up by the Licensee)

Any additional comments or information for the Board to consider

Due to COVID related Operational Lockdown status in Alert, the Sewage Treatment Plant program including funding was delayed several years. A Sewage Treatment Options Anaylsis was completed in 2023 and attached for review or concideration.

Date Submitted: March 31, 2023

Submitted/Prepared by: Nathan Koutroulides, BSc, PMP

Contact Information:

Tel: 613-392-2811 x4821

Fax: 613-965-3368

email: Nathan.Koutroulides@forces.gc.ca

GPS Coordinates for water sources utilized

Source Description	Latitude			Longitude		
	Deg °	Min ′	Sec ″	Deg °	Min ′	Sec ″
Upper Dumbell Lake	82	29	6.2	-62	28	9.5

GPS Locations of areas of waste disposal

Location Description (type)	Latitude			Longitude		
	Deg °	Min '	Sec "	Deg °	Min '	Sec "
Alert Battery Dump	82	29	16	-62	23	15.32
Alert Main Station Landfill	82	30	17	-62	20	14.89
Alert Dump # 3	82	29	18	-62	20	57.01
Landfarm (ALT-11)	82	30	40	-62	18	37.6
Millionaire's Dump	82	29	19	-62	21	30.4
Sewage Terrace/Outfall	82	29	56	-62	21	4.8
Landfarm (ALT-10, new)	82	29	58	-62	21	16

Appendix A

Monitoring Program Station No. ALT-1

Year: 2023

Name: Water Supply at Raw Water Intake

Licence Daily Water Use (to not exceed) Limit: 875 cubic metres [m^3].

Results for: All Purpose Water Monitoring

Daily Water Usage Quantity: 609 cubic metres [m^3].

Annual Water Usage Quantity: 221,517 cubic metres [m^3].

Average Daily Water Usage at CFS Alert - 8AC-ALT1929

Year	Month	Days	Average Daily Intake (Usage)	Maximum Daily Intake	Average Daily Returned	Maximum Daily Return	Average Daily Utilized (Consumed)	Maximum Daily Utilized (Consumed)	Metered	Quantity Utilized
[yr]	*[mo]*	*[day]*	*[m3/day]*	*[m3/day]*	*[m3/day]*	*[m3/day]*	*[m3/day]*	*[m3/day]*	[Y/N]	[m3]
2023	JAN	31	**599**	670	517	590	**82**	**126**	Y	18,565
2023	FEB	28	**597**	696	508	595	**89**	**112**	Y	16,724
2023	MAR	30	**607**	769	519	661	**88**	**142**	Y	18,216
2023	APR	30	**593**	664	513	573	**80**	**107**	Y	17,794
2023	MAY	31	**596**	673	516	587	**81**	**109**	Y	18,483
2023	JUN	30	**614**	711	511	599	**103**	**185**	Y	18,419
2023	JUL	31	**612**	822	514	680	**98**	**164**	Y	18,982
2023	AUG	31	**612**	903	522	960	**90**	**743**	Y	18,976
2023	SEP	30	**623**	688	520	725	**103**	**299**	Y	18,698
2023	OCT	31	**612**	724	524	616	**88**	**135**	Y	18,975
2023	NOV	30	**616**	769	514	648	**103**	**743**	Y	18,485
2023	DEC	31	**619**	724	516	609	**103**	**299**	Y	19,201
Annual Average [m3/day]:			**609**	734	516	654	**92**	264	**Total Annual [m3]:**	**221,517**
Observed Minimum [m3/day]:			593	664	508	***573***	80	107		
Observed Maximum [m3/day]:			***623***	903	524	960	103	743		

Average Daily Water Intake (Usage) from Source: 609 cubic metres [m^3].
Average Daily Water Return to Source: 516 cubic metres [m^3].
Average Daily Water Utilized (Consumed): 92 cubic metres [m^3].

The usage for 2023 was in compliance with, or below the Licence Daily Water Use Limit of 875 m^3.

Please note: Due to staffing issues, a water plant treatment operator was not on site for 10 days in September and 12 Days in October. No metering data was recorded during this time.

As requested by the Board during their technical review of the 2021 Annual report, please see daily, monthly annual quantities in cubic metres not reported as averages.

January

Month	Jan.	Year	2023										
	Raw *1												
	S	TR	Supply				Return					Station	Du
Day	PSI	PSI	PSI	Flow m^3/d	read m^3	total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Station Use m^3	
1	13	20	51	601	1,270,692	630	50	16	501	1094790	534	96	1
2	11	19	61	680	1,271,251	559	55	17	534	1095277	487	72	2
3	11	18	61	657	1,271,876	625	60	17	526	1095839	562	63	2
4	11	18	65	623	1,272,546	670	60	16	527	1096429	590	80	2
5	12	18	66	636	1,273,114	568	62	17	524	1096871	442	126	2
6	11	18	64	646	1,273,728	614	61	16	527	1097399	528	86	2
7	12	18	66	635	1,274,331	603	61	17	526	1,097,913	514	89	2
8	12	20	65	630	1,274,922	591	61	16	526	1,098,427	514	77	2
9	12	18	55	604	1,275,577	655	50	16	468	1,098,984	557	98	3
10	10	16	57	566	1,276,137	560	55	15	491	1,099,464	480	80	3
11	10	15	54	601	1,276,758	621	49	15	510	1,099,999	535	86	3
12	9	14	54	617	1,277,318	560	48	15	211	1,100,492	493	67	3
13	9	18	56	585	1,277,945	627	51	16	483	1,101,036	544	83	3
14	10	12	50	634	1,278,482	537	45	15	513	1,101,499	463	74	3
15	9	15	56	580	1,279,063	581	51	16	496	1,102,011	512	69	3
16	9	12	53	627	1,279,671	608	49	16	498	1,102,539	528	80	1
17	9	12	52	582	1,280,258	587	49	15	494	1,103,050	511	76	1
18	11	18	52	630	1,280,848	590	47	15	488	1,103,561	511	79	1
19	12	18	52	560	1,281,425	577	48	15	490	1,104,063	502	75	1
20	12	20	50	590	1,282,035	610	47	14	476	1,104,589	526	84	1
21	12	19	47	600	1,282,581	546	44	15	500	1,105,062	473	73	1
22	12	20	49	580	1,283,189	608	45	15	509	1,105,584	522	86	1
23	12	18	59	655	1,283,780	591	54	15	545	1,106,083	499	92	2
24	11	20	68	614	1,284,359	579	63	15	524	1,106,618	535	44	2
25	12	20	65	635	1,285,012	653	60	16	527	1,107,154	536	117	2
26	12	18	65	628	1,285,586	574	60	16	526	1,107,652	498	76	2
27	12	18	67	620	1,286,252	666	61	16	525	1,108,228	576	90	2
28	12	20	65	620	1,286,804	552	62	15	525	1,108,710	482	70	2
29	11	18	62	654	1,287,427	623	58	16	524	1,109,251	541	82	2
30	12	18	57	596	1,288,063	636	51	16	495	1,109,798	547	89	3
31	12	15	54	598	1,288,627	564	49	15	493	1,110,285	487	77	3

February

Month	Feb.	Year	2023	RT WTP Page 2 of 4 - PLANT PHYSICAL CHECKS									
	Raw *1	Distribution Loop *2											
	S	TR	Supply				Return						Du
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Station Use m^3	
1	10	12	53	613	1,289,183	556	48	16	480	1110757	472	84	3
2	56	60	52	611	1,289,759	576	48	16	515	1111250	493	83	3
3	12	16	55	588	1,290,363	604	51	15	468	1111761	511	93	3
4	12	16	51	630	1,291,037	674	46	15	503	1112323	562	112	3
5	12	16	49	632	1,291,614	577	44	16	472	1112805	482	95	3
6	12	16	58	593	1,292,103	489	53	16	479	1113231	426	63	1
7	12	16	58	640	1,292,713	610	46	16	496	1,113,759	528	82	1
8	56	60	59	615	1,293,297	584	54	16	524	1,114,266	507	77	1
9	56	60	58	623	1,293,909	612	53	17	529	1,114,795	529	83	1
10	56	60	60	608	1,294,544	635	55	17	530	1,115,343	548	87	1
11	12	16	58	627	1,295,240	696	55	16	521	1,115,938	595	101	1
12	56	60	58	625	1,295,822	582	52	17	520	1,116,442	504	78	1
13	56	60	54	667	1,296,353	531	49	17	520	1,116,895	453	78	2
14					1,296,970	617				1,117,432	537	80	2
15	56	60	65	628	1,297,581	611	60	17	523	1,117,943	511	100	2
16	56	60	64	645	1,298,208	627	59	17	523	1,118,469	526	101	2
17	12	16	63	681	1,298,845	637	57	17	524	1,119,006	537	100	2
18	12	16	66	622	1,299,530	685	62	17	524	1,119,588	582	103	2
19	12	16	62	665	1,300,163	633	57	17	522	1,120,126	538	95	2
20	56	60	63	655	1,300,693	530	58	16	524	1,120,567	441	89	3
21	12	16	51	594	1,301,270	577	47	17	485	1,121,051	484	93	3
22	12	16	54	565	1,301,845	575	50	17	483	1,121,536	485	90	3
23	56	60	52	588	1,302,427	582	48	17	480	1,122,033	497	85	3
24	56	60	48	631	1,303,005	578	45	17	472	1,122,529	496	82	3
25	56	60	50	605	1,303,651	646	46	17	480	1,123,076	547	99	3
26	56	60	54	576	1,304,226	575	50	17	489	1,123,565	489	86	3
27	12	16	52	582	1,304,726	500	49	17	494	1,123,982	417	83	1
28	12	16	57	639	1,305,351	625	53	17	525	1,124,510	528	97	1

March

Month	Mar	Year	2023	#####								
	Raw *1	Distribution Loop *2										
	S	TR	Supply				Return				Station	Du
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3		
1	56	60	57	613	1,305,965	614	52	17	521	1125037	527	87	1
2					1,306,681	716				1125621	584	132	1
3	12	16	55	668	1,307,383	702	50	16	507	1126209	588	114	1
4	56	60	59	611	1,307,932	549	54	16	520	1126680	471	78	1
5	56	60	59	623	1,308,541	609	54	16	520	1127209	529	80	1
6	56	60	56	657	1,309,070	529	50	17	520	1127655	446	83	1
7	56	60	65	639	1,309,683	613	60	17	525	1,128,179	524	89	2
8	56	60	64	628	1,310,305	622	59	17	522	1,128,706	527	95	2
9	12	20	65	627	1,310,910	605	60	18	522	1,129,227	521	84	2
10	12	20	65	626	1,311,557	647	60	18	523	1,129,769	542	105	2
11	12	20	65	644	1,312,240	683	59	18	521	1,130,354	585	98	2
12	56	60	61	674	1,312,838	598	58	18	522	1,130,856	502	96	2
13	12	20	54	614	1,313,356	518	49	18	516	1,131,303	447	71	2
14	12	20	54	638	1,313,949	593	49	18	489	1,131,811	508	85	3
15	12	20	56	585	1,314,528	579	51	18	464	1,132,301	490	89	3
16	12	20	57	564	1,315,114	586	52	18	473	1,132,801	500	86	3
17	12	20	54	584	1,315,753	639	51	17	482	1,133,351	550	89	3
18	12	20	55	574	1,316,364	611	51	17	492	1,133,911	560	51	3
19	56	60	56	579	1,317,091	727	51	17	490	1,134,496	585	142	3
20	56	60	56	578	1,317,469	378	51	17	490	1,134,827	331	47	1
21	56	60	56	616	1,318,071	602	51	17	516	1,135,343	516	86	1
22	56	60	57	586	1,318,675	604	52	16	503	1,135,859	516	88	1
23	56	60	57	609	1,319,270	595	51	16	523	1,136,373	514	81	1
24	12	20	55	608	1,319,910	640	50	16	503	1,136,920	547	93	1
25	12	20	52	638	1,320,555	645	46	17	520	1,137,483	563	82	1
26	56	60	57	588	1,321,161	606	52	17	511	1,138,003	520	86	1
27	12	20	60	681	1,321,667	506	55	17	522	1,138,445	442	64	2
28	12	20	64	619	1,322,278	611	58	17	525	1,138,970	525	86	2
29	12	20	63	631	1,323,047	769	58	18	522	1,139,631	661	108	2
30	12	16	61	637	1,323,520	473	58	179	525	1,140,044	413	60	2
31	11	16	63	638	1,324,174	654	59	18	522	1,140,606	562	92	2

April

Month	April	Year	2023	P Page 2 of 4 - PLANT PHYSICAL CHECKS										
	Raw *1		Distribution Loop *2											
	S	TR	Supply				Return							
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Station Use m^3	Duty HL	
1	16	11	60	674	1,324,709	535	59	18	524	1141071	465	70	2	
2	11	15	59	670	1,325,332	623	54	18	521	1141611	540	83	2	
3	16	19	67	586	1,325,980	648	63	18	523	1142167	556	92	2	
4	14	18	56	586	1,326,537	557	51	18	490	1142649	482	75	3	
5	13	18	53	621	1,327,151	614	48	17	500	1143160	511	103	3	
6	12	18	57	579	1,327,717	566	52	17	485	1143643	483	83	3	
7	12	18	57	576	1,328,318	601	52	17	488	1,144,146	503	98	3	
8	12	18	55	590	1,328,905	587	50	16	496	1,144,657	511	76	3	
9	12	18	54	591	1,329,498	593	52	17	489	1,145,178	521	72	3	
10	12	18	54	615	1,330,071	573	49	17	506	1,145,683	505	68	1	
11	13	20	58	629	1,330,662	591	54	17	524	1,146,196	513	78	1	
12	13	20	57	633	1,331,267	605	51	17	523	1,146,716	520	85	1	
13	13	20	60	611	1,331,884	617	54	16	521	1,147,251	535	82	1	
14	12	20	56	641	1,332,529	645	51	17	520	1,147,807	556	89	1	
15	13	20	57	621	1,333,062	533	53	17	524	1,148,277	470	63	1	
16	13	20	56	628	1,333,688	626	51	17	519	1,148,825	548	78	1	
17	12	18	58	628	1,334,269	581	53	16	524	1,149,330	505	76	2	
18	9	14	68	630	1,334,894	625	63	17	525	1,149,871	541	84	2	
19	9	18	71	612	1,335,558	664	66	17	521	1,150,444	573	91	2	
20	9	14	71	646	1,336,117	559	66	17	525	1,150,925	481	78	2	
21	9	14	60	629	1,336,716	599	55	17	520	1,151,448	523	76	2	
22	9	14	68	611	1,337,306	590	52	17	522	1,151,965	517	73	2	
23	9	14	58	630	1,337,902	596	53	17	522	1,152,487	522	74	2	
24	9	15	55	636	1,338,520	618	51	17	520	1,153,052	565	53	3	
25	9	15	53	594	1,339,088	568	49	17	478	1,153,513	461	107	3	
26	9	15	52	589	1,339,671	583	49	17	486	1,154,015	502	81	3	
27	9	15	53	591	1,340,258	587	49	17	494	1,154,519	504	83	3	
28	13	18	53	578	1,340,846	588	48	17	484	1,155,028	509	79	3	
29	12	18	53	599	1,341,375	529	47	18	511	1,155,495	467	62	3	
30	13	12	55	567	1,341,968	593	50	18	482	1,156,010	515	78	3	

May

Month	May	Year	2023	P Page 2 of 4 - PLANT PHYSICAL CHECKS									
	Raw *1		Distribution Loop *2										
	S	TR	Supply				Return						
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Station Use m^3	Duty HL
1	9	12	55	655	1,342,560	592	49	18	520	1156521	511	81	1
2	13	18	59	619	1,343,135	575	54	18	515	1157025	504	71	1
3	12	18	56	628	1,343,746	611	51	18	520	1157557	532	79	1
4	12	18	60	610	1,344,368	622	55	18	522	1158092	535	87	1
5	13	18	56	655	1,344,982	614	51	18	518	1158619	527	87	1
6	12	18	58	630	1,345,555	573	53	18	532	1159123	504	69	1
7	12	18	56	638	1,346,196	641	52	19	526	1,159,676	553	88	1
8	12	18	63	672	1,346,775	579	58	18	521	1,160,172	496	83	2
9	10	16	70	570	1,347,373	598	65	18	522	1,160,695	523	75	2
10	10	16	66	631	1,347,966	593	61	18	523	1,161,218	523	70	2
11	10	16	59	684	1,348,571	605	53	17	522	1,161,714	496	109	2
12	9	15	63	631	1,349,174	603	58	17	523	1,162,269	555	48	2
13	9	15	63	642	1,349,780	606	58	17	524	1,162,793	524	82	2
14	10	15	59	651	1,350,364	584	54	17	520	1,163,304	511	73	2
15	9	15	54	639	1,350,967	603	49	18	519	1,163,821	517	86	3
16	16	18	56	567	1,351,556	589	50	17	491	1,164,324	503	86	3
17	16	18	56	570	1,352,154	598	51	16	487	1,164,836	512	86	3
18	16	18	53	596	1,352,747	593	50	16	477	1,165,342	506	87	3
19	13	18	54	579	1,353,335	588	49	15	485	1,165,838	496	92	3
20	12	18	55	585	1,353,889	554	50	16	481	1,166,322	484	70	3
21	12	18	52	605	1,354,471	582	48	15	484	1,166,823	501	81	3
22	13	18	55	585	1,355,050	579	51	15	487	1,167,327	504	75	3
23	13	18	59	619	1,355,629	579	53	16	497	1,167,826	499	80	1
24	13	18	59	613	1,356,212	583	53	16	522	1,168,330	504	79	1
25	15	20	58	631	1,356,818	606	53	15	524	1,168,851	521	85	1
26	56	60	59	609	1,357,458	640	54	15	522	1,169,402	551	89	1
27	12	16	55	661	1,358,131	673	50	16	523	1,169,989	587	86	1
28	56	60	58	620	1,358,745	614	53	17	521	1,170,521	532	82	1
29	56	60	72	657	1,359,231	486	67	17	525	1,170,947	426	60	2
30	14	18	71	629	1,359,846	615	65	17	521	1,171,476	529	86	2
31	14	18	72	618	1,360,451	605	66	16	522	1,171,994	518	87	2

June

Month	June	Year	2023	P Page 2 of 4 - PLANT PHYSICAL CHECKS										
	Raw *1		Distribution Loop *2											
	S	TR	Supply				Return							
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Station Use m^3	Duty HL
1	14	20	72	622	1,361,079	628	67	16	525	1172519	525	103	2
2	56	60	65	700	1,361,712	633	60	16	521	1173056	537	96	2
3	14	26	71	623	1,362,410	698	66	17	523	1173655	599	99	2
4	14	28	71	629	1,362,901	491	64	17	523	1174082	427	64	2
5	56	60	55	618	1,363,526	625	49	17	519	1174614	532	93	3
6	10	14	55	586	1,364,110	584	51	17	482	1175115	501	83	3
7	10	14	54	604	1,364,701	591	50	17	459	1,175,605	490	101	3
8	10	14	56	586	1,365,325	624	50	17	491	1,176,116	511	113	3
9	10	14	54	604	1,365,913	588	50	17	472	1,176,603	487	101	3
10	56	60	53	614	1,366,484	571	49	17	475	1,177,077	474	97	3
11	56	60	50	620	1,367,178	694	46	17	472	1,177,652	575	119	3
12	56	60	58	632	1,367,679	501	53	17	510	1,178,071	419	82	1
13	14	20	55	653	1,368,307	628	50	17	522	1,178,584	513	115	1
14	56	60	53	666	1,368,931	624	48	17	509	1,179,098	514	110	1
15	56	60	54	658	1,369,554	623	48	15	492	1,179,611	513	110	1
16	14	20	57	635	1,370,210	656	51	13	507	1,180,151	540	116	1
17	56	60	71	647	1,370,921	711	66	13	524	1,180,677	526	185	2
18	14	20	69	644	1,371,530	609	65	15	522	1,181,209	532	77	2
19	56	60	70	644	1,372,043	513	65	15	524	1,181,648	439	74	2
20	56	60	67	666	1,372,673	630	62	15	521	1,182,170	522	108	2
21	14	20	71	641	1,373,310	637	66	15	521	1,182,691	521	116	2
22	14	20	68	661	1,373,942	632	62	15	523	1,183,217	526	106	2
23	56	60	69	652	1,374,583	641	64	15	524	1,183,751	534	107	2
24	14	20	67	656	1,375,289	706	63	15	526	1,184,344	593	113	2
25	14	20	66	710	1,375,933	644	61	15	532	1,184,872	528	116	2
26	14	20	68	663	1,376,456	523	62	16	524	1,185,310	438	85	2
27	56	60	68	652	1,377,093	637	64	16	521	1,185,835	525	112	3
28	56	60	54	597	1,377,687	594	50	17	463	1,186,330	495	99	3
29	14	20	55	573	1,378,273	586	51	16	473	1,186,815	485	101	3
30	54	60	56	591	1,378,870	597	51	15	483	1,187,319	504	93	3

July

Month	7	Year	2023	P Page 2 of 4 - PLANT PHYSICAL CHECKS										
	Raw *1		Distribution Loop *2											
	S	TR	Supply				Return							
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Station Use m^3	Duty HL
1	10	14	53	616	1,379,545	695	48	16.0	476	1187879	570	125	3
2	10	14	54	616	1,380,143	598	49	16.0	477	1188386	507	91	3
3	10	14	53	598	1,380,760	617	51	17.0	485	1188913	527	90	3
4	10	14	53	619	1,381,231	471	48	17.0	482	1189318	405	66	3
5	10	14	54	613	1,381,827	596	49	18.0	499	1189820	502	94	1
6	10	14	57	638	1,382,441	614	52	18.0	523	1190342	522	92	1
7	56	60	57	635	1,383,067	626	52	18.0	517	1,190,870	528	98	1
8	56	60	57	640	1,383,778	711	51	18.0	517	1,191,472	602	109	1
9	10	14	50	701	1,384,389	611	45	18.0	521	1,191,991	519	92	1
10	10	14	56	655	1,384,921	532	51	18.0	520	1,192,433	442	90	1
11					1,385,532	611				1,192,880	447	164	
12	55	60	57	670	1,386,228	696	52	17.0	510	1,193,489	609	87	1
13	55	52	53	691	1,387,050	822	47	17.0	517	1,194,169	680	142	2
14	12	65	67	681	1,387,698	648	62	16.0	526	1,194,705	536	112	2
15	12	13	67	668	1,388,294	596	62	17.0	522	1,195,211	506	90	2
16	54	53	72	626	1,388,920	626	66	16.6	526	1,195,740	529	97	2
17	12	11	66	677	1,389,402	482	61	16.6	524	1,196,152	412	70	2
18	12	12	70	656	1,390,042	640	64	16.5	522	1,196,685	533	107	2
19	12	12	64	663	1,390,637	595	60	16.0	522	1,197,176	491	104	3
20	54	53	51	670	1,391,378	741	46	15.9	470	1,197,797	621	120	3
21	54	53	56	579	1,391,805	427	52	16.1	476	1,198,162	365	62	3
22	25	31	54	611	1,392,500	695	49	15.9	487	1,198,743	581	114	3
23	54	53	56	576	1,393,094	594	52	16.2	477	1,199,242	499	95	3
24	12	11	46	673	1,393,731	637	42	15.9	450	1,199,772	530	107	3
25			68	620	1,394,226	495	66	16.4	524	1,200,187	415	80	1
26	57	52	50	635	1,394,833	607	54	15.5	518	1,200,696	509	98	1
27	13	15	56	633	1,395,402	569	52	15.3	517	1,201,165	469	100	1
28	11	11	56	642	1,396,050	648	51	14.8	496	1,201,697	532	116	1
29	54	54	57	643	1,396,688	638	52	14.9	518	1,202,243	546	92	1
30	54	53	57	644	1,397,258	570	51	13.4	522	1,202,695	452	118	1
31	10	11	59	647	1,397,832	574	53	13.5	521	1,203,252	557	17	1

August

Month	August	Year	2023	P Page 2 of 4 - PLANT PHYSICAL CHECKS										
	Raw *1		Distribution Loop *2											
	S	TR	Supply				Return							
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Station Use m^3	Duty HL
1	8.9	8.2	57	635	1,398,454	574	53	13.8	523	1203751	557	17	2
2	8.9	10.8	71	624	1,399,146	692	65	13.5	526	1204332	581	111	2
3	9.1	8.8	65	700	1,399,632	486	59	12.8	522	1204747	415	71	2
4	8.4	8.0	74	617	1,400,323	691	68	12.8	524	1205329	582	109	2
5	54.9	54.0	71	644	1,400,962	639	66	12.8	524	1205871	542	97	3
6	12.0	11.6	65	658	1,401,579	617	60	12.9	525	1206408	537	80	2
7	10.5	11.3	71	638	1,402,221	642	65	12.9	522	1,206,963	555	87	2
8	52.9	51.3	72	638	1,402,740	519	66	12.9	526	1,207,408	445	74	2
9	7.8	7.5	78	575	1,403,560	820	72	12.9	525	1,208,102	694	126	2
10	7.4	6.9	70	625	1,403,902	342	65	13.3	524	1,208,397	295	47	2
11	7.7	7.3	71	630	1,404,481	579	66	13.2	523	1,208,890	493	86	2
12	49.4	48.4	72	579	1,405,384	903	77	12.8	525	1,209,050	160	743	2
13	8.6	8.3	69	660	1,405,603	219	64	7.3	524	1,210,010	960	-741	2
14	6.1	5.7	70	638	1,406,385	782	65	13.0	523	1,210,504	494	288	2
15	54.4	55.9	72	634	1,407,067	682	68	13.1	525	1,211,078	574	108	2
16	8.5	8.2	70	647	1,407,543	476	66	13.1	525	1,211,488	410	66	2
17	7.9	7.4	71	631	1,408,246	703	65	13.1	524	1,212,085	597	106	2
18	8.0	7.6	71	651	1,408,789	543	65	13.2	523	1,212,553	468	75	2
19	7.3	8.0	71	648	1,409,377	588	65	13.1	521	1,213,055	502	86	2
20	47.6	35.2	71	643	1,410,190	813	67	13.1	525	1,213,716	661	152	2
21	8.2	7.8	72	630	1,410,612	422	67	13.3	524	1,214,115	399	23	2
22	7.9	7.6	68	661	1,411,224	612	63	13.2	524	1,214,638	523	89	2
23	8.6	8.3	73	622	1,411,844	620	68	13.3	520	1,215,169	531	89	2
24	7.8	7.4	68	682	1,412,461	617	64	12.9	524	1,215,682	513	104	2
25	9.1	8.8	68	675	1,413,092	631	63	12.9	522	1,216,218	536	95	2
26	8.3	7.9	71	642	1,413,794	702	65	13.1	522	1,216,813	595	107	2
27	7.8	7.6	74	610	1,414,392	598	63	13.5	524	1,217,331	518	80	2
28	7.5	7.2	73	620	1,414,916	524	67	13.4	525	1,217,779	448	76	2
29	53.4	52.4	69	678	1,415,635	719	64	13.3	525	1,218,385	606	113	2
30	10.7	11.5	65	736	1,416,204	569	61	12.6	525	1,218,842	457	112	2
31	49.2	48.5	64	654	1,416,856	652	64	12.6	523	1,219,376	534	118	2

September

Month	Septembe	Year	2023	P Page 2 of 4 - PLANT PHYSICAL CHECKS									
	Raw *1		Distribution Loop *2										
	S	TR	Supply				Return						
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Station Use m^3	Duty HL
1													
2													
3													
4													
5													
6													
7													
8	9	16	54	616	1,204,348	589	49	17	496	1,038,524	508	81	3
9	11.0	19.0	72	622	1,422,563	562	67	14.7	523	1,224,072	476	86	2
10	10.0	20.0	70	647	1,423,192	629	64	15.0	524	1,224,603	531	98	2
11	12.0	16.0	72	640	1,423,858	666	67	16.0	523	1,225,157	554	112	2
12	11.0	15.0	56	650	1,424,435	577	51	16.2	519	1,225,639	482	95	1
13	11.0	18.0	56	637	1,425,106	671	51	16.1	522	1,226,197	558	113	1
14	11.0	15.0	59	626	1,425,699	593	54	16.9	517	1,226,696	499	94	1
15	12.0	16.0	57	639	1,426,366	667	52	17.2	515	1,227,230	534	133	1
16	12.0	18.0	53	689	1,426,950	584	48	13.1	514	1,227,728	498	86	1
17	11.0	18.0	56	665	1,427,597	647	51	16.8	507	1,228,251	523	124	1
18	11.0	18.0	60	654	1,428,259	662	56	16.6	513	1,228,778	527	135	2
19	9.0	14.0	61	638	1,428,892	633	55	16.0	525	1,229,503	725	-92	2
20	10.0	15.0	62	641	1,429,517	625	57	17.1	522	1,229,829	326	299	2
21	8.4	12.0	63	626	1,430,147	630	57	17.4	526	1,230,357	528	102	2
22	8.6	14.0	61	645	1,430,790	643	56	17.3	522	1,230,894	537	106	2
23	8.5	14.0	59	652	1,431,358	568	54	17.5	527	1,231,374	480	88	2
24	9.5	15.0	62	634	1,431,963	605	57	17.0	524	1,231,884	510	95	2
25	12.0	15.0	57	642	1,432,651	688	51	16.0	519	1,232,459	575	113	1
26	11.0	18.0	57	636	1,433,252	601	52	16.0	519	1,232,962	503	98	1
27	11.0	17.0	55	668	1,433,877	625	51	16.0	520	1,233,486	524	101	1
28													
29													
30													

October

Month	Oct.	Year	2023	P Page 2 of 4 - PLANT PHYSICAL CHECKS										
	Raw *1		Distribution Loop *2											
	S	TR	Supply				Return							
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Station Use m^3	Duty HL	
1	d DW Operator at site				1,436,373	624				1235601	529	95		
2	d DW Operator at site				1,436,997	624				1236130	529	95		
3	d DW Operator at site				1,437,621	624				1236659	529	95		
4	d DW Operator at site				1,438,245	624				1237188	529	95		
5	d DW Operator at site				1,438,869	624				1237717	529	95		
6	d DW Operator at site				1,439,493	624				1238246	529	95		
7	d DW Operator at site				1,440,117	624				1,238,775	529	95		
8	d DW Operator at site				1,440,741	624				1,239,304	529	95		
9	d DW Operator at site				1,441,365	624				1,239,833	529	95		
10	d DW Operator at site				1,441,989	624				1,240,362	529	95		
11	d DW Operator at site				1,442,613	624				1,240,891	529	95		
12	d DW Operator at site				1,443,237	624				1,241,420	529	95		
13	53	52	57	649	1,443,854	617	53	16	515	1,241,946	526	91	1	
14	10	9	57	654	1,444,565	711	52	16	525	1,242,550	604	107	1	
15	54	53	58	641	1,445,157	592	53	16	523	1,243,052	502	90	1	
16	12	12	74	620	1,445,711	554	68	16	523	1,243,471	419	135	2	
17	55	54	69	664	1,446,237	526	61	15	528	1,244,087	616	-90	2	
18	55	55	74	634	1,446,809	572	67	15	524	1,244,579	492	80	2	
19	12	12	64	697	1,447,376	567	59	15	523	1,245,063	484	83	2	
20	55	54	70	660	1,448,073	697	65	15	524	1,245,647	584	113	2	
21	12	11	72	633	1,448,797	724	67	15	526	1,246,256	609	115	2	
22	55	54	73	631	1,449,406	609	68	15	525	1,246,780	524	85	2	
23	7	7	56	611	1,449,894	488	50	15	537	1,247,200	420	68	3	
24	11	11	54	605	1,450,452	558	49	15	513	1,247,681	481	77	3	
25	12	12	52	638	1,451,167	715	47	15	506	1,248,285	604	111	3	
26	53	11	57	586	1,451,869	702	52	15	515	1,248,873	588	114	3	
27	12	11	53	631	1,452,349	480	48	15	509	1,249,280	407	73	3	
28	11	11	52	630	1,452,922	573	48	15	505	1,249,774	494	79	3	
29	12	12	56	596	1,453,587	665	51	15	494	1,250,343	569	96	3	
30	69	68	58	635	1,454,138	551	52	15	526	1,250,818	475	76	1	
31	7	7	59	630	1,454,724	586	53	15	527	1,251,317	499	87	1	

November

Month	NOV	Year	2023	P Page 2 of 4 - PLANT PHYSICAL CHECKS										
	Raw *1		Distribution Loop *2											
	S	TR	Supply				Return							
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Sation Use m3	Duty HL
1	8	8	58	642	1,455,282	558	52	15	526	1251790	473	85	1
2	8	8	57	645	1,456,038	756	52	15	525	1252418	628	128	1
3	11	12	59	629	1,456,692	654	54	15	527	1252976	558	96	1
4	12	11	60	620	1,457,233	541	54	15	526	1253445	469	72	1
5	12	11	58	650	1,457,944	711	52	15	524	1254056	611	100	1
6	54	53	70	649	1,458,414	470	66	15	531	1254462	406	64	2
7	10	10	71	640	1,459,183	769	65	15	527	1,255,110	648	121	2
8	10	10	70	666	1,459,726	543	67	14	530	1,255,570	460	83	2
9	10	11	71	632	1,460,219	493	67	15	528	1,255,994	424	69	2
10	10	12	68	649	1,460,849	630	62	15	527	1,256,531	537	93	2
11	14	16	72	620	1,461,417	568	67	15	527	1,257,021	490	78	2
12	11	18	68	658	1,462,075	658	62	15	527	1,257,582	561	97	2
13	12	18	69	641	1,462,679	604	62	151	525	1,258,099	517	87	2
14	12	18	56	59	1,463,301	622	50	153	505	1,258,628	529	93	3
15	13	18	51	616	1,463,892	591	47	15	478	1,259,131	503	88	3
16	12	18	52	594	1,464,473	581	48	15	494	1,259,629	498	83	3
17	11	16	55	597	1,465,099	626	51	15	470	1,260,139	510	116	3
18	12	16	55	596	1,465,644	545	50	15	473	1,260,587	448	97	3
19	12	18	54	604	1,466,259	615	50	15	460	1,261,091	504	111	3
20	12	19	57	653	1,466,861	602	51	15	542	1,261,578	487	115	1
21	11	18	56	648	1,467,499	638	51	15	528	1,262,104	526	112	1
22	12	19	57	647	1,468,128	629	51	16	523	1,262,625	521	108	1
23	12	20	57	657	1,468,791	663	52	15	528	1,263,175	550	113	1
24	12	18	56	649	1,469,463	672	50	15	505	1,263,710	535	137	1
25	12	18	56	652	1,470,050	587	51	15	517	1,264,186	476	111	1
26	12	19	55	662	1,470,684	634	50	144	511	1,264,709	523	111	1
27	12	20	56	644	1,471,347	663	51	14	516	1,265,234	525	138	2
28	12	18	47	641	1,471,974	627	51	14	489	1,265,729	495	132	3
29	12	20	55	609	1,472,563	589	50	14	466	1,266,204	475	114	3
30	20	21	55	605	1,473,209	646	51	14	481	1,266,725	521	125	3

December

Month	Dec	Year	2023	P Page 2 of 4 - PLANT PHYSICAL CHECKS										
	Raw *1		Distribution Loop *2											
	S	TR	Supply				Return					Station	Duty HL
Day	PSI	PSI	PSI	Flow m^3/d	Read m^3	Total m^3	PSI	0^F	Flow m^3/d	Read m^3	Total m^3	Use m^3	
1	12	18	56	592	1,473,792	583	52	14	479	1,267,202	477	106	3
2	12	18	51	628	1,474,364	572	46	14	507	1,267,671	469	103	3
3	12	18	57	592	1,474,989	625	52	14	477	1,268,187	516	109	3
4	12	18	54	616	1,475,585	596	50	14	473	1,268,668	481	115	3
5	11	18	54	684	1,476,228	643	48	14	521	1,269,188	520	123	1
6	11	18	54	664	1,476,869	641	48	14	534	1,269,715	527	114	1
7	12	20	58	659	1,477,522	653	53	14	521	1,270,248	533	120	1
8	12	18	56	678	1,478,178	656	50	14	519	1,270,783	535	121	1
9	12	18	56	652	1,478,811	633	51	14	505	1,271,287	504	129	1
10	15	18	54	680	1,479,460	649	48	14	530	1,271,818	531	118	1
11	14	23	57	650	1,480,095	635	51	14	524	1,272,333	515	120	2
12	12	20	70	674	1,480,729	634	64	14	530	1,272,859	526	108	2
13	12	20	70	658	1,481,408	679	65	14	531	1,273,397	538	141	2
14	12	20	69	650	1,482,039	631	63	14	530	1,273,931	534	97	2
15	12	20	71	657	1,482,678	639	65	15	530	1,274,474	543	96	2
16	12	18	68	677	1,483,299	621	63	15	530	1,275,005	531	90	2
17	13	20	72	635	1,483,927	628	67	15	533	1,275,534	529	99	2
18	16	14	72	629	1,484,537	610	66	15	531	1,276,048	514	96	3
19	8	14	52	615	1,485,138	601	46	15	497	1,276,555	507	94	3
20	9	16	55	587	1,485,722	584	50	15	497	1,277,049	494	90	3
21	10	16	54	697	1,486,319	597	49	15	487	1,277,542	493	104	3
22	10	16	51	637	1,486,917	598	47	15	489	1,278,027	485	113	3
23	12	16	53	611	1,487,601	684	49	15	488	1,278,603	576	108	3
24	12	16	53	597	1,488,215	614	49	15	491	1,279,108	505	109	3
25	56	60	56	579	1,488,768	553	51	15	496	1,279,601	493	60	3
26	56	60	53	600	1,489,367	599	48	15	485	1,280,116	515	84	3
27	12	16	53	621	1,489,857	490	48	15	529	1,280,539	423	67	1
28	56	60	59	618	1,490,464	607	53	15	530	1,281,062	523	84	1
29	12	16	55	646	1,491,068	604	50	15	527	1,281,592	530	74	1
30	12	16	56	651	1,491,792	724	51	15	526	1,282,201	609	115	1
31	56	60	58	622	1,492,410	618	53	15	527	1,282,730	529	89	1

Appendix B

Monitoring Program Station No. ALT-2 & ALT 3
Year: 2023
Month: June, July and August
ALT-2 Name: Sewage Terrace Outfall Point
ALT-3 Name: Sewage Terrace Final Discharge Point
Description: Effluent Quality Results.

Notes:
The Alert Sewage Terrace System is being monitored by Nasittuq Corporation, under service contract by DND and administrated by 8 Wing Trenton Environmental Management in Trenton, Ontario. Water quality samples are collected and analyzed by ALS Canada Ltd., Ontario.

Summary of Results:

ALT-2 is located at the Sewage Terrace Outfall Point.
ALT-3 is located at the Sewage Terrace Final Discharge Point (Parr Inlet).

In reference to **Part E, Item 4**, for ALT-3 and /or Alt 13, the results are summarized:

Jun-23			
	Date Sampled		30-Jun
	Licence Specific Criteria		**Alt- 2**
Benzene (ug/L)	370		NA
Toluene (ug/L)	2		NA
Ethylbenzene (ug/L)	90		NA
Lead (ug/L)	1		4.65
Oil and Grease (mg/L)	15 (NVS)		8.7
Phenols (ug/L)	20		29.5
$BOD_{5\ (mg/L)}$	80		30.5
pH			7.4
TSS (mg/L)	70		27.5
Oil and Grease (mg/L)	5 (NVS)		8.7
	CCME Criteria (marine)		NA
pH	7.0 to 8.7		7.4
Conductivity	---		541
Temperature (field)	---		NA
TSS (mg/L)	---		27.5
Oil and Grease (mg/L)	---		8.7
Nitrate-Nitrite (mg/L)	---		ND
Ammonia Nitrogen (mg/L)	---		11.1
Sulphate (mg/L)	---		8.68
Total Hardness (mg/L)	---		152
Total Alkalinity (mg/L)	---		199
Total Phenols (mg/L)	---		0.0295
TOC (mg/L)	---		40.7
Fecal Coliforms (CFU/100mL)	---		ND
Aluminum (ug/L)	---		109
Antimony (ug/L)	0.5		NA
Arsenic (ug/L)	12.5		2.81
Barium (ug/L)			NA
Beryllium (ug/L)			NA
Bismuth(ug/L)			NA
Boron (ug/L)			NA
Cadmium(ug/L)	12		0.0856
Calcium (ug/L)	---		48000
Chromium (ug/L)	---		6.48
Cobalt (ug/L)			NA
Copper (ug/L)	2		430
Iron (ug/L)	---		1750
Lead (ug/L)	2		4.65
Lithium (ug/L)			NA
Magnesium (ug/L)	---		7880
Manganese (ug/L)			NA
Mercury (ug/L)	0.16		ND
Molybdenum (ug/L)			NA
Nickle (ug/L)	8.3		6.72
Phosphorus (ug/L)			NA
Potassium (ug/L)	---		6130
Selenium (ug/L)			NA
Silicon (ug/L)			NA
Silver(ug/L)			0.148
Sodium (ug/L)	---		30200
Stontonium (ug/L)			NA
Sulfur (ug/L)			NA
Thallium (ug/L)			NA
Tin(ug/L)			NA
Titanium (ug/L)			NA
Uranium(ug/L)			NA
Vanadium (ug/L)			NA
Zinc(ug/L)	10		37.1
BOD5 (mg/L)	---		30.5
Chloride (mg/L)	---		39.6
Benzene (ug/L)	110		NA
Ethylbenzene (ug/L)	25		NA
Toluene (ug/L)	215		NA
Xylenes (ug/L)	---		NA
F1 (ug/L)	---		NA
F2 (ug/L)	---		NA
F3 (ug/L)	---		NA
F4 (ug/L)	---		NA
Acenaphthene (ug/L)	---		NA
Acenaphthylene (ug/L)	---		NA
Acridine (ug/L)	---		NA
Benzo(a)anthracene (ug/L)	---		NA
Benzo(o)pyrene (ug/L)	---		NA
Benzo(b)fluoranthere (ug/L)	---		NA
Benzo(g,h,i)perylene (ug/L)	---		NA
Benzo(k)fluoranthere (ug/L)	---		NA
Chrysene (ug/L)	---		NA
Dibenzo(ah)anthracene (ug/L)	---		NA
Fluoranthene (ug/L)	---		NA
Fluorene (ug/L)	---		NA
Indeno(1,2,3-cd)pyrene (ug/L)	---		NA
1+2-Methylnapthalenes (ug/L)	---		NA
1-Methylnapthalene (ug/L)	---		NA
2-Methylnapthalene (ug/L)	---		NA
Napthalene (ug/L)	1.4		NA
Phenanthrene (ug/L)	---		NA
Pyrene (ug/L)	---		NA
Quinoline (ug/L)	---		NA

Jul-23					
	Date Sampled	02-Jul	03-Jul	04-Jul	26-Jul
	Licence Specific Criteria	**Alt-2**	**Alt-2**	**Alt-3**	**Alt-2**
Benzene (ug/L)	370	NA	NA	NA	NA
Toluene (ug/L)	2	NA	NA	NA	NA
Ethylbenzene (ug/L)	90	NA	NA	NA	NA
Lead (ug/L)	1	0.158	0.158	0.158	1.02
Oil and Grease (mg/L)	15 (NVS)	8.7	ND	ND	8.7
Phenols (ug/L)	20	37.8	19.3	3.8	NA
$BOD_{5\ (mg/L)}$	80	24.8	10.4	4.1	35
pH		7.47	7.61	7.92	7.67
TSS (mg/L)	70	46.5	18.5	12.1	65.1
Oil and Grease (mg/L)	5 (NVS)	8.7	ND	ND	8.7
	CCME Criteria (marine)	NA	NA	NA	NA
pH	7.0 to 8.7	7.47	7.61	7.92	7.67
Conductivity	---	1640	708	432	572
Temperature (field)	---	NA	NA	NA	NA
TSS (mg/L)	---	46.5	18.5	12.1	65.1
Oil and Grease (mg/L)	---	8.7	ND	ND	8.7
Nitrate-Nitrite (mg/L)	---	ND	0.114	0.563	ND
Ammonia Nitrogen (mg/L)	---	10.7	5.2	4.16	15
Sulphate (mg/L)	---	7.04	7.98	6.83	6.16
Total Hardness (mg/L)	---	207	148	127	151
Total Alkalinity (mg/L)	---	206	174	148	186
Total Phenols (mg/L)	---	0.0378	0.0193	0.0038	0.0181
TOC (mg/L)	---	34.5	17.7	13.1	38.8
Fecal Coliforms (CFU/100mL)	---	7000	ND	ND	58000
Aluminum (ug/L)	---	110	126	453	125
Antimony (ug/L)	0.5	NA	NA	NA	NA
Arsenic (ug/L)	12.5	2.39	2.86	7.9	1.53
Barium (ug/L)		NA	NA	NA	NA
Beryllium (ug/L)		NA	NA	NA	NA
Bismuth(ug/L)		NA	NA	NA	NA
Boron (ug/L)		NA	NA	NA	NA
Cadmium(ug/L)	12	0.0427	0.0372	0.102	0.0504
Calcium (ug/L)	---	66600	46700	38700	47900
Chromium (ug/L)	---	0.68	ND	ND	0.54
Cobalt (ug/L)		NA	NA	NA	NA
Copper (ug/L)	2	121	66	56.7	145
Iron (ug/L)	---	1500	1120	1070	825
Lead (ug/L)	2	1.04	0.864	1.94	1.02
Lithium (ug/L)		NA	NA	NA	NA
Magnesium (ug/L)	---	9940	7610	7360	7740
Manganese (ug/L)		NA	NA	NA	NA
Mercury (ug/L)	0.16	ND	ND	ND	ND
Molybdenum (ug/L)		NA	NA	NA	NA
Nickle (ug/L)	8.3	4.87	4.82	20	3.62
Phosphorus (ug/L)		NA	NA	NA	NA
Potassium (ug/L)	---	10400	5900	5780	5730
Selenium (ug/L)		NA	NA	NA	NA
Silicon (ug/L)		NA	NA	NA	NA
Silver(ug/L)		0.035	0.016	0.016	0.025
Sodium (ug/L)	---	231000	74800	29800	30400
Stontonium (ug/L)		NA	NA	NA	NA
Sulfur (ug/L)		NA	NA	NA	NA
Thallium (ug/L)		NA	NA	NA	NA
Tin(ug/L)		NA	NA	NA	NA
Titanium (ug/L)		NA	NA	NA	NA
Uranium(ug/L)		NA	NA	NA	NA
Vanadium (ug/L)		NA	NA	NA	NA
Zinc(ug/L)	10	20.9	12.8	17.9	25.5
BOD5 (mg/L)	---	24.8	10.4	4.1	35
Chloride (mg/L)	---	389	109	38.3	55
Benzene (ug/L)	110	NA	NA	NA	ND
Ethylbenzene (ug/L)	25	NA	NA	NA	ND
Toluene (ug/L)	215	NA	NA	NA	ND
Xylenes (ug/L)	---	NA	NA	NA	ND
F1 (ug/L)	---	NA	NA	NA	ND
F2 (ug/L)	---	NA	NA	NA	ND
F3 (ug/L)	---	NA	NA	NA	ND
F4 (ug/L)	---	NA	NA	NA	ND
Acenaphthene (ug/L)	---	NA	NA	NA	ND
Acenaphthylene (ug/L)	---	NA	NA	NA	ND
Acridine (ug/L)	---	NA	NA	NA	ND
Benzo(a)anthracene (ug/L)	---	NA	NA	NA	ND
Benzo(o)pyrene (ug/L)	---	NA	NA	NA	ND
Benzo(b)fluoranthere (ug/L)	---	NA	NA	NA	ND
Benzo(g,h,i)perylene (ug/L)	---	NA	NA	NA	ND
Benzo(k)fluoranthere (ug/L)	---	NA	NA	NA	ND
Chrysene (ug/L)	---	NA	NA	NA	ND
Dibenzo(ah)anthracene (ug/L)	---	NA	NA	NA	ND
Fluoranthene (ug/L)	---	NA	NA	NA	ND
Fluorene (ug/L)	---	NA	NA	NA	ND
Indeno(1,2,3-cd)pyrene (ug/L)	---	NA	NA	NA	ND
1+2-Methylnapthalenes (ug/L)	---	NA	NA	NA	ND
1-Methylnapthalene (ug/L)	---	NA	NA	NA	ND
2-Methylnapthalene (ug/L)	---	NA	NA	NA	ND
Napthalene (ug/L)	1.4	NA	NA	NA	ND
Phenanthrene (ug/L)	---	NA	NA	NA	ND
Pyrene (ug/L)	---	NA	NA	NA	ND
Quinoline (ug/L)	---	NA	NA	NA	ND

Aug-23						
	Date Sampled	09-Aug	09-Aug	15-Aug	15-Aug
	Licence Specific Criteria	**Alt-2**	**Alt-3**	**Alt-2**	**Alt-3**
Benzene (ug/L)	370	ND	ND	ND	ND
Toluene (ug/L)	2	ND	ND	ND	ND
Ethylbenzene (ug/L)	90	ND	ND	ND	ND
Lead (ug/L)	1	1.94	2.62	2.29	0.894
Oil and Grease (mg/L)	15 (NVS)	12.6	7.9	51.6	9.4
Phenols (ug/L)	20	8.7	9.8	1.37	8.5
$BOD_{5\ (mg/L)}$	80	47.1	41.7	103	16.1
pH		7.6	7.78	7.26	7.82
TSS (mg/L)	70	43.2	74.6	108	13
Oil and Grease (mg/L)	5 (NVS)	12.6	7.9	51.6	9.4
	CCME Criteria (marine)	NA	NA	NA	NA
pH	7.0 to 8.7	7.6	7.78	7.26	7.82
Conductivity	---	446	524	440	436
Temperature (field)	---	NA	NA	NA	NA
TSS (mg/L)	---	43.2	74.6	108	13
Oil and Grease (mg/L)	---	12.6	7.9	51.6	9.4
Nitrate-Nitrite (mg/L)	---	ND	ND	0.014	ND
Ammonia Nitrogen (mg/L)	---	7.31	10.8	12.2	6.93
Sulphate (mg/L)	---	6.84	12.5	2.58	7.4
Total Hardness (mg/L)	---	136	162	120	135
Total Alkalinity (mg/L)	---	168	187	174	158
Total Phenols (mg/L)	---	0.0087	0.0098	0.00137	0.0085
TOC (mg/L)	---	35.4	39.4	76.7	21.3
Fecal Coliforms (CFU/100mL)	---	NA	NA	100000	12000
Aluminum (ug/L)	---	82	343	154	97.5
Antimony (ug/L)	0.5	NA	NA	NA	NA
Arsenic (ug/L)	12.5	1.37	3.89	0.83	1.13
Barium (ug/L)		3.85	3.85	3.85	3.85
Beryllium (ug/L)		NA	NA	NA	NA
Bismuth(ug/L)		NA	NA	NA	NA
Boron (ug/L)		NA	NA	NA	NA
Cadmium(ug/L)	12	0.0838	0.0715	0.102	0.0309
Calcium (ug/L)	---	43300	48100	37600	41000
Chromium (ug/L)	---	1.42	1.16	0.97	0.58
Cobalt (ug/L)		NA	NA	NA	NA
Copper (ug/L)	2	96.5	142	296	129
Iron (ug/L)	---	755	1960	865	1040
Lead (ug/L)	2	1.94	2.62	2.29	0.894
Lithium (ug/L)		NA	NA	NA	NA
Magnesium (ug/L)	---	6780	10100	6270	8010
Manganese (ug/L)		NA	NA	NA	NA
Mercury (ug/L)	0.16	0.0074	ND	ND	ND
Molybdenum (ug/L)		NA	NA	NA	NA
Nickle (ug/L)	8.3	4.75	9.26	2.24	3.45
Phosphorus (ug/L)		NA	NA	NA	NA
Potassium (ug/L)	---	6040	6980	6880	4830
Selenium (ug/L)		NA	NA	NA	NA
Silicon (ug/L)		NA	NA	NA	NA
Silver(ug/L)		0.039	0.042	0.217	0.033
Sodium (ug/L)	---	24400	36600	17800	27700
Stontonium (ug/L)		NA	NA	NA	NA
Sulfur (ug/L)		NA	NA	NA	NA
Thallium (ug/L)		NA	NA	NA	NA
Tin(ug/L)		NA	NA	NA	NA
Titanium (ug/L)		NA	NA	NA	NA
Uranium(ug/L)		NA	NA	NA	NA
Vanadium (ug/L)		NA	NA	NA	NA
Zinc(ug/L)	10	46.3	43.7	52.8	23.3
BOD5 (mg/L)	---	47.1	41.7	103	16.1
Chloride (mg/L)	---	28	36.6	22.1	34.7
Benzene (ug/L)	110	ND	ND	ND	ND
Ethylbenzene (ug/L)	25	ND	ND	ND	ND
Toluene (ug/L)	215	ND	ND	ND	ND
Xylenes (ug/L)	---	ND	ND	ND	ND
F1 (ug/L)	---	ND	ND	ND	ND
F2 (ug/L)	---	ND	ND	ND	ND
F3 (ug/L)	---	ND	ND	ND	ND
F4 (ug/L)	---	ND	ND	ND	ND
Acenaphthene (ug/L)	---	ND	ND	ND	ND
Acenaphthylene (ug/L)	---	ND	ND	ND	ND
Acridine (ug/L)	---	ND	ND	ND	ND
Benzo(a)anthracene (ug/L)	---	ND	ND	ND	ND
Benzo(o)pyrene (ug/L)	---	ND	ND	ND	ND
Benzo(b)fluoranthere (ug/L)	---	ND	ND	ND	ND
Benzo(g,h,i)perylene (ug/L)	---	ND	ND	ND	ND
Benzo(k)fluoranthere (ug/L)	---	ND	ND	ND	ND
Chrysene (ug/L)	---	ND	ND	ND	ND
Dibenzo(ah)anthracene (ug/L)	---	ND	ND	ND	ND
Fluoranthene (ug/L)	---	ND	ND	ND	ND
Fluorene (ug/L)	---	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene (ug/L)	---	ND	ND	ND	ND
1+2-Methylnapthalenes (ug/L)	---	ND	ND	ND	ND
1-Methylnapthalene (ug/L)	---	ND	ND	ND	ND
2-Methylnapthalene (ug/L)	---	ND	ND	ND	ND
Napthalene (ug/L)	1.4	ND	ND	ND	ND
Phenanthrene (ug/L)	---	ND	ND	ND	ND
Pyrene (ug/L)	---	ND	ND	ND	ND
Quinoline (ug/L)	---	ND	ND	ND	ND

- Oil and Grease parameters exceed the maximum allowable concentrations at ALT-2 and once for ALT-3 for Oil and Grease.
- TSS exceeded the Licence parameters of 70mg/L. DND is in the process of conducting background sampling program of other small tributaries away from DND activities to ascertain if the 70mg/L set criteria is achievable in natural tributaries in the Alert area. This action item is ongoing in order to collect a multiyear data set.
- Lead, Copper, Nickle and Zinc exceedances are likely attributable to atmospheric deposition. DND is in the process of conducting a multiyear background sampling program away from DND activities to link correlations in the summer of 2022-2026 DND has also obtained a third party consultant (Chemist) to report on these observed exceedances. A report will be provided to the NWB once finalized. A draft report of last years sampling is attached in Appendix K.
- The analytical certificates detailing the 2023 performance of the Alert Sewage Terrace System is included in this Appendix (B).
- Due to wet conditions in June only one sample was collected. Due to frequent safety concerns associated with wildlife interactions, limited samples were collected. DND is committed to demonstrating compliance to the NWB Licence.

Appendix C

Monitoring Program Stations No. ALT-4-5-6-7
Year: 2023
Description: Runoff and Leachate.

Results:

June (Runoff Season)
Analytical Results for ALT-4, 5,6 and 7 are summarized below and attached in Appendix E and Appendix F.
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Jun-23					
	Date Sampled	30-Jun	30-Jun	30-Jun	30-Jun
	Licence Specific Criteria	**Alt-5**	**Alt-6**	**Alt-7**	**Alt-4**
Benzene (ug/L)	370	NA	NA	NA	NA
Toluene (ug/L)	2	NA	NA	NA	NA
Ethylbenzene (ug/L)	90	NA	NA	NA	NA
Lead (ug/L)	1	0.334	2.77	0.404	2.48
Oil and Grease (mg/L)	15 (NVS)	ND	ND	ND	ND
Phenols (ug/L)	20	6.5	3.6	1.8	3.7
$BOD_{5\ (mg/L)}$	80	NA	NA	NA	NA
pH		7.99	7.92	7.94	8.04
TSS (mg/L)	70	4.3	22.1	185	96.3
Oil and Grease (mg/L)	5 (NVS)	ND	ND	ND	ND
	CCME Criteria (marine)	NA	NA	NA	NA
pH	7.0 to 8.7	7.99	7.92	7.94	8.04
Conductivity	---	197	116	186	178
Temperature (field)	---	NA	NA	NA	NA
TSS (mg/L)	---	4.3	22.1	185	96.3
Oil and Grease (mg/L)	---	ND	ND	ND	ND
Nitrate-Nitrite (mg/L)	---	ND	ND	0.297	0.874
Ammonia Nitrogen (mg/L)	---	ND	0.0055	0.0187	ND
Sulphate (mg/L)	---	28.4	13.8	20.1	9.05
Total Hardness (mg/L)	---	64.9	48.5	49.7	87.8
Total Alkalinity (mg/L)	---	75.7	56.7	49.6	65.2
Total Phenols (mg/L)	---	0.0065	0.0036	0.0018	0.0037
TOC (mg/L)	---	2.58	0.87	2.07	1.6
Fecal Coliforms (CFU/100mL)	---	NA	NA	NA	NA
Aluminum (ug/L)	---	303	885	180	1220
Antimony (ug/L)	0.5	NA	NA	NA	NA
Arsenic (ug/L)	12.5	0.67	2.57	0.27	2.76
Barium (ug/L)		NA	NA	NA	NA
Beryllium (ug/L)		NA	NA	NA	NA
Bismuth(ug/L)		NA	NA	NA	NA
Boron (ug/L)		NA	NA	NA	NA
Cadmium(ug/L)	12	0.0059	0.0145	0.0053	0.0204
Calcium (ug/L)	---	19500	15600	14800	25200
Chromium (ug/L)	---	0.68	1.86	ND	2.54
Cobalt (ug/L)		NA	NA	NA	NA
Copper (ug/L)	2	4.1	7.08	1.8	4.44
Iron (ug/L)	---	311	1640	276	2450
Lead (ug/L)	2	0.334	2.77	0.404	2.48
Lithium (ug/L)		NA	NA	NA	NA
Magnesium (ug/L)	---	3940	2310	3090	6050
Manganese (ug/L)		NA	NA	NA	NA
Mercury (ug/L)	0.16	ND	ND	ND	ND
Molybdenum (ug/L)		NA	NA	NA	NA
Nickle (ug/L)	8.3	1.53	5.49	0.79	5.43
Phosphorus (ug/L)		NA	NA	NA	NA
Potassium (ug/L)	---	3990	1650	994	1220
Selenium (ug/L)		NA	NA	NA	NA
Silicon (ug/L)		NA	NA	NA	NA
Silver(ug/L)		0.331	0.331	0.111	0.01
Sodium (ug/L)	---	9820	4260	8750	5920
Stontonium (ug/L)		NA	NA	NA	NA
Sulfur (ug/L)		NA	NA	NA	NA
Thallium (ug/L)		NA	NA	NA	NA
Tin(ug/L)		NA	NA	NA	NA
Titanium (ug/L)		NA	NA	NA	NA
Uranium(ug/L)		NA	NA	NA	NA
Vanadium (ug/L)		NA	NA	NA	NA
Zinc(ug/L)	10	ND	8.2	ND	9.2
BOD5 (mg/L)	---	NA	NA	NA	NA
Chloride (mg/L)	---	10.7	1.66	21	14.7
Benzene (ug/L)	110	NA	NA	NA	NA
Ethylbenzene (ug/L)	25	NA	NA	NA	NA
Toluene (ug/L)	215	NA	NA	NA	NA
Xylenes (ug/L)	---	NA	NA	NA	NA
F1 (ug/L)	---	NA	NA	NA	NA
F2 (ug/L)	---	NA	NA	NA	NA
F3 (ug/L)	---	NA	NA	NA	NA
F4 (ug/L)	---	NA	NA	NA	NA
Acenaphthene (ug/L)	---	NA	NA	NA	NA
Acenaphthylene (ug/L)	---	NA	NA	NA	NA
Acridine (ug/L)	---	NA	NA	NA	NA
Benzo(a)anthracene (ug/L)	---	NA	NA	NA	NA
Benzo(o)pyrene (ug/L)	---	NA	NA	NA	NA
Benzo(b)fluoranthere (ug/L)	---	NA	NA	NA	NA
Benzo(g,h,i)perylene (ug/L)	---	NA	NA	NA	NA
Benzo(k)fluoranthere (ug/L)	---	NA	NA	NA	NA
Chrysene (ug/L)	---	NA	NA	NA	NA
Dibenzo(ah)anthracene (ug/L)	---	NA	NA	NA	NA
Fluoranthene (ug/L)	---	NA	NA	NA	NA
Fluorene (ug/L)	---	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene (ug/L)	---	NA	NA	NA	NA
1+2-Methylnapthalenes (ug/L)	---	NA	NA	NA	NA
1-Methylnapthalene (ug/L)	---	NA	NA	NA	NA
2-Methylnapthalene (ug/L)	---	NA	NA	NA	NA
Napthalene (ug/L)	1.4	NA	NA	NA	NA
Phenanthrene (ug/L)	---	NA	NA	NA	NA
Pyrene (ug/L)	---	NA	NA	NA	NA
Quinoline (ug/L)	---	NA	NA	NA	NA

- TSS exceeded the Licence parameters of 70mg/L at ALT-4 and 7.
- Lead, Copper, Nickle and Zinc exceedances are likely attributable to atmospheric deposition. DND is in the process of conducting a multiyear background sampling program away from DND activities to link correlations in the summer of 2022-2026 DND has also obtained a third party consultant (Chemist) to report on these observed exceedances. A report will be provided to the NWB once finalized. A draft report of last years sampling is attached in Appendix K.

July

The Department of National Defence was successful in collecting and analyzing samples at Monitoring Program Station ALT-4, 5 and 6, during the period of runoff in July 2023. Unfortunately, there was no water to sample at ALT- 7 for analytical results. Analytical Results for ALT-4, 5 and 6 are summarized below and attached in Appendix E and Appendix F.

Jul-23						
	Date Sampled		03-Jul		03-Jul	03-Jul
	Licence Specific Criteria		**Alt-4**		**Alt-5**	**Alt-6**
Benzene (ug/L)	370		NA		NA	NA
Toluene (ug/L)	2		NA		NA	NA
Ethylbenzene (ug/L)	90		NA		NA	NA
Lead (ug/L)	1		4.22		0.669	6.14
Oil and Grease (mg/L)	15 (NVS)		ND		ND	ND
Phenols (ug/L)	20		NA		NA	NA
$BOD_{5\ (mg/L)}$	80		NA		NA	NA
pH			8.06		7.53	8.39
TSS (mg/L)	70		121		47.5	276
Oil and Grease (mg/L)	5 (NVS)		ND		ND	ND
	CCME Criteria (marine)		NA		NA	NA
pH	7.0 to 8.7		8.06		7.53	8.39
Conductivity	---		172		1310	226
Temperature (field)	---		NA		NA	NA
TSS (mg/L)	---		121		47.5	276
Oil and Grease (mg/L)	---		ND		ND	ND
Nitrate-Nitrite (mg/L)	---		0.3		ND	0.104
Ammonia Nitrogen (mg/L)	---		ND		0.0476	ND
Sulphate (mg/L)	---		8.85		624	18.1
Total Hardness (mg/L)	---		92.6		496	60.8
Total Alkalinity (mg/L)	---		83.7		58.6	79.1
Total Phenols (mg/L)	---		0.0023		0.0016	0.0018
TOC (mg/L)	---		1.44		2.64	1.73
Fecal Coliforms (CFU/100mL)	---		NA		NA	NA
Aluminum (ug/L)	---		2220		165	4510
Antimony (ug/L)	0.5		NA		NA	NA
Arsenic (ug/L)	12.5		6.26		ND	6.98
Barium (ug/L)			NA		NA	NA
Beryllium (ug/L)			NA		NA	NA
Bismuth(ug/L)			NA		NA	NA
Boron (ug/L)			NA		NA	NA
Cadmium(ug/L)	12		0.0307		ND	0.0121
Calcium (ug/L)	---		27800		195000	10700
Chromium (ug/L)	---		4.68		ND	8.86
Cobalt (ug/L)			NA		NA	NA
Copper (ug/L)	2		7.6		ND	17.2
Iron (ug/L)	---		3900		274	8100
Lead (ug/L)	2		4.22		0.669	6.14
Lithium (ug/L)			NA		NA	NA
Magnesium (ug/L)	---		5620		2230	8290
Manganese (ug/L)			NA		NA	NA
Mercury (ug/L)	0.16		0.0061		0.0095	0.0132
Molybdenum (ug/L)			NA		NA	NA
Nickle (ug/L)	8.3		10.2		ND	18.8
Phosphorus (ug/L)			NA		NA	NA
Potassium (ug/L)	---		2000		97200	6900
Selenium (ug/L)			NA		NA	NA
Silicon (ug/L)			NA		NA	NA
Silver(ug/L)			0.02		ND	0.733
Sodium (ug/L)	---		5420		4430	24800
Stontonium (ug/L)			NA		NA	NA
Sulfur (ug/L)			NA		NA	NA
Thallium (ug/L)			NA		NA	NA
Tin(ug/L)			NA		NA	NA
Titanium (ug/L)			NA		NA	NA
Uranium(ug/L)			NA		NA	NA
Vanadium (ug/L)			NA		NA	NA
Zinc(ug/L)	10		19.7		ND	21.6
BOD5 (mg/L)	---		NA		NA	NA
Chloride (mg/L)	---		8.66		10.4	19.4
Benzene (ug/L)	110		ND		ND	ND
Ethylbenzene (ug/L)	25		ND		ND	ND
Toluene (ug/L)	215		ND		ND	ND
Xylenes (ug/L)	---		ND		ND	ND
F1 (ug/L)	---		ND		ND	ND
F2 (ug/L)	---		ND		ND	ND
F3 (ug/L)	---		ND		ND	ND
F4 (ug/L)	---		ND		ND	ND
Acenaphthene (ug/L)	---		ND		ND	ND
Acenaphthylene (ug/L)	---		ND		ND	ND
Acridine (ug/L)	---		ND		ND	ND
Benzo(a)anthracene (ug/L)	---		ND		ND	ND
Benzo(o)pyrene (ug/L)	---		ND		ND	ND
Benzo(b)fluoranthere (ug/L)	---		ND		ND	ND
Benzo(g,h,i)perylene (ug/L)	---		ND		ND	ND
Benzo(k)fluoranthere (ug/L)	---		ND		ND	ND
Chrysene (ug/L)	---		ND		ND	ND
Dibenzo(ah)anthracene (ug/L)	---		ND		ND	ND
Fluoranthene (ug/L)	---		ND		ND	ND
Fluorene (ug/L)	---		ND		ND	ND
Indeno(1,2,3-cd)pyrene (ug/L)	---		ND		ND	ND
1+2-Methylnapthalenes (ug/L)	---		ND		ND	ND
1-Methylnapthalene (ug/L)	---		ND		ND	ND
2-Methylnapthalene (ug/L)	---		ND		ND	ND
Napthalene (ug/L)	1.4		ND		ND	ND
Phenanthrene (ug/L)	---		ND		ND	ND
Pyrene (ug/L)	---		ND		ND	ND
Quinoline (ug/L)	---		ND		ND	ND

- Lead and Copper exceedances are likely attributable to atmospheric deposition. DND is in the process of conducting a multiyear background sampling program away from DND activities to link correlations in the summer of 2022-2026. DND has also obtained a third party consultant (Chemist) to report on these observed exceedances. A report will be provided to the NWB once finalized. The report is expected to be finalized in 2025.

August

The Department of National Defence was not successful in collecting samples at Monitoring Program Station ALT-4, 5, 6 or 7, during the period of runoff in August 2023 as the sampling stations were frozen over and free from any standing or flowing water.

September

The Department of National Defence was not successful in collecting samples at Monitoring Program Station ALT-4, 5, 6 or 7, during the period of runoff in September 2023 as the sampling stations were frozen over and free from any standing or flowing water.

Appendix D

Monitoring Program Stations No. ALT-8-9-10-11

Year: 2023

Description: Discharge from Tank Farm Secondary Containments ALT-8-9-10 & Landfarm Facility ALT-10-11.

Results:

The Department of National Defence (DND) intended to discharge water from the Fuel Tank Farm Secondary Containments at ALT-8-9-10 in June 2023. At least 10 days notice was provided to the Inspector and Nunavut Water Board, the email chain is attached below.

Water samples from within the secondary containments of ALT-8-8.1-9 -10 were collected on 30 June 2023 and analyzed; analytical results are summarized below and attached in Appendix E.

Two samples were taken at ALT-8 (sample identifications: ALT-8 and ALT-8.1) to better represent the freshet quality due to the large size of the Secondary Containment facility.

ALT-8 had one exceedance of Lead. No water was discharged from this location.

In June 2023, analytical results (Appendix E) of the berm water results at the Lower Airfield Tank Farm (ALT- 8.1), Upper Tank Farm (ALT-9), and the Day Tank (Dry) (ALT-10) are compliant to the Effluent Quality Limits of the Alert Water Licence, as per Part E, Item 12 and 13.

DND had no intentions to discharge any water from Land Farm Treatment Facilities at ALT-11 and ALT-12.

Notes (extra spaces removed):

From: "Monteith, Joseph" <joseph.monteith@rcaanc-cirnac.gc.ca>
Date: 2023-07-07 8:16 a.m. (GMT-06:00)
To: "Tam A@CFB Trenton WENV@Trenton" <Andrew.Tam@forces.gc.ca>
Subject: RE: CFS Alert 8AC-ALT1929 - Discharge of Upper Tank Farm Secondary Containment Berm Water Notice - Request CIRNA Inspector's Approval

Good morning,

You may proceed with the decant.

Best Regards,

Joseph Monteith

Sent from my Bell Samsung device over Canada's largest network.

-------- Original message --------
From: Andrew.Tam@forces.gc.ca
Date: 2023-07-07 7:14 a.m. (GMT-06:00)
To: "Monteith, Joseph" <joseph.monteith@rcaanc-cirnac.gc.ca>
Cc: NATHAN.KOUTROULIDES@forces.gc.ca
Subject: CFS Alert 8AC-ALT1929 - Discharge of Upper Tank Farm Secondary Containment Berm Water Notice - Request CIRNA Inspector's Approval

Good morning Joseph,

Please find attached the analytical results for 8AC-ALT1929 ALT-9 Upper Tank Farm Secondary Containment.

The results from the lab have come back with below detections for all parameters. All cells were sampled, all water are compliant. As per the water license conditions, I (DND) am providing you with our 10 day notice of intent to dewater ALT-9.

To help hasten, may I (DND) please request CIRNA Inspector's approval to begin de-watering procedures to tundra, with appropriate sediment erosion mitigation measures, as soon as possible?

For context, this specific request is only for ALT-9 as DND has a military storage tank maintenance and cleaning crew on route to CFS Alert to perform summer operational work at this tank farm.

Please let me know if this is can supported?

Thank you,
Andrew

Andrew Tam, Ph.D.
DND 8 Wing Environmental Management Officer
Andrew.Tam@forces.gc.ca
Cell: 613-243-7532

Jun-23										
	Date Sampled	30-Jun	30-Jun	30-Jun	28-Jun	28-Jun	28-Jun	28-Jun	28-Jun	30-Jun
	Licence Specific Criteria	**Alt-8**	**Alt-8.1**	**Alt-9**	**Alt-9.1**	**Alt-9.2**	**Alt-9.3**	**Alt-9.5**	**Alt-9.5**	**Alt-10**
Benzene (ug/L)	370	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene (ug/L)	2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene (ug/L)	90	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead (ug/L)	1	1.53	0.212	0.201	0.158	0.174	0.168	0.208	0.419	0.501
Oil and Grease (mg/L)	15 (NVS)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenols (ug/L)	20	4.2	6.1	5.1	NA	NA	NA	NA	NA	2.6
$BOD_{5\ (mg/L)}$	80	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH		8.04	7.95	7.81	7.95	7.9	7.93	7.88	7.8	7.85
TSS (mg/L)	70	ND	ND	ND	ND	ND	ND	ND	3.4	ND
Oil and Grease (mg/L)	5 (NVS)	ND	ND	ND	ND	NA	NA	NA	NA	ND
	CCME Criteria (marine)	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	7.0 to 8.7	8.04	7.95	7.81	7.95	7.9	7.93	7.88	7.8	7.85
Conductivity	---	5.08	121	98.5	124	124	112	93.2	97.9	199
Temperature (field)	---	NA	NA	NA	NA	NA	NA	NA	NA	NA
TSS (mg/L)	---	ND	ND	ND	NA	NA	NA	NA	NA	ND
Oil and Grease (mg/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate-Nitrite (mg/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	0.424
Ammonia Nitrogen (mg/L)	---	0.0055	0.005	ND	ND	ND	ND	ND	0.0087	0.0058
Sulphate (mg/L)	---	5.37	NA	2.64	4.99	6.04	4.9	3.04	2.45	33.5
Total Hardness (mg/L)	---	63.8	51.4	39.2	46.7	46.2	41.8	35.8	38	54.8
Total Alkalinity (mg/L)	---	87.6	70	63.6	67.6	64.6	44.9	48.4	43.1	55.2
Total Phenols (mg/L)	---	0.0042	0.0061	0.0051	0.0012	0.0029	0.009	0.0019	0.0112	0.0026
TOC (mg/L)	---	2.07	1.43	1.18	1.47	1.65	1.26	1.02	0.71	0.79
Fecal Coliforms (CFU/100mL)	---	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (ug/L)	---	59	28	35.5	49.5	63.8	50.7	55.3	69.3	99.9
Antimony (ug/L)	0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic (ug/L)	12.5	2.22	2.39	1.38	3.85	2.63	1.99	1.73	1.46	5.05
Barium (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth(ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Boron (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium(ug/L)	12	0.0058	0.0059	0.019	ND	ND	ND	ND	ND	0.0062
Calcium (ug/L)	---	18200	15100	12700	13200	13600	12600	11000	12000	12500
Chromium (ug/L)	---	1.33	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper (ug/L)	2	2.74	2.67	1.42	2.5	2.45	1.74	2.02	1.28	1.28
Iron (ug/L)	---	74	32	53	52	67	62	62	95	157
Lead (ug/L)	2	1.53	0.212	0.201	0.158	0.174	0.168	0.208	0.419	0.501
Lithium (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium (ug/L)	---	4470	3320	1830	3340	2980	2500	2020	1950	5730
Manganese (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury (ug/L)	0.16	ND	ND	ND	ND	ND	ND	ND	ND	ND
Molybdenum (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickle (ug/L)	8.3	1.74	1.47	0.85	1.15	1.11	0.88	0.87	1.27	2.14
Phosphorus (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium (ug/L)	---	2260	1460	711	1800	1450	1060	774	703	3340
Selenium (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Silicon (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver(ug/L)		ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium (ug/L)	---	5800	2520	3240	3460	3240	3370	2520	2220	14700
Stontonium (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Tin(ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Titanium (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium(ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium (ug/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc(ug/L)	10	4.7	3	5.3	ND	3	3.3	ND	4.9	ND
BOD5 (mg/L)	---	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride (mg/L)	---	5.08	4.24	4.68	2.9	3.21	2.56	2.29	3.36	13.3
Benzene (ug/L)	110	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene (ug/L)	25	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene (ug/L)	215	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
F1 (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
F2 (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
F3 (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
F4 (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acridine (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(o)pyrene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthere (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthere (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzo(ah)anthracene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
1+2-Methylnapthalenes (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Methylnapthalene (ug/L)	---	ND	ND	ND	ND	0.031	ND	ND	ND	ND
2-Methylnapthalene (ug/L)	---	ND	ND	ND	ND	0.015	ND	ND	ND	ND
Napthalene (ug/L)	1.4	ND	ND	ND	ND	0.016	ND	ND	ND	ND
Phenanthrene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND
Quinoline (ug/L)	---	ND	ND	ND	ND	ND	ND	ND	ND	ND

Appendix E

Analytical Results for ALT-2-3-4-5-6-7-8-9-10-11-12
Year: 2023

Description: Analytical Results for June/July 2023 attached as separate PDF.

Appendix F

Analytical Results for ALT-2-3-4-5-6-7-8-9-10-11-12
Year: 2023

Description: Analytical Results for August/September 2023 attached as separate PDF.

Appendix G

List of Waste Disposal Activities
Year: 2023
Reference: 8AC-ALT1929

Monthly Waste Incineration at CFS Alert - 8AC-ALT1929					
Year *[yr]*	**Month** *[mo]*	**Incineraion Days per Month** *[day]*	**Solid waste Incinerated (Millionaire's Dump)** *[lbs]*	**Liquid Waste Incinerated** *[Liters]*	**Loose Waste Incinerated (Main Station Landfill)** *[lbs]*
2023	JAN	7	**400**	210	3200
2023	FEB	3	**0**	30	1800
2023	MAR	3	**600**	3	1600
2023	APR	13	**800**	0	9800
2023	MAY	8	**0**	40	12000
2023	JUN	6	**0**	0	8000
2023	JUL	7	**0**	0	10500
2023	AUG	17	**0**	700	11250
2023	SEP	13	**1500**	180	18000
2023	OCT	10	**4500**	120	10500
2023	NOV	9	**0**	0	13500
2023	DEC	12	**1200**	560	13500
Annual Average [lbs/L/mo]:			**750**	154	9471
Observed Minimum [Lbs/L/mo]:			0	0	1600
Observed Maximum [Lbs/L/mo]:			***4500***	700	18000

Main Station Landfill:
-Deposition of non-hazardous incinerator ash and all acceptable materials to site.

Millionaire's Dump:
-In 2018 the Millionaire's dump was closed to disposal of all station waste. No material was placed in the dump in 2023

Battery Dump:
-No wastes were deposited at this site; no waste deposition is allowed at this site. The battery dump was successfully recapped in September 2022.

Dump #3:
-No wastes were deposited at this site; no waste deposition is allowed at this site.

Landfarms:

ALT-11 Landfarm
- ALT-11 (Airfield Land farm) is currently at capacity. No new material was added to this location in 2023.

ALT 12 (Day tank)
- ALT -12 (Day Tank Land Farm)is currently at capacity. The land farm was then treated and turned in fall 2023. Future sampling will be conducted and monitored as the remediation process continues.

The Temporary Land Farm planned to be constructed in 2023 was not completed. The construction of the new Land Farm will be completed in 2024.

Hazardous Waste Backhauled from CFS Alert in 2023:

CFS Alert Hazardous Waste Generator #NUG100048;
DND Hazardous Waste Carrier #NUC200012.

The only Hazardous waste reportedly backhauled was 8 drums of phosphoric acid solution and 8 drums of glycol/water mix.

All hazardous wastes from CFS Alert were collected at 8 Wing Trenton and transferred to contractors for proper disposal under 8 Wing Trenton's Ontario Hazardous Waste Generator #ON0046507.

Appendix F

Progressive and Final Reclamation Work Undertaken
Year: 2023
Reference: 8AC-ALT1929, Part B, Item 1.

Progressive Reclamation Work Undertaken in 2023:

A. Contaminated Sites In-Situ Bioremediation Work:
Continuation of the pilot scale in-situ bioremediation study for petroleum hydrocarbon biodegradation at the following sites:
1) Oxidator Building;
2) Baker's Dozen.
Develop long term monitoring program for PHC contamination in key areas.
These locations were monitored in 2023, however no sampling or work was completed in these areas.

B. Reclaim of Soils in the Landfarm (ALT-11) Treatment Facility:
Regular monitoring of the downgrade area adjacent to the large biopile area will be performed to ensure no PHC contamination is moving from biopile area or from contaminated areas upgradient and to the west of the large biopile area.

C. Rotation of Soils in the Landfarm (ALT-11) Treatment Facilities:
Continuation of the microbial nutrient augmentation and aeration process to increase oxygen content in the contaminated soil to promote microbial and bacterial activity within the landfarm facilities. This was conducted at the ALT-11 Landfarms.

D. Rotation of Soils in the Landfarm (ALT-12) Treatment Facilities:
Continuation of the microbial nutrient augmentation and aeration process to increase oxygen content in the contaminated soil to promote microbial and bacterial activity within the landfarm facilities. This was conducted at the ALT-12 Landfarms

Future works proposed for 2024:

A. Contaminated Sites In-Situ Bioremediation Work:
Continuation of the pilot scale in-situ bioremediation study for petroleum hydrocarbon biodegradation at the following sites:
1) Oxidator Building;
2) Baker's Dozen.
Develop long term monitoring program for PHC contamination in key areas.

B. Rotation of Soils in the Landfarm (ALT-11) Treatment Facilities:

Continuation of the microbial nutrient augmentation and aeration process to increase oxygen content in the contaminated soil to promote microbial and bacterial activity within the landfarm facilities. This will be conducted at the ALT-11 Landfarms.

C. Rotation of Soils in the Landfarm (ALT-12) Treatment Facilities:
Continuation of the microbial nutrient augmentation and aeration process to increase oxygen content in the contaminated soil to promote microbial and bacterial activity within the landfarm facilities. This will be conducted at the ALT-12 Landfarms

D. In-Situ Bio-Containment Pilot Research Study:
As indicated with the INAC Inspectors during the 2018 Inspections, DND is taking a proactive approach, developing novel bio-containment barriers, to treat runoff and subsurface waters generated and passing through the boundaries of Federal Contaminated Sites. This activity will be conducted, and the effectiveness assessed, through a pilot research project with the National Research Council of Canada. The general purpose of these bio-containment barriers is to develop a microbial technology solution for bioremediation of runoff and subsurface waters that pass through and/or are generated from contaminated sites prior to reaching the Arctic Ocean. This work has applicability for the entire Canadian Arctic environment.

E. Environmental Sampling for Per- and polyfluoroalkyl substances (PFC) Delineation
Further conduct environmental sampling and screening for PFCs as well as to evaluate the potential of biodegradation of PFC as a remediation approach.

E. Phase 2 Environmental Site Assessment (ESA)/ Detailed Risk Assessment
DND has procured a firm/consultant to conduct a Phase 2 ESA/ detailed risk assessment in 2020. Due to COVID related constraints the consultants first time to site was in 2023. They conducted sampling in areas identified in their Phase 1 ESA. This program is expected to continue for the next few years. Once the detailed report is completed, the report will be distributed to the Board for review.

F. Landfill Reclamation Plan
DND has procured a firm to conduct a Landfill Reclamation plan. Current submission schedule is planned for 2024. Once the detailed report is completed, the report will be distributed to the Board for review.

Appendix H

Proposed/ future Infrastructure Works
Year: 2023
Reference: 8AC-ALT1929 Schedule B item l.

Future works proposed for 2024:

A. Sewage Discharge Flow Monitoring:
Installation of a flow monitor on the discharge point of ALT-2 will be installed in the summer of 2023 as was previously planned for 2020 but delayed due to COVID and engineering issues with current piping system and the gage. Results will be published in the 2023 Annual report or when requested.

B. Temporary Contaminated Soil Storage
DND proposed and was approved to construct a 1,000m3 capacity contaminated soils storage facility, this would allow existing contaminated soil piles that are not currently contained to be placed in a safe storage space, until the new large storage space is construct North East (NE) of the Alert's Runway. The overall footprint is 33m x 43m x 1.75m in height and located 200m West by North West (WNW) of the "Millionaire's Dump" (ALT-6).

D. Construct new waterline planned 2024/25.
During the winter of 2020/2021 the current water lines from Dumbell Bay to the Alert water treatment facility froze solid and broke the waterlines in 26 places along the 2km stretch of line. This summer, construction of a new waterline is expected to take place to replace the existing waterline and provide upgraded safeguards to ensure freeze protection going forward.

Appendix I

Detailed Spill Report
Year: 2023

8 Wing Environmental Management
Canadian Forces Base Trenton
74 Polaris Avenue, Room 305
PO Box 1000 Stn Main
Astra ON K0K 3W0

09 May 2023

Water Resources Officer, CIRNA
Field Operations Unit
Nunavut Regional Office
P.O. Box 100
Iqaluit, NU X0A 0H0

DETAILED REPORT: GLYCOL SPILL, 29 March 2023

INTRODUCTION

1. This report is a follow-up to the initial spill report issued to NT-NU Spill report line on 29 March, 2023. The original Glycol release was discovered on 29 March 2023 and was repaired on 29 March 2023. The site is located in Building 17 (Transport Garage), Canadian Forces Station (CFS) Alert. This spill was a result of a line break on a de-icing truck. The initial release was reported as 1500 Litres. Total loss of Glycol was 1000 Litres.

2. This spill is being reported as required under the conditions in Part H, Section 3.C of CFS Alert's Nunavut Water Board (NWB) Licence 8AC-ALT1929 pursuant to the Nunavut Waters and Nunavut Surface Rights Tribunal Act.

3. This spill is being reported as required under the Canadian Environmental Protection Act, Part 9 section 212(1).

4. This spill is being reported under the Environmental Protection Act paragraph 5.1(a). The spill was reported to the Northwest Territories/Nunavut (NT/NU) 24-Hour Spill Report Line on 29 March, 2023. The spill report reference number is 2023-122.

DETAILS

1. Time, date, and location of the spill occurrence.

   a. The spill was discovered at 08:16 EST on 29 March 2023. The spill location is located at 82°N 29’ 53” and 62°W 21’ 11”.

2. Amount and type of spilled product.

   a. 1000 Litres of ETHYLENE GLYCOL MONOETHYL ETHER was released to the ground below building 17 (Transport Garage).

3. Root cause(s) of the spill.

   a. A break/split line on the de-icing truck discharge line was the root cause of the spill.

4. Measures taken to contain and clean up the spill site.

   a. Team all assisted in the initial step of absorbing and plugging the floor drains in the transport building. It is estimated they were able to absorb/ stop approximately 500 Litres of the 1500 Litres split from draining to ground under the building. That Material was placed in over packs and cleaning up of spill area. The leak was controlled and initial remediation was completed on 29 March 2023, at 09:00.

   b. The floor drains lead into the environment, accumulation beneath the building, and then likely to melt-out during the spring melt (late June). Unfortunately, there is no access underneath or around the operational building and concrete slab foundation.

   c. DND/Nasittuq will need to monitor the downgradient external site(s) for spill impact (seepage) this spring melt.

   d. The leak was monitored daily for additional loses

   e. The repair to the truck corrected the leak.

5. Recurrence prevention.

   a. This spill occurrence was due to a physical breakdown of the truck pipe that could not have been foreseen.

6. Summary.

a. This is a detailed spill report issued to CIRNA on 29 March 2023. This letter indicates that the indoor floor spill was cleaned up and the leaking truck (source) repaired.

b. A release of 1500 Litres of Glycol was discovered on 29 March 2023 inside building 17 Transport at Alert. The source of the leak on the truck was repaired on 29 March 2023.

b. The spill was reported to the NT-NU 24-Hour Spill Report Line (NT-NU Report number 2023-122) on 29 March 2023, by 8 Wing Environmental Management.

c. This Glycol spill was a result of a truck pipe break. The repair was completed on 29 March 2023 and has since been pressure tested and returned to service.

Report compiled by:

//Nathan//

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8 Wing Trenton
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Appendix J

CFS Alert Wastewater Treatment Options Analysis.
Attached as a separate PDF Document.

CFS Alert:

Wastewater Treatment Option Analysis Report

Final Options Analysis Report

Client Reference:

N.200111.20.02 - TRS20010 HAR-Build-Sewage Treatment Plt-ALE-C039

Prepared for:

CFS Alert

Prepared by:

Nunami Stantec Limited

January 19, 2024

Project No.: 144903393

NUNAMI
STANTEC LIMITED

Limitations and Sign-off

The conclusions in the Report titled CFS Alert Wastewater Treatment Options Analysis are Nunami Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Nunami Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Nunami Stantec has assumed all information received from DCC (the "Client"), CFS and third parties in the preparation of the Report to be correct. While Nunami Stantec has exercised a customary level of judgment or due diligence in the use of such information, Nunami Stantec assumes no responsibility for the consequences of any error or omission contained therein.

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1 Introduction

1.1 Background

The Canadian Forces Station (CFS) Alert is located on the North-Eastern tip of Ellesmere Island, Nunavut. This CFS hosts and maintains intelligence facilities in support of Department of National Defence (DND) operations.

Wastewater (WW) generated from bathrooms, kitchen, and workplace operations at CFS Alert is collected through heated and insulated high density polyethylene (HDPE) gravity pipelines. Following collection, the wastewater is discharged to an outfall on a terraced wetland treatment system. The current system does not have any primary or secondary treatment, which results in high levels of grease & oil being discharged into the marine system.

The terraced wetland is located on the eastside of the gymnasium and water treatment plant (WTP). The landscape has been altered by the placement of six berms to create a terraced area where wastewater is diverted in a zigzag fashion as it travels downslope to Parr Inlet of the Arctic Ocean. The berms were created from the local gravel/rock overburden and are intended to diminish the velocity of the wastewater as it is forced to travel a winding path between the berms. The purpose of this pattern is to enhance the settling of larger particles in the wastewater and also function as a mechanical sieve with a portion of wastewater permeating through the detention berms.

CFS Alert produces on average approximately 80 - 100 m^3 of wastewater per day that is directed to the terraced wetland for treatment. The existing CFS Alert terraced wetland system is situated in a permanent permafrost region and the system is frozen for approximately 9 months of the year, and sampling of the effluent is performed on monthly basis only from May to September inclusive. The hydraulic retention time (HRT) of the wetland is generally considered to be one of the more important aspects of treatment since it influences the settling of materials and contact time with microbial organisms. The slower the wastewater travels through the wetland the greater the potential for solids to settle and microbial degradation to occur.

Most of this frozen wastewater is typically released over a period of 4 to 6 weeks, resulting in an increased flow rate greater than the average wastewater generation of 80-100 m^3/day. This, in turn, results in flow rates that would be much faster than constant release. From the performance of the terrace wetland system from 2012 to 2015, it was noticed that none of the four compliance parameters (TSS, BOD, PH and FOG) met the license requirements. In 2016, the sample data indicated that the performance of the terrace wetland system met the license except the Oil and Grease. The samples collected in 2016 were collected in July with increased performance due to growth of microbial organisms.

Based on the description above, it is evidenced that the existing Terrace Wetland treatment process is not meeting the treatment standards stipulated in the current water license for CFS Alert. CFS Alert has shown interest in investigating alternative options to treat the wastewater to meet the license requirements.

1.2 Project Objectives

This report has been prepared to achieve the following objectives:

- Generate the flow projection for the proposed wastewater treatment facility.
- Summarize the raw wastewater characteristics.
- Review government regulation, and set up the design criteria.
- Complete Treatment options analysis and technology evaluations; and
- Conduct the opinion of probable cost estimates.

2 System Design Criteria

2.1 Wastewater Flow Projection

Population at CFS Alert can be highly variable, depending on the season and activities at the site. Generally, the station hosts 65-100 individuals all year-round, but the population could reach 200 people during the peak season. It is noted that the station can accommodate up to 500 people.

Based on the reference documents provided by CFS Alert, the following summary, assumptions, and conclusions will be carried to this treatment option analysis.

- In Document “Annex C-20171124-U-7635-1_ESU-GEOTECH-O_ALERT Sewage Treatment Initial Design” it stated that the annual water consumption at the station is approximately 29,199 m^3.
- As per the recent water summary report provided by CFS Alert, it is noticed that the Annual Water consumption in 2020 was 25,197 m^3, and it was 27,326 m^3 for 2021.
- As described in “RMC Green Team/DND Quality Management Program for Water and Wastewater Treatment Facilities, CFS Alert, Initial Site Visit Report”, the water treatment plant is operated in an average capacity of 80 m^3/day based on the WTP operation data from September 2016 to August 2017.
- Cooling water is required to cool electrical equipment at the facility that water is currently discharged into the wastewater collection system. There is an option that the colling water could be separated from the system and or reducing the cooling water usage, but right now there is no clear data on percentage of cooling water within the total wastewater discharge.
- Therefore, for this treatment process analysis, it is recommended to size treatment processes based on an annual water consumption of 30,000 m^3. Current water demands are 30,000 $m^{3,}$ which equals to 82 m^3/day. With ongoing efforts to optimize the cooling water system and discharge paths which could reduce the overall wastewater generated from the station, we recommend using 70% of the annual water consumption as wastewater generation, which will be 21,000 m^3 per year and in an average day of 57.4 m^3/day.
- It is a standard practice to design a wastewater treatment system to handle a maximum daily flow and it is typical to use a peak factor of 1.5 for the maximum daily flow to average daily flow. Therefore, the treatment system design capacity shall be 1.5 times of 57.4 m^3/day which is 86.1 m^3/day, round up to 90 m^3/day. Meanwhile, a treatment system shall consider a hydraulic capacity to handle peak hourly flow to avoid the system flushing and biological

treatment process upset. A peak factor of 4 is typically used to calculate the peak hour flow to average daily flow. Therefore, the treatment capacity of the plant shall be based on the following parameters:

- Treatment capacity: 90 m^3/day
- Hydraulic capacity: 229.6 m^3/day

2.2 Raw Wastewater Characteristics

The table below summarized the raw wastewater parameters based on the water quality data provided by CFS Alert.

Table 2-1 CFS Alert WWTP Influent Characteristics Summary

Wastewater Parameters	2012	2013	2014	2015	2016	Average	Peak
Biochemical Oxygen Demand (BOD5) mg/L	734	133	151	410	309	347	410
Carbonaceous Biochemical Oxygen Demand (cBOD5) mg/L	371	143	227	339	274	271	339
Total Suspended Solid (TSS) mg/L	337	114	183	297	269	240	297
Volatile Suspended Solid (VSS) mg/L	309	99	138	273	231	210	273
pH	7	7.2	7.8	7.8	7.7	7.5	7.8
Fat, Oil and Grease (FOG) mg/L	58	50	53	82	89	66	82
Chemical Oxygen Demand (COD) mg/L	479	248	358	833	630	510	630

Notes: Typically, an analysis will not consider the biggest and smallest number to calculate the average and peak date such as 734 mg/l and 133 mg/l will be deleted for BOD_5 analysis, the peak will be 410 mg/l to be carried onto design parameter.

The treatment process shall be designed based on the following parameters (peak date):

- BOD_5 410 mg/l
- TSS 297 mg/l
- PH 7.8
- FOG 82 mg/l

2.3 Treated Effluent Discharge Requirements

The wastewater collected from the CFS Alert station shall be treated through a wastewater treatment plant (WWTP) to meet the discharge requirements regulated by the license issued by Nunavut Water Board. As per "Nunavut Water Board Type "A" Water Licence No. 8 AC – ALT 1929" Part E, the following requirements will be considered during the treatment process selections:

- Maximum discharge rate: Effluent volume to be recorded.
- Discharge quality shall meet the following requirements:
    - BOD_5 < 80 mg/L
    - pH: Between 6 to 9
    - TSS < 70 mg/L
    - Oil and Grease < 5 mg/L and no visible sheen
- Direct all treated effluent from the WWTP to the Terrace Wetland Treatment area prior to discharge to Parr Inlet

3 Performance of Existing System

Based the data provided by CFS Alert, the following table summarized the system performance through the existing terrace wastewater treatment process during year of 2012 to 2016.

Table 3-1 CFS Alert WWTP Effluent Characteristics Summary

Parameter	2012	2013	2014	2015	2016	Required by NWB
BOD5 mg/L	111	39	76	401	13	80
cBOD5 mg/L	88	22	58	212	25	N/A
TSS mg/L	124	590	805	880	48	70
VSS mg/L	52	48	58	157	26	N/A
pH	7.5	7.5	7.8	8	8.4	6 to 9
FOG mg/L	37	14	23	130	9	5
COD mg/L	262	120	191	546	97	N/A

From 2012 to 2015, none of the four compliance parameters except PH met the license requirements. In 2016, the performance parameters were lower than other years, the major reason for it was because the sample was taken in July when the system started performing due to growth of microorganisms.

Therefore, the existing terrace wetland system stopped working during the wintertime which is from October to May, and it could not meet the monthly discharge requirements as per the license.

4 Treatment Options

As per the discussion with CFS Alert, three options will be investigated:

- Improved Terrace Wetland System
- Primary Treatment Followed by Existing Terrace Wetland
- Packaged Mechanical Plant

4.1 Terrace Wetland System

The hydraulic retention time (HRT) of the wetland is one of the more important aspects of treatment since it influences the settling of materials and contact time with microbial organisms. The slower the wastewater travels through the wetland the greater the potential for solids to settle and microbial degradation to occur. However, based on the performance of the existing terrace wetland treatment, the terrace sewage system is frozen for approximately 9 months of the year. Most of this frozen wastewater is typically released over a period of 4 to 6 weeks, resulting in an increased flow rate greater than the typical flow generated by the facility, resulting in flow rates that would be much faster than the normal rate at which wastewater is generated. In a result, the wetland will have a challenge to provide enough hydraulic retention time for TSS settlement and bacterial growing to consume BOD5 to meet the license requirements for final effluent.

The existing terrace treatment system would require major upgrades in order to meet the needs. The retention capabilities of terrace system are limited and any upgrades consisting of retention ponds/lagoons would create a wildlife hazard for the aerodrome due to becoming an attractant for avian species commonly found around wastewater retention ponds during thaw free times of year. The number one priority is to ensure the aerodrome is always safe. Also, given the remoteness of Alert and the shortness of the thaw free periods, and overcast conditions the treatment effectiveness of any retention ponds during the aerobic process is limited. The extreme cold temperatures and surrounding permafrost would have a major impact on the anerobic process during the winter that retention ponds rely on in locations further south. Given these factors there is not any certainty that any design improvements once constructed will ensure that governing treatment parameters will be met. Therefore, terrace wetland treatment process will not be investigated further during this study.

Given that existing terrace systems is currently the only treatment system available to the base, DND should continue to maintain the facility and repair any berms that have eroded or slumped over time and continue to do so until a new treatment option is available.

4.2 Primary Treatment Followed by Terrace Wetland

As per the performance from 2012 to 2016, the TSS, BOD5 and FOG were the problematic parameters to meet the license requirements. One option can be considered is to add a primary treatment process to remove TSS and FOG then discharge into the existing terrace wetland system.

This option may reduce the concentration of TSS and FOG concentration in the final effluent, but with an occupancy up to 500 people in the future, the high flow and BOD5 load to the terrace wetland treatment system will be questionable to meet the license requirements. Again, there is no certainty that any improvements to the existing terrace wetland system will have a positive impact on the

treatment capabilities and ensure the current and future governing parameters will be met. For long term strategy, a mechanical plant with a biological treatment process shall be considered, no further investigation will be carried for this study.

4.3 Packaged Mechanical Plant

Biological treatments rely on bacteria, nematodes, or other small organisms to break down organic wastes using normal cellular processes. Biological treatment is used worldwide because it is effective and more economical than many mechanical or chemical processes. An aerobic biological treatment method is the activated sludge process, which is widely used for the secondary treatment of both domestic and industrial wastewater. It is well suited for treating waste streams high in organic or biodegradable content and is often used to treat municipal sewage.

A mechanical plant with a heated building housing the activated sludge biological treatment process will be suitable for CFS Alert and its cold weather situation. In this study, the treatment technology evaluation will focus on three most popular treatment process: Membrane Bioreactor (MBR), Moving Bed Bioreactor (MBBR), and Sequencing Batch Reactor (SBR). These three options are considered as they are the most common treatment technologies for packaged plants of this size, they are able to meet the treated effluent quality criteria, are compact, and/ or are well established treatment processes in industry.

4.4 Option Evaluation

The following table provides of summary of the evaluation criteria needed to identify the most appropriate method of sewage treatment that will meet the required treatment standards.

	Treatment Options		
Evaluation Criteria	Improved Terrace Wetland System	Primary Treatment Followed by Existing Terrace Wetland	Packaged Mechanical Treatment Plant
Meets Existing Effluent Standards (Normal*)	X	X	√
Meets Existing Effluent Standards (Peak*)	X	X	√
Meets Existing Effluent Standards (Full*)	X	X	√
Capable of Meeting Future Effluent Standards	X	X	√
Capable of Dealing with Base Expansion Effectively	X	X	√
Does Not Attract Wildlife	X	X	√

*Note: Normal = Normal Operations (50 -100 personnel), Peak = Peak Operations (200 personnel), Full = Full Capacity (500 personnel)

At one time the best option to treat sewage at CFS Alert was the terrace system, especially given the cost of building and operating a mechanical treatment plant at such a northern remote location. Mechanical treatment technology has improved becoming more effective in smaller package plants and it has developed into one of the more viable options. An option that will meet the more stringent standards stipulated in today's water licenses. Standards that will arguably become more stringent over time.

5 Assessment of Building 168

5.1 General

The location of Building 168 (Bldg. 168) in close proximity of the sanitary sewer outfall pipes does make it an option to house any recommended mechanical treatment equipment. The primary issue with Bldg. 168 is that it was not originally designed for this specific application.

The building 168 was originally designed to be a heated warehouse and provide storage facilities for the base.

The concrete slab on grade is only 150mm thick with welded-wire mesh not rebar that would be consistent when designing a building to house mechanical processing equipment. The slab as designed cannot provide the support needed for an equalization tank or withstand the vibration created by the processing equipment. The perimeter walls for the building sit on 6” x 6” timber grade beams that are both doweled into the ground and the concrete slab. Suitable for the original purpose but not for a working wastewater treatment plant.

The dimensions of the building are 12.3 m (long) by 9.2 m (wide). Bldg. 168 is wide enough to house the installation of mechanical processing equipment, but it is not nearly long enough to house mechanical processing equipment. Any mechanical processing to operate effectively and efficiently must be designed to flow in a systematic manner by creating a train of processing equipment. Typical a length of 18 m to 20 m would be required. While on paper you can design a process that is more compact you have to allow for easy access to all the components of the treatment process for routine maintenance and repairs.

The base of the building only includes rigid insulation to prevent the degradation of the existing permafrost. Using the building for wastewater treatment will require additional heating to maintain a temperature so that the microorganisms in the processing equipment can thrive. To combat this additional mitigative measures would be required to ensure the permafrost remains intact and does not start to degrade and cause differential settlement of the slab and building.

Nunami Stantec did conducted a thorough review of the building drawings and has deemed it unsuitable for reuse as a wastewater treatment plant from a structural perspective. The design of this building would now be governed by the Nation Building Code of Canada 2020 and would be deemed a Post Disaster Facility. This involves very stringent design requirements and aspects which do not exist in the current structure. Nunami Stantec offers the following observations to support our assessment.

- There is an absence of structural sheathing on the building. The drawings note Metal Liners and Pre-finished Rib Roofing which are not considered to be structural shear walls or roof diaphragms. These elements are a finishing material and hold no calculated structural capacities. Nunami Stantec considered the building to be without structural shear walls or a roof diaphragm to resist wind or seismic loading. The same applies to vertical snow and dead loads as well as wind loading applied to the surface of these elements.

- Roof trusses are illustrated to be jointed at the mid-span of the building with no note of a ridge beam. Trusses are typically designed to span from Point A to B. If two jointed trusses are designed to span from Point A to B to C, Point B must be provided with a support member, typically a beam. As the building is built and based on the information that was provided remedial work would have to carried out by installing a beam at the mid-point and columns to support the beam.

- Although no detailed analysis was conducted under our current scope of options, Nunami Stantec does not believe it is appropriate to use 38x140mm wall studs spaced at 610mm o/c in the design of a Post Disaster facility given the plate height of 3660mm and the total lack of adequate shear walls. Note that said dimensions are soft conversions from the imperial drawings reviewed. No design loads are noted on the drawings, which is not typical.

- The floor slab is noted to have a compressive strength of 20 MPa. This floor slab should, at the very least, be classified with an Exposure Class of F1 which dictates a minimum compressive strength of 30 MPa. Further design and analysis could possibly push this classification in to a category of even higher design strength.

- The floor slab is essentially unreinforced as the drawings indicate only a Welded-Wire-Mesh as reinforcement. This type of reinforcement is only intended for light foot traffic or as a Temperature & Shrinkage reinforcement. In this scenario, the slab and reinforcement are not adequate to support the equipment weights found in a wastewater facility nor would they suffice to restrain said equipment from seismic forces. This combined with the low compressive strength of the concrete deems it inadequate for the intended future use.

- The use of 150x150 timbers as a strip footing is highly unacceptable. The amount of SLS and/or ULS bearing pressure on these timbers would very likely exceed the bearing resistance of the insultation layers below as well as the permafrost layer. Although the insulation layer is simply noted and “Rigid Insulation” it is likely HI-40 (or equivalent) while HI-100 or even higher would likely be required for such a minimal bearing width. Furthermore, on any building of any type, we are generally seeing minimum footing widths of 450 to 600mm.

Based on this assessment and observations Bldg. 168 is not a viable option for further consideration to house wastewater treatment equipment or be converted into a wastewater treatment plant. No features of the existing building can used for a WWTP, essentially to use this site the BLDG. 168 would have to be demolished and a new building constructed in its place.

5.2 Building Requirements

Given the nature and use of a building to house the essential services that the building will provide it must be designed specifically for the intended use.

Key to such a design is a proper foundation. A foundation that can provide a stable platform for the processing equipment as well eliminate the possibility of any settlement due to permafrost degradation.

For buildings of this nature to most appropriate design consideration for the foundations includes the following:

Adfreeze Piles

Adfreeze piles are steel pipe piles that are installed in permafrost by drilling an oversized hole, inserting the steel pile, and backfilling the ring and inside of the pile with a saturated granular backfill, which then freezes following installation to match the pre-existing ground conditions. The pile obtains its strength or bearing capacity from the bond between the steel pile and the frozen backfill and adjacent frozen ground. The permafrost is protected by extending the piles above the granular building pad and constructing the building above the pad with a continuous air space that is between the underside of the building and the pad. This allows the continuous circulation of ambient air beneath the building, which protects the permafrost from degradation. Adfreeze piles have been used in areas of permafrost for more than 50 years. Adfreeze piles can support loads in the range of 100 to 200 kN per pile.

Thermosyphons

Thermosyphons are a passive method to stabilize areas of thaw that are or can be affected infrastructure. Passive thermosyphons are simple devices consisting of vertical sealed pipes that are embedded in the permafrost. They contain pressurized two-phase gas moves through the sealed closed-loop system, they operate by the difference in temperature between the cold winter air and the warmer ground temperature. The thermosyphons will draw out the heat under a building a heat exchange mechanism thus preventing the permafrost form thawing. They require no external power supply. They have been used in NWT for over fifty years and are a common solution to prevent the degradation of the permafrost. The use of thermosyphons also allows foundations to be installed directly in or on the ground

Greenland Foundation

A Greenland Foundation consists of reinforced concrete footings combined with a concrete pier/column that provides a similar support as piles. The concrete footing is formed and poured directly on the permafrost, usually with insulation to reduce the required depth of burial, with the piers supporting grade beams and/or reinforced slabs, glulam beams, wooden beams above the permafrost that provides support to the structure while maintaining an airspace between the underside of the structure and the ground. This allows the circulation of ambient air and protects the permafrost form degrading. In some cases, the gravel pad below the structure may include insulation and/or air ventilation ducts to reduce the thermal impact in the underlying permafrost.

While all three types of foundations have had successful applications in the extreme north the Adfreeze piles have had the most success and have proven to stand up best over time from our experience. For the purpose of this report the Adfreeze piles will be recommended for use as the foundation for a new building or package plant.

Another important requirement for the building will be the insulation values of the walls and roof. Building heat loss will be a major factor in the costs of operating the facility once constructed. As well in the event of a power outage and issues with switching over to the redundant power supply the building must be able to retain heat so the microorganisms that form part of the sewage treatment process are not hurt or killed off. The recommend R values for the building will be R-40 for the walls and R-60 for the roof.

5.3 Civil Work

The intent of any design in a remote northern location is to reduce the number of moving parts essentially keeping any design or process as simple as possible in order to reduce the operations and maintenance requirements.

To service a mechanical treatment plant there are options as how the plant can be fed. One option would be to include the installation of a small sewage lift station that would receive the sewage generated by the base through the gravity sewers and then pump the sewage into the treatment plant. Most plant designs would include an equalization tank that would regulate the flow of sewage into the plant. A second option would be able to site and construct the plant at a location where it can be fed directly by the gravity sewers.

The topography in and around Bldg. 168 and the sewage outfall line provides the ideal circumstances that would allow for the siting and installation of the plant that can be fed by gravitational means.

The new location will require an extension of the road that currently provides access to Bldg. 168. The extension of the road would be approximately 60m in length and would be 7m wide. The plant would need a vehicle turnaround/parking area that would be 30m by 20m.

Currently the sewage outfall pipe was installed on the ground. In order to divert the flow to the new plant, an approximately 80m of existing wastewater pipe need to be installed with bypassing isolation valves.

6 Treatment Technology Evaluations and Selection

6.1 Common Considerations for all Treatment Options

6.1.1 Sludge Handling

The wasted activated sludge generated from the biological treatment process shall be collected for further treatment. For CFS Alert, sludge dewatering system shall be considered as there is no space for the sludge storage. The dewatered dry solid would be hauled to the landfill for disposal.

6.1.2 Equalization Tank

An equalization tank upstream of the treatment unit for MBR, MBBR, and SBR shall be considered for the package. This tank will provide a buffer for handling the variable flows expected at this site, preventing surges/washouts during peak flows, and providing consistent flow and loading to the biological process. This equalization tank can often be included in a vendor packaged design.

6.1.3 Influent Screening

It is recommended to install influent screens upstream of the treatment unit for MBR, MBBR, and SBR technologies. The screen prevents large solids and grit from entering the treatment process causing buildup or damage in the reactors. Screen sizing to be confirmed by vendors for the wastewater characteristics and treatment technology selected. The screenings will be dewatered and discharged into a waste bin; the dry screenings can be disposed to landfill.

6.2 Membrane Bioreactor (MBR)

6.2.1 Technology Description

Membrane Bioreactor (MBR) is based on an advanced activated sludge process that utilizes membranes for solids separation instead of secondary clarifiers. The membranes used in the process are either submerged or external to the bioreactor tanks. Submerged MBR systems utilizing either hollow fiber ultrafiltration or flat sheet membranes are more common in municipal wastewater applications. Submerged hollow fiber membranes can be considered due to their wider acceptance in the industry. In this configuration, the membranes are submerged inside separate membrane tanks and an applied vacuum produces an effluent (permeate resulting from membrane filtration process) allowing the solids in the biomass to be retained in the bioreactor. This concept is illustrated in Figure 6-1.

Use of membrane for solids separation allows the process to operate at high mixed liquor suspended solids (MLSS) concentration (8,000-12,000 mg/L) irrespective of sludge settling characteristics and provides superior effluent water quality. Operation at high MLSS also reduces the required bioreactor volume and use of membrane replaces the need for clarifiers thereby reducing the overall footprint of the plant. MBR plants require a higher air requirement compared to a conventional activated sludge process which includes meeting the oxygen demands (e.g., for BOD_5 removal and nitrification) as well for air scouring of the membrane surface (to prevent bacterial growth).

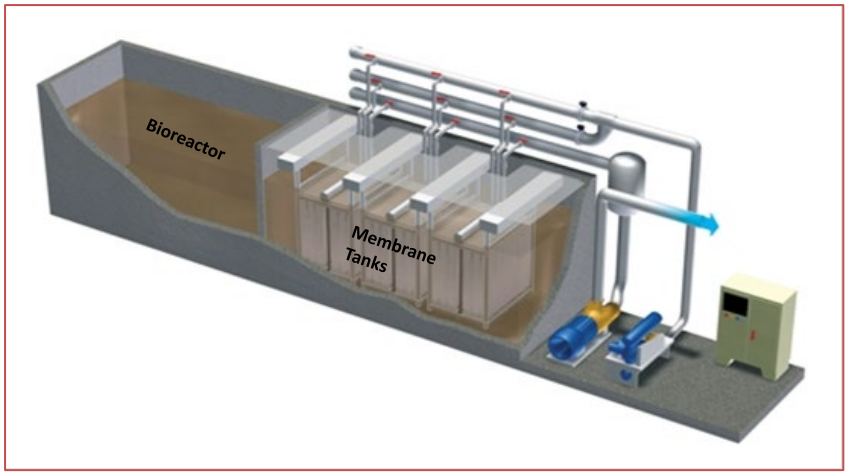


Figure 6-1 Example MBR Configuration

Although air scouring removes some of the solids which collect on the membrane surface, regular membrane cleaning is required to remove particles remaining on the membrane surface. Periodically throughout the day, (based either on high headloss across the membrane due to fouling or a timed cycle) the effluent from the MBR process or permeate stored in the tank is pumped backward through the membrane. This is known as “backpulsing”. This backward flow direction forces the attached particles from the membrane surface and back into the mixed liquor, causing a decrease in the headloss across the membrane. Backpulsing is an efficient way of removing easily reversible fouling. However, over time organic and inorganic particles adsorb to the membrane and cannot be removed by backpulse cleaning alone. As a result, typically twice a year, sodium hydroxide and citric acid solution are injected into the membrane tank via chemical dosing pumps. Backpulse frequency and duration, and chemical dosing requirements are determined by the manufacturer specific to the project. MBR membranes will have to be replaced at the end of their lifespan, typically around 10-12 years depending on vendor recommendations.

One of the limitations of the membrane process is the inability to adequately handle fluctuating flows and long sustained peak hourly flows, therefore an equalization tank is recommended upstream of the treatment unit to provide a buffer during low and peak flow periods. The installation of multiple treatment trains will provide the ability to run one train at a time for low flow periods, as well as providing process redundancy.

Fine screens are utilized upstream of the MBR unit to protect the membranes from solid debris in the wastewater stream. These screens are often available to be included in the vendor packaged treatment system.

6.2.2 Advantages and Disadvantages

The advantages and disadvantages of the MBR process are summarized in Table 6-1.

Table 6-1 Advantages and Disadvantages of Option 1: MBR System

Advantages	Disadvantages
• Smallest footprint and compact design. • High-quality effluent achievable, capable for producing low turbidity, bacteria, TSS, and BOD. • Performance not affected by solids settleability or bulking sludge	• High aeration requirements due to both oxygenation and membrane scouring. • Additional chemicals required to control membrane fouling, hence higher chemical consumption costs. • Requires screening upstream of reactor unit to protect the membranes. • Expensive and higher operator level requirement

6.3 Moving Bed Biofilm Reactor (MBBR)

6.3.1 Technology Description

MBBR is an attached growth process where the microorganisms grow/attach as a biofilm on floating synthetic media (see Figure 6-2). The floating media moves around the tank and is kept in suspension by a diffused aeration system in the aerobic zone of the process or by a mixing system for anoxic or anaerobic zones (if necessary). A sieve or media retention screen is typically used at the end of the MBBR tank to prevent the carrier media from escaping to the downstream clarification process. Excess bacteria slough off from the media are separated downstream using sedimentation tanks or dissolved air flotation tanks.

Since a higher concentration of biomass can be maintained on the surface of the media without having to increasing the mixed liquor concentration, MBBR plants are much more compact compared to suspended growth activated sludge plants. The MBBR process also allows retaining the nitrifying bacteria in the system more efficiently than the suspended growth activated sludge plants and can withstand the effect of load variations and temperatures.

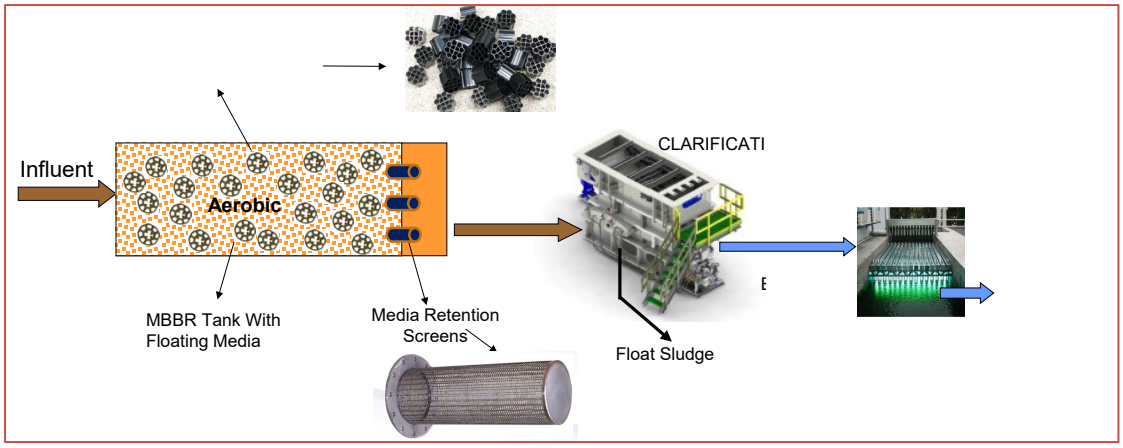


Figure 6-2 MBBR Process Schematic

The MBBR is a flow-through process with no return activated sludge (RAS). Also, several manufacturers offer a variety of plastic carrier media with a basic goal of offering a high surface area per unit volume. This allows the maximum available surface area on which the microorganisms can attach, grow, and proliferate, providing effective treatment. The tanks are partially filled with the media and percentage of fill is project specific but typically ranges from 30% ~ 60%.

Some media attrition is expected during the operation of MBBR processes, and it is common to have to replace a small amount of the carrier media on a regular basis due to breakdown or damage.

For clarification i.e., for solids-liquid separation downstream of the MBBR tanks, a Dissolved Air Flotation (DAF) system can be used to achieve high effluent quality, however this may not be required to meet the effluent BOD and TSS limits for this treatment application. The DAF system removes suspended solids, fats, oils, greases, and non-soluble organics by dissolving air into water under pressure whereby forming micro-air-bubbles which causes suspended materials to float to the surface of a vessel to achieve liquid/solids separation. An alternative option would be to utilize a simple disk filter to remove any solids that may fall off of the floating media, which would provide cost savings. The floating material (sludge) will be collected and stored for further treatment such as dewatering.

Upstream screens are recommended to protect the MBBR unit from large solids entering the reactor basin and damaging the media or aeration system or blocking the effluent media screens.

6.3.2 Advantages and Disadvantages

Several relative advantages and disadvantages of the MBBR system are provided in Table 6-2 below.

Table 6-2 Advantages and Disadvantages of Option 2: MBBR System

Advantages	Disadvantages
• Multiple available equipment suppliers in North America. • Media provides very large surface area for attached biomass growth within tank volume. • No requirement for return activated sludge pumping.	• Tank maintenance can be a challenge with plastic media. • Tank requires constant aeration to maintain movement of media. • Some attrition of media is expected, replacement media must be purchased. • DAF operation will require high level operator

6.4 Sequencing Batch Reactor (SBR)

6.4.1 Technology Description

A Sequencing Batch Reactor (SBR) is a fill-and-draw, non-steady state activated sludge type treatment system where the biological oxidation of organic matter, nitrification, other desired treatment objectives and clarification (solid/liquid separation) are carried out in the same tank, typically in a timed sequence. As such, the SBR process does not require any secondary clarifiers and in most cases operates without primary clarification. Also, the SBR process does not require any return activated sludge (RAS), or any internal mixed liquor recycle streams. In general, a typical treatment cycle consists of filling the bioreactor with wastewater (FILL), aeration and/or mixing of the bioreactor contents (i.e., mixed liquor or biomass) known as the REACT, followed by settling (SETTLE) of the biomass. Aeration is provided by fine bubble diffusers and blowers.

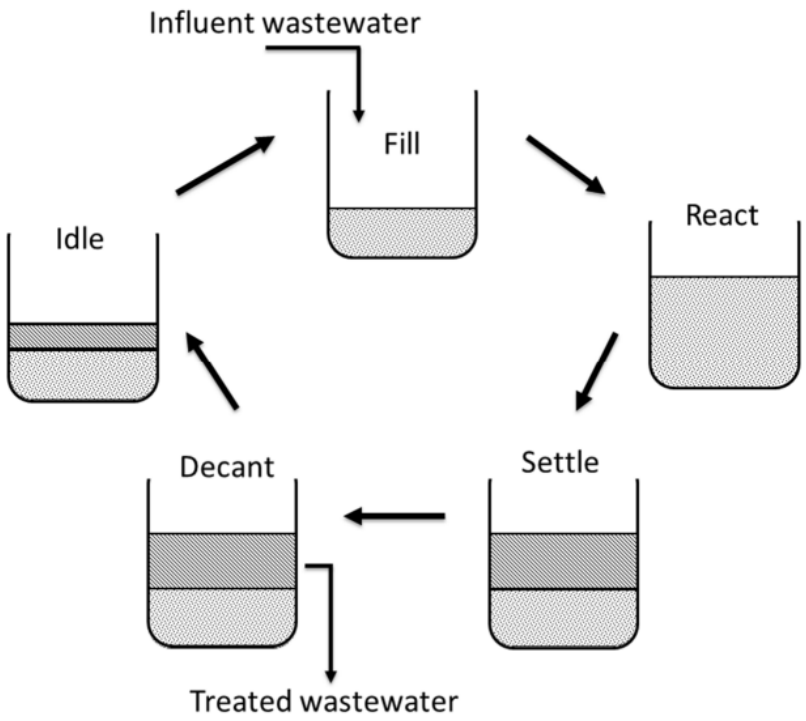


Figure 6-3 SBR Operation Cycle (Che Mid, E and Dua, V, 2018)

Treated effluent is then finally discharged via the decanter mechanism (DECANT). An IDLE stage may follow during which waste activated sludge is discharged and the SBR tank time sequence is adjusted prior to starting the cycle all over again. The activated sludge will be collected and dewatered for landfill disposal.

Several variations of the SBR are available which includes the following variations:

- Continuous inflow and intermittent decant.
- Intermittent or Batch inflow and intermittent decant (also referred to as the true batch system)
- Continuous inflow and continuous decant (also referred to as the modified SBR or MSBR)

Ammonia removal is achieved during the REACT phase and via control of appropriate solids residence time (SRT) in the system. While most SBRs can be designed to remove some phosphorus biologically (depends on the raw wastewater characteristics), chemicals can be dosed into the tank at end of the aeration cycle to precipitate phosphorus. The precipitation is wasted during the normal sludge wasting process. The chemical complex increases the solids concentration in the bioreactor and needs to be accounted in the design.

Upstream screens are recommended to protect the SBR unit from large debris. The screening will be dewatered for landfill disposal.

6.4.2 Advantages and Disadvantages

Several relative advantages and disadvantages of the SBR system are provided in Table 6-3 below.

Table 6-3 Advantages and Disadvantages of Option 3: SBR System

Advantages	Disadvantages
• Simple operation due to automated reactor sequencing. • All treatment steps are performed in a single tank and secondary clarifiers are not required. • There is no need for either internal or return sludge recycle stream. • Less system complicity and easy maintenance.	• Less available as a packaged vendor system. • Larger tankage required compared to MBR and MBBR systems.

6.5 Technology Selection

Based on the technology description mentioned above and considering the operation situation in Alert, a SBR packaged plant will be recommended due to its one tank operation, less complicity, simple operation with fully automatic reactor sequencing and lower capital cost typically.

7 Packaged Treatment Plant Sizing

7.1 System Description

Upon working with a popular vendor Napier-Reid on system sizing and budgetary price, the SBR treatment process will have the following process flow diagram:

Collection System → Screening → Equalization Tank → SBR → Ocean

Waste Sludge Dewatering → Landfill

Pre-treatment: The wastewater is piped into a screw screen sitting on top of an influent EQ tank, the screened water flows into the EQ tank by gravity. The screening will be dewatered and discharged in a waste bin and be disposed to landfill.

The wastewater in the EQ tank is continuously pumped to an SBR reactor for biological conversions. Treated water leaves the plant during decant period through the existing discharge pipe. The surplus sludge is pumped into a sludge holding tank, and from there, it goes to a screw press to dewater.

The waste sludge will go through sludge digestion process and will be dewatered by a screw press sitting on top of the sludge holding tank that is built next to the EQ tank. The dewatered sludge is at about 20% of dry solid for hauling out to landfill. The filtrate flows back to the influent EQ tank by gravity for further treatment.

All the tanks are covered and ventilated. The Screw Screen and the Screw Press will be in a 40 ft container sitting on top of the Influent EQ tank and the Sludge Digester (sludge digestion process). The vent gas from the SBR Reactor, the Influent EQ Tank & the Sludge Digester, and the container will be treated by Activated Carbon for odor removal.

7.2 Key System Components

7.2.1 SBR Process Design Data

Table 7-1 SBR Process Design Criteria

F/M ratio	0.45	kg BOD/kg MLVSS/d
SVI	120	ml/g
MLSS at TWL MLSS at BWL	2366 4051	mg/l mg/l
Waste sludge production	35	kg/d

Sludge Retention Time	3.2	days
Hydraulic Retention Time AVG/PEAK TSS of WAS to the sludge holding tank WAS flow to the sludge holding tank	13.5/5.4 8.5 4.4	hrs. g/l m3/d
Total normal cycle time	4	hr.
Feed & react time	2	hr.
Settle time	1	hr.
Decant time	1	hr.
Total peak flow cycle time	3	hr.
Feed & react time	1.5	hr.
Settle time	0.75	hr.
Decant time	0.75	hr.

7.2.2 System Sizing

Screw screen: One Tubular screen press, GCP/C 200, 3.1m (L) x0.41 m (W) x 2.27 m (H), a combined machine for screening aimed at separating the solid particles and compacting and dewatering the solids extracted.

Influent EQ Tank: One Influent EQ Tank, 6.50 m (L) x 3.25 m(W) x 3.00 m(H) made of 304SS.

SBR Tank: One SBR tank, 6.50 m (L) x 2.60 m (W) x 3.50 m(H) made of 304SS.

Sludge Holding Tank: One sludge holding tank plus digester, 5.70m (L) x 3.25 m (W) x 3.00 m (H) made of 304SS

Sludge Dewater: One Pre-thickening Screw press: 3.46 m (L) x 1.52 m (W) x 1.68m (H)

Odor Removal: Three Sets of order removal packages to treat the vent gas.

Blower Assemblies: Two SBR blower assemblies, one on duty and one for common standby for SBR and the sludge holding tank, each with an airflow of 5 m3/min at 5.85 psi. Blowers are mounted on individual steel bases with bolt holes for mounting on a concrete pad.

Control System:

- One Control panel, NEMA12, 120/1/60, providing monitoring and controls for all equipment in SBR reactors and chemical dosing systems. The panels will be 120/1/60, c/w PLC, and IO Modules, 21” IPC With HMI Software, UPS, selector.
- One NEMA-12 Power panel will be supplied for all motors of the system. The panels will be 575/3/60, c/w VFDs starters (blowers, pumps), etc. selector switches, and indicator on the door.

7.2.3 Pre-engineered Buildings

Two pre-engineered buildings will be specified for the packaged plant, the building will be located on top of concrete slab-on-grade foundations. The details of the building are listed below:

- Concrete foundations will be specifically sized for each building. Foundation sizing will account for floor loads, pre-engineered building reactions and column/bracing anchorage.
- Building one: Non-classified 4.6 m(L) x 6 m (W) x 5.6 m (H) per-engineered steel structure with moment resisting frames in the short direction and tension x-bracing in the other direction.
- Building two: Classified 5.0 m (L) x 6m (W) x 5.6 m (H) per-engineered steel structure with lateral systems as noted above.

8 Electrical Design

8.1 System Description

The WWTP will require a new service line from the base to the new proposed WWTP site. The client is requested to provide the existing peak/demand load of the generator and/or confirm the additional capacity of existing generators to accommodate the proposed additional loads (115kW) of the new WWTP facility below. If the existing generators do not have sufficient capacity to supply the additional proposed loads, then a dedicated generator to supply the facility loads will need to be provided.

The loading and sizing calculation will be completed during schematic and detailed design stages based on refined building area information and in accordance with estimated demands. 120/208V distribution panels will likely be located in the facility adjacent to the concentration of the loads being served. During further design, if coordination with process or mechanical teams determines larger electrical loads require 600 volts, a step-up/step-down transformer shall be considered (depending on available incoming service) to serve such loads with appropriate power.

The electrical loading and sizing are estimated based on preliminary building area in accordance with CEC suggested demand factors, and available information from mechanical and process design teams at this stage in the following table.

Table 8-1 Preliminary Electrical Load Estimates

120 m^2 Basic Building Load	3 kW
Process System	25 kW
Mechanical HVAC	80 kW
5% Other Misc. / Future Expansion	5.4 kW
Total Load (approx.)	**115 kW**

Currently, the calculations are based on 120/208V, 3-Φ service; if the information received from site results to be different, the design will be refined and updated accordingly.

Lighting and other smaller electrical loads will be predominantly fed from 120V supply as well as small miscellaneous mechanical equipment, and the rest of the heavier machines and process units will be fed from 208V, 3-Φ supply. All communication systems power will be fed from 120V.

A new system ground will be achieved by interconnecting artificial ground electrodes formed by copper clad ground rods or plates with continuous copper grounding conductor. All applicable pipes will be provided with proper bonding connections.

8.2 Standby Power Supply

The new facility has process systems intended for continuous operations; as such, a full backup power is required for critical loads as well as other basic building loads. CFS Alert is currently equipped with two diesel power plants Bldg. 145 Main Power Plant and Building 146 Standby Power Plant. Bldg. 145 is equipped with four (4) 950 kW Caterpillar prime generators, during peak loads (approximately 1,000 kW) only two of the generators are required. Bild. 146 contains two (2) 1.8MW Caterpillar prime generators. The main power plant has sufficient redundancy and can supply the

necessary power to operate the package WWTP. The combination of Building 145 and Building 146 allows for uninterrupted service. At this stage, it is assumed that the full load of the WWTP will be provided with the existing power plant(s). Therefore, a dedicated facility backup generator is not required.

8.3 Building Electrical Systems

8.3.1 Lighting and Lighting Control

The lighting systems shall be designed considering the light levels recommended by the Illuminating Engineering Society of North America (IESNA).

Fixtures will be chosen to suit an industrial operation and explosion proof devices throughout interior and exterior spaces. Vandal resistance will be considered. High efficiency LED luminaires will be specified throughout.

It is the design intent to provide lighting control by means of occupancy sensors for a majority of the interior spaces, with selected lights to function as night lights to illuminate the areas at all times.

8.3.2 Emergency Lighting / Exit Signage

The emergency lighting system will be accomplished by using battery packs and double remote heads with low voltage LED lamps. The battery packs and remote heads would be specified to suit the environment.

AC light emitting diode (LED) type exit lights which conform to CAN/CSA-C860 will be used to provide energy efficiency and to meet the proposed CSA/NBC standard. Exit lights will be self-powered style with integral emergency batteries to reduce DC wiring requirements.

The exit signs specified will meet the National Building Code requirement that exit signs consist of a green pictogram and a white or lighted tinted graphical symbol, commonly referred to as the “running man”.

8.3.3 Fire Alarm System

As the project progresses into detailed design stages, coordination with the client shall be conducted to determine the client’s needs and desires related to a fire alarm system for the new facility. During that time, further information regarding any existing fire alarm system shall be investigated.

9 Operational Costs

The two significant costs of operating the WWTP will be the heating of the facility and the electrical costs needed to operate the treatment plant.

The estimated costs to heat the building and heat the coils of the air handling unit based on $1.47* per litre of fuel will be $12,495 annual. This estimate was based on fuel consumption of approximately 8,500 liters year.

The electrical costs to operate the package WWTP based on the electrical needs of 250kWh per day and a fuel cost of $1.47* per liter are approximately $52,185 per year. This is based on a fuel consumption of approximately 35,500 litres annually to generate the needed electrical power to operate the facility.

It should be noted that these operational costs are Class D estimates and based on the limited information available at the time this report was written. The operating costs must be revisited during the detailed design stage as more specific information will becomes available.

The WWTP will require routine maintenance that should be able to be carried out by the Facility Maintenance Contractor for the base. To aid in the maintenance and operation of the facility it is suggested that DND enter into a service contract with the supplier of the package plant that can monitoring the daily performance and operation of the plant remotely. Connectivity may be an issue in terms of providing a communication link between the plant and supplier. The logistics of providing such a service should explored in greater depth during the detailed design stage should DND proceed in this direction. The typical cost of such a service contract can range from $25,000 to $50,000 annually.

*Note: Cost of fuel provide by DND October 2023

9.1 Transportation of Plant

CFS Alert is unique in terms of how the base is providing the necessary items needed to operate and expand including building materials. In the case any package plant will have to be designed to meet the mandated shipping requirements due to the constraints associated with shipping everything to Thule, Greenland or Iqaluit Nunavut via sealift and then making the final leg of the trip to CFS Alert via airlift form either Thule or Iqaluit.

During the detailed design stage extra attention must be given to ensure the components of the treatment plant, the assemblies (piping, controls, wiring, etc.) and pre-engineered building can be disassembled to fit the payload of the aircraft.

Major assemblies will have to meet the following dimensions 2.74m (height) by 3.04m (width) and cannot exceed 16.9m in length to ensure they fit into the payload of the C-130 Hercules aircraft. Lengths will vary depending on the ease and capabilities of handling the packages. During the detailed design stages the designers and manufacturers must take into account the capabilities of the ground crews to determine the final dimensions and weight of each package Other components will have to be properly fitted and packaged into crates. Fragile components that need protection from

exposure of the elements must be packaged appropriately knowing that these components could be exposed to the elements along various stages of journey including waiting on the docks In Montreal and during the transfer from the sealift to the aircraft in either Thule or Iqaluit.

10 Class D Cost Estimate

The following is a Nunami Stantec's opinion on the construction costs and is considered a Class D Construction Cost Estimate. The estimate is intended to provide a realistic, high-level, cost of construction, including direct and indirect costs. The detailed estimate is included in Appendix B of this report.

Table 10.1 Class D Construction Cost Estimate

Components	**Cost in CAD**
Mobilization and demobilization	$159,000
Civil Works & Building Foundation	$1,243,510
Mechanical Works & Commissioning	$205,251
Electrical Works & Commissioning	$152,143
Packaged WWTP	$ 3,881,700
Package Delivery	$199,480
CFS Alert Northern Remoteness Factor	$232,500
Subtotal	**$6,073,584**
General Requirements & Fee	$1,275,452.64
Net Construction Cost	**$7,349,036.64**
Engineering (15%)	$1,102,355.50
Contingency*	$2,560,349.24
Total	**$11,011,741.38**

*Note: Please see detailed construction cost estimate in Appendix B for a breakdown of the Contingency.

10.1 Conclusions and Recommendations

The Terraced Wetland System alone is not enough to treat the wastewater to meet the license requirements. This system must be combined with Oil and Grease separator that has capacity for further removal. This combination of treatment provides very little process control and reliability of achieving consistent effluent quality. The soil of the wetland field needs to meet certain standards which has not been confirmed for the intended location for this project. If the effluent quality regulations ever change, it may be very difficult to adjust the treatment system to meet more stringent effluent requirements without adding another technology, and significant additional cost.

From the evaluation, MBR process requires a higher operator level with high capital cost, SBR and MBBR technologies are both comparable in capital cost and complexity. Both technologies require upstream screening and would exceed the current treated effluent criteria while still maintaining a relatively small footprint and both MBBR and SBR technologies are well established in the wastewater treatment industry.

Between MBBR and SBR, we recommend a high-rate SBR for this treatment. We have approached a vendor and discussed the background and project challenges. Based on the design criteria we provided, both Nunami Stantec and the Vendor agreed that high-rate SBR could be a good fit for this project. Furthermore, the Vendor has done a few high-rate SBR projects on north, one of them is at Fort Simpson WWTP, where same F/M was used with satisfactory results, BOD and TSS being well below the discharge limits. We have also attached a reference letter.

It is known that heterotrophic bacteria are not sensitive to the temperature based on our experience. Besides, the vendor has set up BioWin simulations which have shown that both BOD and TSS are well below the designed effluent levels with the designed configurations of the SBR reactor. Regarding the peak flow interference, as an EQ tank with 4.5 hrs. HRT for peak flow has been included, its impact is minimized and will not affect the performance.

10.2 Suggested Course Of Action

It is clear that the most appropriate long-term solution for wastewater treatment at CFS Alert is the installation of a packaged WWTP.

The only issue facing DND in moving forward is budget and the schedule associated with completing the detailed design, tendering and construction of the facility. Budget approval may take up to 12 months, the detailed design including any necessary predesign field work would take 6 to 9 months to complete, tendering 4 months, manufacturing of the plant 6 to 9 months with shipping occurring the summer after manufacturing and construction and commissioning taking place the following summer.

This scheduled can be improved upon by separating the work into separate contracts and have the plant pre-purchased. This would also reduce the overall cost on a major component, the WWTP package plant that is estimated to cost $3,881,700. This way two tenders can go out at the same time, one for the supply, installation, and commissioning of the package plant and one for site preparation. While the plant is being manufactured the site can be prepared so that everything is ready for the plant that would be scheduled to arrive the following summer.

This schedule will still take 3 to 4 years to complete the construction of the WWTP. This also means the existing treatment system must be maintained and kept in good operating condition during this

period. Keeping the existing system can also provide some redundancy should the WWTP be required to be taken offline for repairs and/or maintenance.

The following is suggested course of action:

- Seek budget approval for project or revised existing budget amount to reflect current economic conditions and seek approval.
- Conduct site review of existing terrace system and future site of WWTP. Identify repairs needed for existing system.
- Complete necessary repairs to existing terrace system.
- Complete Detailed design of WWTP.
- Prepare tender packages.
- Advertise tenders (1 for site preparation and connection of sewage treatment plant, 1 for the supply, installation, and commissioning of WWTP).
- Award contracts and complete work.

Appendix A – Conceptual Site Layout

PARKING

C-SPAN61

C-SPAN60

PARKING

40

29

146

168

EXISTING DISCHARGE

PROPOSED BYPASS VALVE

PROPOSED INLET
TO EXISTING DISCHARGE

PROPOSED OUTLET
TO EXISTING DISCHARGE

PROPOSED WASTEWATER
TREATMENT PLANT (6m X 20m)

POPOSED ACCESS ROAD
AND TURNAROUND

30.0

20.0

68.6

7.0

N

0 10 30 50m

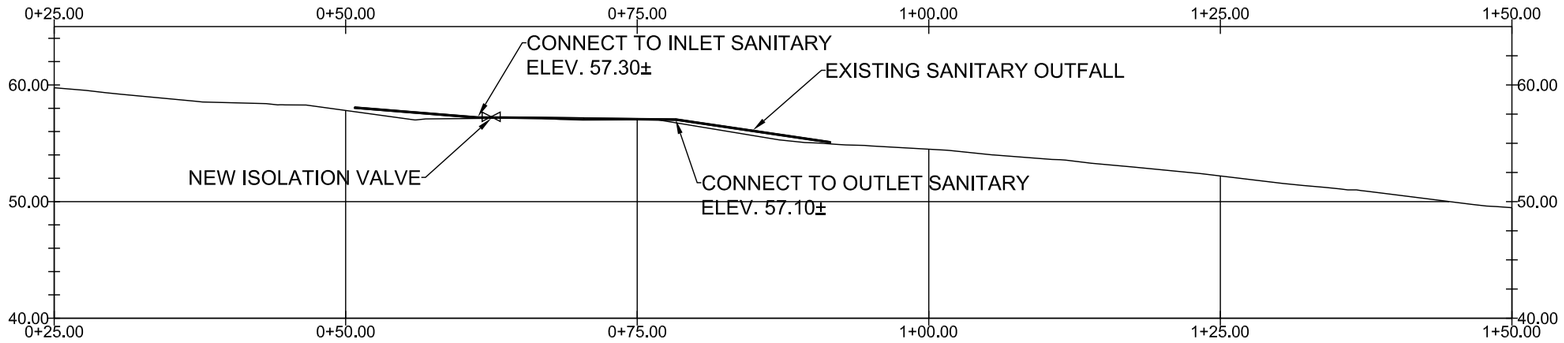
1:1000

NUNAMI

STANTEC LIMITED

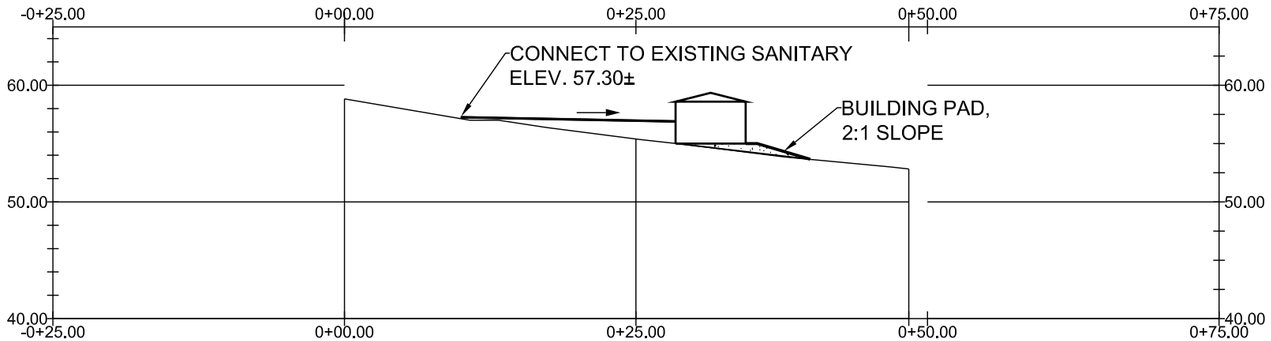
ALERT SITE PLAN
PROPOSED WASTEWATER TREATMENT PLANT

ALERT, NU



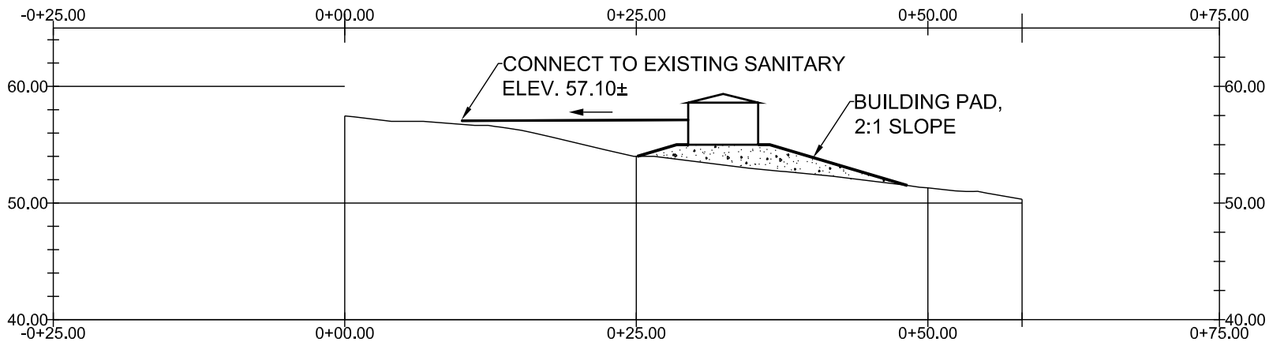
EXISTING OUTFALL PROFILE

N.T.S.



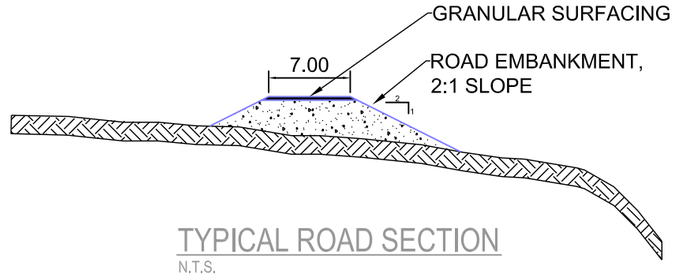
PROPOSED INLET PROFILE

N.T.S.



PROPOSED OUTLET PROFILE

N.T.S.



TYPICAL ROAD SECTION

N.T.S.

NUNAMI

STANTEC LIMITED

CROSS-SECTIONS
PROPOSED WASTEWATER TREATMENT PLANT

ALERT, NU

Appendix B – Class D Construction Cost Estimate

Stantec

Class D Estimate – Rev.0

CFS Alert Wastewater Treatment Option Analysis
Alert, Nunavut

October 12, 2023

Prepared for:

Defence Construction Canada

Prepared by:

Stantec Consulting Ltd.

Stantec Project No.: 1449 03393

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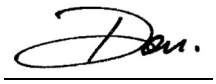
Signed: 

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APPENDICES

1.0 Basis of Estimate

1.1 Purpose

This Class D estimate for the Alert wastewater treatment options analysis project (the “Project”) is intended to provide a realistic, high-level, cost of construction, including direct and indirect costs.

1.2 Project Scope

The Canadian Forces Station (CFS) Alert is located on the North-Eastern tip of Ellesmere Island, Nunavut.

Wastewater is collected by a network of heated insulated high density polyethylene gravity pipelines that collect sewage and wastewater from the buildings onsite (i.e., bathroom, kitchen, workplace, etc.) and discharges to the outfall then to a terraced wetland system that is located to the east of the gymnasium and water treatment plant. The current system does not have any primary or secondary treatment, which leads to high grease & oil content being discharged into the marine system.

The existing terrace wetland treatment process is not suitable for CFS Alert. The purpose of this project is to investigate alternative options to treat the sanitary wastewater generated on site.

Due to the remote location of Alert, access is limited to military flights.

1.3 Methodology

The estimate is based on our assessment of the information provided, measured quantities where possible and competitive rates for the project type and geographical area.

The estimate represents the fair market value effective on the date estimated. The value is not representative of low bids and assumes competitive bidding for all works.

General requirements, indirects and fees may vary from the estimated value depending on procurement methodology, phasing and staging requirements, construction schedule and degree of self performed work by the General Contractor.

We have assumed procurement and delivery of materials and process equipment to occur in 2024 and construction to occur in 2025 with a schedule duration of 1.5 months without any personnel rotations.

The estimate was prepared using a nonstandard format for ease of quantity take-offs and grouping of work packages.

This estimate was completed at a Class D level. It is intended to provide a realistic opinion of probable construction costs (OPCC) for direct and indirect costs.

This Class D estimate is considered to have an expected degree of accuracy of -20% and +30%.

1.4 Unit Rates

All rates are based on fair wage labour. Work is assumed to be performed 10 hours/day, 7 days a week.

Labour and material rates include the components of subcontractor overheads and mark-ups.

All equipment and granular materials, except for small specialized tools, are assumed to be provided by the Client at no cost to the contractor.

1.5 Mark-Ups & Allowances

1.5.1 General Requirements

General requirements have been included. This includes the General Contractor's indirect costs such as overheads, bonding, insurance, supervision and miscellaneous items such as B25 kits. Temporary facilities, utilities, security, etc, is assumed to be provided by the Client at no cost.

1.5.2 Fee

A General Contractor fee in the amount of 10% has been included to the total of direct construction cost plus item1.5.1 above.

1.5.3 Engineering

Engineering in the amount of 15% has been included in the estimate value. This captures professional fees required to progress the design.

1.5.4 Design Contingency

Design contingency in the amount of 15% has been included in the estimate value for design unknowns. It is expected that as the specifications and design develops and becomes more detailed, additional items and costs may be added to the construction cost and this value will decrease

1.5.5 Escalation

Costs are based on 2023 Canadian dollars. Material procurement is anticipated to occur in 2024 including shipment to Alert. The majority of works are anticipated to occur in 2025.

Escalation is generally calculated using an adjusted escalation per year approach. The escalation allowance is meant to capture increases in construction costs due to changes in market conditions from the time of the estimate is prepared to the commencement of construction. For projects with a schedule greater than 12 months, the allowance is calculated using the midpoint of the construction.

We are currently assuming escalation at a rate of 4% per year on the components of labour, material and equipment. For this project, we anticipate construction occurring in 2025. We have calculated escalation at 4% per year for 2 years on the material, equipment and labour components scheduled to occur in 2025. This results in an escalation value of approximately 3% on the total estimate value.

This rate is based on historical references, however, there is no way to accurately predict future escalation or market conditions.

1.5.6 Construction Contingency

Construction contingency in the amount of 10% has been included in the estimate value for construction unknowns which could not be predicted, examples may include unforeseen ground conditions or various items listed in the exclusions.

1.5.7 Tax

Any applicable taxes have not been included in the estimate.

1.6 Significant Risks

There are numerous risk factors which could impact the cost of the project, those with the potential for the greatest impact based on our current knowledge of the project include:

Site Constraints – The project site is in the remote location of Alert, Nunavut. All materials, equipment and personnel must travel or be transported by military flights from either Trenton, Montreal or Thule, Greenland . There is a 10-day minimum turnaround time for flights to and from the site. Additional cost may be included by bidders for inefficiency and potential delay risk.

Schedule – We have assumed a total construction schedule of 1.5 months. Given the nature and location of the project, any delay due to inclement weather, equipment breakdowns, etc, will directly impact productivity and labour costs. It is difficult to predict the value bidders will include for this risk.

Bidder Turnout – Due to the nature of this project there may be fewer bidders which decreases the competitiveness of the procurement pool and can potentially have an impact on cost certainty.

1.7 Assumptions, Inclusions & Exclusions

The following are assumed, included or excluded in the estimate:

1.7.1 General

- Material procurement and delivery to be completed in 2024
- Material receiving and verification will be completed by DND
- Payment of purchased materials by the Client upon delivery by contractor
- All construction utilities and equipment including fuel, maintenance and repairs to be provided by the Client at no cost, small specialized tools to be provided by the Contractor
- All granular material to be provided by the Client at no cost
- All air transportation of contractor personnel, materials and equipment including loading and unloading to Alert and vice versa will be provided by the Client at no cost
- All accommodations and food in Alert will be provided by the Client at no cost
- Assume all concrete and slurry materials to be shipped to site in bags and mixed on site
- Assume steel liners and sand slurry for adfreeze piles

1.7.2 Exclusions

- Soft costs including legal, professional services, material testing, permitting and development charges/fees
- Financing costs
- Costs related to unforeseen ground conditions, underground obstructions or contaminants
- Environmental remediation including removal and disposal of contaminated materials and designated materials remediation or disposal (asbestos, PCBs, etc)
- Taxes
- Costs for unusual delays, schedule impacts, additional measures, resourcing or cost impacts related to equipment provided by others, inclement weather, unforeseen conditions or events

1.8 Statement of Probable Costs

This Opinion of Probable Construction Cost (OPCC) represent Stantec's best judgment as a design professional familiar with the Construction industry. Unless and to the extent otherwise indicated by Stantec, such opinions or evaluations are based on current market rates for labour, material and equipment. Stantec has no control over the costs of said labour, materials, or equipment, construction contractor's methods of determining bid prices, competitive bidding environments, unidentified field conditions, market conditions, inflationary or deflationary price cycles, unforeseen events or any other factors that may affect the OPCC, the project budget or negotiating conditions at the time of project execution. Client further acknowledges that the OPCC is a "snapshot" in time and that the reliability of the OPCC will degrade over time. Accordingly, Stantec does not warrant or represent that construction bids or negotiated prices will not vary from the Client's project budget or Stantec's OPCC. It is recommended that a minimum of four (4) bids be received to ensure competitive pricing.

This estimate does not constitute an offer to undertake any work.

1.9 Reference Documents

The following reference documents serve as the estimating basis:

Reference Documents	Date
CFS Alert Wastewater Treatment Option Analysis	October 2023

Appendix A

Class D Estimate Rev.0 – CFS Alert Wastewater Treatment Options Analysis

Stantec

	Class D Estimate	**Date:**	**October 12, 2023**	**Rev.0**
	CFS Alert Wastewater Treatment Options Analysis	**Estimated By:**	**MQ, DJ, NS**	
	Alert, Nunavut	**Checked By:**	**DC**	

Item No.	Description	Qty	Unit	Unit Material	Unit Equipment	Unit Labour	Total Material	Total Equipment	Total Labour	Total Cost
1.0	**Civil Works**									
1.1	Site Clearing & Preparing Sub-Grade	1,320	m2	-	-	24.00	-	-	31,680.00	31,680.00
1.2	Regrade Existing Sanitary Sewer Line Pipe	80	m	-	-	200.00	-	-	16,000.00	16,000.00
1.3	Load, Haul & Unload Granular Materials	3,280	m3	-	-	20.00	-	-	65,600.00	65,600.00
1.4	Grade & Compact Granular Materials	3,280	m3	-	-	13.00	-	-	42,640.00	42,640.00
1.5	Adfreeze Piles (Assume 15m x 200mm dia.)	32	ea	8,980.00	5,200.00	5,500.00	287,360.00	166,400.00	176,000.00	629,760.00
1.6	Grade Beams (300mm x 450mm x 6m reinforced)	8	ea	2,300.00	6,680.00	5,300.00	18,400.00	53,440.00	42,400.00	114,240.00
1.7	Concrete Slab (21m x 7m x 200mm reinforced)	1	ls	87,540.00	25,050.00	65,000.00	87,540.00	25,050.00	65,000.00	177,590.00
1.8	Pipe Lateral Support & Clamps	28	ea	1,800.00	750.00	1,200.00	50,400.00	21,000.00	33,600.00	105,000.00
1.9	Assembly & Installation of Pre-Engineered Building	1	ea	-	-	55,000.00	-	-	55,000.00	55,000.00
1.10	Regrading of Disturbed Areas	2,000	m2	-	-	3.00	-	-	6,000.00	6,000.00
									Sub-Total	**1,243,510.00**
2.0	**Mechanical Works**									
2.1	200mm HDPE Pipe complete with Insulation	15	m	886.00	-	231.00	13,290.00	-	3,465.00	16,755.00
2.2	50mm HDPE Pipe complete with Insulation	10	m	222.00	-	116.00	2,220.00	-	1,160.00	3,380.00
2.3	200mm HDPE 45 Elbow	8	ea	216.00	-	462.00	1,728.00	-	3,696.00	5,424.00
2.4	200mm HDPE Flange	8	ea	270.00	-	452.00	2,160.00	-	3,616.00	5,776.00
2.5	200mm HDPE Tee	8	ea	432.00	-	693.00	3,456.00	-	5,544.00	9,000.00
2.6	200mm HDPE Reducing Tee	1	ea	432.00	-	693.00	432.00	-	693.00	1,125.00
2.7	200mm HDPE Bypass Valve	3	ea	2,000.00	-	924.00	6,000.00	-	2,772.00	8,772.00
2.8	50mm HDPE 45 Elbow	4	ea	54.00	-	231.00	216.00	-	924.00	1,140.00
2.9	50mm HDPE Flange	2	ea	68.00	-	226.00	136.00	-	452.00	588.00
2.10	50mm HDPE Tee	1	ea	108.00	-	348.00	108.00	-	348.00	456.00
2.11	50mm HDPE Bypass Valve	1	ea	500.00	-	472.00	500.00	-	472.00	972.00
2.12	200mm Joint Insulation Kit	3	ea	795.00	-	452.00	2,385.00	-	1,356.00	3,741.00
2.13	200mm Flange Joint Insulation Kit	8	ea	1,593.00	-	462.00	12,744.00	-	3,696.00	16,440.00
2.14	200mm Elbow Insulation Kit	8	ea	1,750.00	-	462.00	14,000.00	-	3,696.00	17,696.00
2.15	200mm Tee Insulation Kit	8	ea	2,625.00	-	683.00	21,000.00	-	5,464.00	26,464.00
2.16	200mm Valve Insulation Kit	3	ea	3,000.00	-	693.00	9,000.00	-	2,079.00	11,079.00
2.17	50mm Joint Insulation Kit	2	ea	200.00	-	226.00	400.00	-	452.00	852.00
2.18	50mm Flange Joint Insulation Kit	2	ea	400.00	-	231.00	800.00	-	462.00	1,262.00
2.19	50mm Elbow Insulation Kit	4	ea	438.00	-	231.00	1,752.00	-	924.00	2,676.00
2.20	50mm Tee Insulation Kit	1	ea	660.00	-	345.00	660.00	-	345.00	1,005.00
2.21	50mm Valve Insulation Kit	1	ea	1,000.00	-	348.00	1,000.00	-	348.00	1,348.00
2.22	Sequencing Batch Reactor (SBR) Equipment	1	ea	3,720,000.00	-	161,700.00	3,720,000.00	-	161,700.00	3,881,700.00
2.23	Startup and Commissioning	1	ea	-	-	69,300.00	-	-	69,300.00	69,300.00
									Sub-Total	**4,086,951.00**
3.0	**Electrical Works**									
3.1	45kVA,120/208V, Step-Up Transformer	1	ea	12,470.00	-	18,000.00	12,470.00	-	18,000.00	30,470.00
3.2	Wood Pole	2	ea	2,500.00	440.00	15,500.00	5,000.00	880.00	31,000.00	36,880.00
3.3	Install Crossarms on Poles	2	ea	2,450.00	260.00	9,000.00	4,900.00	520.00	18,000.00	23,420.00
3.4	Conductors, 210kcmil	140	m	30.00	5.00	50.00	4,200.00	700.00	7,000.00	11,900.00
3.5	Building Connections	1	ls	2,500.00	-	15,000.00	2,500.00	-	15,000.00	17,500.00
3.6	Heat Trace Cable, 400 Degree, 208V, 5 Watts per LF	15	m	55.00	-	200.00	825.00	-	3,000.00	3,825.00
3.7	Heat Trace Thermostat	1	ea	648.00	-	2,500.00	648.00	-	2,500.00	3,148.00
3.8	Testing and Commissioning	1	ea	-	-	25,000.00	-	-	25,000.00	25,000.00
									Sub-Total	**152,143.00**
4.0	**Expenses - Shipping to Alert**									
4.1	Labour for Packing/Moving Materials	10	days	-	-	2,728.00	-	-	27,280.00	27,280.00
4.2	Shipping Materials/Specialty Crates - Pipes	2	ea	1,300.00	-	-	2,600.00	-	-	2,600.00
4.3	Shipping Materials/Specialty Crates - Fittings/Miscellaneous	10	ea	960.00	-	-	9,600.00	-	-	9,600.00
4.4	Shipping Material Sequencing Batch Reactor (SBR) Equipment	6	ea	10,000.00	-	-	60,000.00	-	-	60,000.00
4.5	Shipping Material Concrete & Equipment	5	ea	10,000.00	-	-	50,000.00	-	-	50,000.00
4.6	Freight	1	ls	-	50,000.00	-	-	50,000.00	-	50,000.00
									Sub-Total	**199,480.00**
5.0	**Expenses for Travel (Mobilization and Demobilization)**									
5.1	Labour Wages	4	days	-	-	23,250.00	-	-	93,000.00	93,000.00
5.2	Accommodation, Meals & Travel	4	days	-	-	9,000.00	-	-	36,000.00	36,000.00
5.3	Transportation	1	ea	-	30,000.00	-	-	30,000.00	-	30,000.00
									Sub-Total	**159,000.00**

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	Class D Estimate	**Date:**	**October 12, 2023**	**Rev.0**
	CFS Alert Wastewater Treatment Options Analysis	**Estimated By:**	**MQ, DJ, NS**	
	Alert, Nunavut	**Checked By:**	**DC**	

Item No.	Description	Qty	Unit	Unit Material	Unit Equipment	Unit Labour	Total Material	Total Equipment	Total Labour	Total Cost
6.0	**CFS Alert Northern Remoteness Factor**									
6.1	Labour - Regular Time - Weekday	10	days	-	-	23,250.00	-	-	232,500.00	232,500.00
									Sub-Total	**232,500.00**
	Sub-Total									**6,073,584.00**
	General Requirements							10%		607,358.40
	Fee							10%		668,094.24
	Net Construction Cost (w/o Contingencies & Tax)									**7,349,036.64**
	Contingencies & Allowances									
	Engineering Allowance							15%		1,102,355.50
	Design Contingency							15%		1,267,708.82
	Escalation Contingency							3%		291,573.03
	Construction Contingency							10%		1,001,067.40
										-
	Total Construction Cost (incl. Contingencies & Allowances, w/o Tax)									**11,011,741.38**

Appendix K

CFS Alert Background Lead Investigation.

Attached as a separate PDF Document.

This is the draft document. RMC will be back on site during the summer of 2024 to continue sampling program. Final report expected in late 2024.

Investigation into background lead (Pb) within meltwater, the surrounding environment and other locations at Canadian Forces Station (CFS) Alert

For 8 Wing Environmental Officer
Environmental Management

Department of National Defence

Prepared by:

The RMC Green Team

Contact:

Dr. E. Maria Skordaki
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March 2024

EXECUTIVE SUMMARY

In January 2023, the RMC Green Team was approached by Dr. Andrew Tam, the Environmental Officer at 8 Wing Trenton, with regards to establishing a baseline and background conditions for total lead (Pb) levels in the meltwater of the Lower and Upper Airfield Tank Farms located at Canadian Forces Station (CFS) Alert.

As such, the RMC Green Team built a targeted Pb sampling program that allowed for the determination of possible sources of total Pb in the meltwater, identification of metal behaviour patterns as well as introduction of baseline values for total lead and other metals, such as total copper (Cu) and total zinc (Zn), from a geochemical perspective. The samples were collected from locations ALT1-9, as well as other points around the Station (Figures 1-4).

Key observations, as derived from the RMC Green Team sampling campaign at CFS Alert in summer 2023 (June 27th-July 12th), showed that background metal values around CFS Alert facilities were elevated or exceed CCME water quality guidelines for the protection of aquatic life, at certain locations (Figures 5-10 and attached ALS Lab results).

To confirm the above preliminary observations, additional environmental sampling is proposed for the summer of 2024, within CFS Alert facilities, focusing on: i) the Lower and Upper Airfield Tank Farms, and including other locations within the Station (such as the landfarm or the Battery Dumb), and ii) background locations (such as the Upper Dumbell Lake or streams at >3km distance from the main Station complex). The components of the proposed Sampling Plan for summer 2024 at CFS Alert are included in the Recommendations section.

Specifically, the RMC Green Team key observations, in terms of the metal levels within the CFS Alert environment, include:

- Sample 31A-GT was collected as a background sample to depict natural metal concentrations away from the sites of interest, i.e. the Tank Farms. It was gathered from a stream on route towards the antenna farm - by the local bridge. This sample exceeded ON153/94 T1 GW-All as well as CCME Aquatic Life Maximum Acceptable Concentrations (MAC) for total Cu (MAC is 2ppb (CCME)), total Pb (MAC is 1ppb (CCME)) and total Zn (MAC is 6ppb (CCME, most stringent), with 5.68ppb Cu, 4.08ppb Pb and 8.9ppb respectively. The Pb, Cu and Zn exceedances at this location show that the baseline at CFS Alert area, for these metals, may be higher than anticipated.
- Further, sample 10-GT, a grab sample collected at ALT-1 (Upper Dumbell Lake) on June 29th 20203, showed elevated concentrations of total copper at 1.48ppb (MAC is 2ppb (CCME)), total lead at 0.694ppb (MAC is 1ppb (CCME)) and total zinc at 3.1 ppb (MAC is 6ppb (CCME, most stringent). These background metal values are at 50% or higher of the CCME MAC; it appears that these metals are naturally occurring around CFS Alert, as a result of the weathering of the local geological formations.
- Sample 7A-GT, a grab sample collected from a stream running by the Arctic Lookout (approximately 5km southeast from the main Station complex), showed a total copper concentration at 1.21 ppb (MAC is 2ppb (CCME)) and total lead at 0.292ppb (MAC is 1ppb (CCME)). Again, this background sample, gathered at a considerable distance from CFS Alert facilities, depicted elevated metal concentrations, at 50% and 30% of the total copper and lead respective MACs.
- The initial collection of meltwater samples for laboratory analysis on June 29th at the berm of Tank 5 in the Lower Tank Farm showed 0.263ppb total Pb. A subsequent sample that was collected on July 2nd showed an elevated 118ppb total Pb concentration. This 2nd sample was collected closer to the bottom of Tank 5 (in the Lower Tank Farm facility) than the 1st one. Follow-up sampling should be conducted in order to examine the source of the elevated Pb presence in the 2nd sample; this may be a result of: i) further leaching from the tanks (from the paint or the exposed steel) due to warmer weather, or ii) enrichment of Pb in the berm meltwater due to evaporation, or iii) intrusion of metal-impacted surface water from surrounding water bodies into the berm meltwater.

- There was evidence of peeling of the exterior coating and rust on the tanks of the ALT 8 Lower Airfield Tank Farm. The "21GT-orange paint" paint chip sample that was taken from tank 4A, Lower Tank Farm, showed 45300ppm total Pb. Paint chips were visible in the meltwater; further sampling should be conducted in order to determine if the paint is a primary lead source in the Lower Tank Farm.
- Water samples from the Tank Farms were analysed by the RMC Green Team on-site, with field equipment. The results were in agreement with the lab results, i.e. Lower Tank Farm 1A sample (29 June): 17.8ppb dissolved Pb, and Lower Tank Farm 5A sample (close to the bottom of the Tank): 83ppb dissolved Pb.

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Table of Contents

Tables and Figures in Text:

1. INTRODUCTION

CFS Alert is a strategically located weather and military station situated on the northeastern tip of Ellesmere Island in Nunavut, Canada. It is approximately 817 kilometers away from the geographic North Pole. Originally established as a High Arctic Weather Station in 1950, it has been continuously operational since 1958 under the management of the Department of National Defense (DND).

CFS Alert is strategically situated overlooking Parr Inlet and Dumbell Bay along the Arctic Ocean. The station is located in proximity to several small freshwater lakes, including Dumbell Lakes (Upper Dumbell and Lower Dumbell), which serve as the primary source of drinking water for the station. These lakes rely on surface water runoff to maintain their levels.

CFS Alert encompasses around 98 structures, including sea containers. Key engineering components of the station encompass a water treatment plant (WTP), a wastewater collection system with a sewage outfall and terrace, POL (Petroleum, Oil, and Lubricants) storage facilities, power generation infrastructure, an incineration facility, an airstrip, multiple landfill sites, landfarms, and quarry operations.

There are two airfield fuel storage tank farms at CFS Alert, the Upper and the Lower Tank Farm. CFS Alert's meltwater gets contained within the fuel storage tank farm facilities' berms (secondary containment). According to 8 Wing Environment, this melt water must be pumped out from the secondary containment to maintain the infrastructure's capacity in the event of a catastrophic fuel tank loss and spill (as CEPA 1999 Storage Tank Regulations 2008 requirement). However, prior to pumping and discharging snow melt water onto the tundra each summer (in July), testing must take place to ensure that it meets applicable water quality criteria, as regulated by the Nunavut Water Board. Nunavut Water Board has imposed a quality testing criteria for Lead concentrations in water to be <1.0 ug/L (ppb) for any grab samples. For +10 years, 8 Wing Environment monitors the lead levels in the airfield fuel tank farms; if meltwater grab samples fail (i.e. if lead concentrations are measured to be at 1.0 or >1.0 ug/L), then the meltwater becomes designated as hazardous waste, and the water must be sent through an on-site portable GAC/Heavy Metal filtration system for discharge (plus the effluent discharge must be metal tested at the beginning, middle, and near-end treatment process to monitor for treatment effectiveness or contaminant breakthrough.

The RMC Green Team has expertise in terms of determining lead (Pb) levels within the environment and more specifically, within the water treatment systems, sanitary distribution systems, and holding tanks for related DND infrastructure and Royal Canadian Navy vessels. As such, in terms of the scenario described by Dr. Tam at CFS Alert, it was suggested that the RMC Green Team commence and build a targeted Pb sampling program.

2 OBJECTIVE AND SCOPE

The objective of this agreement is to establish a baseline and background conditions for lead (Pb) levels in the meltwater at Canadian Forces Station (CFS) Alert.

As such, the RMC Green Team has built a targeted Pb sampling program that allows for the determination of possible sources of total Pb in the meltwater of the fuel storage tank farms and other CFS Alert facilities, identification of metal behaviour patterns as well as introduction of baseline values for total lead and other metals, such as total copper (Cu) and total zinc (Zn), from a geochemical perspective.

Further, the RMC Green Team provides input and advice with regards to water sampling, relevant environmental sampling, water testing, investigations on potential contaminants for melt water, operations / routines that may adversely impact the melt water, interpretation of analytical results, protocols and policies applicable to lead (Pb).

3. RMC Green Team Site-Visit Observations – Summer 2023

The RMC Green Team conducted a 2-week long site-visit/sampling campaign at CFS Alert in the summer of 2023 and collected water and paint samples from the Upper and Lower Airfield Fuel Storage Tank Farms, as well as other locations within and around the Station. Sampling locations ALT 1-11 are depicted in Figure 1. Table 1 includes the distances of the sampling locations ALT 1-11 from surface water bodies (including the drinking water source for the Station (the Upper Dumbell Lake), and the airfield.

The following tasks were completed during this 1st sampling campaign, as part of the meltwater quality assessment at CFS Alert:

1. Environmental sampling at relevant locations using appropriate sampling techniques. i.e. surface water, gravel berms, tank paint chips;
2. Background sampling, involving source water as well as drinking water, to include sampling locations away from anthropogenic impact;
3. From the samples that were collected in the field:
    a. 12 samples were tested on-site using a Palintest Kemio Kit for lead (Pb) as well as other field equipment to determine general water quality parameters, and/or
    b. 39 samples were sent to an accredited laboratory for total metal analysis (ICP-MS methods).

The accredited lab results, as presented in the attached folder (ALS Lab Results_CFS Alert_RMC Green Team_July 2023), were compared with:

i) The CCME For the Protection of Aquatic Life guidelines, as well as

ii) The Ontario Regulation 153/04 - April 15, 2011 Standards. (July, 2011). 153 T1-Ground Water-All Types of Property Uses (Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act.

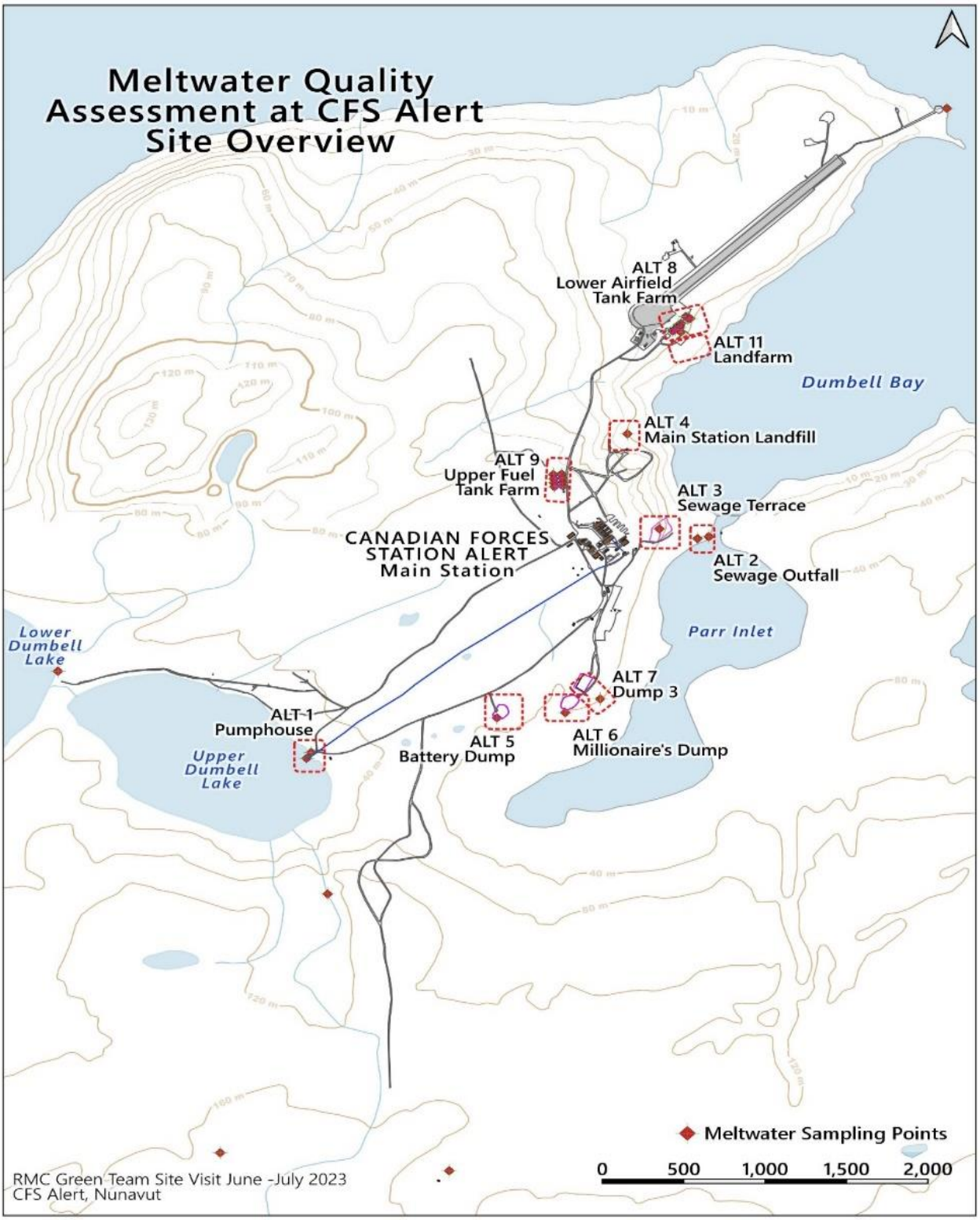

Figure 1: Sampling locations ALT 1-11 (Meltwater Quality Assessment at CFS Alert, Nunavut).

Table 1: ALT 1-11 sites and approximate distances to surface water bodies.

ALT Sampling Locations	Approximate Distance from		
	Waterbody	Drinking Water Source (Upper Dumbell Lake)	Airfield
ALT-1 - Pumphouse	0 m (Upper Dumbell Lake)	0 m	3.6 km
ALT-2 – Sewage Outfall	85 m (Parr Inlet)	2.9 km	1.6 km
ALT-3 – Sewage Terrace	300 m (Parr Inlet)	2.7 km	1.5 km
ALT-4 – Main Station Landfill	200 m (Dumbell Bay)	3 km	890 m
ALT-5 – Battery Dump:	560 m (Parr Inlet)	1.2 km	3 km
ALT-6 – Millionaire's Dump:	400 m (Parr Inlet)	1.6 km	2.7 km
ALT-7 – Dump 3	350 m (Parr Inlet)	1.7 km	2.6 km
ALT-8 - Lower Airfield Tank Farm	250 m (Dumbell Bay)	3.7 km	150 m
ALT-9 - Upper Airfield Tank Farm	750 m (Dumbell Bay)	2.5 km	1.3 km
ALT-11 - Landfarm	150 m (Dumbell Bay)	3.7 km	250 m

Table 2 includes the summary of field activities conducted by the RMC Green Team at CFS Alert during the summer 2023 site-visit, along with areas of concern and key observations in terms of the background metal values, as determined by the analysis of the water samples.

Table 2. RMC Green Team Site-Visit Summary June 27th- July 12th

Investigation into background lead (Pb) within meltwater, the surrounding environment and other locations at Canadian Forces Station (CFS) Alert **For 8 Wing Environmental Officer, Environmental Management Department of National Defense** **RMC Green Team Site-Visit Summary June 27th- July 12th**	
Base:	**CFS Alert**
Population:	65 people on the station all year-round Peak Season: Approximatively 200 people
Date:	June 27th- July 12th
Staff:	<u>RMC Green Team</u> Dr. E. Maria Skordaki Mr. Jorge Orellana Ms. Emilie Breuvart
	<u>Base Personnel (interviews)</u> Dr. Andrew Tam - 8 Wing Environment Officer, Environmental Management Mr. Nathan Koutroulides - Deputy 8 Wing Environment Officer, Environmental Management MAJ Melissa Chandler - CO MWO Bryce Culver - SWO Mr. Yves Asselin - WTP Operator (H_2O) Mr. Boris Poredos - Site Manager
Site visit objective:	Investigation into background lead (Pb) and other heavy metals of concern within melt water, the surrounding environment and other locations at CFS Alert
Previous visits	October 2018
Background	CFS Alert is a strategically located weather and military station situated on the northeastern tip of Ellesmere Island in Nunavut, Canada. It is approximately 817 kilometers away from the geographic North Pole. Originally established as a High Arctic Weather Station in 1950, it has been continuously operational since 1958 under the management of the Department of National Defense (DND). CFS Alert is strategically situated overlooking Parr Inlet and Dumbell Bay along the Arctic Ocean. The station is located in proximity to several small freshwater lakes, including Dumbell Lakes (Upper Dumbell and Lower Dumbell), which serve as the primary source of drinking water for the station. These lakes rely on surface water runoff to maintain their levels. CFS Alert encompasses around 98 structures, including sea containers. Key engineering components of the station encompass a water treatment plant (WTP), a wastewater collection system with a sewage outfall and terrace, POL (Petroleum, Oil, and

	Lubricants) storage facilities, power generation infrastructure, an incineration facility, an airstrip, multiple landfill sites, landfarms, and quarry operations.
Design (Sampling Areas for environmental assessment of meltwater at CFS Alert)	**ALT 1- Pumphouse**: Positioned south, approximately 2.5 km of the main station, at Upper Dumbell Lake, which functions as the station's drinking water source. The lake's water supply is replenished through surface water runoff. **ALT 2- Sewage Outfall and ALT 3- Sewage Terrace System:** A heated, insulated, high-density polyethylene gravity pipelines to collect sewage and wastewater from various onsite sources, such as bathrooms and kitchens. These pipelines channel the sewage to an outfall, which flows downhill (approximately 400 m) through the sewage terrace leading toward Parr Inlet. This terraced wetland is situated on a rocky hillside to the southeast of the main station. It is designed to regulate the flow, allowing for the gradual settling of solids and facilitating the natural biological breakdown of sewage materials. **ALT 4- Main Station Landfill:** Landfill for main station materials that are non-hazardous and incinerator ash located approximately 1 km north of the main station. The landfill consists of several layers of material and gravel. ALT-4 has no containment or berms surrounding the site. **ALT 5- Battery Dump:** Landfill for depleted batteries and asbestos located approximately 1.5 km south of the main station. The landfill consists of several layers of material and gravel. ALT-5 has no containment or berms surrounding the site. **ALT 6- Millionaire's Dump:** Landfill for large metal and non-hazardous materials located approximately 1 km south of the main station. The landfill consists of several layers of material and gravel. ALT-6 has no containment or berms surrounding the site. **ALT 7- Dump 3:** Landfill for scrap materials and vehicle parts located approximately 1 km south of the main station. The landfill consists of several layers of material and gravel. ALT-7 has no containment or berms surrounding the site. **ALT 8- Lower Airfield Tank Farm:** Consists of a total of six (6) aboveground tanks. Tank 1 and 2 have a capacity of 455,000 liters each. They are used to store DF-8 fuel, which will eventually be pumped to the Upper Tank Farm for the main station's operational needs. Tanks 3, 4, 5, and 6, each with a capacity of 236,000 liters, are used for the storage of aviation fuel (JP-8). These tanks support the operational needs of the CFS Alert airfield. Each tank is surrounded by a containment berm consisting of a membrane overlain with gravel approximately 1.5m in height. **ALT 9- Upper Tank Farm:** Consists of a total of eight (8) aboveground tanks. Tank 1, 2, 3, and 4 have a capacity of 455,000 liters. They are used to store DF-8 fuel for the main station's operational needs. Tanks 5, 6, 7 and 8 have a capacity of 480,477 L and used to store DF-8 fuel for the main station's operational needs. Each tank is surrounded by a containment berm consisting of a membrane overlain with gravel approximately 1.5m in height. **ALT 11- Landfarm:** Consists of soil contaminated with petroleum hydrocarbon (JP-8 fuel). The site comprises an engineered liner and a berm. The landfarm operates year-round. Table 1 shows the distances of the sampling areas from adjacent surface water bodies.
Operation	The sites are operational and require personnel on-site. Sites are monitored and sampled bi-annually by the 8 Wing Environment Team.

Testing	Thirty nine (39) Meltwater and Surface Water Samples were collected and analysed (Figures 1-10 and Table 4 show the locations): ALT-1 - Pumphouse: - One grab from the raw water hose; - One grab from Upper Dumbell Lake; and, - One grab from Lower Dumbell Lake. ALT-2 – Sewage Outfall: - One grab from meltwater in the vicinity of the outfall. ALT-3 – Sewage Terrace: - One grab from meltwater in the vicinity of the outfall. ALT-4 – Main Station Landfill: - One grab from meltwater near the main station landfill. ALT-5 – Battery Dump: - One grab from meltwater near the Battery Dump. ALT-6 – Millionaire's Dump: - One grab from meltwater near the Millionaire's Dump. ALT-7 – Dump 3: - One grab from meltwater near Dump 3. ALT-8 - Lower Airfield Tank Farm: - 14 Fourteen samples were collected from meltwater within the tank's containment berms during the site visit. These samples were taken at various intervals during the site-visit as the meltwater depth gradually decreased, and the ambient temperature increased. ALT-9 - Upper Airfield Tank Farm: - 9 Nine samples were collected from meltwater within the tank's containment berms during the site visit. These samples were taken at various intervals during the site-visit as the meltwater depth gradually decreased - and the ambient temperature increased. ALT-11 - Landfarm: - One grab from meltwater near landfarm containment berm. Surface Water Samples: - One grab from surface water near Arctic Lookout approximately 10 km south east from the main station. - One grab from surface water going towards the antenna farm approximately 30 km south east from the main station. - One grab from surface water going towards the GAW Lab approximately 30 km south east from the main station.

	Water was collected by directly dipping the sample container into the stream or meltwater basin, involving the use of bottles lowered beneath the water surface. At each sampling location, a fresh pair of nitrile gloves was worn, and the water was collected in containers suitable for the specific analytical parameters specified by the laboratory.
Laboratory and Data Recording	- ALT 2: Monthly sampling of effluent - ALT 3: Monthly during summer (during times of flow) - Monitoring is conducted annually by 8 Wing Environment and prior to the release of effluent specifically from the tank farms and landfarm sites.
Geology/ Stratigraphy	**Vegetation Type:** permafrost region classified as continuous permafrost and lacks significant surface vegetation. Low-lying tundra vegetation, including mosses, lichens, grasses, Arctic plants such as blue grass, chickweed, arctic poppy, saxifrage, arctic willow, and mountain avens. **Topography:** rocky hills and valleys composed of shale and slate. The surrounding area consists of tundra soils comprised of clay, silt and gravel. **Average Precipitation:** Alert experiences the most precipitation (in the form of rain and snow) during the months of July, August and September. Alert receives on average approximately 154 mm of precipitation annually. (*Environment Canada*) **Temperature:** Average annual air temperature of -18°C, with August being the warmest at 3°C and December to March being the coldest, often below -30°C (NOAA Global Monitoring Laboratory, 2024). **Geology:** permafrost region classified as continuous permafrost. To date the maximum permafrost depth measured was 480 m in 1997. **Stratigraphy:** The surface horizon at Alert and surrounding area consists of tundra soils comprised of clay, silt and some gravel. The soil in this region is classified as a cryosol comprised of clayey silt. The region is underlain by shale and slate. **Hydrogeology:** continuous permafrost region and lacks significant surface vegetation; therefore, runoff is the primary water drainage process at the site. Runoff at the main station flows primarily to the east into Dumbell Bay Inlet, which are joined to the Lincoln Sea.
Surface Water Quality Monitoring	With the exception of ALT 1, the surface water sampled is not used as a drinking water source for humans. The surface water samples mainly consist of meltwater found within the POL tank farm berms and meltwater at the other ALT sites. Background samples from streams were collected to assess background concentrations. Background samples were systematically collected from five (5) distinct areas in the vicinity of the Base to establish environmental baselines. They represent various environmental conditions around the Base and serve as reference points for further analysis: 1. 7A-GT: A surface water sample was obtained from a meltwater stream located near the Arctic Lookout, situated to the southeast of the main base. 2. 8A-GT: A seawater sample (oceanic) was obtained at the beach by the northern end of the runway. 3. 31A-GT: A stream along the route leading to the antenna farm, in close proximity to the bridge crossing south of the main base area. 4. 32A-GT: A stream along the route leading to the GAW Lab south of the main

	base area. 5. 33A-GT: A surface water sample collected from the connecting lake that links to Upper Dumbell Lake.
Sewage and Waste Collection System - Description	CFS Alert uses a system of heated, insulated, high-density polyethylene gravity pipelines to collect sewage and wastewater from various onsite sources, such as bathrooms and kitchens. The collected sewage is piped to an outfall, which includes a sewage terrace. The sewage terrace is located on a rocky hillside to the southeast of the main base area, featuring a moderate to steep slope leading towards Parr Inlet. The sewage terrace is designed with berms that are configured in a zigzag pattern to promote the settling of large particles and reduce flow velocity. However, due to the silt and shaly soils in the area, the berms are not as pronounced or intact as intended, resulting in waste streams flowing rather directly towards Parr Inlet, instead of following a zigzag pattern. Unused drinking water, along with excess wastewater from the treatment plant, is mixed with the sewage and discharged into the terrace system through the sewage outfall. There is no sewage treatment before this discharge. The collection system is managed to prevent pipe freezing. Alert's waste facilities comprise of a sewage terrace system and four landfills: Main Station Landfill, Millionaire's Dump, Battery Dump, and Dump 3. Combustible garbage is incinerated, leaving only ashes and clinker for disposal in the Main Station Landfill, which is covered when possible. Other on-site dumps include Millionaire's Dump for large metals and bulky waste, Dump 3 for vehicle parts and metallic objects, and the Battery Dump which was formerly used for battery disposal. Recyclables materials like metals, aluminum, plastics, and glass bottles are gathered and sent to 8 Wing Trenton for recycling.
Areas of Concern	• During the site visit, the RMC Green Team's initial observation was that the berms at ALT 8 Lower Airfield Tank Farm and ALT-9 Upper Tank Farm effectively contained the meltwater. The meltwater level was observed to be high (close to the height of a rubber field boot). However, at the Lower Airfield Tank Farm, the water gradually decreased over the course of the visit with temperatures around 1-degree Celsius ambient temperature. While some evaporation may occur due to the meltwater being exposed to sunlight for 24 hours/day, it is likely that seepage of water occurs through the gravel berms, affecting the surrounding area. • The initial collection of meltwater samples for laboratory analysis on June 29th at the berm of Tank 5 in the Lower Tank Farm showed 0.263ppb total Pb. A subsequent sample that was collected on July 2nd showed an elevated 118ppb total Pb concentration. This 2nd sample was collected closer to the bottom of Tank 5 (in the Lower Tank Farm facility) than the 1st one. Follow-up sampling should be conducted in order to examine the source of the elevated Pb presence in the 2nd sample; this may be a result of: i) further leaching from the tanks (from the paint or the exposed steel) due to warmer weather, or ii) enrichment of Pb in the berm meltwater due to evaporation, or iii) intrusion of metal-impacted surface water from surrounding water bodies into the berm meltwater. • There was evidence of peeling of the exterior coating and rust on the tanks of the ALT 8 Lower Airfield Tank Farm. The "21GT-orange paint" paint chip sample that was

	taken from tank 4A, Lower Tank Farm, showed 45300ppm total Pb. Paint chips were visible in the meltwater, flowing away from the tanks at the Lower Tank Farm. • Water samples from the Tank Farms were analysed on-site with field equipment during the site-visit. The results are in agreement with the lab results, i.e. Lower Tank Farm 1A sample (29 June): 17.8ppb dissolved Pb, and Lower Tank Farm 5A sample (close to the bottom of the Tank): 83ppb dissolved Pb. • The Sewage Terrace and outfall system ALT 2 and ALT 3 are in fair/poor condition. They show signs of erosion and breaks in the terrace's zig-zag berms, causing effluent to flow directly downhill rather than following the intended pattern (which was initially designed to increase retention time for the wastewater, thus increasing the potential for settling of contaminants) due to the low (or collapsed) berms which are built with silt and shaly, permeable soils in the area. • CFS Alert is located in a continuous permafrost region and lacks significant surface vegetation; therefore, runoff is the primary water drainage process at the site. Runoff at the main station flows primarily to the east into Dumbell Bay Inlet, which are joined to the Lincoln Sea. Potential sources of contamination include animal waste from wildlife, as well as runoff from old petroleum barrels in the surrounding watershed, tank farm leachate, landfarm, dumps (active and inactive) and sewage. Figures 5-10 in Appendix B and Table 3 below show the sampling locations with metal exceedances.
Key observations regarding background metal levels	Background metal values around CFS Alert facilities are elevated or exceed CCME water quality guidelines for the protection of aquatic life at certain locations. • Sample 31A-GT was collected as a background sample to depict natural metal concentrations away from the sites of interest, i.e. the Tank Farms. It was gathered from a stream on route towards the antenna farm - by the local bridge. This sample exceeded ON153/94 T1 GW-All as well as CCME For the Protection of the Aquatic Life Maximum Acceptable Concentrations (MAC) for total Cu (MAC is 2ppb (CCME)), total Pb (MAC is 1ppb (CCME)) and total Zn (MAC is 6ppb (CCME, most stringent), with 5.68ppb Cu, 4.08ppb Pb and 8.9ppb respectively. The Pb, Cu and Zn exceedances at this location show that the baseline at CFS Alert area, for these metals, may be higher than anticipated (Figure 15 and attached ALS Lab results). • Further, sample 10-GT, a grab sample collected at ALT-1 (Upper Dumbell Lake) on June 29th 20203, showed elevated concentrations of total copper at 1.48ppb (MAC is 2ppb (CCME)), total lead at 0.694ppb (MAC is 1ppb (CCME)) and total zinc at 3.1 ppb (MAC is 6ppb (CCME, most stringent). These background metal values are at 50% or higher of the CCME MAC; it appears that these metals are naturally occurring around CFS Alert, as a result of the weathering of the local geological formations. • Sample 7A-GT, a grab sample collected from a stream running by the Arctic Lookout (approximately 5km southeast from the main Station complex), showed a total copper concentration at 1.21 ppb (MAC is 2ppb (CCME)) and total lead at 0.292ppb (MAC is 1ppb (CCME)). Again, this background sample, gathered at a considerable distance from CFS Alert facilities, depicted elevated metal concentrations, at 50% and 30% of the total copper and lead respective MACs.

Table 3, below, includes the sampling locations where metal exceedences were observed, according to the accredited laboratory analytical results.

Table 3. Summary of exceedances (in µg/L) in meltwater and surface water samples collected during RMC Green Team's site-visit from June 27th to July 12th.

Location/ Sample	Analyte Concentration (µg/L)	Applicable Guidelines (µg/L)
ALT 1: Pumphouse		
9A-GT	Copper, total: 6.83	2 (CCME[2]) - 5 (T1 GW All[1])
ALT 6: Millionaire's Dump		
12A-GT	Copper, total: 5.18	5 (T1 GW All[1]) - 200 (CCME[2])
ALT 2: Sewage Outfall		
14A-GT	Chromium, total: 7.96	11 (T1 GW All[1])
	Copper, total: 499	2 (CCME[2]) - 5 (T1 GW All[1])
	Lead, total: 5.23	1 (CCME[2]) - 1.9 (T1 GW All[1])
ALT 8 Lower Tank Farm		
16A-GT (Tank 4)	Lead, total: 4.37	1.9 (T1 GW All[1]) - 100 (CCME[2])
17A- GT (Tank 6)	Chromium, total: 7.61	4.9 (CCME[2])
	Lead, total: 21.1	1 (CCME[2]) - 1.9 (T1 GW All[1])
30A-GT (Tank 5)	Chromium, total: 10.5	4.9 (CCME[2])
	Lead, total: 118	1 (CCME[2]) - 1.9 (T1 GW All[1])
ALT 4 Main Station Landfill		
26A-GT	Copper, total: 5.14	2 (CCME[2]) - 5 (T1 GW All[1])
	Lead, total: 3.06	1 (CCME[2]) - 1.9 (T1 GW All[1])
ALT 11 Landfarm		
29A-GT	Copper, total: 7.37	2 (CCME[2]) - 5 (T1 GW All[1])
Surface Water Background		
31A-GT	Copper, total: 5.68	2 (CCME[2]) - 5 (T1 GW All[1])
	Lead, total: 4.08	1 (CCME[2]) - 1.9 (T1 GW All[1])
ALT 3: Sewage Terrace		
34A-GT	Copper, total: 59.5	2 (CCME[2]) - 5 (T1 GW All[1])
	Lead, total: 1.98	1 (CCME[2]) - 1.9 (T1 GW All[1])
	Nickel, total: 21.2	14 (T1 GW All[1]) - 25 (CCME[2], if water hardness=1)
35A-GT	Copper, total: 34.6	2 (CCME[2]) - 5 (T1 GW All[1])
	Lead, total: 3.18	1 (CCME[2]) - 1.9 (T1 GW All[1])

[1]Ontario Regulation 153/04 - April 15, 2011 Standards. (July, 2011). 153 T1-Ground Water-All Types of Property Uses (Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act

[2]Canada CCME Canadian Environmental Quality Guidelines (Sept, 2021). CCME Water Quality Guidelines for the Protection of Aquatic Life.

4 RECOMMENDATIONS

The RMC Green Team proposes a new sampling plan, for Fiscal Year 2024, for the investigation into background lead (Pb) and other metals within meltwater and the surrounding environment at CFS Alert.

This proposed sampling plan is comprised of:

i) Two (2) sampling campaigns at CFS Alert, during the summer and 'shoulder' seasons. This plan will allow for data collection during melting (summer) and dry ('shoulder') periods, in order to optimise the information gathering in terms of determining baseline values for total lead and other metals;

ii) Sampling locations ALT1-9, as per summer 2023 field activities, which will allow for comparisons of metal levels between the two data sets (2023 % 2024);

iii) Water and (surficial) soil samples from ALT 1-11, to confirm naturally occurring metal levels and/or anthropogenic impact from landfarms, landfills, dumb areas and sewage from the Station's activities;

iv) Sampling locations at a considerable distance from the Station, and from roads, in an effort to determine baseline metal values. These locations can include the 2023 'background' sampling points (Arctic Lookout, on route to the Antenna farm (from the stream below the bridge), on route to the GAW Lab (stream)), as well as other points that will be selected on-site, based on how uninterrupted will be deemed from Station-oriented environmental impact;

v) Water samples will be collected for: a) on-site field testing (for dissolved Pb, temperature, pH), and b) accredited laboratory analysis for metals (primarily Pb, Cu, Zn, Ni, Cr, Fe, Cd).

vi) Approximately 50-60 water samples will be collected for accredited laboratory analysis (for metals, as mentioned above), and 10-20 water samples for on-site testing.

vii) Approximately 20-30 soil samples will be collected from locations ALT 1-11, and the background sampling points, for accredited laboratory analysis (for metals, as mentioned above).

APPENDIX A: Sampling Locations, CFS Alert (Figures 1-4 and Table 4).

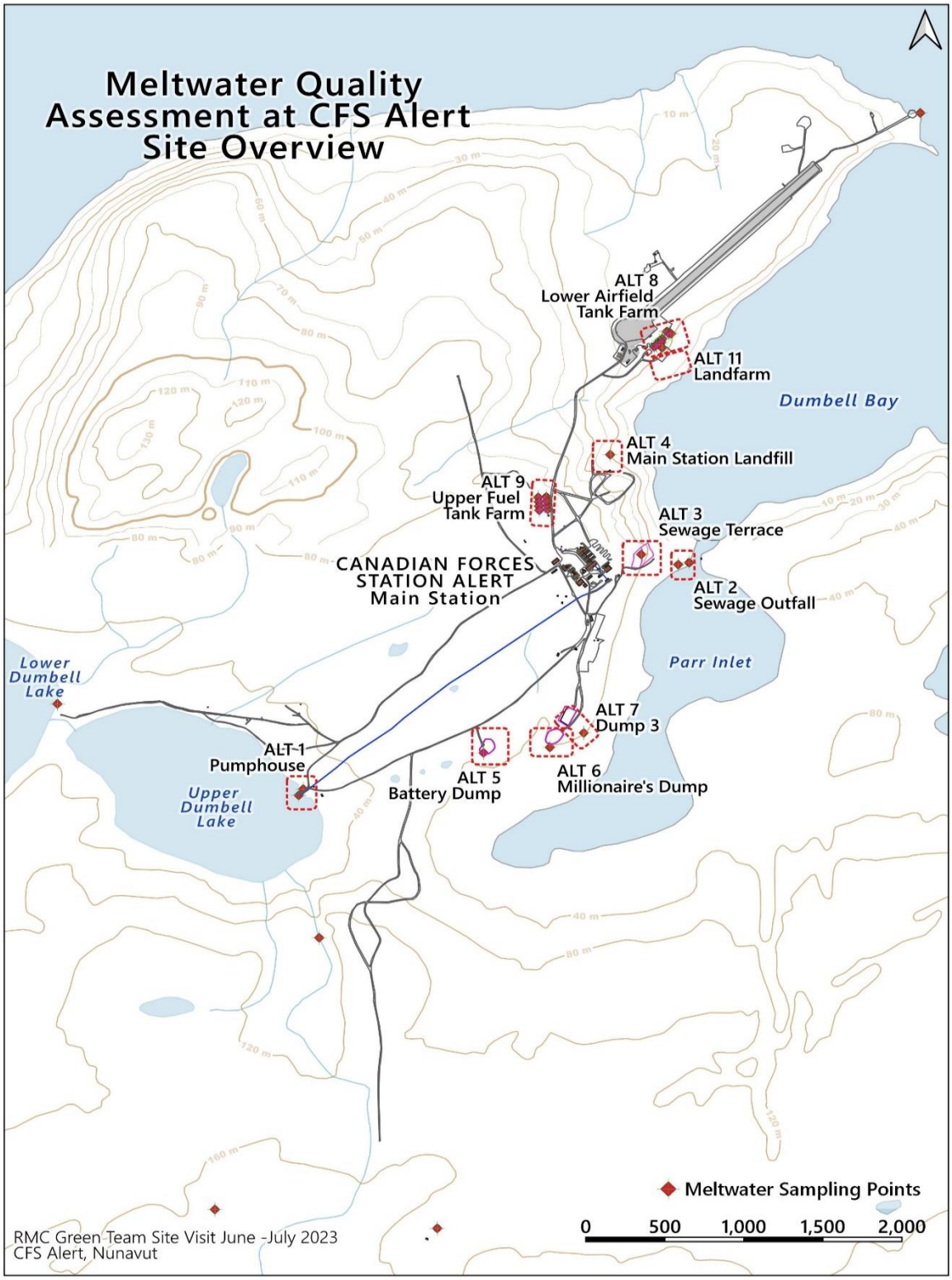

Figure 2: Sampling locations ALT 1-11 (Meltwater Quality Assessment at CFS Alert, Nunavut).

Figure 2: ALT 8- Lower Tank Farm Sampling Points.

Figure 3: ALT 9- Upper Tank Farm Sampling Points.

Figure 4: Surface Water Sampling Points.

Table 4: CFS Alert Site Visit Meltwater Sampling Points (Coordinates and Observations/Descriptions).

Map Label	Name	Site Location	GPS Coordinates			Date	Time	Observations & Notes
			Lat	Long	Elev (m)			
1A-GT	Tank 1(1A)	ALT 8; Lower Tank Farm 1A	82.512479	-62.30624	68	6/29/2023	11:23 AM	Lower Tank Farm
2A-GT	Tank 2 (2A)	ALT 8; Lower Tank Farm 2A	82.512439	-62.30657	63	6/29/2023	11:26 AM	Lower Tank Farm
3A-GT	Tank 3(3A)	ALT 8; Lower Tank Farm 3A	82.512119	-62.30933	53	6/29/2023	11:31 AM	Lower Tank Farm
4A-GT	Tank 4(4A)	ALT 8; Lower Tank Farm 4A	82.511989	-62.31058	38	6/29/2023	11:33 AM	Lower Tank Farm
5A-GT	Tank 5(5A)	ALT 8; Lower Tank Farm 5A	82.51184	-62.31105	29	6/29/2023	11:35 AM	Lower Tank Farm Domestic Fuel
6A-GT	Tank 6(6A)	ALT 8; Lower Tank Farm 6A	82.51173	-62.31194	37	6/29/2023	11:37 AM	Lower Tank Farm Diesel
-	Tank 5(5AA)	ALT 8; Lower Tank Farm 5A; Bottom of tank	82.51174	-62.31181	40	6/29/2023	11:38 AM	Lower Tank Farm; Diesel; Adjacent to tank
8A-GT	Ocean (X Marine)	Beach by Lower Tank Farm	82.52545	-62.19570	-2	6/29/2023	11:49 AM	Sample taken near beacon road; end of runway
9A-GT	Up DL Pump	ALT 1; Pumphouse	82.484989	-62.46932	62	6/29/2023	1:42 PM	Upper Dumbell Lake; Pumphouse; sample from raw water hose
10A-GT	Up DL	ALT 1; Upper Dumbell Lake Source	82.48536	-62.46737	44	6/29/2023	1:55 PM	Upper Dumbell; from the lake
11A-GT	BTR Dump	Alt 5; Battery Dump	82.48743	-62.38906	52	6/29/2023	2:03 PM	ALT 5 Battery Dump
12A-GT	ALT 6	ALT 6; Millionaire's Dump	82.487719	-62.36030	41	6/29/2023	2:20 PM	ALT 6 Millionaire's Dump
13A-GT	ALT 7	ALT 7; Main Dump	82.48856	-62.34552	43	6/29/2023	2:33 PM	ALT 7 Main Dump
14A-GT	ALT 2	ALT 2; Sewage Outfall	82.49921	-62.31965	59	6/29/2023	8:04 PM	ALT 2; Sewage Outfall Wastewater terrace
7A-GT	Arctic lookout	Stream	82.47645	-62.4611	104	6/29/2023	8:29 PM	Arctic Lookout; Runoff stream

15A-GT	2A-P	Tank 2A	82.51255	-62.30731	26	6/30/2023	9:28 AM	Back of tank 1A and 2A; Perimeter Contaminated Water
16A-GT	Lower tank farm (4A)	ALT 8; Lower Tank Farm 4A	82.51192	-62.30988	30	6/30/2023	9:38 AM	Bottom of the tank
17A-GT	Lower tank farm (6A)	ALT 8; Lower Tank Farm 6A	82.51164	-62.31291	30	6/30/2023	9:48 AM	Bottom of the tank
18A-GT	Tank 8	ALT 9; Upper tank farm; T8	82.502719	-62.36406	78	6/30/2023	11:22 AM	upper tank farm
19A-GT	Tank 1	ALT 9; Upper tank farm; T1	82.5027	-62.36406	83	6/30/2023	11:26 AM	upper tank farm
20A-GT	Tank 2	ALT 9; Upper tank farm; T2	82.50243	-62.36384	81	6/30/2023	11:28 AM	upper tank farm
21A-GT	Tank 3	ALT 9; Upper tank farm; T3	82.50217	-62.36379	79	6/30/2023	11:30 AM	upper tank farm
22A-GT	Tank 4	ALT 9; Upper tank farm; T4	82.50193	-62.36368	82	6/30/2023	11:32 AM	upper tank farm
23A-GT	Tank 5	ALT 9; Upper tank farm; T5	82.50198	-62.36003	80	6/30/2023	11:37 AM	upper tank farm
24A-GT	Tank 6	ALT 9; Upper tank farm; T6	82.50198	-62.36012	84	6/30/2023	11:40 AM	upper tank farm
25A-GT	Tank 7	ALT 9; Upper tank farm; T6	82.50248	-62.3601	84	6/30/2023	11:41 AM	upper tank farm
26A-GT	ALT 4	ALT 4; Main station landfill	82.50521	-62.33259	18	6/30/2023	1:38 PM	Main station landfill
27A-GT	Tank 1 (Ltank F 1Ad)	ALT 8; lower tank farm	82.51241	-62.30549	31	7/02/2023	12:20 PM	lower tank farm
28A-GT	Tank 4 (tank F 4AD)	ALT 8; lower tank farm	82.5118	-62.31035	33	7/02/2023	12:30 PM	lower tank farm
29A-GT	Lower Tank F Bay Perimeter	ALT 8 and ALT 11; SLF	82.51158	-62.30944	29	7/02/2023	12:34 PM	Bay Front Tank 4A and 5A, lower tank farm
30A-GT	5AAD	ALT 8; lower tank farm	82.51174	-62.31188	33	7/02/2023	12:48 PM	Similar point 5AA; water levels lower than first sample
31A-GT	River bridge	Open water; surface water	82.45898	-62.41133	147	7/02/2023	2:15 PM	Stream; near bridge toward antenna farm
32A-GT	River 2 GAWL North	River water; surface water	82.46023	-62.5073	171	7/02/2023	3:09 PM	stream to GAW Lab

33A-GT	Upper and Lower Dumbell	Lake; surface water	82.49058	-62.57358	24	7/02/2023	3:30 PM	Lower Dumbell Lake (near connection)
34A-GT	A	ALT 3; Sewage Terrace System	82.49858	-62.30363	66	7/04/2023	1:26 PM	Exit final effluent; sewage terrace
35A-GT	B	ALT 3; Sewage Terrace System	82.49869	-62.2989	5	7/04/2023	1:33 PM	sewage terrace
36A-GT	1A07	ALT 8; Lower Tank Farm	-	-	-	7/07/2023	1:10 PM	-
37A-GT	4A07	ALT 8; Lower Tank Farm	-	-	-	7/07/2023	1:24 PM	-
38A-GT	4	ALT 9; Upper tank farm	-	-	-	7/07/2023	1:38 PM	-
32A-GT	39A-GT	DI Water; BLANK	-	-	-	7/07/2023	-	-

APPENDIX B: Sampling Locations, CFS Alert, with exceedences (Figures 5-10).

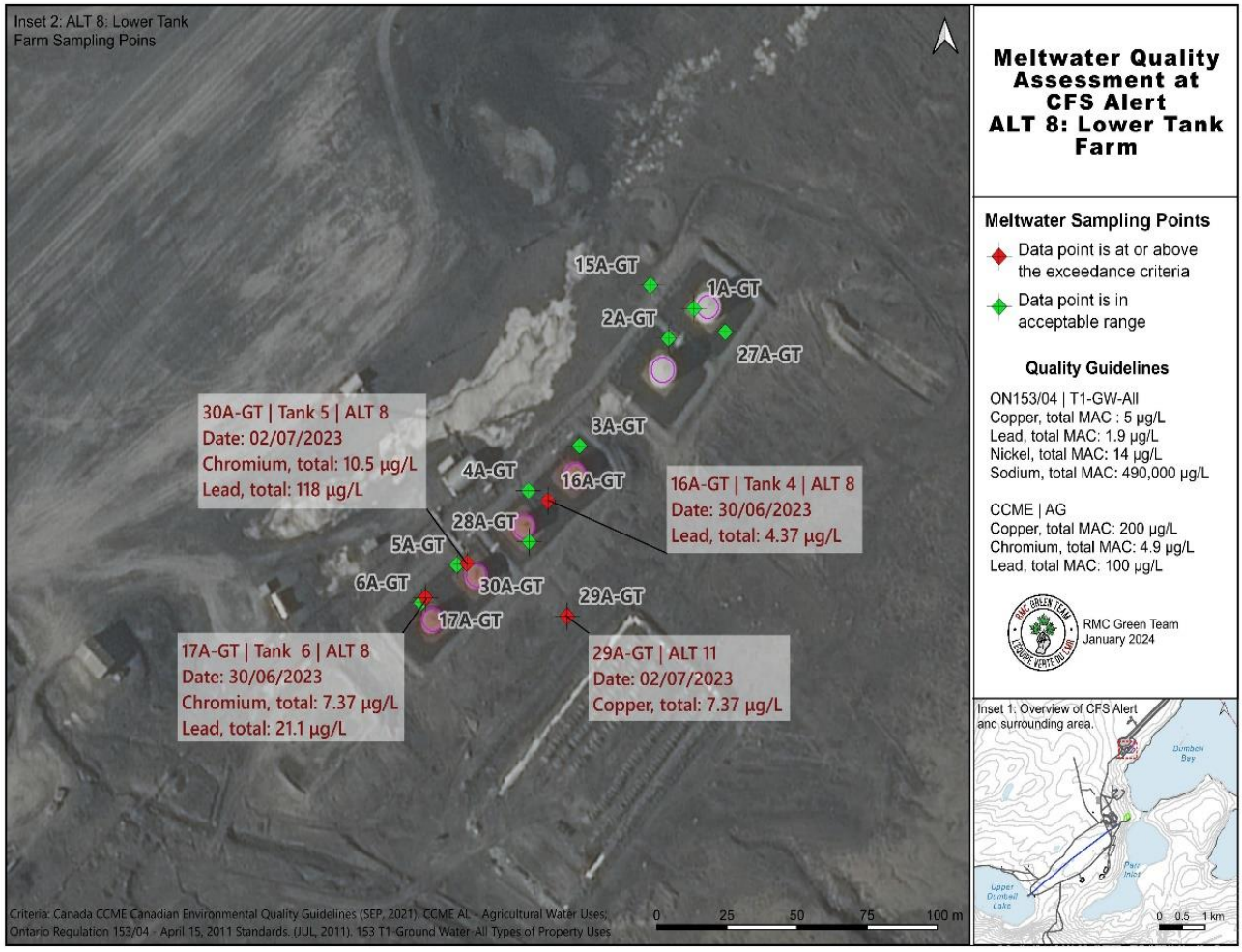

Figure 5: ALT 8- Lower Tank Farm Meltwater Sampling Points.

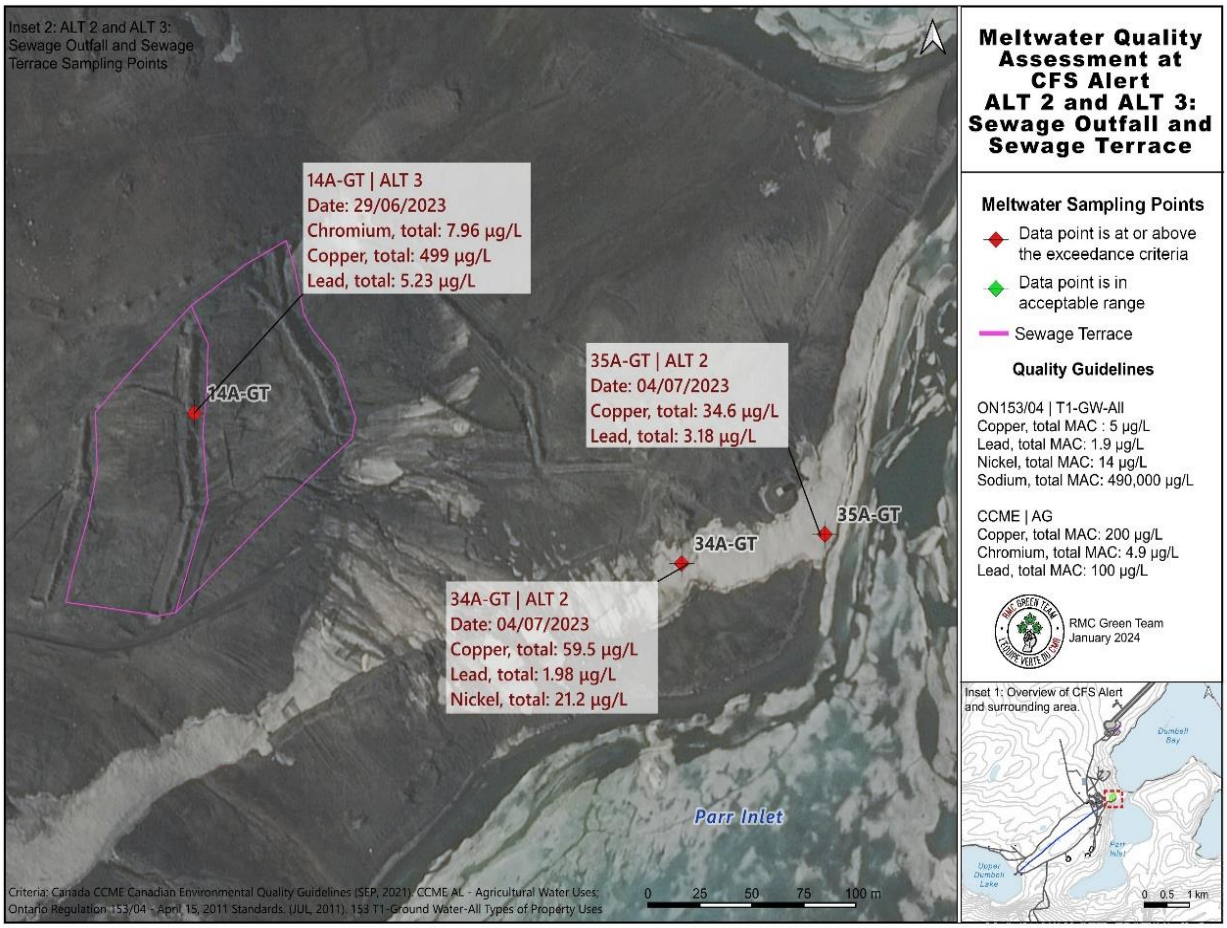

Figure 6: ALT 2- Sewage Outfall and ALT 3 Sewage Terrace Meltwater Sampling Points.

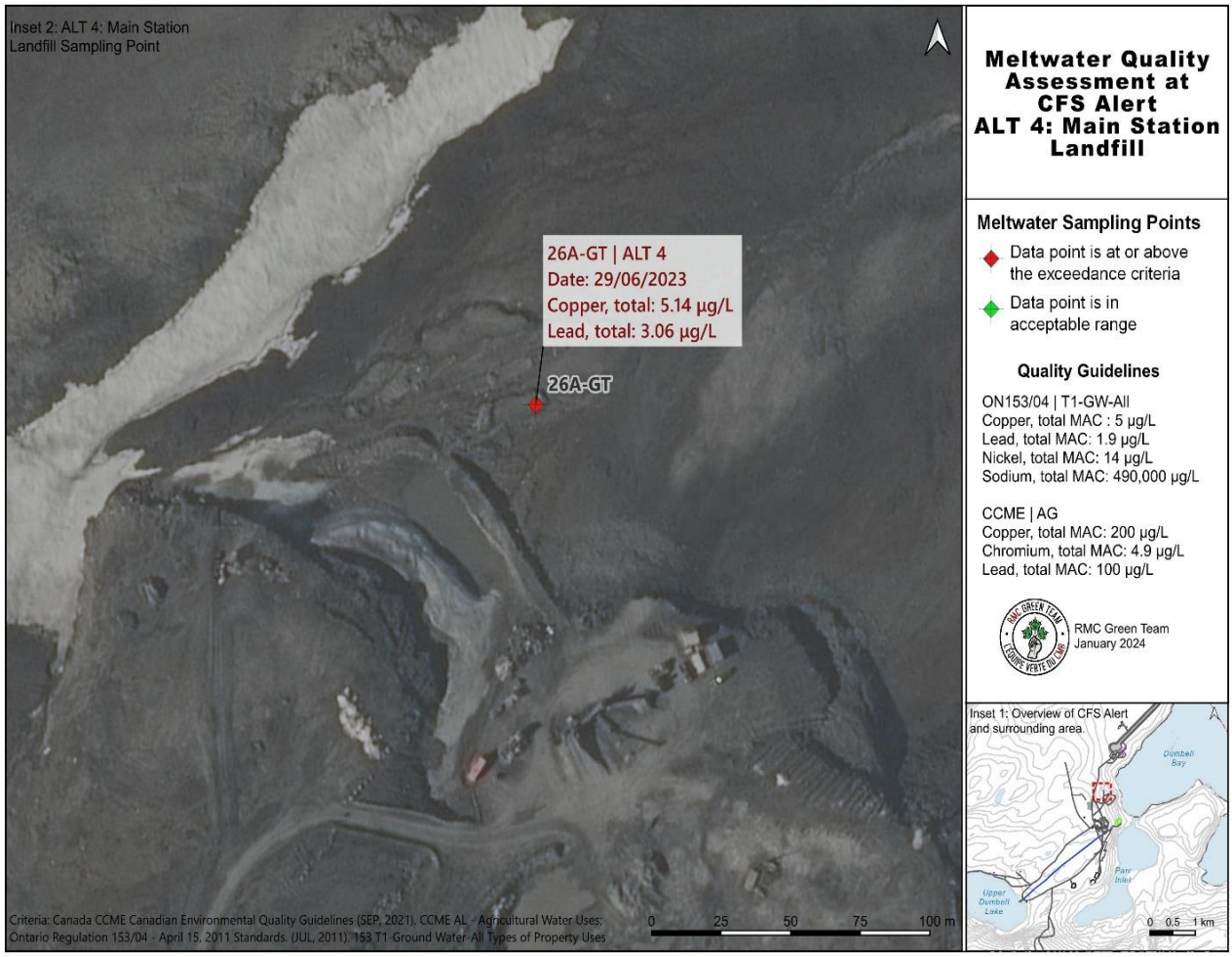

Figure 7: ALT 4- Main Station Landfill Meltwater Sampling Points.

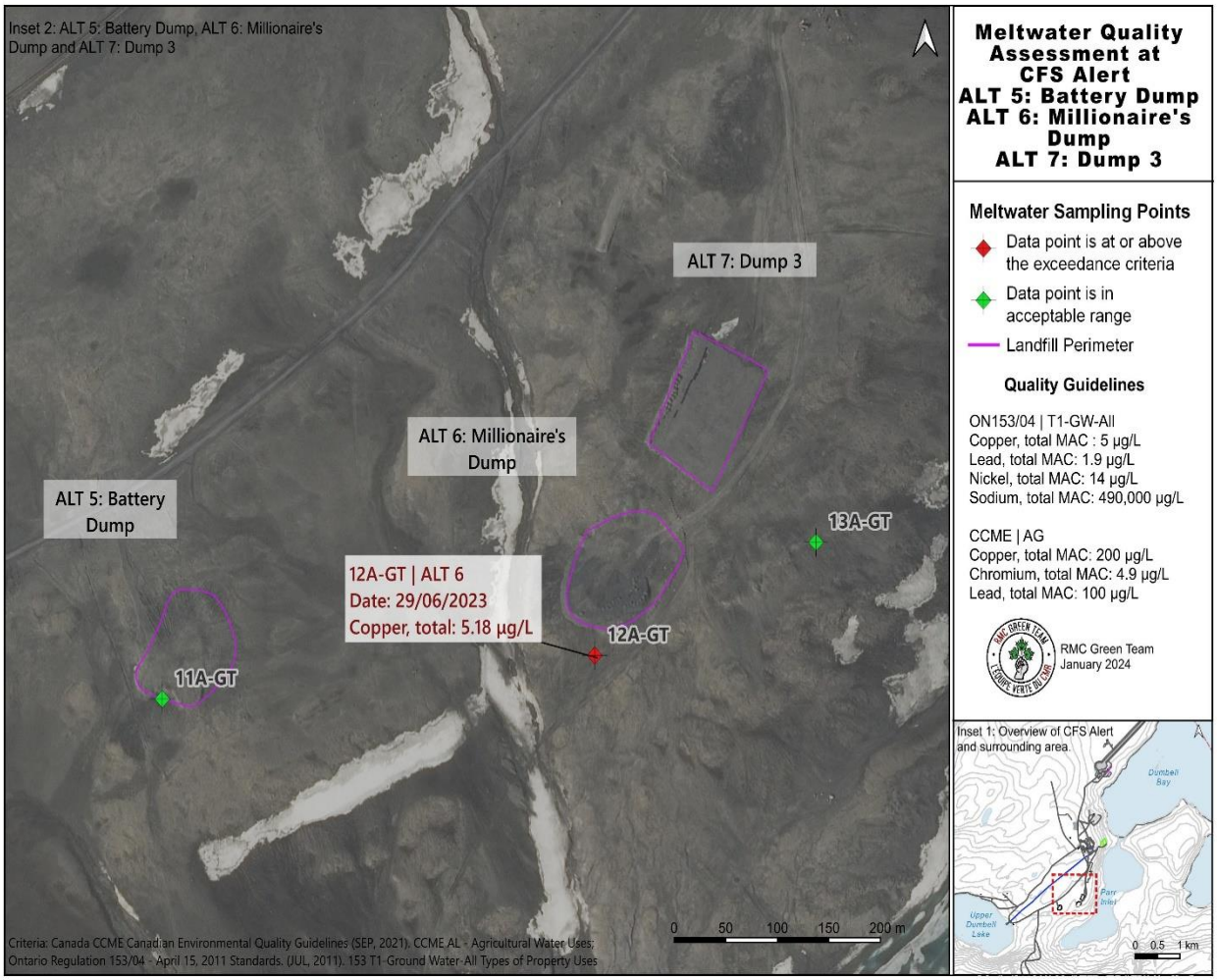

Figure 8: ALT 5- Battery Dump, ALT 6- Millionaire's Dump and ALT 7- Dump 3 Meltwater Sampling Points.

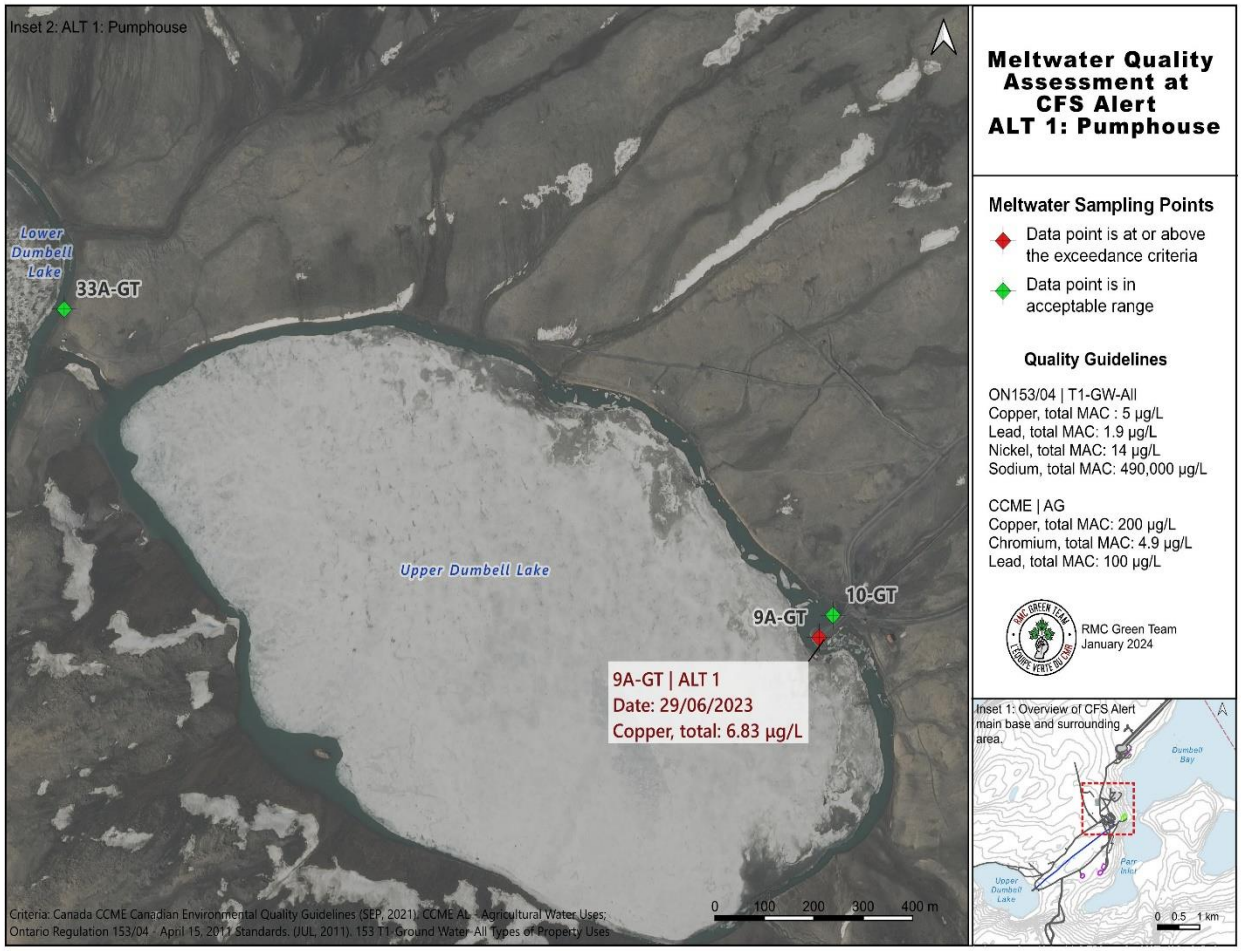

Figure 9: ALT 1 - Pumphouse Meltwater Sampling Points.

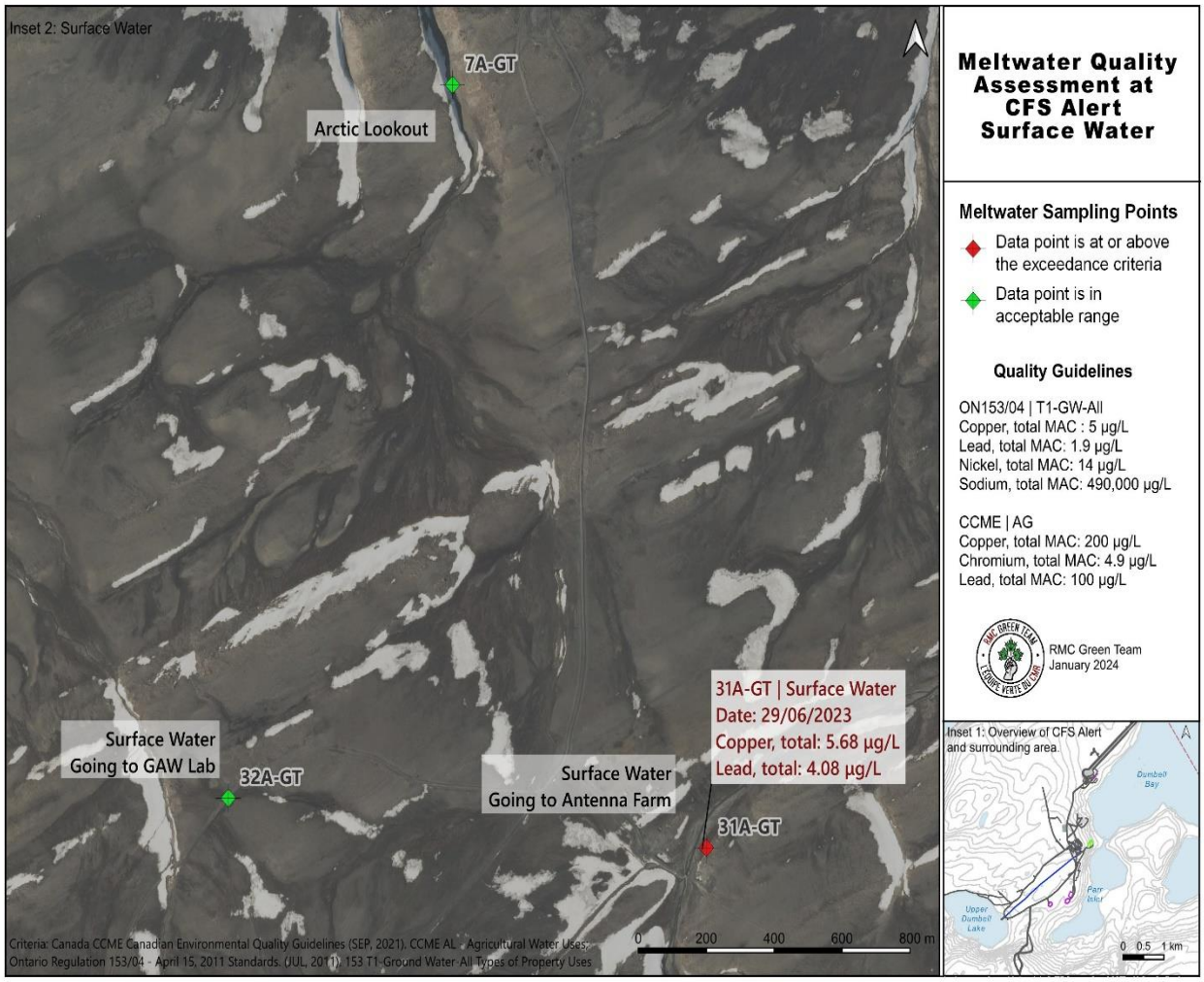

Figure 10: Surface Water Sampling Points.

APPENDIX C: Summary of Site-Visit Sampling - ALT 8: Lower Tank Farm.

Sample ID	Location	Sample Date	Picture
1A-GT	ALT-8; Tank 1 Containment Berm	29-Jun-2023	
2A-GT	ALT-8; Tank 2 Containment Berm	29-Jun-2023	
3A-GT	ALT-8; Tank3 Containment Berm	29-Jun-2023	

4A-GT	ALT-8; Tank 4 Containment Berm	29-Jun-2023	
5A-GT	ALT-8; Tank 5 Containment Berm	29-Jun-2023	
6A-GT	ALT-8; Tank 6 Containment Berm	29-Jun-2023	
15A-GT	ALT 8; Between Tank 1 and Tank 2	30-Jun-2023	

16A-GT	ALT 8; Tank 4 Containment Berm	30-Jun-2023	
17A-GT	ALT 8; Tank 6 Containment Berm	30-Jun-2023	
27A-GT	ALT 8; Tank 1 Containment Berm	02-Jul-2023	
28A-GT	ALT 8; Tank 4 Containment Berm	02-Jul-2023	

30A-GT	ALT 8; Tank 5 Containment Berm	02-Jul-2023	
36A-GT	ALT 8; Tank 1 Containment Berm	07-Jul-2023	
37A-GT	ALT 8; Tank 4 Containment Berm	07-Jul-2023	
29A-GT	ALT 11; Landfarm Area	02-Jul-2023	

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