North Atlantic

Appendix 4: North Atlantic Project Wastewater Sources: Process and Surface Wastewater

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Acronyms

BFW	Boiler Feedwater
CW	Cooling Water
HGP	Hydrogen Generation Plant
HP	Hydrogenation Plant
LOHC	Liquid Organic Hydrogen Carrier
MCH	Methylcyclohexane
NNF	Not Normally Flow
RO	Reverse Osmosis

1 Introduction

The following is an overview of the project wastewater sources. This is a combination of surface water that will collect in the area and wastewater from the Hydrogen Generation Plant (HGP) and Hydrogenation Plant (HP). The description, along with corresponding flow diagrams, highlights raw water sources, key flow streams, and characterisations of wastewater for both facilities and surface water at the site.

In both the HGP and HP, bunded areas underneath the process equipment for secondary containment of any lubricant oils or grease will be included in the engineering design for the facilities.

2 Hydrogen Generation Plant

The Hydrogen Generation Plant (HGP) functions as an independent unit that produces green hydrogen through PEM electrolysis supported by renewable wind energy. Figure 1 demonstrates the process flow for the HGP. Raw water is drawn from Inkster's Pond and sent into the electrolyzer cabinets to be treated through reverse osmosis (RO). The produced demineralized water is utilized for hydrogen production; the subsequent wastewater is the reject from the RO process. This wastewater is measured, routed to treatment if necessary, and eventually discharged at the final outfall location.

Figure 1 also shows the HGP firewater system. The HGP firewater system operates with no routine make-up demand (i.e., Normally No Flow (NNF)), relying on a dedicated 1,817 m^3 storage tank capable of supplying two hours of emergency firewater. Therefore, this system is a closed loop with no discharge.

2.1 HGP Wastewater Stream

Wastewater from the HGP will be reject water from the RO system within the electrolyzer cabinets. As seen in Figure 1, for 30,000 tonnes of hydrogen production per year, the electrolyzer cabinets will consume a maximum of approximately 100.5 m^3/hr (Stream 1) of raw water from Inkster's Pond. With an assumed reject ratio of ~50%, this results in roughly 50.3 m^3/hr (Stream 2) of wastewater during operation of the HGP.

3 Hydrogenation Plant

The Hydrogenation Plant (HP) converts green hydrogen from the HGP into a Liquid Organic Hydrogen Carrier (LOHC) for storage and transportation. The HP has stringent conditions to ensure process safety and product quality; thus, both the inlet toluene and hydrogen require specific purities for proper conversion into Methylcyclohexane (MCH). Hydrogen from the HGP is produced at the necessary purity, however due to the cyclic nature of the toluene feedstock, impurities can build up requiring pre-treatment. A Toluene

Pre-treatment System is implemented within the HP to remove impurities from the inlet toluene, as presented in Figure 2.

Additionally, similar to existing industrial refineries, process equipment and operating conditions within the HP are maintained by steam and cooling mediums. This includes a boiler system for steam generation and a cooling water (CW) system for temperature regulation, detailed in Figures 3 and 4 respectively. Both systems require make-up water that has been treated through demineralization. The demineralization system presented in Figure 2 is necessary to remove minerals and other impurities from the make-up water, preventing equipment damage and mitigating buildup in these sensitive systems.

Based on the above systems, the HP will generate effluent from four main sources, wastewater from the demineralized water treatment system, blowdown from the boiler system, blowdown from the cooling water system, and wastewater from the toluene purification unit. Wastewater, along with blowdown, will be measured for parameters of concern, routed to treatment if necessary, and eventually discharged at the final outfall location. The firewater system, depicted in Figure 2, has no routine make-up demand (i.e. NNF) and stores 2,544 m^3 of water directly from Inkster's pond in a storage tank capable of providing two hours of emergency firewater.

3.1 Distillation Column Residual Condensate

As outlined in Section 2.3.2.6 of the original Environmental Assessment Registration document, the reaction which generates MCH from toluene and hydrogen is not tolerant of the presence of water. As such, the toluene pre-treatment package has a distillation column that will be installed upstream of the HP reactors to strip water from the toluene stream that feeds into the reactor (Figure 2). For the 30 ktpa production case, water is expected to be extracted from the distillation column at a rate for 57 kg/hr (Stream 4). This stream, which is expected to be relatively pure given it is drawn from a distillation column, will be condensed and sent to an oil-water separation unit. Separated oil (condensate) from the separation system will be periodically pumped out and trucked to a licensed industrial wastewater treatment facility for treatment and disposal.

Due to the residual nature of the oil, the wastewater from the oil-water separator will be limited to less than 15 ppm of oil and will be suitable for discharge based on Schedule A of *Environmental Control Water and Sewage Regulations, 2003*. The exact type of oily water separator is not selected at this time. However, similar to the other effluent streams, this wastewater stream will be measured for parameters of concern, routed to further treatment if necessary, and eventually discharged at the final outfall location (Stream 7).

3.2 Demineralized Water Effluent Streams

Demineralized water required for the HP systems will be generated through a new water treatment system that utilizes fresh water from Inkster's Pond Industrial Water Supply Area. The production of demineralized water will create a wastewater stream; however, the closed loop design for the CW and boiler systems will minimize the amount of make-up water required and the associated wastewater generation.

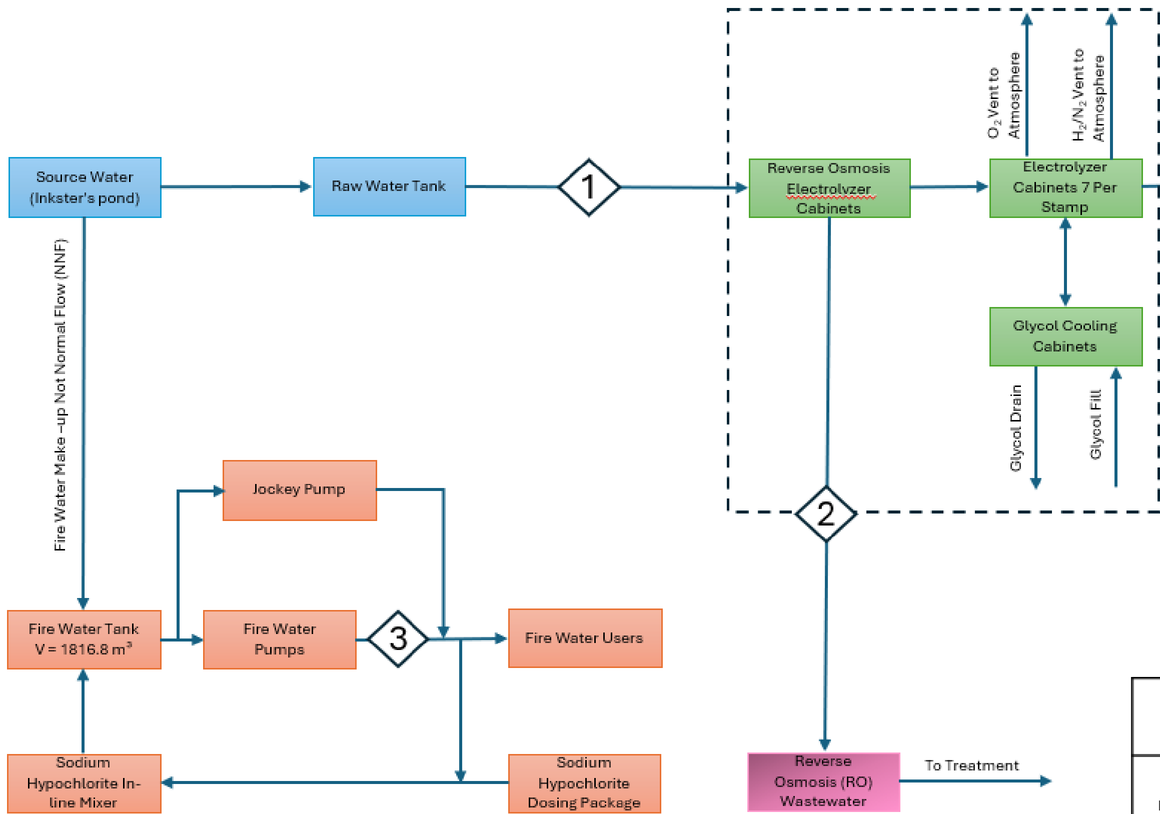
As seen in Figure 2, the amount of source water anticipated to be drawn from Inkster's Pond is 6.0 m^3/hr (Stream 5). Currently a typical rejection for the treatment process is assumed to be ~25%, resulting in 1.5 m^3/hr (Stream 6) of wastewater and approximately 4.5 m^3/hr of makeup water for both the boiler feedwater (BFW) and CW. The wastewater from the demineralized water treatment system will have a composition similar to wastewater found in typical industrial demineralization systems that are employed for BFW and CW. The existing outfall at the Come By Chance Industrial Site (Appendix B2) can handle such wastewater should the project utilize this outfall location.

3.3 Boiler Feedwater and Cooling Systems Blowdown

Both the boiler and CW systems operate as closed-loop systems. As seen in their respective diagrams (Figures 3 and 4), the BFW circulates at a constant rate of 154 m^3/hr (Stream 10), while the CW circulates at 226 m^3/hr (Stream 13). Wastewater generation from these systems is limited to blowdown from the surface condensate drum (boiler system) and the cooling tower (CW system). Each source contributes approximately 2.25 m^3/hr of blowdown (Streams 11 and 14). Due to the purity requirements of the make-up water for the boiler and CW systems, the blowdown from these systems will be relatively pure and are expected to meet the requirements of Schedule A of *Environmental Control Water and Sewage Regulations, 2003.*

These losses are replenished using the 4.5 m^3/hr of demineralized water, maintaining stable operation while minimizing water consumption and discharge.

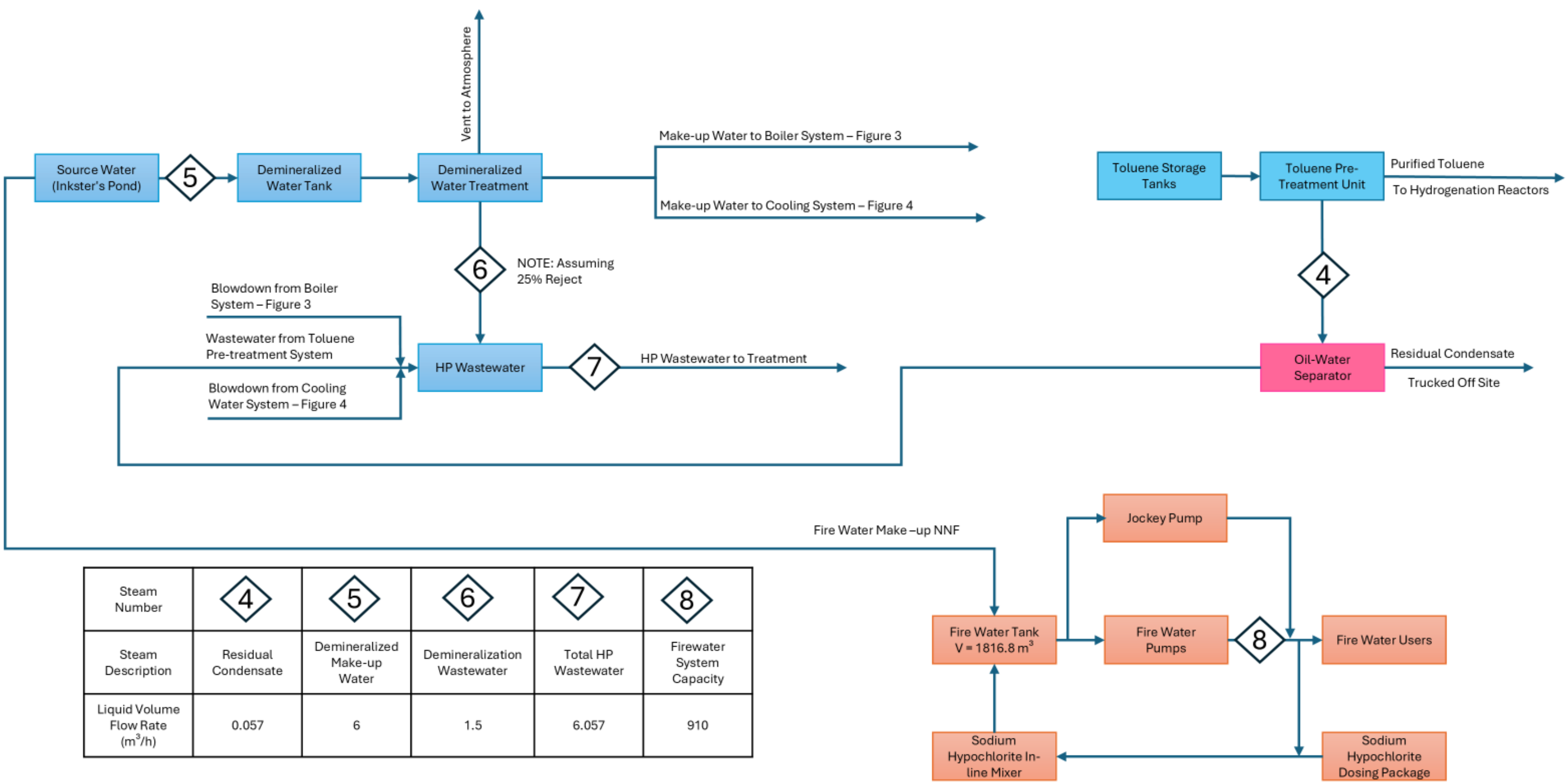
Hydrogen Generation Plant (HGP) – Electrolyzer & Firewater Systems



Steam Number	1	2	3
Steam Description	Raw water to Electrolyzers	RO Reject Wastewater	Fire Water System Capacity
Liquid Volume Flow Rate (m^3/h)	100.5	50.275	910

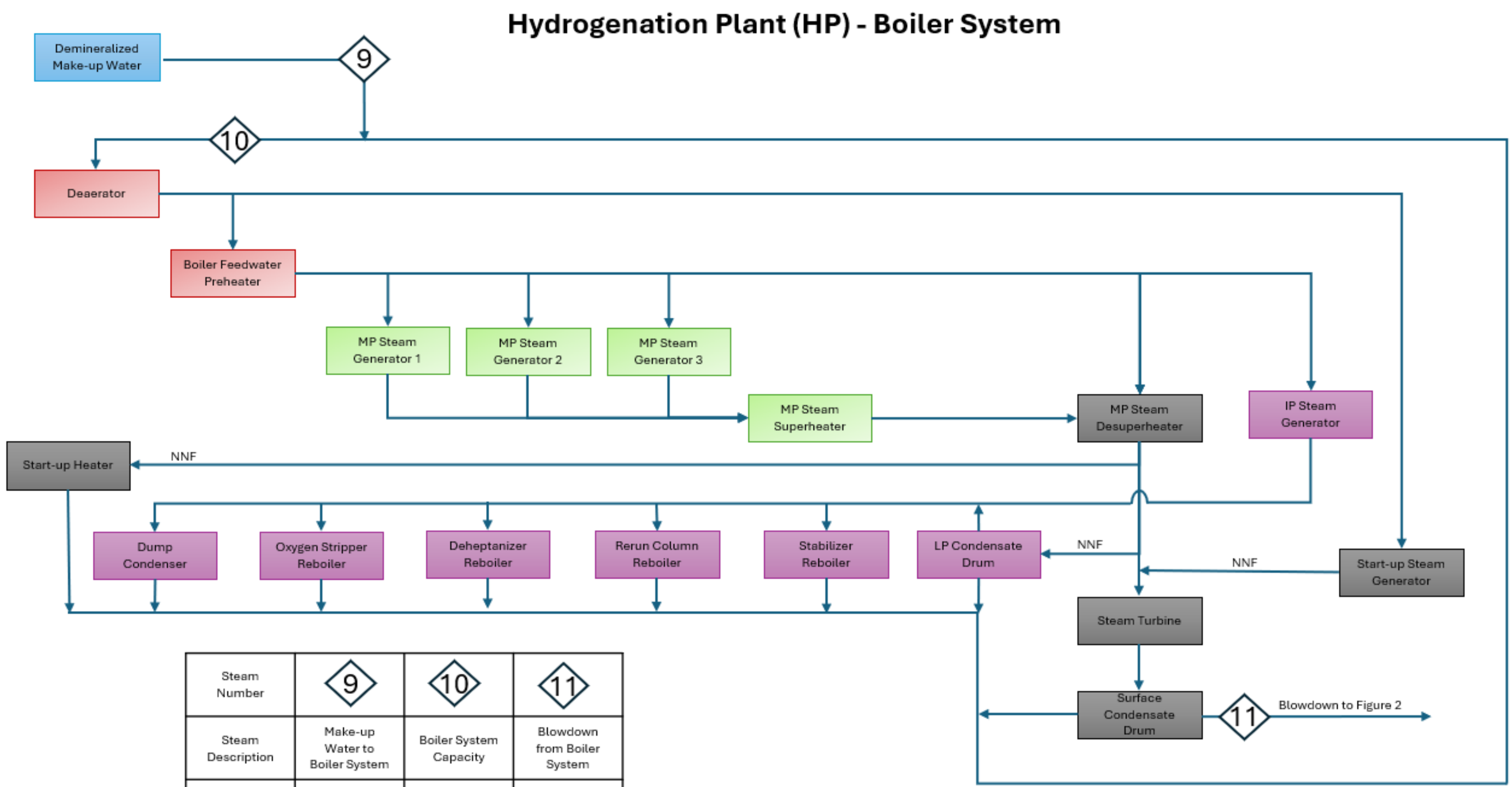
Figure 1 HGP Electrolyer and Firewater System

Hydrogenation Plant (HP) - Demineralized Water Treatment, Toluene Pre-treatment & Firewater Systems



Steam Number	4	5	6	7	8
Steam Description	Residual Condensate	Demineralized Make-up Water	Demineralization Wastewater	Total HP Wastewater	Firewater System Capacity
Liquid Volume Flow Rate (m^3/h)	0.057	6	1.5	6.057	910

Figure 2 HP Demineralized water, Toluene Pre-treatment and Firewater System.



Steam Number	9	10	11
Steam Description	Make-up Water to Boiler System	Boiler System Capacity	Blowdown from Boiler System
Liquid Volume Flow Rate (m^3/h)	2.25	154	2.25

Figure 3 HP Boiler System

Hydrogenation Plant (HP) - Cooling Water (CW) System

Steam Number	12	13	14
Steam Description	Make-up Water to Cooling Water System	Cooling Water System Capacity	Blowdown from Cooling Water System
Liquid Volume Flow Rate (m^3/h)	2.25	226	2.25

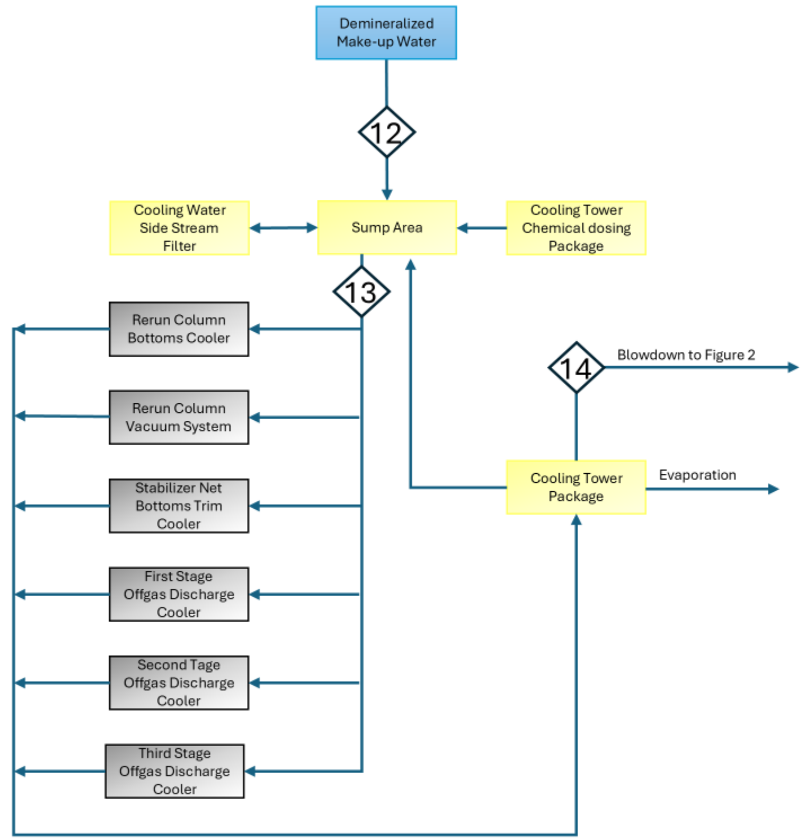


Figure 4 HP Cooling Water System

4 Surface water

A final source of wastewater from the project is surface water. Surface water runoff from both the HGP and HP will be collected to an open drains system, as per Sections 2.3.1.6 and 2.3.2.8 of the original Environmental Assessment Registration Document.

North Atlantic has conducted a surface water runoff sampling program throughout key process areas at the site. Figure 5 presents the sample locations. Based on the characterization provided in Table 1, the wastewater from this source is compliant with Schedule A of *Environmental Control Water and Sewage Regulations, 2003*. As per the EA registration, this stream will be routed to the Braya holding tank and eventually discharged through the existing outfall.

North Atlantic	FIGURE TITLE: **Stormwater Sampling Locations**	NOTES: The location of proposed project infrastructure is considered preliminary and is subject to change.	PREPARED BY: J. Crocker	DATE: 2026-03-12
			REVIEWED BY:	
			APPROVED BY:	
	PROJECT TITLE: North Atlantic Wind to Hydrogen Project		CRS: WGS 1984 UTM Zone 22N	
			sem	

SEM MAP ID: 016-015-GIS-EPR-069-Rev0

Figure 5 Surface/Stormwater Sample Locations

5 Wastewater Stream Characterization

Table 1 below presents the wastewater and effluent stream characterization in relation to Schedule A of *Environmental Control Water and Sewage Regulations, 2003,* and respective stream flowrates. It includes the wastewater streams outlined in this report:

HGP RO wastewater from electrolyzer streams.

HP - demineralization wastewater, BFW blowdown, CW blowdown.

Surface/stormwater water results (referred to in section 4.0).

Note: Toluene pre-treatment wastewater is not included as it is source water with a trace amount of residual oil. It will be routed to a separator to ensure compliance.

Information regarding electrolzyer wastewater modelling can be found in Attachment 1 of this document. The modeling uses source water results to determine the final characteristics of the RO wastewater for electrolyzers. For parameters that were not detectable (ND) for items that could be present in trace amounts, ½ of the reporting detection limit (RDL) was used. These are shown as modelled source water in Table 1.

The process of demineralizing source water for the HGP and HP is undertaken to remove minerals and other impurities to prevent damage to equipment and avoid buildup in sensitive systems. The process as a result removes many minerals, some cations, anions and metals. The process of reverse osmosis also removes 99% of dissolves solids, coliforms, chemicals and metals. This was the basis for the assumed amounts shown in Table 1 for the Demineralization wastewater.

For both Boiler Feedwater and Cooling Water Blowdown, the Demineralized water provides the feedwater for these systems. It is assumed that these processes can increase the concentration of some parameters of schedule A potentially by ~ 4 times in the wastewater. This is typical from these types of processing. North Atlantic has engaged with an Engineering firm and manufacturers of similar equipment to confirm the validity of this assumption. Therefore, the table shows a range for the assumed result, using the demineralized water (assumed) and the modeled source water to be conservative.

6 Conclusion

The wastewater streams described in this document and shown in Table 1 are below the prescribed limits of Schedule A for discharge. The results clearly demonstrate that the project's wastewater will meet the level of compliance necessary for discharge. This will be further verified during the commissioning phase of the project with field measurements to ensure the treatment and systems are operating as intended before any discharges occur. The discharges once operational will be verified regularly and reported as per legislation.

Table 1 Wastewater/Effluent Stream Characterization

Parameter	Schedule A Limits (mg/L)[1]	Measured Source Water (mg/L)[1]	Modelled Source Water (mg/L)[1]	Demineralization Wastewater (mg/L)[1]	BFW Blowdown (mg/L)[1]	Cooling Water Blowdown (mg/L)[1]	Electrolyzers RO wastewater (mg/L)[1]	Surface water Sample 1 (mg/L)[1]	Surface water Sample 2 (mg/L)[1]
Stream Flow From Figures	**-**	-	-	1.5 m^3/hr	2.25 m^3/hr	2.25 m^3/hr	50.3 m^3/hr	Varied based on precipitation	Varied based on precipitation
B.O.D.	**20**	ND[2]	1	ND	ND-4	ND-4	4	ND	ND
Coliform - faecal	**1000/100mL**	6 (MPN/100mL)	6 (MPN/100mL)	ND	ND-24 (MPN/100mL)	ND-24 (MPN/100mL)	24 (MPN/100mL)	24 (CFU/100mL)	1.0 (CFU/100mL)
Coliform - total	**5000/100mL**	345 (MPN/100mL)	345 (MPN/100mL)	<345 (MPN/100mL)	ND -1380 (MPN/100mL	ND -1380 (MPN/100mL	1380 (MPN/100mL)	5.0 (CFU/mL)	5.0 (CFU/mL)
Solids, total dissolved [TDS]	**1000**	52	52	<52	ND-208	ND-208	ND-208	130	190
Solids, total suspended [TSS]	**30**	ND	1.5	ND	ND-6	ND-6	ND-6	ND	ND
Oils (Ether extract)	**15**	ND	0	ND	ND	ND	ND	ND	ND
Floating debris, oils and grease	**None to be visible**	ND	0	ND	ND	ND	ND	ND	ND
Arsenic	**0.5**	0.00024	0.00024	ND	ND-0.00096	ND-0.00096	0.00096	ND	ND
Barium	**5.0**	0.00776	0.00776	ND	ND-0.03104	ND-0.03104	0.03104	0.022	0.032
Boron	**5.0**	ND	0.005	ND	ND-0.02	ND-0.02	0.02	ND	ND
Cadmium	**0.05**	ND	0.0000053	ND	0.000021	0.000021	0.000021	0.00003	ND
Chlorine	**1.0**	0	0				0	ND	ND
Dissolved Chloride (Cl-)	**N/A[3]**	6.3	6.3	ND	ND-25.05	ND-25.05	25.05	ND	ND
Chromium (hexavalent)	**0.05**	ND	0.00025	ND	ND-0.001	0.001	0.001	ND	ND

Parameter	Schedule A Limits (mg/L)[1]	Measured Source Water (mg/L) [1]	Modelled Source Water (mg/L) [1]	Demineralization Wastewater (mg/L) [1]	BFW Blowdown (mg/L) [1]	Cooling Water Blowdown (mg/L) [1]	Electrolyzers RO wastewater (mg/L) [1]	Surface water Sample 1 (mg/L) [1]	Surface water Sample 2 (mg/L) [1]
Chromium (trivalent)	**1.0**	ND	0.00025	ND	ND-0.001	0.001	0.001	ND	ND
Copper	**0.3**	0.00085	0.00085	ND	0.0034	0.0034	0.0034	0.0014	0.001
Cyanide	**0.025**	ND	0.0025	ND	0.01	0.01	0.01	ND	ND
Iron (total)	**10**	0.481	0.481	ND	ND-1.924	1.924	1.924	0.38	0.096
Lead	**0.2**	0.000215	0.000215	ND	ND-0.00086	0.00086	0.00086	ND	ND
Mercury	**0.005**	0.0000076	0.0000076		ND-0.00003	0.00003	0.00003	ND	ND
Nickel	**0.5**	0.00092	0.00092	0.00368	0.00368	0.00368	0.00368	0.0072	ND
Nitrates	**10**	ND	0.01	ND	ND-0.04	0.04	0.04		
Nitrogen (ammoniacal)	**2.0**	0.31	0.31	ND	ND-1.24	ND-1.24	1.24	ND	ND
Phenol	**0.1**	ND	0.0005	ND	ND-0.002	ND-0.002	0.002	ND	ND
Phosphates (total as) P_2O_5)	**1.0**	0.0231	0.0231	0.0231	0.0231-0.0924	0.0231-0.0924	0.0924		
Phosphorus (elemental)	**0.0005**	0	0	0	0	0	0	ND	ND
Selenium	**0.01**	0.000099	0.000099	ND	ND-0.000396	ND-0.000396	0.000396	ND	ND
Sulphides	**0.5**	ND	0.0055	ND	ND-0.022	ND-0.022	0.022	ND	ND
Silver	**0.05**	ND	0.000005	ND	ND-0.00002	ND-0.00002	0.00002	ND	ND
Zinc	**0.5**	ND	0.0015	ND	ND-0.006	ND-0.006	0.006	0.015	0.021

Notes:

[1]All units are in mg/L unless otherwise noted.

[2]ND = Not detected at a concentration equal or greater than the detection limit.

[3]Dissolved Chloride is included in the table for effluent modelling purposes only

Attachment 1: Electrolyzer Water Quality Analysis Report

Objective

The objective of this report is to assess the quality of feed water supplied by NARC and evaluate its suitability for use in OEM's water treatment and purification systems—particularly for applications requiring high-purity water such as PEM electrolyzers. This analysis aims to:

- Compare measured water quality parameters against OEM's required limits.
- Identify contaminants that exceed acceptable thresholds.
- Estimate likely reject-water characteristics based on mass balance.

Input Data

Facility water details provided by NARC:

Parameter	Concentration (mg/L)
B.O.D.	1
Coliform - faecal	6 (MPN/100mL)
Coliform - total	345 (MPN/100mL)
Solids, total dissolved [TDS]	52
Solids, total suspended [TSS]	1.5
Oils (Ether extract)	0
Floating debris, oils and grease	0
Arsenic	0.00024
Barium	0.00776
Boron	0.005
Cadmium	0.0000053
Chlorine	0
Dissolved Chloride (Cl-)	6.3
Chromium (hexavalent)	0.00025
Chromium (trivalent)	0.00025
Copper	0.00085
Cyanide	0.0025
Iron (total)	0.481
Lead	0.000215
Mercury	0.0000076

Parameter	Concentration (mg/L)
Nickel	0.00092
Nitrates	0.01
Nitrogen (ammoniacal)	0.31
Phenol	0.0005
Phosphates (total as P2O5)	0.0231
Phosphorus (elemental)	N/A
Selenium	0.000099
Sulfides	0.0055
Silver	0.000005
Zinc	0.0015

Results

The performance of the electrolyzer cabinet is evaluated by using the measured cation and anion inputs. An advanced mass-balance approach, incorporating DI-water quality constraints, is applied to estimate the expected characteristics of the reject water with greater accuracy.

Reject Water Characteristics:

Parameters	Value	Unit
B.O.D.	4	mg/L
Coliform - faecal	24	(MPN/100mL)
Coliform - total	1380	(MPN/100mL)
Solids, total dissolved [TDS]	208	mg/L
Solids, total suspended [TSS]	6	mg/L
Oils (Ether extract)	10	mg/L
Floating debris, oils and grease	20	mg/L
Arsenic	0.00096	mg/L
Barium	0.03104	mg/L
Boron	0.02	mg/L
Cadmium	0.000021	mg/L
Chlorine	0	mg/L
Dissolved Chloride (Cl-)	25.05	mg/L
Chromium (hexavalent)	0.001	mg/L

Parameters	Value	Unit
Chromium (trivalent)	0.001	mg/L
Copper	0.0034	mg/L
Cyanide	0.01	mg/L
Iron (total)	1.924	mg/L
Lead	0.00086	mg/L
Mercury	0.00003	mg/L
Nickel	0.00368	mg/L
Nitrates	0.04	mg/L
Nitrogen (ammoniacal)	1.24	mg/L
Phenol	0.002	mg/L
Phosphates (total as P_2O_5)	0.0924	mg/L
Phosphorus (elemental)	0	mg/L
Selenium	0.000396	mg/L
Sulfides	0.022	mg/L
Silver	0.00002	mg/L
Zinc	0.006	mg/L