Appendix E

Transportation Impact Study and Traffic Management Plan

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Argentia Renewables Project

Issued by: Argentia Renewables Wind LP
Project Facility: All Locations
Affected Facility: All Locations

Effective Date: July 31, 2024

Document Maintenance and Control

Argentia Renewables Wind LP (Argentia Renewables), an affiliate of Pattern Energy Group LP (Pattern), is responsible for the distribution, maintenance and updating of this Transportation Impact Study and Traffic Management Plan for the Argentia Renewables Project (the "Project"). This plan will be updated when needed for reasons including but not limited to reflecting changes in site-specific implementation, updating contact information, changes to scientific methods and survey best practices.

Document Revision Record				
Issue Date (mm/dd/yyyy)	**Rev. #**	**Prepared by**	**Approved by**	**Issue Purpose**

Index of Major Changes/Modifications in Latest Version

Item #	Description of Change	Relevant Section

Table of Contents

List of Figures

List of Tables

1.0 Introduction

This Transportation Impact Study (TIS) and Traffic Management Plan (TMP) have been developed by Argentia Renewables Wind LP (Argentia Renewables), an affiliate of Pattern Energy Group LP (Pattern) for the Argentia Renewables Project (the Project), which involves the Construction, Operation and Maintenance, and eventual Decommissioning and Rehabilitation of an onshore wind energy generation facility (Argentia Wind Facility) and a green hydrogen and ammonia production, storage, and export facility (Argentia Green Fuels Facility). This plan focuses on the sections of existing public roads within the Project Area; however, attention is also given to the private (Port of Argentia (POA) and Project extensions) road networks that will be used for the Project.

The TIS examines the required utilization of existing infrastructure for transporting oversized and overweight Project materials and equipment, especially during Project Construction Phase, and the potential interaction with other traffic along the proposed transportation routes. The TMP identifies mitigation and control measures for Project-related traffic during all phases of the Project.

Project wind turbine components will be received at the POA dock and subsequently transported to a laydown area on the POA property prior to delivery to each turbine site for erection. Only short sections of public roads will be required for transport of large (oversize and overweight) equipment items. Other Project usage of the public road network will be limited generally to conventional vehicles and loads associated with personnel, supplies, and service transportation.

1.1 Legal

This document has been developed in compliance with the requirements of the Province of Newfoundland and Labrador. As a component of a Project Registration under the **Environmental Protection Act (Environmental Assessment Regulations)**, this document is considered to reflect a commitment by Argentia Renewables to carry out the actions described and to report on results achieved.

1.2 Scope

The TIS and TMP assesses the potential effects of transporting oversized and overweight Project materials and equipment over existing roadways, during the Construction Phase, Operation and Maintenance Phase, and Decommissioning and Rehabilitation Phase of the Argentia Renewables Project. The focus of attention has been placed on the Construction Phase as it involves the bulk of Project materials and equipment transport.

In April 2023, the NL Department of Environment and Climate Change (NL DECC) - Environmental Assessment Division, issued its Guidance for Registration of Onshore Wind Energy Generation and Green Hydrogen Production Projects. The intent of this TIS and TMP is to comply with Section 4.5 (item #4) of the Guidance document.

1.3 Objectives

The objective of this TIS and TMP is to identify the potential effects of Project traffic on public roads and traffic, and to develop mitigation measures that will reduce or avoid negative effects.

1.4 Roles and Responsibilities

Argentia Renewables will be accountable for the review and acceptance of the TIS and TMP. All employees, contractors, and visitors to the Project site will be made aware of this document during orientation. The following roles have specific duties regarding Traffic Management:

Executive Staff:

- Responsible for the entire Project governance.
- Responsible for overall transport and traffic law compliance of the Company.
- Responsible to ensure all support and resources are available to successfully implement the TMP.

Project Manager:

- Responsible to ensure permits and all authorization conditions are in place and known to managers.
- Manage the development and application of all permits and required authorizations from applicable municipal, provincial and federal regulators.

Construction Manager:

- Provide required supports and resources for the TMP.
- Ensure equipment and transport compliance of all permits and authorizations.
- Report to the on-site Environmental staff of any traffic incidents or sightings of wildlife by construction staff.
- Ensure staff are working safely and following all traffic policies and Rules of the Road.

Occupational Health and Safety Manager:

- Provide training and resources related to health and safety at the Project site for all stages of the Project (including traffic safety).
- Promote and maintain safe working conditions through policies and procedures.
- Meet all legislative requirements related to health and safety.

- Investigate, track, and report all near misses and incidents related to the Project.
- Analyse and conduct lessons learned to avoid recurrence.
- Develop and enforce policies related to the Project.

Environmental Manager:

- Investigate and document any environmental incidents, interactions, or sightings.
- Ensure all staff are updated on weather conditions that could potentially impede or restrict transportation activities.

All Employees and Contractors:

- Complete orientation and training on traffic issues and management procedures specific to their area or work type.
- Aware of traffic management procedures related to their area or work type.

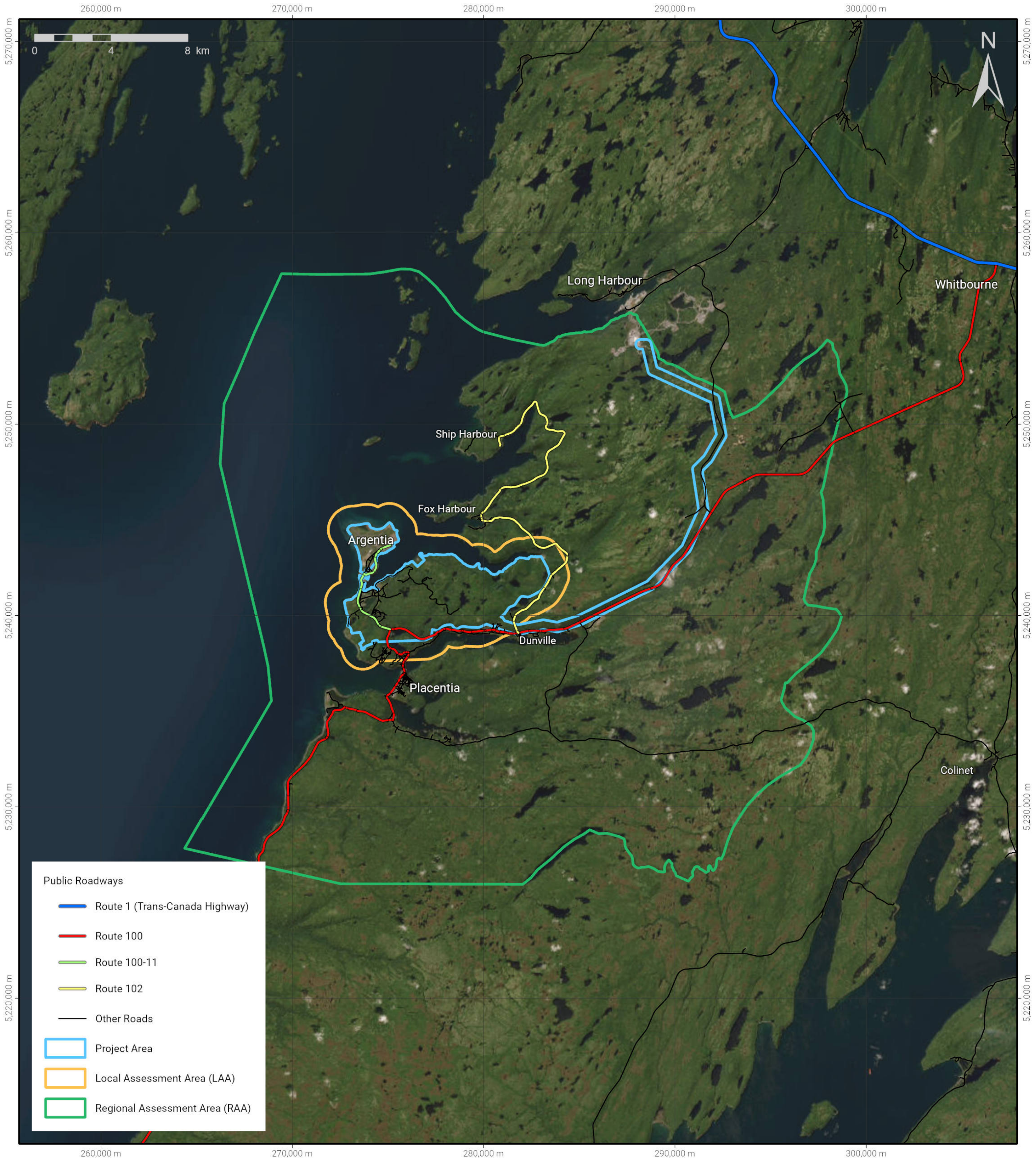
2.0 Road Infrastructure

This section of the management plan describes the existing road network in the Project area, including public highways, and the road network within the Town of Placentia. Infrastructure access roads to be constructed for the Project are also described.

2.1 Highways

2.1.1 Route 100 – Cape Shore Highway

Route 100 – Cape Shore Highway (Figure E-2.1.1-1) is a 108 km undivided two-lane, two-way highway with intermittent siding passing lanes, and has a posted speed limit of 100 km/h, with speed reductions through residential areas. The highway forms the primary access route for the area, connecting to the Trans-Canada Highway at Whitbourne, and branching at Freshwater. One branch leads directly to the ferry terminal in the POA (Route 100-11), while the second leg extends south along the coastline of eastern Placentia Bay, also known as the Cape Shore, terminating in the town of Branch (Route 100-S). Along with the Trans-Canada Highway, Route 100 is a major transportation route capable of accommodating transportation demands associated with the Project.



Pattern | Argentia Renewables	FIGURE NUMBER: E - 2.1.1 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 06/06/2024
	FIGURE TITLE: Regional Roadways - Whitbourne to Placentia	NOTES: Roads data sourced from National Topographic Service (CanVec)	REVIEWED BY:	
	PROJECT TITLE: Argentia Renewables		APPROVED BY:	
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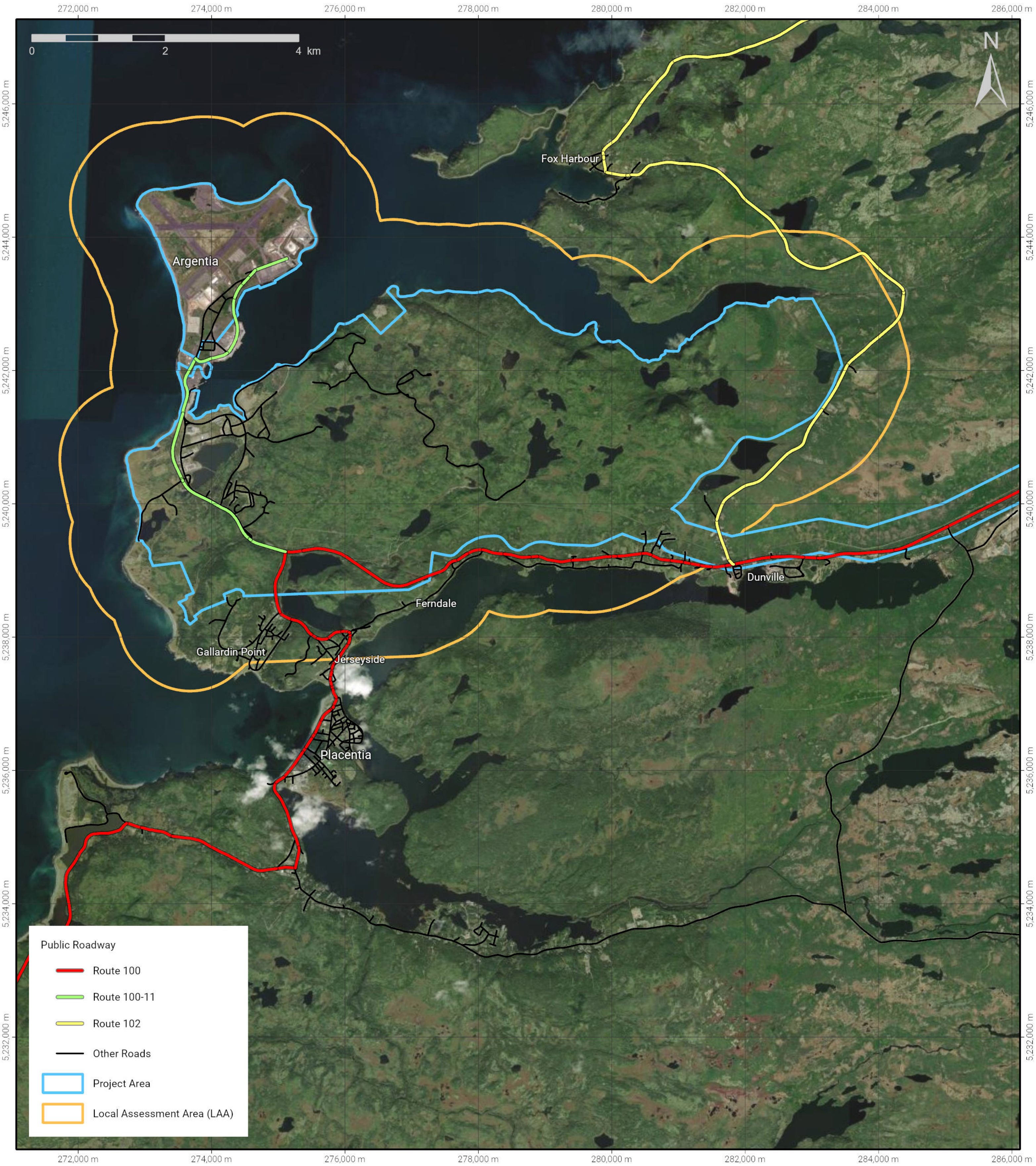
SEM MAP ID: 238-005-GIS-120-Rev0

2.1.2 Route 102 – Ship Harbour/Fox Harbour Road

Route 102 – Ship Harbour / Fox Harbour Road is a 24 km access route connecting the communities of Fox Harbour and Ship Harbour to Route 100 at Dunville. It is a two-way, undivided two-lane access route and has a posted speed limit of 60 km/h, however, speed limits are reduced in residential areas.

2.2 Local Roads

The main routes within the Town of Placentia (Figure E-2.2-1) are two-way, undivided two-lane roadways. Some side roads and streets are reduced to single-direction single laneways, or two-direction one lane roads. While most streets are interconnected or have separate entry and exit routes, other roads and streets terminate without a connection or proper exit. In more rural parts of the municipality some roadways are reduced to two-way, single or double lane paved or unpaved roadways. Route 100 traverses two separate parts of the municipality and constitutes the major access for the area. The posted speed limit is 50 km/h within the municipality and residential areas.



Pattern | Argentia Renewables	FIGURE NUMBER: E - 2.2 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 06/06/2024
	FIGURE TITLE: Regional Roadways - Town of Placentia	NOTES: Roads data sourced from National Topographic Service (CanVec)	REVIEWED BY:	
			APPROVED BY:	
	PROJECT TITLE: Argentia Renewables		sem	

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2.2.1 Port of Argentia and Project Roads

The POA is an industrial marine port, located approximately 5 km north of the community of Placentia. Currently, the traffic pattern on roads serving the POA comprise a mix of users including industrial vehicles linked to POA operations, the transportation of goods, service and maintenance vehicles for POA facilities, commuter traffic associated with the Cenovus construction site, tourist traffic associated with the Marine Atlantic Ferry Service, and general traffic serving the local area. The frequency of traffic on these roads varies throughout the day and week, correlating with vessel schedules, cargo handling activities, and operational shifts at the POA. Commuter traffic adheres to consistent patterns in alignment with the work schedules of the local population (Porter 2023).

The POA road network (Figure E-2.2.1-1) is mostly two-lane, two-way undivided roads, with Route 100-11 bisecting the area, terminating at the Marine Atlantic Ferry Terminal.

In 2023, upgrades were completed to Waterfront Drive within the POA. This project included the widening of the road as well as the selected relocation or burial of Collector Lines. The existing road was excavated and rebuilt using rockfill. The upgraded road can now accommodate loads of up to 8.8t/m^2 which greatly exceeds the typical day-to-day vehicle and trucks loads use for general operations at the port. The primary objective of these enhancements was to facilitate the efficient and safe transportation of monopiles from the marine terminal to the runway area. These improvements represent a proactive effort to optimize the POA's logistics and infrastructure, ultimately contributing to the smooth flow of goods and materials supporting a variety of industries (Roche 2023).

The Project will utilize a combination of the existing POA road network and the newly constructed roads. Figure E-2.2.1-2 presents the layout of the current existing roadways as well as the extent of proposed new construction or upgraded roads required to support equipment delivery to the wind turbine sites. Modifications include upgrading road base, widening of the roadway and shoulders, and in some instances, realigning and altering curvature to achieve restricted turning radii (Porter 2023).

Pattern | Argentia Renewables	FIGURE NUMBER: E - 2.2.1 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 06/06/2024
	FIGURE TITLE: Port of Argentia Roadways	NOTES: Roads data sourced from National Topographic Service (CanVec)	REVIEWED BY:	
			APPROVED BY:	
	PROJECT TITLE: Argentia Renewables		sem	

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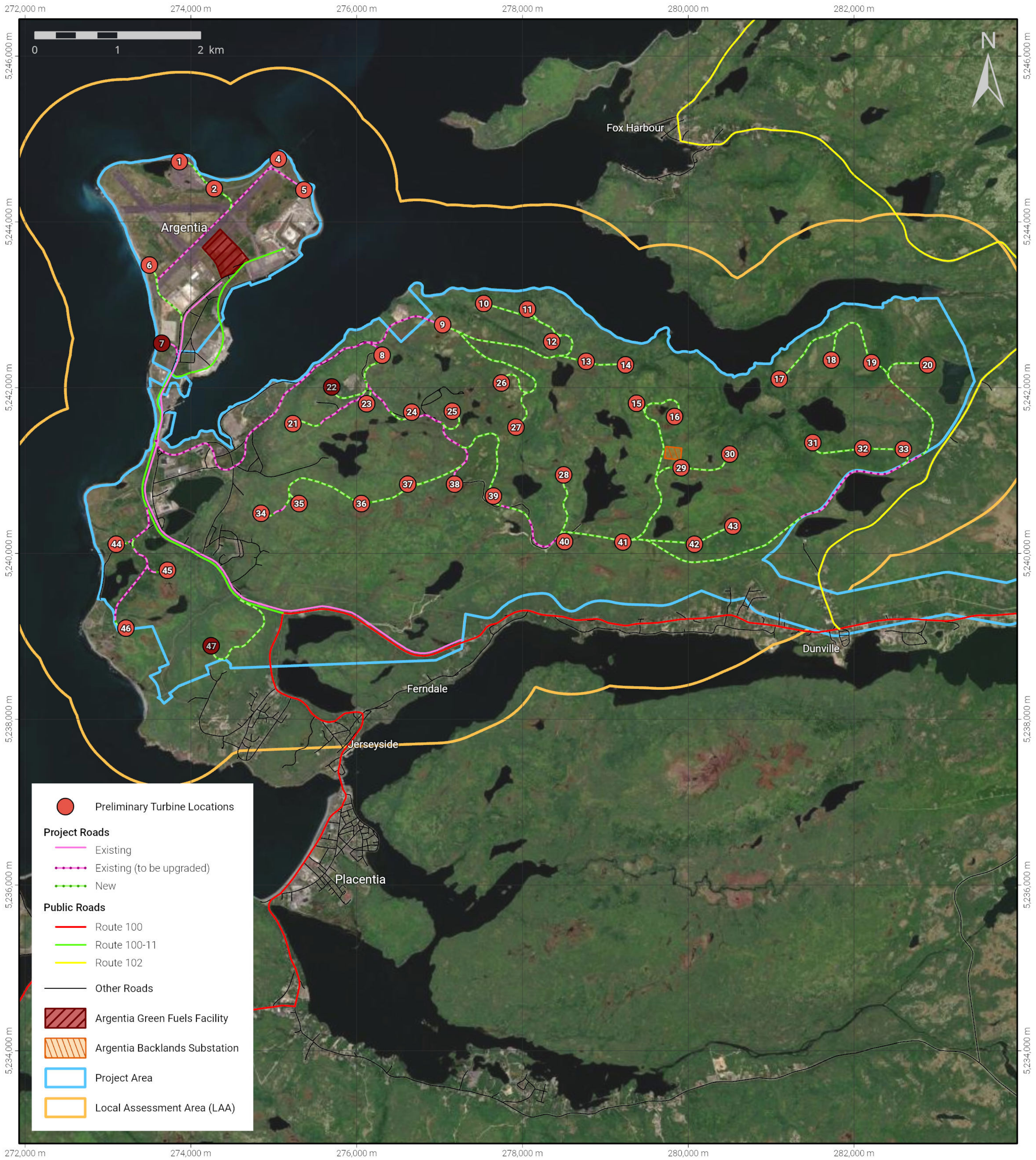

Pattern | Argentia Renewables

FIGURE NUMBER: E - 2.2.1 - 2

FIGURE TITLE: Project Infrastructure Access Routes (Current vs Planned)

PROJECT TITLE: Argentia Renewables

COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N

NOTES: Project infrastructure is considered preliminary and is subject to change. Roads data sourced from National Topographic Service (CanVec)

PREPARED BY: C. Bursey

DATE: 24/07/25

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APPROVED BY:

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As part of the preliminary design process, a study was conducted to develop Project requirements for road widths, grades and turning radii (Porter 2023). This work was completed prior to detailed design of the Project and will be updated as the design process progresses. The preliminary design basis is scaled from a reference project built using a comparable turbine model and experience in similar terrain. Table E-2.2.1-1 provides an overview of the preliminary layout design basis.

The design parameters developed for Road Bend and Intersections are illustrated in Figures E-2.2.1-3, E-2.2.1-4 and E-2.2.1-5 below, and are based on a reference turbine model, which will need to be refined once a final turbine model has been selected (Porter 2023).

Table E-2.2.1-1 Preliminary Layout Design Basis (CPL 2023).

	Argentia Project
Turbine	
Blade Length	80 m
Hub Height	119 m
Nacelle Weight Only	87 mT
Tower Sections	5
Tower Section Max Length	27.0 m
Tower Section Max Weight	71 mT (max)
Blade Transport Vehicle	Single Tridem Axle
Nacelle Transport Vehicle	Triple Tridem Axle
Site Works	
Subgrade	
Grubbing and Stripping Depth	0.3 m
Overburden Depth	1.5 m
Typical Road Section	
Running Surface Width	4.8 m
Cross Slope	2%
Road Base Thickness	0.3 m
Road Surfacing Thickness	0.1 m
Cut Slopes in Rock	1:4
Cut Slopes in Overburden	1.5:1
Overburden Slope Set Back	1.0 m
Fill Slopes	Rockfill 1.5:1 Other 2:1
Ditch W x D	0.5 m x 0.5 m
Minimum Clearing Width	Top of Cut + 3.0 m Base of Fill + 1.0 m 15 m minimum
Road Geometric Design	
Minimum Horizonal Curve Radius No Widening (0 to 45°)	200 m
Minimum Horizonal Curve Radius 50% Widening (0 to 45°)	100 m
Turn Around Area Radius	Crane Assist
Minimum Vertical Curve K ($K = Lc / \Delta G$)	18.0 m
Maximum Normal Grade	8%
Maximum Grade (with Assist)	13%
Road Straight at Turbine Areas	Preferred 120 m Minimum 80 m Grade: 0% preferred, 2% max
Turbine Areas	
Delivery and Assembly Basis	Full Steel Tower Tower Section Storage Single Blade Delivery and Offload
Crane Hard Stand Area	30 m x 25 m
Turbine Site Area	80 m x 55 m
Additional Road Widening for Crane Boom Assembly	100 m x 5 m

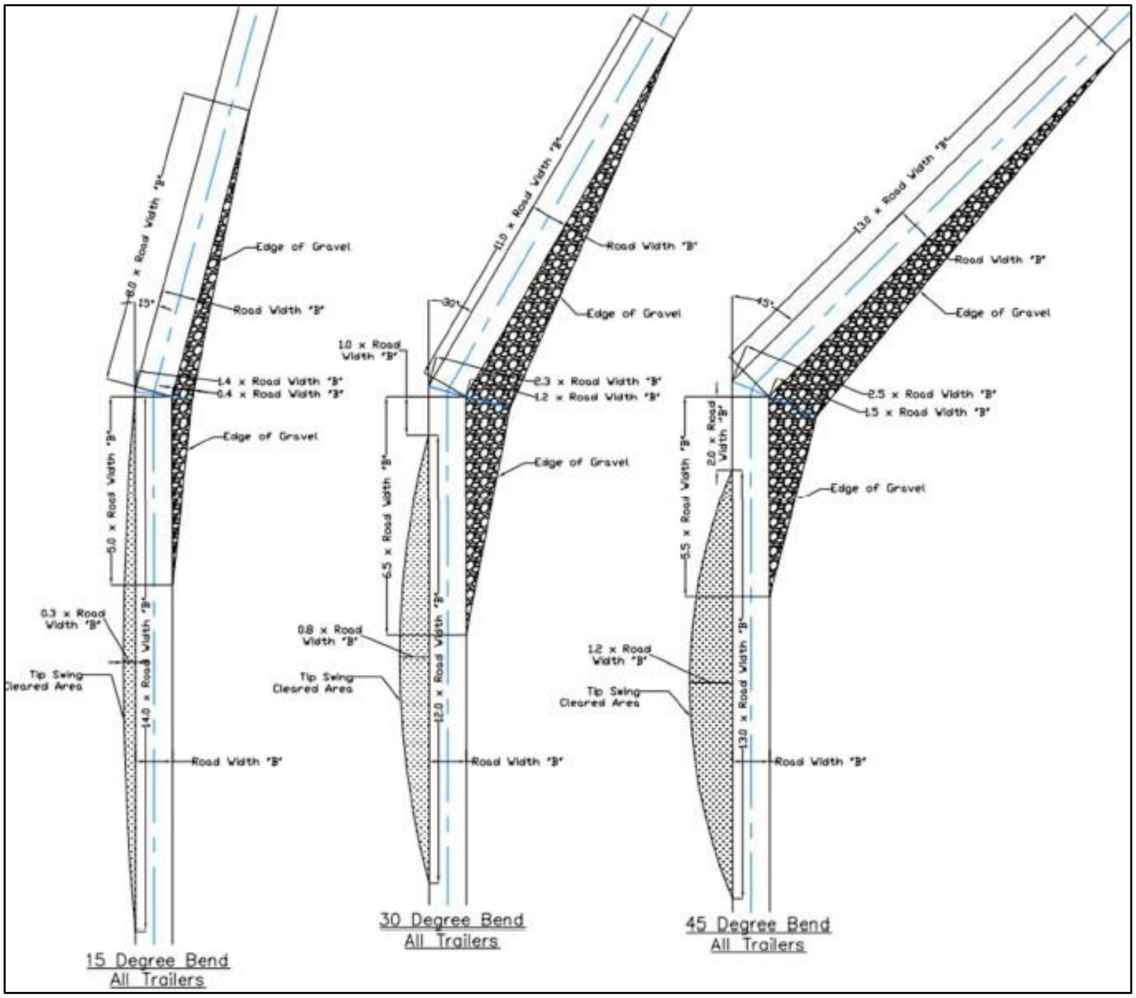


Figure E-2.2.1-3 Standard Blade Truck Templates – Various Bends (CPL 2023).

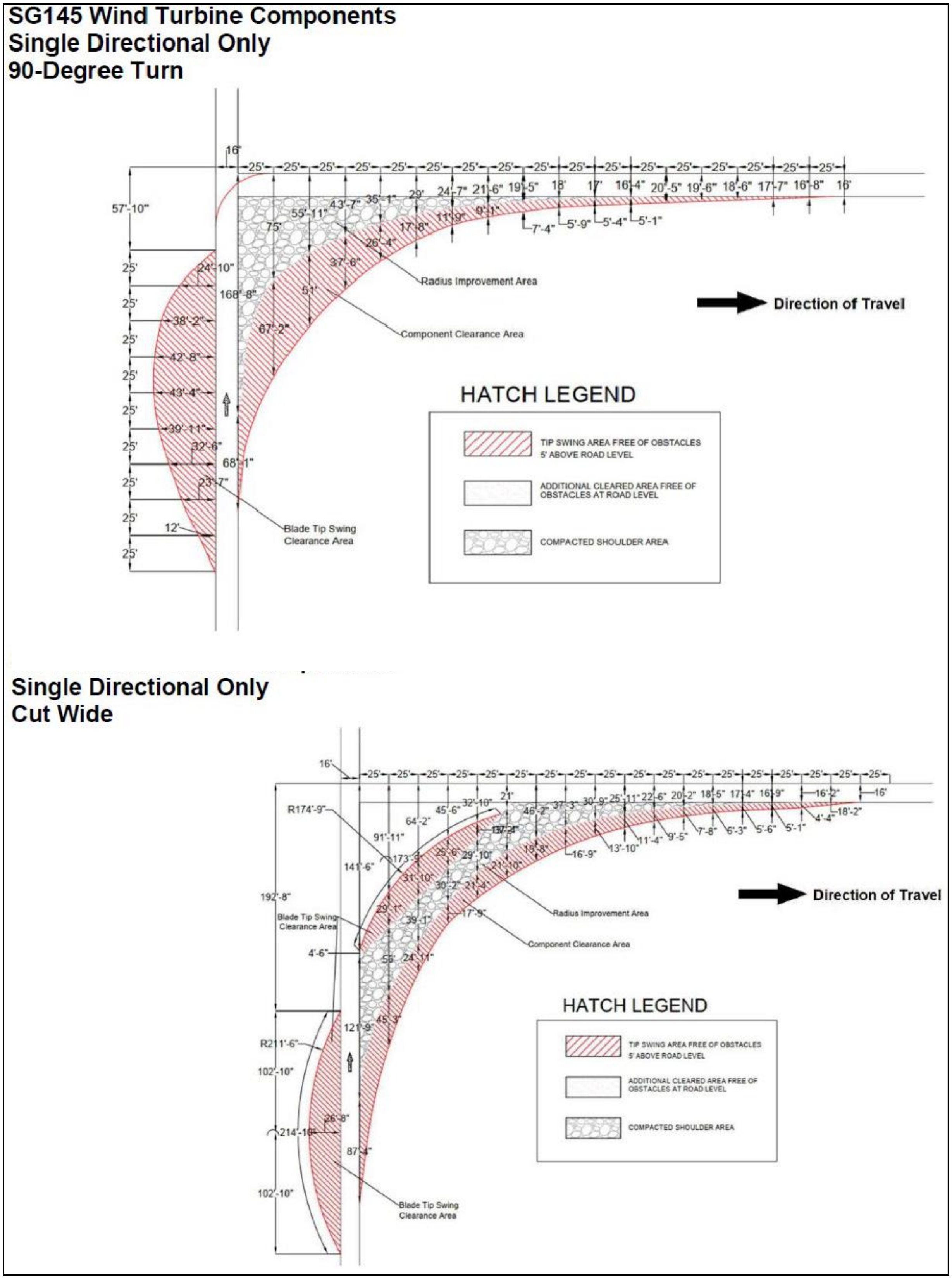


Figure E-2.2.1-4 Standard Blade Truck Templates – 90° Bend (CPL 2023).

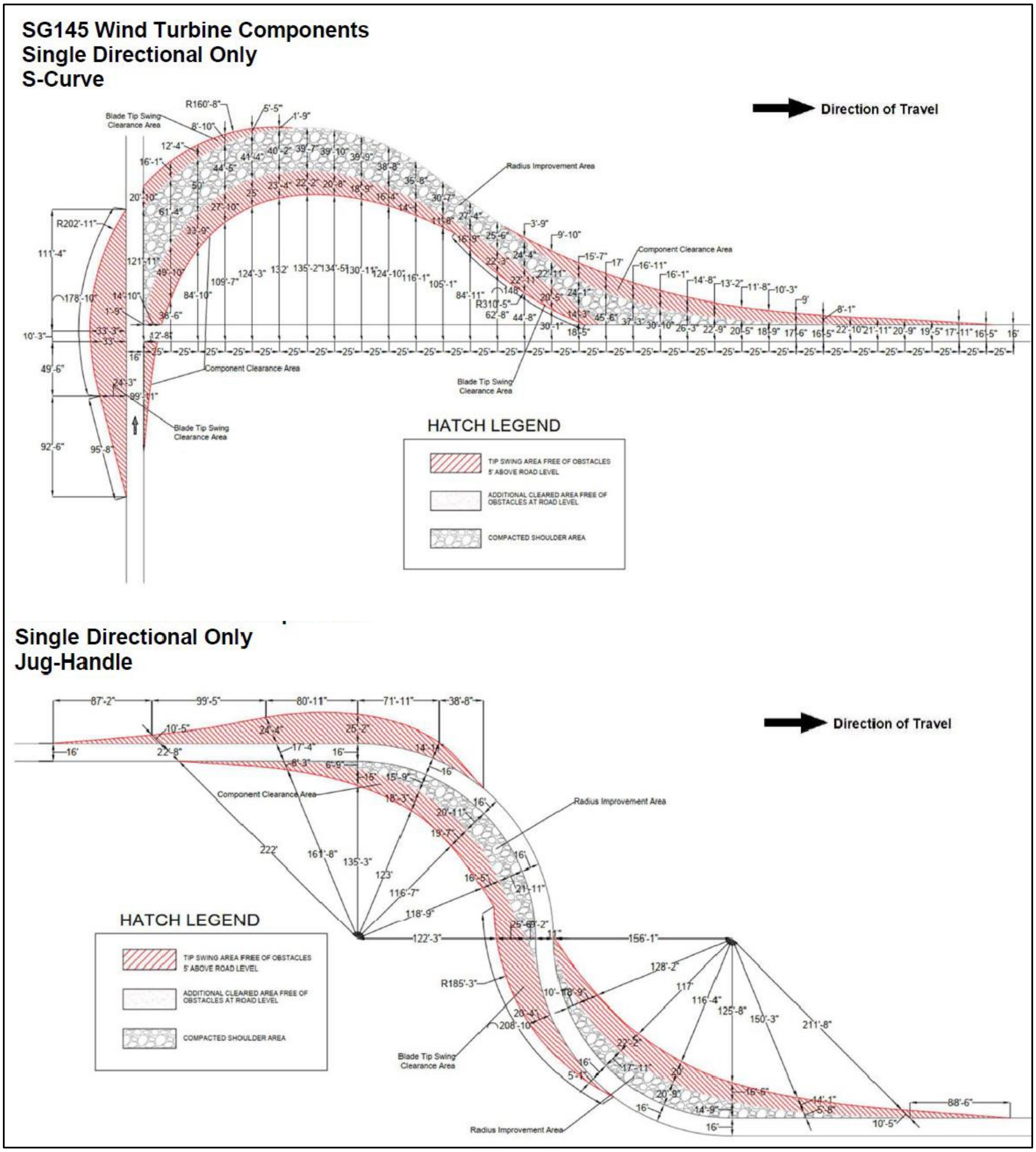


Figure E-2.2.1-5 Standard Blade Truck Templates – S-Curve and Jug-Handle (CPL 2023).

2.3 Bridges, Overpasses, and Culverts

2.3.1 Bridges and Overpasses

There is one overpass located in the Project Area that may be used for the transportation of oversized or overweight loads. The overpass is located at the intersection of Cooper Drive and Highway 102 leading into the Argentia Peninsula. In general, the Project will avoid use of this overpass for large components; wind turbine components will arrive to the POA via vessel and will not be transported over this overpass, however, transportation of other oversized or overweight equipment and materials for the Argentia Green Fuels Facility may be required. In the event the overpass cannot be avoided for transportation of an oversized or overweight load, an application for an *Overweight and Over Dimensional Special Permit* will be applied for as per the **Vehicle Regulations, 2002** under the **Highway Traffic Act.**

2.3.2 Culverts

Culverts, while not a physical obstruction, can present a limit on the load weight and width for safe travel. When planning transport routes, culvert crossings will be avoided where possible. In the instance a culvert cannot be avoided, Argentia Renewables will take the following precautions:

- A qualified inspector will conduct a culvert inspection and determine load capacities.
- Reduce loads to fall within the determined capacity, e.g. by making multiple trips rather than a single trip.
- If unavoidable, apply measures such as reinforcing the culvert, widening roads, or constructing temporary routing around the road section.

3.0 Transport Methods

The required major components for the Project will be transported by sea to the POA. From dockside, road transport will deliver equipment to the assembly/erection sites. Most deliveries to the Argentia Green Fuels Facility will involve very short distances, all within the POA boundaries. Wind turbine parts will require access within the Project roadway network, and, to a very limited extent, along sections of public roads.

3.1 Load Ratings

Vehicles that exceed weight and dimension limits as prescribed in the **Vehicle Regulations***, 2002* under the **Highway Traffic Act,** must apply to Service NL, Motor Vehicle Division for an *Overweight and Over Dimensional Special Permit*. This permit can be issued for either a single trip or on an annual basis. Each permit type has a different list of specifications regarding the vehicle’s overall weight, width, height, and length, including overhangs. Table E-3.1-1 below presents the difference of allowed weights and dimensions based on a Single or Annual Permit.

Table E-3.1-1 Maximum Allowable Overweight and Over Dimension under the Vehicle Regulations 2002.

	Maximum Mass (kg)	Maximum Dimension (m)				
		Width	Height	Front Overhang	Rear Overhang	Length
Single Trip	70,000 (120,000 two vehicle concept)	4.88	4.88	3.1	6.2	35
Annual Permit	64,000	4.27	4.5	3.1	5.5	30

It is also important to note, that a vehicle's axle weight, axle spacings, tire sizes, and tire numbers may also result in an additional Excessive Overweight/Over Dimension permit, a subcategory of the same permit application.

3.2 Transport Vehicles

The wind turbine components will be transported by a series of triple tridem axle flatbed style conventional transport trailers, and in the case of the wind turbine blades, by a specialized single tridem axle transport (Figure E-3.2-1). These types of transports have a relatively small turning radius enabling transport in areas of high topographic relief. This system enables navigation of compact roadways with steep grades and tight turns, such as are present within the Argentia Backlands of the POA. As the dimensions of the Project equipment and components required for transport have not been fully defined, the vertical and horizontal clearances will need to be assessed once detailed design of the Project has been completed.

Figure E-3.2-1 Blade Transport Example Construction Vehicle.

Construction vehicles and heavy equipment, such as excavators, cranes, concrete trucks, and front-end loaders, make up another portion of vehicles that will be used during the Construction Phase of the Project. Most vehicles are highway capable, and some may require an Overweight / Over Dimensional permit from ServiceNL depending on the vehicle).

Tracked construction equipment such as excavators as well as those with limited self-travel ability will be transported on float trailers. Two styles are commonly used – flatbeds and “gooseneck” trailers. These types typically have a weight range of 2 to- 35 tonnes.

4.0 Traffic Analysis

This section provides an overview of the existing usage of public roadways in the Project area as well as estimates for Project traffic during the Construction Phase. The potential implications of transporting oversized and overweight vehicles on public roads is then considered in light of potential effects on other traffic.

The POA is strategically located at the pre-existing industrial area which is appropriately zoned as “Industrial” by the Town of Placentia and is connected to a well-developed road transportation network. It is conveniently situated within a reasonable distance from the urbanized industrial zones of the northeastern Avalon Peninsula, making it a significant hub for moving cargo daily and provides the 40 tenants of the site with access to services such as repairs, supplies, housing, and other services (Roche 2023).

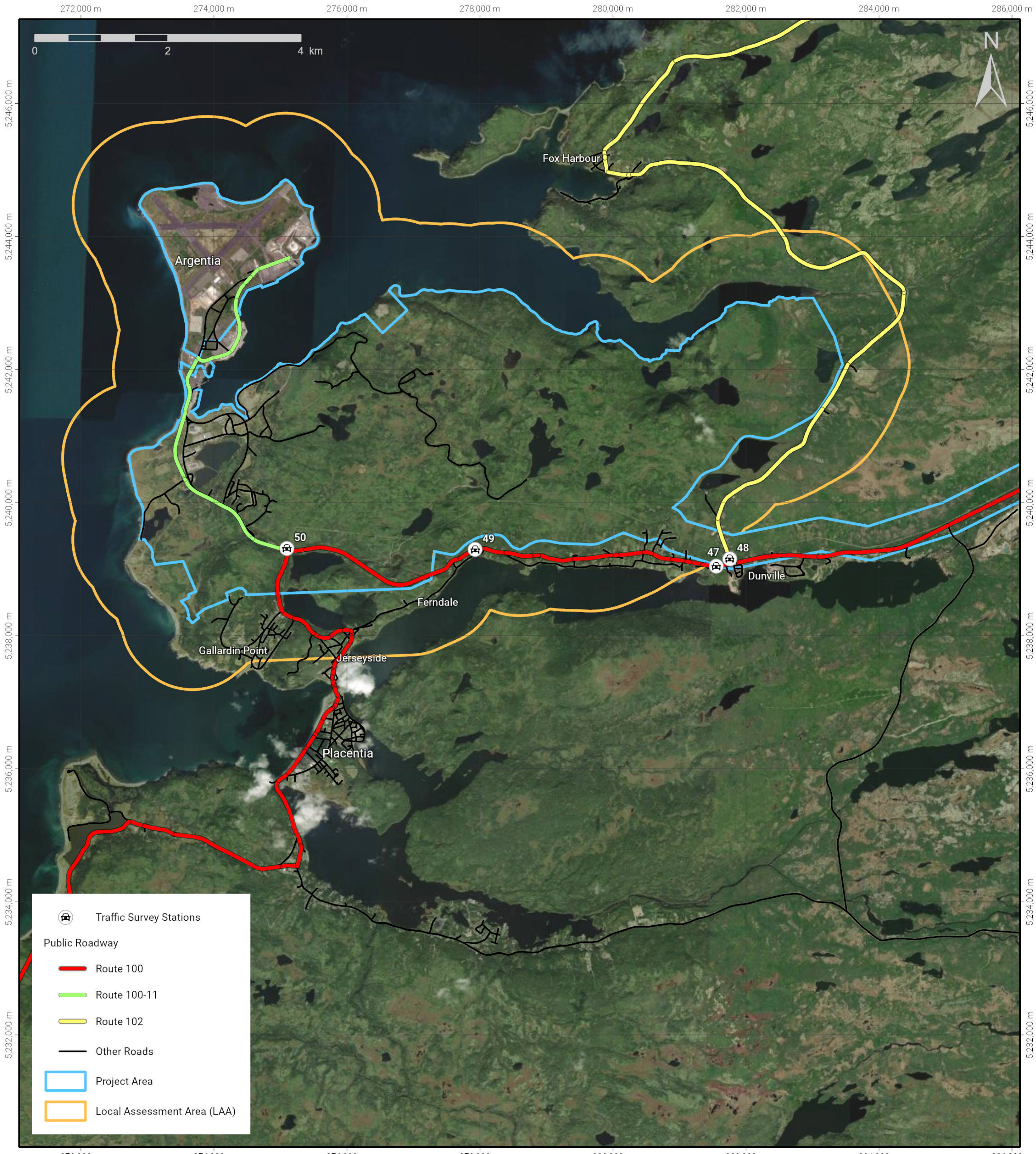
4.1 Baseline Traffic Volume

Annual Average Daily Traffic (AADT) volumes are the combined metric used to determine the amount a roadway is used. In February 2016, the NL Department of Transportation and Infrastructure (NLDTI formerly Department of Transportation and Works) conducted a 24-hour traffic survey in the Placentia area. Vehicles were captured using radar stations located as indicated on Figure E-4.1-1. Summary results of the survey have not been published but are available on request from the NLDTI; summary results are presented in Table E-4.1-1.

Table E-4.1-1 Traffic Survey Data – NL DTI 2016.

Station Location	Station ID:	AADT	% Trucks
Junction 100-15 Int to Fox Hr on Route 100 south of Fox Harbour Rd	47	3,497	8.58%
Junction 100-15 Int to Fox Hr on Fox Harbour Rd	48	679	3.60%
Junction 100-20 Int to Ferndale on Route 100 south of Ferndale Rd	49	1,558	8.41%
Junction 100-25 Int to Argentia on Route 100 just past Argentia Rd	50	1,665	4.90%

Station 47, located on Route 100 south of the Fox Harbour Road junction, exhibits the highest usage among the local population, with an Average Annual Daily Traffic (AADT) of 3,497 over a 24-hour period. This outcome is expected, given that the station captures all traffic traveling along Route 100 to and from the Placentia area via the Trans-Canada Highway. Station 48, located on the Fox Harbour Highway, showed the lowest AADT, with 679. This is consistent as both Fox Harbour and Ship Harbour have a lower population compared to the entirety of the Placentia area. Station 49, located at the junction of Route 100 and Ferndale Road, intercepts a portion of the traffic traveling between the highway and the local area, as well as those heading towards the Town of Placentia and further along the Cape Shore route. Ferndale Road serves as an example of an alternate eastern route providing access to the lower part of the peninsula, distinct from the Route 100-S branch that passes through Placentia. Station 50, located on Route 100 west of the junction with Route 100-S leading to the Town of Placentia, captures traffic traveling to and from the POA. This survey provides a baseline for traffic flow in the area and is exclusive of both the Cenovus White Rose Extension Project and the seasonal Marine Atlantic ferry operations.



Pattern | Argentia Renewables	FIGURE NUMBER: E - 4.1 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 06/06/2024
	FIGURE TITLE: Traffic Survey Locations – NL DTI 2016	NOTES: Roads data sourced from National Topographic Service (CanVec) Traffic Survey Locations provided by NL Department of Transportation and Infrastructure	REVIEWED BY:	
	PROJECT TITLE: Argentia Renewables		APPROVED BY:	
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The Marine Atlantic ferry service connecting North Sydney, NS, and Argentia, NL, operates from June to September. According to the 2024 passenger ferry timetable, arrivals from North Sydney are set for 09:30 on Mondays, Thursdays, and Saturdays, with departures the same day at 17:00 (Marine Atlantic, 2024). Vehicle capacity depends on the type of vehicle transported, as large vehicles (e.g., transport trucks and recreational vehicles) use more space. Argentia Renewables will work with the POA and Marine Atlantic to plan Project activities to avoid effects on ferry-related road traffic during the Construction Phase.

4.2 Construction Phase Project Traffic Volume

Each turbine will be constructed in sequence, enabling staged delivery of components. The chosen wind turbines for the Project consist of 10 components, and it is expected that the entire components for two to three turbines can be delivered by sea per day. As shown in Table E-4.2-1, it is expected that delivery of all wind turbine components to each installation site will take a total of 460 trips. Wind turbine component specifications are provided in Table E-4.2.2-2. Assuming the Project employs two transports for blade delivery and two transports for other component delivery, each being able to conduct one round trip per day, the total cumulative number of days required for all deliveries will be 149.5 days over two construction seasons.

Table E-4.2-1 Wind Turbine Component Transport Times.

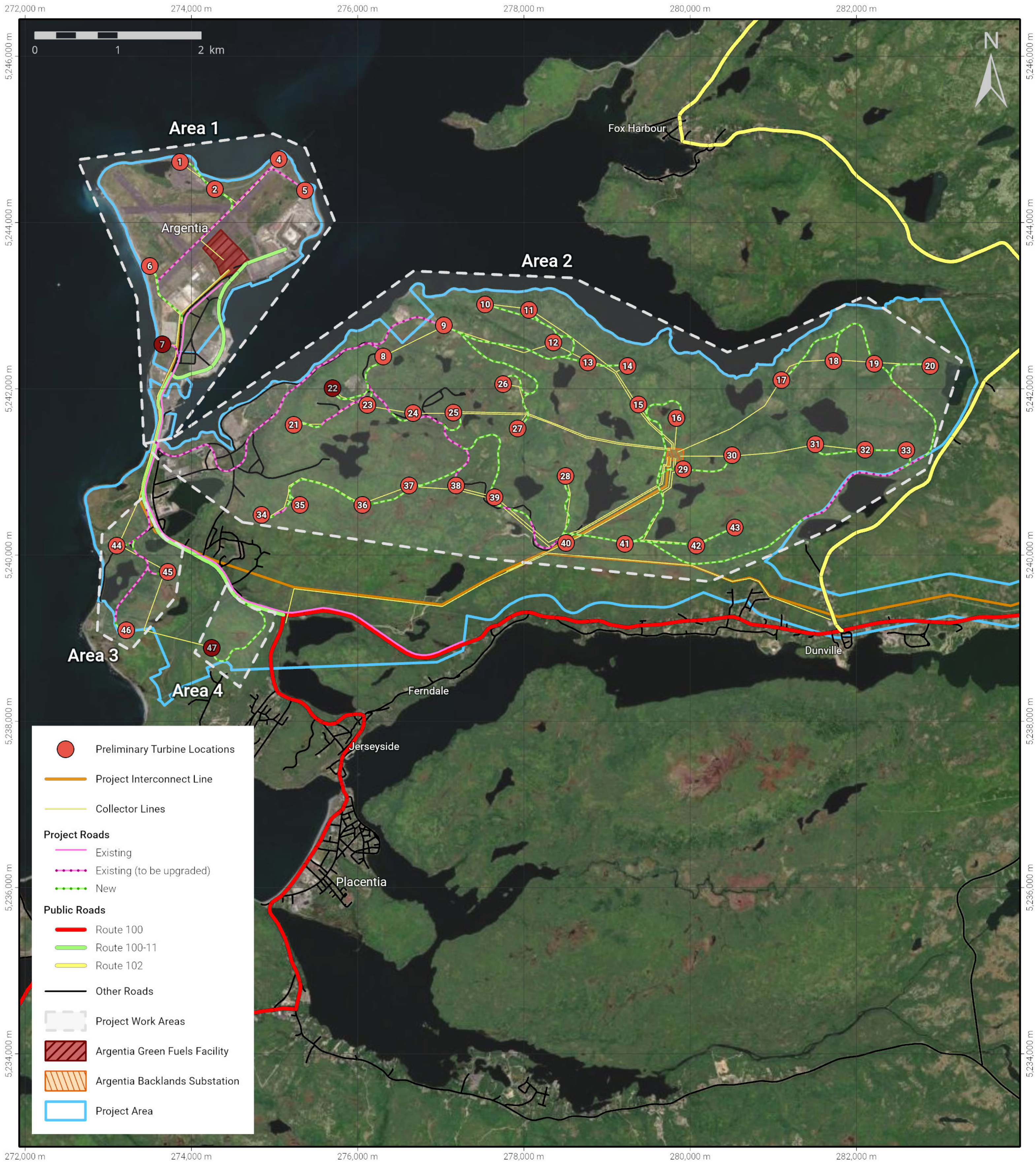
Total Number of Wind Turbine Sites	Total Number of Components	Daily Round Trips per Transport Vehicle
46	460	1

Table E-4.2-2 Wind Turbine Component Specifications for the 6.8 MW Wind Turbine.

Turbine Component	**Weight (mT)**	Dimensions (L x W x H) (m)
1 x Nacelle (including drivetrain)	87	18.3 x 4.2 x 4.4
1 x Hub	35	4.7 x 4.4 x 4.1
3 x Blades	29	80 x 4.4 x 3.8
5 x Tower Sections	71 (max)	27.0 m (Max length)

4.3 Traffic Interactions Analysis

As presented in Figure E-4.3-1, E-4.3-2 and Table E-4.3-1, the Project can be divided into four working areas. Area 1 is the section of the POA containing wind turbines #1 through #7; Area 2 contains wind turbine locations #8 through #43; Area 3 has turbines #44 to #46; and Area 4 has turbine # 47.



Pattern | Argentia Renewables	FIGURE NUMBER: E - 4.3 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 24/07/25
	FIGURE TITLE: Project Infrastructure Area Map	NOTES: Proposed project infrastructure is considered preliminary and is subject to change. Roads data sourced from National Topographic Service (CanVec)	REVIEWED BY:	
			APPROVED BY:	
	PROJECT TITLE: Argentia Renewables		sem	

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Pattern | Argentia Renewables	FIGURE NUMBER: E - 4.3 - 2	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 24/07/25
	FIGURE TITLE: Project Transportation Access via Public Roads	NOTES: Proposed project infrastructure is considered preliminary and is subject to change. Roads data sourced from National Topographic Service (CanVec)	REVIEWED BY:	
	PROJECT TITLE: Argentia Renewables		APPROVED BY:	
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Table E-4.3-1 Project Area Locations by Turbine Site Number.

Project Work Areas	Area Location	Routes to Access	Wind Turbine Site Numbers
1	Within the POA	Internal roadway network within POA, north of the ferry terminal.	1 - 7
2	POA owned land, known as the Argentia Backlands	200 m of route 100-11, and 2 km north of POA commercial area	8 - 43
3	South from POA, Moll Point area	1 km eastbound on route 100 from POA, turnoff on Cooper Drive	44 - 46
4	Hilltop, west of the community of Freshwater	3 km eastbound on route 100 from POA, Project created access route to hilltop west of community of Freshwater	47

Within Area 1, minimal traffic disruption will be experienced as this area is north of the ferry terminal and is an industrial usage area with mimimal flowthrough traffic. Peak usage occurs during employee commutes associated with shift changes. Even during peak usage time, traffic numbers are expected to be light in the northwest area of the Argentia Peninsula, as this area is mostly used for laydown.

Area 2 contains the majority of the wind turbine locations and, will be accessed along a 200 m stretch of the main highway (Route 100-11) and 2 km of local roadways within the commercial park. As the area has additional access routes to the commercial park, public traffic can be controlled and diverted to other access routes without causing appreciable delays, even during peak traffic periods.

Areas 3 and 4 will be accessed from Route 100. Area 3 requires use of 1 km of Route 100, while Area 4 requires use of 3 km. This section of Route 100 is the primary access route to the POA and the seasonal Marine Atlantic ferry. Transportation of large loads will be scheduled to avoid the 12 hours per week of seasonal Marine Atlantic ferry traffic.

4.4 Operation and Maintenance Phase Project Traffic Volumes

During the Operations and Maintenance Phase of the Project, traffic volumes will be modest overall, while overweight/oversized transport will be minimal and will only be required on an as needed basis for repair or replacement of a major component.

With the exception of emergency repair/replacement activities, traffic will comprise of crew trucks and light vehicles either conducting site maintenance, inspections and monitoring, and security patrols. No special measures will be required during the Operation and Maintenance Phase to avoid interference with public or POA traffic.

4.5 Decommissioning and Rehabilitation Phase Project Traffic Volumes

Eventually the Project will be decommissioned, followed by site rehabilitation and restoration. This phase of the Project will ensure that the Project infrastructure and components will be properly and safely removed, and land disturbances rehabilitated. Part of this phase includes rehabilitation of roads and access routes, should alternate uses not be identified.

During the Decommissioning and Rehabilitation Phase the steps to achieve final closure will follow similar methods and routes as those employed during the Construction Phase. Cranes will be used to take down all components, and the same types of heavy transport vehicles will be used to transport the components to the POA. The priorities for disposal of recovered components will be ranked as resale/reuse, recycling, and finally disposal at an approved site.

5.0 Traffic Management Plan

This section presents the measures that will be implemented to ensure a safe working environment for all Project employees as well as the public. Traffic related mitigation measures will also ensure that Project activities will take place with minimal disruption to the public, local businesses, and the environment.

5.1 Driver Conditions

Employees and contractors who operate any motorized vehicle as part of this Project, including heavy equipment, will adhere to the following Policies:

- Ensure all licences and permits are up to date;
- Follow all vehicle and roadway rules and regulations;
- Ensure that vehicles are in good working order, especially with respect to emissions control devices;
- Respect the road space and its use by other drivers and pedestrians;
- Follow all designated traffic control measures, both inside and outside the Project access routes;
- Exercise courtesy towards others;
- Turn off all flashing and rotating warning light beacons when on public roadways, unless required;
- Maintain a safe following distance from other vehicles and avoid traveling in convoys, unless required; and
- Drive in full compliance with this Management Plan.

5.2 Traffic Control Measures

Traffic related control measures are presented within this section to ensure that all Project employees are informed of their legal responsibilities and are focused on the safety of the local public and general environmental awareness. All appropriate traffic control signage and controls will be in place as described by the Traffic Control Manual 2018 from the NLDTI.

During the traveling season, the Marine Atlantic ferry traffic creates surges of traffic traveling towards the Argentia Peninsula in late afternoons and in the opposite direction in the mornings for three days of the week during. Project employee-related traffic arrivals and departures will be scheduled to precede the existing morning peak hour and follow the existing afternoon peak hour.

As previously noted, movements of oversized and overweight loads will be limited in number and scheduled based on arrival of components to the POA. Given the requirement to access only short stretches of public roads, the Project oversized and overweight traffic will be scheduled to avoid known peak traffic periods. To ensure pedestrian safety, Argentia Renewables will require that all drivers be familiar with all Project rules and measures related to pedestrian safety.

5.3 Monitoring and Reporting

This section details the incident and complaint reporting process, and the process for Argentia Renewables to inform the local community and public users of work activities and schedules.

5.3.1 Incident and Complaint Reporting

Argentia Renewables will document incidents and complaints as per its complaint's resolution protocol outlined in the Public Participation Plan.

5.3.2 Local Notifications and Community Communications

The scheduling and notification of activities that will increase the traffic or affect traffic demands will be communicated with the local community as per the engagement and tools outlined in the Public Participation Plan.

Any maintenance or upgrading activity will be scheduled and conducted according to the appropriate federal, municipal, and provincial permits. Construction traffic notification signage will be erected in advance of the planned work. All signage will follow the *Traffic Control Manual* 2018 from the NLDTI.

5.3.3 Dusting and Noise Concerns

Noise and dust monitoring and mitigation measures will be implemented where required, as discussed in Chapter 4 of the Environmental Registration Document.

6.0 Training

6.1 Driver Education

Driver education, encompassing driver safety training and updates to the TMP, plays a crucial role in enhancing both driver safety and the safety of the broader community. Through targeted efforts such as employer orientation programs, regularly held toolbox meetings, and informative safety briefing, drivers will be equipped with necessary knowledge and skills to navigate roadways safely. These efforts promote safety awareness among drivers and keep them updated on the latest developments and protocols in the TMP, helping to reduce risks and enhance safety.

Project staff, contractors, and visitors will be required to have appropriate vehicle and traffic training, along with specialized Project training encompassing environmental awareness, legal obligations, and traffic regulations briefings.

7.0 Emergency Contacts and Procedures

Table E-7.0-1 presents a summary of individuals and organizations in case of a traffic-based incident. A detailed list of all contact information is available in the Emergency Response Plan.

Table E-7.0-1 Argentia Renewables Contact Information.

Name	Position	Contact Number
Joseph Card, CRSP	H&S Manager	1-226-932-6042
Mark Alderson	Director, Field Operations	1-204-384-7000
	Construction Foreman	
Anthony Jones	Environmental Manager	1-289-962-7446
	On-Site Environmental Contact	
Local Emergency Services		
Organization		**Contact Number**
Police – RCMP – Emergency		911 or 709-227-2000
Occupational Health and Safety (OH&S) Division		(709) 729-4444 (24hr)
Placentia Hospital		709-227-2061
Placentia Emergency Department		709-227-2013
Placentia Fire Department		709-227-2151

	709-227-3200
Town of Placentia	709-227-2151
Marine Atlantic	1-800-341-7981
Port of Argentia	709-227-5502
Town of Fox Harbour	709 227-2271
Placentia Bay Veterinary Clinic, 295 Main Hwy, Bay Roberts, NL, A0A 1G0	709-786-1571
PROVINCIAL RESOURCES	
Ambulance	911
Emergency Measures Organization	709-229-3703
Environment and Lands - Environment Officers	709-729-2550
Health Regional Office	709-229-1551
Regional Medical Health Officer	709-229-1571
Health and Comm. Services Placentia	709-227-0130
Works, Services and Transportation	
Freshwater – Placentia Hwy Depot	709-227-1351
Oil Spill Response (24 Hr.)	1-800-563-9089
FEDERAL RESOURCES	
Environment Canada	
General Weather Forecast	709-772-5534
Environmental Protection	709-772-5585
Canadian Coast Guard – St. John's	709-772-5146
General Inquiries	709-772-5151
Environmental Emergencies	709-772-2083
ADMINISTRATION CONTACTS	
Port of Argentia	
General Manager	
Adam Greene	709-227-4653 (Cell) a.greene@portofargentia.ca
Port Operations Co-ordinator	
Blair McGrath	709-227-1934 (Cell) 709-227-4702 (O) b.mcgrath@portofargentia.ca
HSEQ Coordinator	
Jackie Jones	709-682-3886 (Cell) j.jones@portofargenita.ca

8.0 Plan Review and Updating

This document will be reviewed at least annually and revised/updated as required. Specifically, Plan revisions will be made when:

- New or revised approvals, permits, or license conditions are issued in relation to Traffic Management;
- Corrective or preventative measures are identified following incident investigations;
- Changes occur with Project plans in relation to traffic movement, equipment transportation and access; and
- An annual review of this document is completed.

9.0 References

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Appendix F

Historic Resources Overview

APPENDIX F
Historic Resources Overview Assessment

Table of Contents

List of Figures

List of Tables

List of Acronyms & Abbreviations

Acronym	Definition
BP	Before Present
CE	Common Era
GIS	Geographic Information System
HRDEM	High Resolution Digital Elevation Model
HROA	Historic Resources Overview Assessment
LiDAR	Laser Imaging, Detection, and Ranging
LP	Limited Partnership
MW	megawatt
NL	Newfoundland and Labrador
NRCan	Natural Resources Canada
PA	Potential Area
PAO	Provincial Archaeology Office
SEM	Sikumiut Environmental Management Ltd.
SRF	Site Record Forms
TL	Transmission Line
US	United States
WWII	World War II

1.0 Introduction

Argentia Renewables Wind LP (Argentia Renewables), an affiliate of Pattern Energy Group LP (Pattern), is planning to develop the Argentia Renewables Project (the "Project"), which consists of a green hydrogen and ammonia production and export facility (Argentia Green Fuels Facility) powered by onshore wind generation (Argentina Wind Facility). The Project will be designed to generate approximately 300 megawatts (MW) of wind energy, powering a hydrogen electrolyzer system with an installed capacity of approximately 160 MW. The Argentia Green Fuels Facility will be connected to the Newfoundland and Labrador Hydro (NLH) grid at the Long Harbour terminal station via a 35 kilometre (km) transmission line (the Project Interconnect Line), and there will be overhead transmission infrastructure to facilitate interconnection of the wind turbines. The Argentia Green Fuels Facility will be constructed on brownfield private land owned by the Port of Argentia (the "POA Property") that is zoned for industrial use, while the Argentia Wind Facility will be situated on adjacent private lands (the "Argentia Backlands") north of the communities of Dunville, Ferndale, and Freshwater. The Argentia Wind Facility will include up to 46 potential wind turbine sites, electrical infrastructure, and access roads. The produced hydrogen will be combined with high purity nitrogen extracted from the air. The resulting synthetic process will produce 146,000 metric tonnes (t) of green ammonia annually, which will be stored and exported to international markets by ship from a marine terminal at the Argentia Peninsula.

1.1 Study Area

A desktop review of Precontact and Historic Period, historic and archaeological resources registered for Placentia Bay was conducted, comprising the Regional Assessment Area (RAA) for this study. The Local Assessment Area (LAA) selected for the study comprised a circular area measuring 50 km in diameter centered on a point near the Town of Placentia. For the purposes of this study, the Project Area was divided into three principal sectors based on the potential for direct interaction with Project activities and infrastructure, which are:

- The Argentia Peninsula, where the Argentia Green Fuels Facility will be located;
- The Argentia Backlands, situated adjacent to the Argentia Peninsula and on the north side of Northeast Arm; and
- A linear corridor of 250 m on either side of the Project Interconnect Line, which extends beyond the eastern boundary of the Argentia Backlands northeast and north to Long Harbour.

No part of the marine environment of Placentia Bay, either within Argentia Harbour or Placentia Sound, is included as part of the Project Area (Figure F-1.1-1).

Pattern | Argentia Renewables	FIGURE NUMBER: F - 1.1 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 17/05/2024
	FIGURE TITLE: Historic Resources Overview Assessment Study Area	NOTES: The location of proposed project infrastructure is considered preliminary and is subject to change.	REVIEWED BY:	
			APPROVED BY:	
	PROJECT TITLE: Argentia Renewables		sem	

SEM MAP ID: 238-005-GIS-125-Rev0

1.2 Environmental Setting of the Project Area

1.2.1 Argentia Peninsula

The most westerly sector of the Project Area includes the site where the Argentia Green Fuels Facility and other related Project infrastructure will be situated on the Argentia Peninsula in the area formerly encompassed by the US Naval Air Station. Since the 1940s, when the property was initially acquired by the US Government, virtually the entire peninsula has been developed for military and industrial purposes, which involved the demolition and removal of many dwellings and outbuildings comprising the former community of Argentia (see Section 3.3 and 3.3.2 below), as well as the extraction of a massive quantity of rock, bog and soil overburden, along with the levelling and contouring of the terrain for construction of an airfield and associated infrastructure. Also constructed as part of the Argentia Naval Air Station were several large housing developments to accommodate thousands of service personnel and their families, a hospital and school, and a wide range of recreational and occupational facilities, all of which incorporated above and below ground electrical and water services. In addition to the terrestrial components of the Argentia Peninsula, large sections of the shoreline and foreshore, notable along the eastern side of the peninsula within Argentia Harbour, were developed as docking and servicing facilities for military and supply vessels.

During the latter part of the twentieth century and in the early 2000s, following the complete closure of the Argentia Naval Air Station, major decommissioning activities involving extensive ground and shoreline excavations and alterations were undertaken at the former base (Janes and Worthman 2005), and in more recent times large segments of the peninsula were developed with the intent of using it for future industrial purposes. An undertaking of note that is currently in progress on the site includes construction of a concrete fixed drilling platform that will be used in the offshore as part of the West White Rose Project. As is apparent from this summary of activities, virtually the whole of the Argentia Peninsula has seen a vast amount of ground and shoreline disturbance since the 1940s, thus this sector of the Project Area is appropriately referred to as a brownfield site (see Figure F-1.1-1 above).

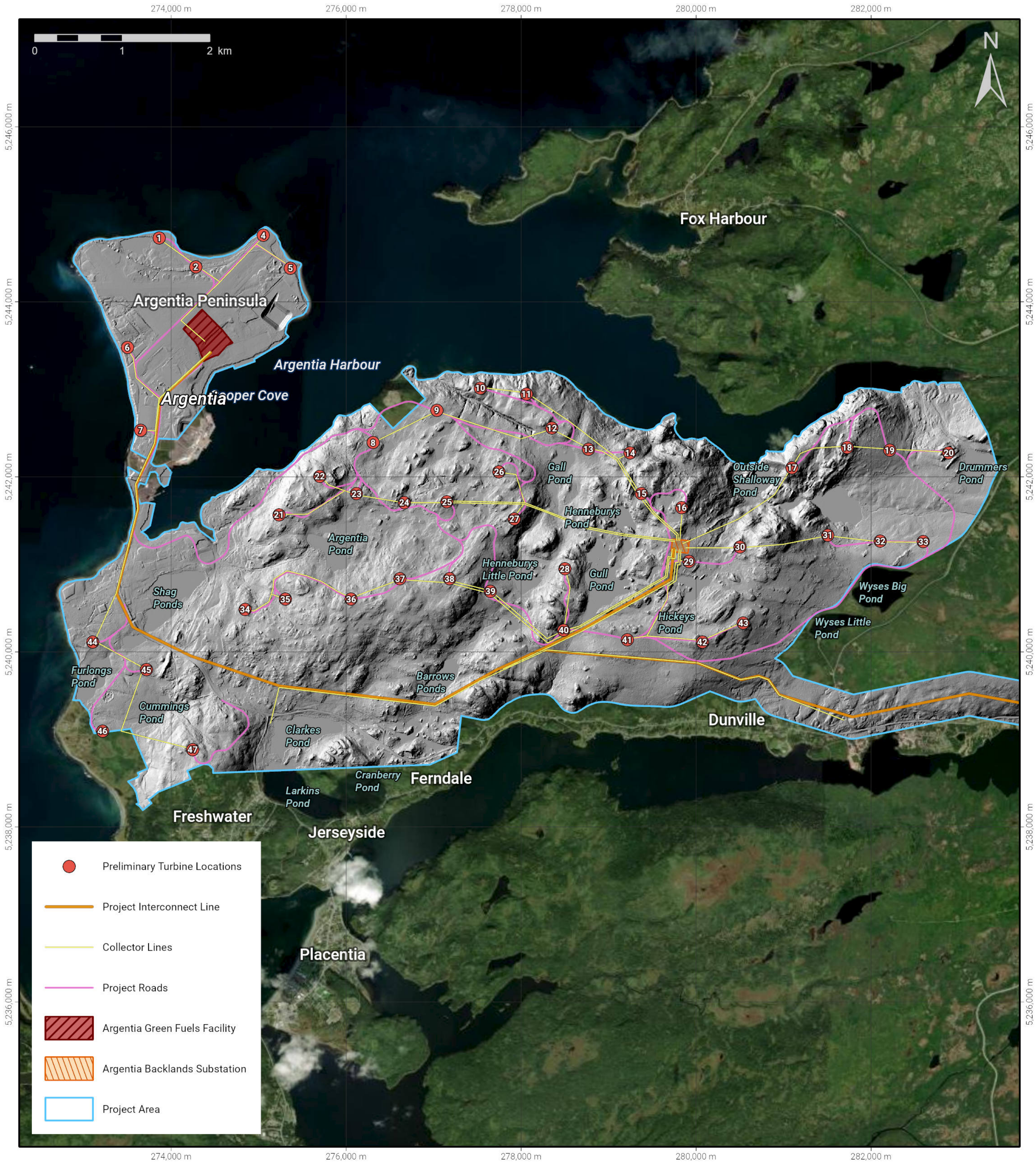
1.2.2 Argentia Backlands

The largest sector of the Project Area is the Argentia Backlands situated to the south and east of the Argentia Peninsula and between Northeast Arm in the south and Placentia Sound in the north. Overall, this sector of the Project Area measures approximately 11 km east to west by a maximum of 4 km north to south at its widest point, and the elevations of the generally uneven and hilly terrain range from sea-level to a maximum of 170 m above it in roughly the central location. Like the Argentia Peninsula where the Naval Air Station was constructed, operated, and eventually decommissioned, a narrow strip of low-lying terrain on the north side of the Argentia Backlands, near the isthmus connecting the headland to the mainland (where the former community of Marquise was located: see Sections 3.3 and 3.3.2 below), was also developed and used for military purposes by the US and was eventually decommissioned in the early 2000s. Due to the extensive and varied ground and shoreline disturbances that occurred throughout this sector of the Argentia Backlands since the 1940s (Janes and Worthman, 2005), this location too is appropriately referred to as a brownfield site.

A recent ecological land classification map shows that a large segment of the Argentia Backlands to the south and east of the area, as discussed above, supports a growth of mature but modest-sized coniferous trees, including stands of spruce and fir. There are many locations where trees have been felled in the recent past, possibly for firewood, but are now regenerating. While there are also relatively small patches of terrain that host mixed species of wood such as fir, spruce, larch (locally referred to as “juniper”) and potentially alder and birch, a large portion of the Argentia Backlands is classified as wetlands and scrub.

Over and above the terrestrial landscape features, the Argentia Backlands has approximately 15 small and moderate-sized ponds that contribute to several small watersheds, the largest pond being Gull Pond situated in roughly the central location. Though the Argentia Backlands has no large rivers, there are many brooks and streams draining from the elevated waterbodies and wetlands, including a relatively large watercourse that flows from Gull Pond toward the northwest into Placentia Sound. While the shoreline back from the water’s edge along most of the north side of the Argentia Backlands is steep-sided, there are a small number of locations where the terrain appears relatively level and potentially well-drained (see Figure F-1.1-1 above).

The image below, produced in part from LiDAR provided by Natural Resources Canada (NRCan), has been altered to show the underlying topography with the surface vegetation removed. As displayed, it clearly highlights that the terrain throughout most of the Argentia Backlands is generally undulating and hilly, and apart from a small strip of ground along the southeast side of Argentia Harbour (where the former community of Marquise and US military facilities were situated), the shoreline back from the water’s edge all the way to the eastern end is relatively steep, with only narrow strips of beach. Coastal locations where the terrain is generally level are restricted to the mouths of small waterways, and even those are few (Figure F-1.2.2-1).



Pattern | Argentia Renewables	FIGURE NUMBER: F - 1.2.2 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 17/05/2024
	FIGURE TITLE: Topographic Relief of the Project Area	NOTES: Elevation data source: Government of Canada - High Resolution Digital Elevation Model (HRDEM) - CanElevation Series	REVIEWED BY:	
	PROJECT TITLE: Argentia Renewables		APPROVED BY:	

SEM MAP ID: 238-005-GIS-126-Rev0

1.2.3 Project Interconnect Line

The portion of the Project Interconnect Line that extends from the eastern edge of the Argentia Backlands will mainly parallel existing rights-of-way, either existing Newfoundland and Labrador Hydro (NLH) transmission line corridors or public roads, and has an overall length of approximately 35 km. The precise location of the Project Interconnect Line is not determined; however, it will be contained within the 500 m wide corridor (i.e., 250 m on either side of a centreline) identified as part of the Project Area.

While parts of the corridor are relatively level, particularly the sections that extend along the north side of Northeast Arm to the north of Dunfield, and the portion situated to the south of the NLH infrastructure at Long Harbour, the bulk of the central area is relatively uneven and steeply contoured. Most of the Project Interconnect Line is wooded with stands of fir, spruce, and juniper, though several locations are wet and boggy. There are approximately five small ponds or parts of ponds situated within the corridor toward the northern end, and the line does intersect with two relatively large waterbodies - Ship Harbour Big Pond and Rattling Brook Big Pond.

1.2.4 Potential Food Resources of the Project Area

It is likely that wood for heating and building was relatively plentiful within the Argentia Backlands and along the Project Interconnect Line. However, food resources in the Project Area were probably limited, with the exception of various types of seasonal, editable berries and several maritime species obtainable from the waters surrounding the Argentia Peninsula. There are locations along the coastline of the Argentia Backlands where mussels could be harvested, and many of the ponds and small waterways likely contained trout in limited numbers. Both sea and freshwater birds were likely present on and around some of the waterbodies at certain times of the year. Beaver, muskrat and other small mammals likely occupied the shorelines of many of the rivers, streams, and brooks. Black bear may also have been extant. Currently, moose are known to be present within the Argentia Backlands and the Project Interconnect Line; however, the habitat is such that caribou would likely not have used the area on a regular basis in the past at any time of year.

2.0 Historic Resources

In NL, historic resources include archaeological materials such as stone tools, ceramics, glass, and metal objects, as well as structural remains (e.g., wooden or stone) that are 50 years old or older and show evidence of manufacture, alteration, or use by humans. It can also include burial, cultural, spiritual, and other heritage sites and artifacts dating to the Precontact and Historic Periods. The Precontact Period refers to the time prior to the sustained presence of Europeans in the "New World" and ongoing "contact" with Indigenous Peoples, which began *circa* 1500 CE. The Historic Period refers to the time after contact and up until *circa* 1970 CE. Historic resources are valued by Indigenous Peoples and the public at large for the general and scientific information they can provided about past peoples, their societies, cultures and lifeways, and the connections and interactions they may have had with other groups.

Historic resources, as defined by the **Historic Resources Act (1985),** also comprise architectural resources (i.e., buildings, structures or sites of built-heritage importance that are registered with Heritage NL), as well as palaeontological resources, which are fossils that if deemed rear and/or significant, are inventoried by the Provincial Archaeology Office (PAO) of the Department of Tourism, Culture, Arts and Recreation, and protected under the provisions of the **Act**.

2.1 Regulatory Requirements

In September 2023, a request for information was submitted to the PAO for information on whether any specific regulatory requirements were warranted for the Project under the **Historic Resources Act (1985)**. Following a review of the Project mapping and other relevant details, Provincial Archaeologist Dr. Jamie Brake responded by stating that, "*Notwithstanding the paucity of known archaeological sites, the PAO feels that a comprehensive desktop survey of the project area is warranted, due to the long history of the region, and the lack of previous archaeological work in this area. Such assessment* [hereinafter referred to as the Historic Resources Overview Assessment – HROA] *should include limited field survey and recording of the* [mid-twentieth century] *military bunkers (ChAl-14) and any other areas deemed to have high* [archaeological] *potential as identified by the desktop and/or field assessment*." The PAO correspondence went on to say that *"…While any sites may be mitigated in lieu of development, any known and/or high potential areas should be avoided where possible*" (PAO email, September 13, 2023).

2.2 HROA Objectives and Rationale

While there are currently no formal provincial guidelines for conducting a HROA, for the purposes of this report, the primary objectives of this study are to:

- Summarize, through a review of publicly available sources, the Precontact and Historic Period human occupation of insular Newfoundland, with a focus on Placentia Bay and the section in the northeast where the Project Area is situated; and

- Based on the background information, identify and plot on mapping the locations of all registered archaeological, architectural, and palaeontological resources situated within the Project Area, as well as any structures or features potentially worthy of registration with the PAO or Heritage NL, along with any terrain where the information review and professional judgement suggest other such resources might occur.

This HROA will serve as an initial statement of the historic resources potential of the Project Area and will be used to assist with Project planning by defining the nature and extent of any future Historic Resources Impact Assessment (HRIA) study that might be required by the PAO to avoid or reduce any potential adverse Project interactions with said resources.

2.3 HROA Principal Investigator

All aspects of this HROA were completed by Roy Skanes (B.A, M. Phil), Senior Archaeologist with SEM. Roy Skanes has 30 years of professional experience in historic resources / archaeological and related background research, and has worked extensively in Newfoundland and Labrador, Nova Scotia, New Brunswick, Quebec, Ontario, and Alberta. Since 1990, he has completed many historic resources overview and impact assessments and research projects related to various types of developments in the province and is qualified to hold an Archaeological Investigation Permit under the provincial **Historic Resources Act (1985)**.

2.4 HROA Approach and Sources

To achieve the objectives of the HROA, it was important to understand which cultural groups may have used the Project Area at various points in time and the types of sites, structures, and materials (including architectural and palaeontological resources) that could be extant within certain environmental settings. This entailed defining a broader study area and investigating what is known about its past from the historical and documentary record and the available archaeological and geological evidence. In accordance with this approach, following a review of information related to the cultural / historical sequence of Newfoundland generally, the full range of Precontact and Historic Period, historic resources / archaeological sites registered for Placentia Bay (*i.e.*, the RAA) was reviewed, along with those that are known for the LAA and the Project Area. The Town of Placentia itself was selected as a key location, as it is the place in Placentia Bay that has seen the most concentrated historical review and archaeological research and site registration projects since its beginnings in the 1970s. Understanding its history and that of the former town of Argentia, situated on the Argentia Peninsula, could provide insight into the cultural groups that may have used the Argentia Backlands and Project Interconnect Line components of the Project Area in the past. To this end, short histories of the longstanding European land-use and occupancy of both these communities are presented, along with a brief discussion of the former fishing village of Marquise, which was situated slightly east of the southern end of the isthmus that connects the Argentia Peninsula to the mainland, within the Project Area.

A principal source of information researched for this HROA was the archaeological site mapping provided by the PAO that showed the locations of all the archaeological sites registered for Placentia Bay, with colour-coding that highlights which cultural groups were identified at each site. Also provided by the PAO was a table listing the Borden numbers of all the sites (the Borden system being the Canadian registry for archaeological finds), along with the relevant archaeological Site Record Forms (SRFs) for those that are located within the LAA. Details obtained from the SRFs provided critical insight into the types of sites and materials that had been recorded during past field research projects; as well as site descriptions and locations; the topographic / geographic settings of each and its elevation above sea level (asl); the degree of field research completed to date; a listing of any informants (local or otherwise) who may have provided details about the find; and a brief statement regarding the current site condition and any factors (natural or otherwise) that may have caused disturbance. Additionally, the archaeological SRFs provide a bibliographic listing of all relevant reports and published articles associated with the site, and the location where any artifacts recovered during sampling or detailed excavation and recording projects are currently housed.

Other material reviewed as part of the HROA included archaeological and historic documentary sources pertaining to the cultural / historical setting of Precontact and Historic-Period Newfoundland, with a particular reference to the longstanding settlement of the northeast section of Placentia Bay. Literature and other information on the environmental factors that could pertain to archaeological potential within the Project Area were also reviewed, some of which discussed the availability of terrestrial and marine fauna within the LAA. Several online and printed sources related to the twentieth century military history of the Argentia Peninsula and the adjacent mainland were researched (some of which was provided by Heritage NL via its Executive Director Mr. Dale Jarvis and Municipal Outreach / Provincial Registrar Andrea O'Brien), as was information related to the past mining activities that occurred in the area - most notably at the late nineteenth / early twentieth century mine situated within the Argentia Backlands near Broad Cove on the south side of Placentia Sound. Sources related to the potential for fossils to be present in the Project Area were also examined and two geologists (Dr. Richard Taylor, formerly of Carlton University, Ottawa, and Gerald Squires, retired NL geologist) were consulted for information on the subject. An enquiry was also made at the PAO to establish if any palaeontological resources were registered for the Project Area.

It is worth noting that despite an online search for published sources discussing the postglacial relative sea-level history of the sector of Placentia Bay where the Project Area is situated, and using such data to better understand where coastal archaeological sites might now be situated in relation to current sea-level, none that adequately describe or illustrate the process and timescale of shoreline submergence and/or emergence were found. While some information was obtained to suggest that the shoreline throughout northern Placentia Bay is currently being inundated at a relatively consistent rate of approximately 2 mm per year or 20 cm per century (2019 personal communication: Melanie Irving & Jenifer Organ, then with the Geological Survey of NL), it could not be established with any certainty when this process began and the intricacies of how sea-levels changed in relation to the terrestrial landscape over time.

Also examined in detail for the HROA were conventional aerial photographs available from the Province of NL as well as two aerial imagery sources, including a Google Earth kmz file that shows the full extent and lay-out of the Project Area and how it will interact with coastal areas, vegetation and landscape features, waterbodies, and any registered archaeological sites situated within its boundaries. From an analytical point of view, the kmz file was an indispensable tool for achieving a primary objective of the HROA, which was to identify and delineate any known archaeological sites and/or suspected cultural materials or structures (such as WWII and/or historic mining infrastructure), as well as landforms and topographic features within the Project Area that appeared conducive to past human settlement and exhibit potential to contain currently unknown historic resources.

A second set of aerial imagery analysed for the HROA was created from high resolution digital elevation model (HRDEM) data acquired from NRCan, which was combined with aerial imagery collected by a remotely piloted aircraft system (RPAS) flight in 2022. The HRDEM data were captured from airborne LiDAR, and a contour and shaded relief map was produced from a Digital Terrain Model, which represents the underlying bare ground with the vegetation removed. The map was then plotted at a resolution of 1 m, with the full extent of Project infrastructure superimposed overtop (for an example of the mapping, see Figure F-1.2-1 above). This imagery was invaluable for analysing the landscape within the Project Area for visible historic resources, and for identifying and delineating terrain where past human settlement and/or other types of land-use was theoretically possible.

2.4.1 Informant Interview Data

Contact was made with both the Placentia Historical Society and Heritage NL for assistance with identifying individuals from the Placentia area who could provide general information regarding how the Project Area may have been used in the relatively recent past for land-use activities such as hunting, fishing, berry picking, and/or wood-cutting, whether they knew if any archaeological materials had ever been found there, or if they could highlight any locations on mapping where potentially significant cultural materials or other types of historic resources might be situated (including, for example, structural remains associated with the WWII defense facilities and/or historic mining activities). Unfortunately, no such individuals were identified. Nevertheless, continuing efforts are encouraged to locate potential informants who might address this data-gap, and questions such as those outlined above should be posed to informants in the event a Land and Resource Use study is conducted for the Project.

3.0 Historic Resources Overview Assessment Results

3.1 Newfoundland Cultural / Historical Overview

3.1.1 Precontact Period

Archaeological research conducted on the Island of Newfoundland since the early-mid twentieth century confirms an occupation by several Indigenous First Nations and Pre-Inuit groups, the earliest of which crossed the Strait of Belle Isle from southern Labrador to the Northern Peninsula approximately 5,500 years ago. These "Maritime Archaic" peoples gradually moved into several other parts of western and eastern Newfoundland (seemingly including the area now encompassed by St. John's on the Avalon Peninsula[1]), and eventually to the south coast and the interior, with sites and materials attributable to this culture dating to the period 5,500 to 3,200 years before present (BP). No sites associated with this group dating to more recent times have been identified (Stantec 2023; Schwarz 2010).

The Maritime Archaic presence in Newfoundland is followed, after a gap of approximately 400 years, by Early Pre-Inuit (Groswater) peoples, with sites attributable to this culture dating to the period *circa* 2,800 to 1,800 years BP. The Early Pre-Inuit presence is followed by Late Pre-Inuit groups (referred to by archaeologists as Middle Dorset) beginning *circa* 1,900 years BP and continuing for only 800 years or so until *circa* 1,100 BP. Research has also shown that Dorset sites are larger and more numerous than those of any other Precontact Period group that occupied the Island of Newfoundland (Stantec 2023; Schwarz 1992), though calculating population numbers from the data currently at hand is not possible.

What is referred to as the Recent First Nations Period of occupation of Newfoundland began *circa* 2,000 years BP and continued until sometime shortly after 1500 CE, which is generally considered to be the time when Europeans arrived in northeastern North America and contacted with Indigenous Peoples. A significant outcome of that contact was the change that occurred in existing Indigenous material culture technology, whereby stone tools were rapidly replaced by metal equivalents.

The earliest expression of the Recent First Nations Period in Newfoundland is referred to as the Cow Head Complex dated to *circa* 1,900 – 1,000 BP,[2] which has been shown to be contemporary with the Dorset occupation, thus confirming a shared presence on the Island of Newfoundland by First Nations

[1] See 2010 article by R. Skanes available at: https://www.gov.nl.ca/tcar/files/Vol9-2010.pdf (p.164-165).

[2] In archaeology, a "complex" is a network of interrelated cultural traits typically represented by specific characteristics of the material culture (artifacts) left behind by a cultural group. The artifacts that are interrelated usually date to a specific time-period and can provide insight into the lives of those who made and used them, and the connections they may have had with earlier and, potentially, more recent peoples.

and Pre-Inuit groups (Mills 2022). The Recent First Nation Period also includes subsequent occupations by the Beaches Complex (*circa* 1,800 – 800 BP) and the Little Passage Complex peoples, which evidence indicates began c*irca* 800 BP and ended with the arrival of Europeans in Newfoundland early in the sixteenth century (Marshall 1996; Schwarz 1992). In the case of the three cultural complexes identified for Newfoundland, each was named after the places on the Island where they were originally identified. It is important to note as well that the Newfoundland Beothuk[3] of the Historic Period are not considered part of the Precontact Period Recent First Nations tradition, but rather are the direct descendants of the Beaches and Little Passage peoples.[4]

3.1.2 Historic Period

3.1.2.1 Indigenous Cultures of the Historic Period

Beothuk sites of the Early Historic Period (also referred to as the Early Contact Period), date to *circa* 1500-1700 CE and have been located throughout Norte Dame Bay and Bonavista Bay, on the east coast of the Avalon Peninsula at Ferryland (see Section 3.1.2.2 below), and at several places on the south coast (Gilbert 2011; Gilbert 1990; Mills 2022). It has also been shown that later, more recent Historic Period Beothuk sites are generally restricted to the Exploits Valley and the shoreline of Beothuk Lake (formerly Red Indian Lake), which appears to have been one of the final refuges of this group during the period leading up to the death of Shanawdithit at St. John's in 1829 - the last person of her culture known to have lived in insular Newfoundland (Pastore 1987; Pastore 1992; Schwarz 1992; Marshall 1996). A small number of Beothuk sites have also been recorded in Placentia Bay (Mills 2022), including one at Come by Chance located approximately 50 km north of the Project Area (taken from PAO site record data).

An early reference that likely refers to Mi'kmaq travelling to Newfoundland from the northeastern North American mainland dates to 1602, when the English explorer Bartholomew Gosnold reportedly encountered a Basque "shallop" (i.e., a relatively small and open wooden boat that could be rowed and/or sailed) off the coast of New England manned by eight "Indians", who described to him parts of the Island and indicated on a drawing what he concluded to be the harbour at Placentia.[5] Other mention of Mi'kmaq in Placentia Bay in the seventeenth century can be found in a recent report prepared for Parks Canada regarding the longstanding yet intermittent land-use and occupancy of the south coast of Newfoundland by Indigenous groups (see: Mills 2022).

[3] https://www.heritage.nf.ca/articles/indigenous/beothuk.php

[4] (see: 2012 article by S. Hull available at: https://nlarchaeology.wordpress.com/2012/03/09/recent-period-tradition-newfoundland/).

[5] See the 2013 article by S. Hull *Newfoundland Mi'kmaq* available at: https://nlarchaeology.wordpress.com/2013/03/01/newfoundland-mikmaq/

Throughout the mid-late eighteenth century, the Mi'kmaq appear to have favoured locations on the Island of Newfoundland such as St. George's Bay, Cape Ray, Bay d'Espoir and Placentia, and in the early period of their occupation they are reported to have travelled back and forth to Cape Breton on a relatively regular basis (Stantec 2023). However, following the demise of the Beothuk in the 1820s, the Mi'kmaq extended their range to include much of the central and western Newfoundland interior, as well as the Bay of Exploits and Gander Bay. It has been reported that by the 1850s, Mi'kmaq hunters and trappers had a large portion of interior Newfoundland to themselves (Pastore 1978; Pastore 1998;[6] Stantec 2023).

3.1.2.2 European Cultures of the Historic Period

The earliest Historic-Period European archaeological site known for the Island of Newfoundland is the well-documented Norse settlement at L'Anse aux Meadows situated near the tip of the Northern Peninsula and dated to just over 1,000 years ago. Though the Norse presence in Newfoundland was likely short-lived and may have lasted for as little as three seasons, starting sometime around the year 1021 CE, the site is significant from the point of view that its occupation occurred at least five centuries prior to the sustained presence of Europeans in the "New World", which began and steadily increased in the years following *circa* 1500 CE. The site at L'Anse aux Meadows is also of importance in that it is the only Viking occupation recorded to date in North America (Handwerk 2021).[7]

Historical records and archaeological research confirm that the first part of the sixteenth century saw the beginnings of the Newfoundland "migratory" fishery, with crews from Brittany, Normandy, England, and other western European countries travelling to ports on the east coast each year to pursue a seasonal fishery that usually began sometime between January and April and continued until August or September, when crews departed with the summer's catch for markets in Europe and the Caribbean. It has also been shown that the well-publicized archaeological site at Ferryland on the Southern Shore of the Avalon Peninsula contains ample evidence deriving from the Early Historic Period. The longstanding research project at Ferryland, currently being conducted under the direction of Dr. Barry Gaulton of Memorial University of Newfoundland, has recorded artifact-bearing soil deposits and cultural features below seventeenth century levels that date to the previous century and are thought to derive from the earlier migratory period. Stone artifacts and the remains of small cobble hearths recorded in association with sixteenth century materials confirm the presence of Beothuk peoples at the site, presumably during fall and/or winter when the area would have been temporarily vacated by migratory European fishers.[8] Other

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[6] The history of the Newfoundland Mi'kmaq. Newfoundland Heritage article available at: https://www.heritage.nf.ca/articles/indigenous/mikmaq-history.php

[7] Handwerk 2021: *New Dating Method Shows Vikings Occupied Newfoundland in 1021* available at: https://www.smithsonianmag.com/science-nature/new-dating-method-shows-vikings-occupied-newfoundland-in-1021-ce-180978903/

[8] For summaries of past and ongoing archaeological research at Ferryland, see the Annual Review Series of the PAO available at: https://www.gov.nl.ca/tcar/artsheritage/culture/archaeology/arch-resources/archaeology-reviews-and-reports/ Also see: Beothuk Archaeology at Ferryland, Heritage Newfoundland and Labrador available at:https://www.heritage.nf.ca/articles/exploration/beothuk-archaeology-ferryland.php

seventeenth century archaeological sites on the Avalon Peninsula that have seen detailed research and analysis include those at Cupids[9] and Placentia in Placentia Bay, including the French fortification Vieux Fort dating to the period 1660-1690 (Crompton 2012).

The eighteenth century, a period which saw significant growth in the resident population of Newfoundland, is well represented at archaeological sites around the Island, including many located within the Town of Placentia (Mills 2022) and at St. John’s (Pope 1997), as well as several others at Carbonear in Conception Bay (Skanes 2019) and at locations in Trinity Bay (Skanes 2018). English settlement, confined until 1713 to the area between Bonavista Bay and Trepassey, gradually expanded into St Mary’s Bay and Placentia Bay, and then north of St. John’s to Fogo and Twillingate, to many locations along the “French Shore” on the Northern Peninsula and eventually even further north into Labrador (Matthews 1988).

Over time, the migratory fishery gradually gave way to a resident-based industry, which eventually saw increasing numbers of European settlers (primarily from southwest England and parts of Ireland) arrive in Newfoundland and, by the beginning of the nineteenth century, the population had grown to approximately 40,000. Though relatively large communities were present in Conception Bay and at other locations on the Avalon Peninsula, many people still resided and fished from remote towns and settlements spread out along the coast. While virtually all permanent residents were involved in the fishery in one way or another, most also partook in small-scale agriculture and logging, and it was not uncommon for families who spent the spring, summer and fall fishing and farming, to move to other more remote, inner-bay locations in the winter where firewood, logs for lumber, and game were more plentiful. This practice of seasonal movements from the outer bays to more sheltered inland locations, referred to as transhumance, was common in many parts of Newfoundland in the Early Historic Period and continued throughout the nineteenth century and into the twentieth, and in recent years has seen degree of professional investigation. The earliest archaeological evidence for “winter housing” in Newfoundland comes from a seventeenth century site situated at the bottom of Trinity Bay near the community of Sunnyside that was partially excavated and recorded in 2010 and 2013 (Gaulton and Mills 2011, 2014). Other winter house sites that have been investigated are situated in St. Mary's Bay near the small community of O'Donnells, and these have been dated to the period 1820s to 1840s (Gaulton and Mills 2011, 2014). A small winter settlement situated on the Pinware River in southern Labrador, upstream of the community of Pinware, is reported to have been used seasonally from the late nineteenth century until as late as the 1940s CE (Skanes 2021).

Given the nature of the economy at other Newfoundland fishing communities near the Project Area such as Placentia, Argentia and Marquise, it is likely that the seasonal movement of people from these relatively exposed coastal locations to inner bay sites was also practiced throughout that area in the early

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[9] For summaries of past and ongoing archaeological research at Cupids, see articles by W. Gilbert published in the PAO’s Annual Review Series available at: https://www.gov.nl.ca/tcar/provincial-archaeology-annual-report-series/

period of settlement. Noteworthy here is the very exposed and treeless Argentia Peninsula, which would have been a particularly difficult location to reside in winter. Thus, it is likely that many people did relocate from there to more sheltered inner bay locations such as the northern part of Placentia Bay or to the inner reaches of Northeast Arm where the Argentia Backlands are situated once fishing had slowed in the fall and the weather became progressively colder and windy.

3.2 History of Placentia

The Town of Placentia is located on the east side of Placentia Bay, at the far western end of Northeast Arm and to the southeast of the present-day communities of Dunville, Ferndale and Jerseyside. Despite the considerable amount of archaeological research that has taken place there, starting in the 1970s and intensifying during the 1990s and 2000s with the Placentia Uncovered Project, no artifacts attesting to a Precontact or Early Historic Period Indigenous presence are registered for the community with the PAO. Moreover, according to one archaeologist whose research was focused there in the 2000s, no materials such as stone artifacts and/or stone chipping debitage were located during her work, nor does she know of any having been found (PAO correspondence from Amanda Crompton relayed to SEM). Despite these results, it is worth noting that this lack of findings is not to say that the area had not been occupied by Indigenous Peoples prior to the regular usage and eventual settlement by Europeans in the sixteenth and seventeenth centuries, it simply means that no materials to confirm such a presence have been discovered. Given the apparent rate of sea-level rise suggested for the region (see 2019 personal communication described in Section 2.2 above), it is possible that any low-lying coastal areas occupied by Indigenous Peoples during the Precontact Period may have been partially or totally inundated and destroyed.

Like other coastal settlements on the Avalon Peninsula where Early Historic-Period fisheries and settlements sprung up, (e.g., Ferryland and Cupids), Placentia can date its beginnings to the first part of the sixteenth century, when crews from several western European countries travelled to the area each year to pursue a seasonal migratory fishery. Having a large and deep harbour for securing vessels, plenty of freshwater nearby and an expanse of cobble beaches (*graves*) ideally suited for processing and drying fish, an additional critical asset that proved important for the development of Placentia in the early period was access to relatively good stands of timber that were essential for construction of dwellings and the broad range of physical infrastructure required for the fishery (Cromwell 2011).

While it is known from historical records that French, Spanish and Portuguese fishers all frequented Placentia Bay during the sixteenth and early seventeenth centuries, Placentia itself was also a principal centre for fishers from the Basque region of the Iberian Peninsula.[10] In 1594, for example, it was noted

[10] For a brief discussion of Basque fishers at Newfoundland and Placentia in the sixteenth and seventeenth centuries, see the article by S. Hull available at: https://nlarchaeology.wordpress.com/2020/09/04/basque-beothuk-and-the-big-squeeze/

by English mariners Whyte and Jones that most ships using the harbour were from the Basque port of St. Jean de Luz (Cromwell 2011; Gaulton and Carter 1996).

By the mid-seventeenth century, the Newfoundland fishery at several ports on the Avalon Peninsula was well established, and to protect their assets and other critical infrastructure at Placentia, some rudimentary fortifications were constructed by Basque and/or English fishers, which were subsequently taken over by French solders and expanded (Cromwell 2011; Proulx 1979). In 1662, when the colony of Plaisance was formerly established as the capital of the French fishing and colonial interests in Newfoundland, a group of fifty settlers and thirty soldiers arrived and constructed a new defense works referred to as “Le Vieux Fort” on elevated ground to the east of Placentia’s “Great Beach” (Mills 2022; Crompton 2021; Cromwell 2011; Gaulton and Carter 1996).

In 1691, Le Sieur de Saint-Ovide de Brouillon, who was appointed Governor, arrived at “Plaisance” and oversaw the construction of Fort Louis on the north side of the harbour entrance and quickly turned the community into a French military stronghold. The following year, the new fortifications were tested, when Plaisance was attacked by approximately 800 English personnel with only 50 soldiers in the garrison. Though the fort withstood the assault, the town was severely damaged, and it was apparent to the French military that the facility was critically inadequate. Consequently, a four-gun battery was constructed on the south shore of “The Gut” and another was established on what is now known as Castle Hill to the north, which was referred to as the "Gaillardin" (Proulx 1979). A series of English attacks on Plaisance in the 1690s led to a renewed recognition that the harbour needed to be better defended, as Placentia was a key port where the French fishing fleet in Newfoundland could operate from and serve as a location where naval vessels could complete repairs prior to or at the end of an Atlantic crossing. Between 1694 and 1695, some effort was expended in rebuilding Fort Louis (Crompton 2021; Cromwell 2011; Gaulton and Carter 1996).

The period of French control of Plaisance was temporary and, in 1713, the colony passed to Britian under the Treaty of Utrecht (Mills 2022; Crompton 2012). In accordance with the terms and conditions outlined in the Treaty, France lost not only the expanding town and fishery, but also all other rights and possessions it held in Newfoundland (Gaulton and Carter 1996).

In the early part of the English control of Placentia, considerable effort was expended in fortifying strategic locations around the harbour, including construction of Fort Fredick near the mouth of The Gut. By the 1770s, a census shows that the population of the town had expanded to 700 and there were an additional 800 people residing throughout the surrounding area. By the end of the century, Placentia played a very limited role for English commerce, as there was a considerable decline in the fishery and trade, with the result that many of the settlement’s buildings and structures fell into an advanced state of disrepair (Gaulton and Carter 1996). From that time on, Placentia was dominated by the new British capital at St. John's, and with the withdrawal of the military garrison from Placentia at the beginning of the nineteenth century, the community quickly reverted to its former role as a fishing outport (Gaulton and Carter 1996). For a short period near the end of the nineteenth century, Placentia and other communities in the area did see the development of a shipbuilding industry, but as large steel vessels rapidly replaced wooden ones, that business also fell into decline (Encyclopedia of NL, 1993, Volume 4, pgs. 317-319).

3.3 History of the Argentia Peninsula and Marquise

The Argentia Peninsula is situated at the far western end of the Project Area. Early maps and photographs suggest that at one time, even as late as the early twentieth century, the peninsula was more-or-less an island connected to the adjacent mainland by only a narrow strip of terrain.[11] Though it is likely that this relatively flat peninsula, which had many large beaches on which to land and deploy small craft and potentially establish encampments of short duration, was used by Indigenous Peoples during the Precontact and Early Historic Periods, no cultural materials, lithic or otherwise, attesting to any such occupation are registered with the PAO.

Settled originally by French fishers in the seventeenth century and known as Petit Plaisance, census records for the peninsula from 1687 suggest a population of 35 and, by the beginning of the eighteenth century, that number had grown to approximately 150 individuals residing in 14 dwellings (taken from Penney 2006). In 1713, in accordance with the terms and conditions of the Treaty of Utrecht, the town fell under the authority of Britian and became known as Little Placentia. It is of particular interest that an inventory of resources remaining at several Placentia Bay communities completed in 1714 following the departure of most of the French residents (apparently some remained and pledged their allegiance to the British Crown), indicates that at that time there were *14 stages, 30 houses and two churches* still in existence at Little Placentia (taken from Penney 2006). Due to its well-protected harbour and expanse of beach-space for processing and drying cod, it rapidly developed into a successful British fishing station and, by the mid-nineteenth century, the population had grown to approximately 600. *Circa* 1900, the community adopted the name Argentia due to the discovery of silver ore deposits in the area, which resulted in the eventual exploration and limited development of Silver Cliff Mine situated on the north side of the Argentia Backlands near Broad Cove.

The former fishing community of Marquise was situated on the south side of Argentia Harbour (formerly known as Baye de la Marquise) on terrain that was eventually acquired by the US Military in the 1940s. Recorded in the 1845 census as a separate community (but in literature sometimes referred to as the Marquise section of Little Placentia), it had a population of 67. While fishing and small-scale farming had always been the backbone of the economy, the opening of the aforementioned mine in the early nineteenth century did provide some employment until *circa* the 1920s (Encyclopedia of NL, 1993, Volume 3, pgs. 466-467).[12] An aerial view of the Argentia Peninsula and Argentia Harbour looking north

[11] See : MUN Digital Archive Initiative, early eighteenth century map - Carte des Bayes, Rades, et Port de Plaisance dans L'lles de Terre-Neuve, avalable at: https://collections.mun.ca/digital/collection/maps/id/856/
[12] Also see report available at: https://gis.geosurv.gov.nl.ca/geofilePDFS/ReceivedBatch51/001N_0869.pdf

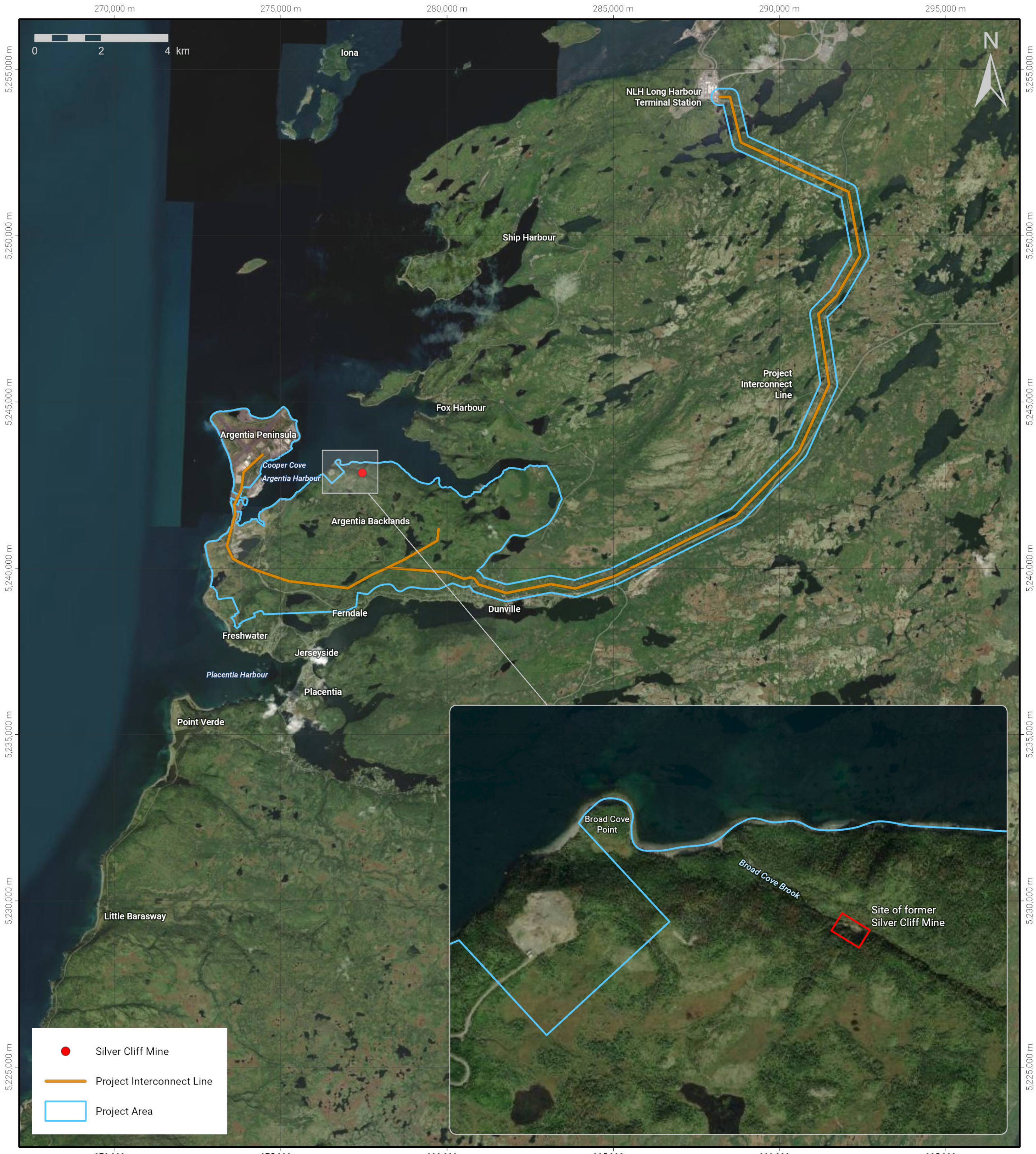
toward the community of Argentia and including the small fishing village of Marquise is included below (Figure F-3.3-1).[13]

Figure F-3.3-1 North View of the Argentia Peninsula Circa 1940. Marquise Situated on the Mainland at the Foot of the Hill Near the Pond.

3.3.1 Silver Cliff Mine

The Silver Cliff Mine was located on the northern side of the Argentia Backlands to the east of the Argentia Peninsula and on the south side of Placentia Sound slightly inland of Broad Cove and Broad Cove Point. It appears from the review of literature and historic aerial imagery completed for this HROA that the principal aboveground components of the mine were situated in what is now an open gravel pit / clearing on the western shore of the small waterway known as Broad Cove Brook (below in Figure F-3.3.1-1). The various mineshafts and subsurface excavations associated with the historic mine were situated near the brook and the aboveground infrastructure (e.g., the mill), but also extended away from there toward the south and southwest.

[13] Online image of unknown source, but likely taken by the US Military circa 1940 prior to construction of the Naval Air Base and removal and demolition of housing and infrastructure at Little Placentia and Marquise.



Pattern | Argentia Renewables	FIGURE NUMBER: F - 3.3.1 -1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 14/06/2024
	FIGURE TITLE: Location of aboveground infrastructure associated with the former Silver Cliff Mine	NOTES:	REVIEWED BY:	
			APPROVED BY:	
	PROJECT TITLE: Argentia Renewables		sem	

SEM MAP ID: 238-005-GIS-128-Rev0

While limited documentation on the history of the mine is available, a chronology of key operational events listed in the online publication *Fourth Year Assessment Report of Prospecting on claim License 14798M* compiled by Jason White and submitted to the Government of NL in 2008, suggest that veins of galena-bearing sulfide were discovered on terrain slightly inland of Broad Cove in the early 1880s, with the Mineral Rights being sold to an English company for $4,500 who then worked the area for a brief period but closed the mine without finding the main deposit. The only record of any ore being shipped during the early period of operation is a reference to a cargo of between 30-40 tons that was sent by sailing vessel to England; however, the vessel and all the crew were reported to have been lost at sea. Subsequently, a second company took control of the mine and worked it for approximately six months, again with limited results. In the early 1920s, work restarted at the mine, with no recorded production available, and in 1928 the mine closed due to lack of working capital, ongoing and costly technical problems with equipment, and a drop in world lead price (summarized from online source by J. White, dated February 2019).[14] Ten years later in 1938, mapping of the mine's subsurface assets were "issued", though it is uncertain if the plans produced at that time were based on new exploration activities or if they were simply copies of existing documents that had been reworked for clarity and scale, possibly by the then Newfoundland Government Geological Survey (copies of plans housed at the NL Government's Air Photo and Map Library, Corner Brook).

Another report compiled in 1925 suggests that at that time the workings at the mine included (or had included) several surface trenches and excavations as well as underground shafts and tunnels where ore was being extracted. Additionally, a scale plan of the operation included with the 1925 report shows that the infrastructure in place on the surface included: a Manager's House and Office; two Stores; a Workman's Shack (also reported as being "Bunk Houses for about 25 men", though another part of the report states "shacks to house 50 to 60 men"); a Mess and Cookhouse; a Carpenter's Shop and Mill (or a "building covering a portion of the mill" capable of "treating" 50 tons of ore per day); a Rock House, an Ore House Crushers; a Power House with a Compressor, a Boiler House and; a Compressor and Smithy (see Figure F-3.3.1-2 below; information and image taken from 1925 online report[15]). It was reported as well that the whole of the plant was driven electrically by power supplied by the United Town Electric Company who had constructed a transmission line more than 60 miles long to deliver power. While there are some discrepancies in the reporting regarding the number of people working and housed at the site, it appears nonetheless that even though short-lived, Silver Cliff Mine at one time had been a relatively considerable operation.

[14] Article available at: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://gis.geosurv.gov.nl.ca/geofilePDFS/Batch2022/001N_1042.pdf

[15] Article available at: https://gis.geosurv.gov.nl.ca/geofilePDFS/Batch04/001N_0061.pdf

To help verify if the aboveground infrastructure and buildings listed and illustrated above were in fact constructed on the site (or if the were simply “proposed”), and for how long they may have stood, contact was made with the Air Photo and Map Library at the provincial Department of Fisheries, Forestry and Agriculture to obtain copies of any aerial photography that showed the portion of the Argentia Backlands where Silver Cliff Mine was located. While the library does have several relevant photographs in their collections dating back to 1940s when the US Military commenced operations in the area (see Section 3.3.2 below), most were taken at such a high altitude and scale (e.g., 1:50,000 or more) that identifying and confirming what infrastructure (if any) was on the ground was not possible. However, one photograph of the area taken in 1951 at a 1:15,840-scale (26 years after the 1925 report), does show the large clearing next to Broad Cove Brook where the aboveground infrastructure was reported to be situated, though no clear evidence of the range of buildings listed above is discernible. While it seems unlikely, due to the amount of work that would have been involved, it is possible that all the aboveground structures shown on the plan of the mine compiled in 1925 were demolished or dismantled and/or removed intact.[16] Despite a similar search of the photographic collections housed at The Rooms Provincial Museum in St. John’s and at the Centre for Newfoundland Studies at Memorial University of Newfoundland, no ground-level historic images showing the mine and its buildings were located.

[16] Aerial photograph, dated 1951, available at Department of Fisheries, Forestry and Agriculture’s Air Photo and Map Library, Corner Brook, NL, reference code: A-13363-48

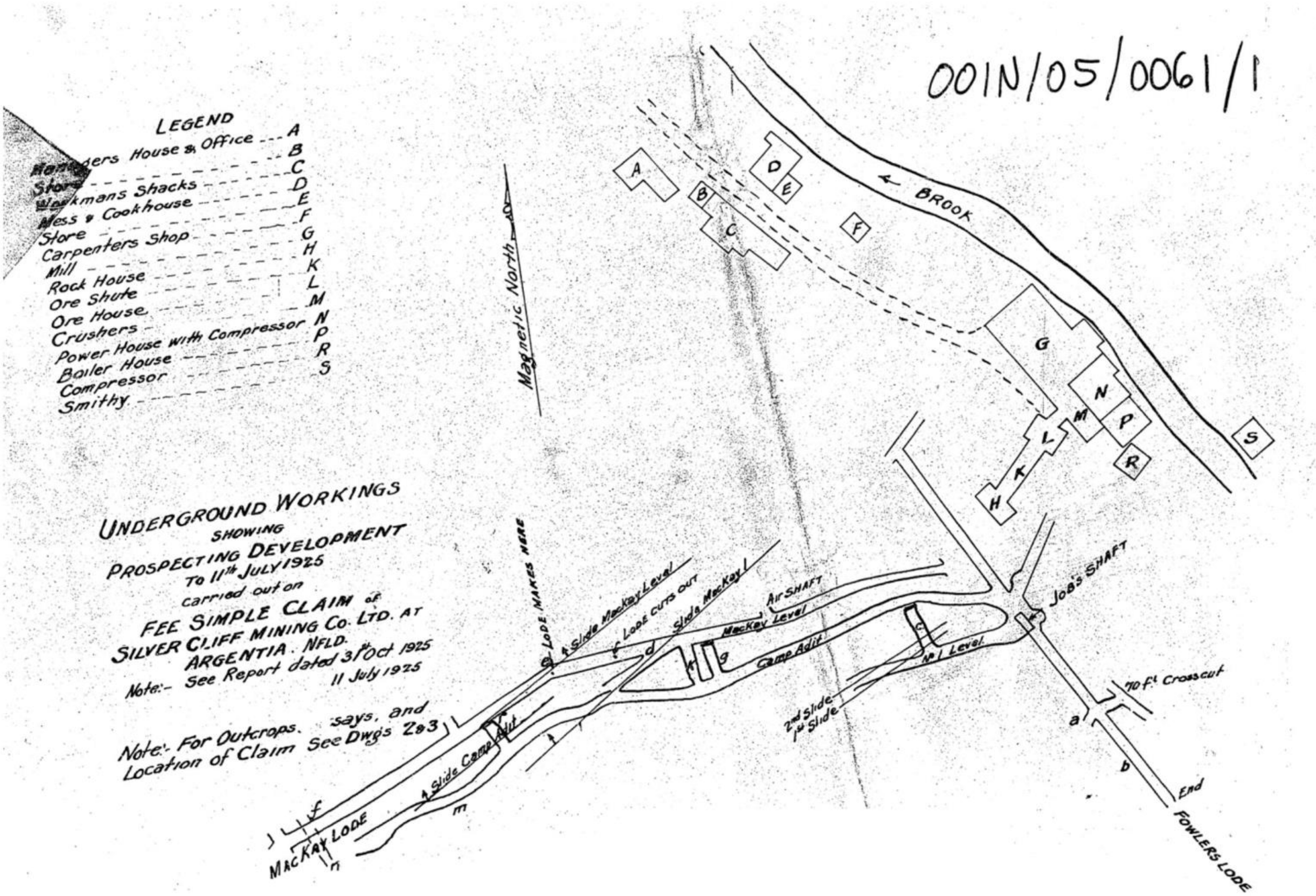


FIGURE NUMBER:	COORDINATE SYSTEM:	PREPARED BY:	DATE:
F - 3.3.1 - 2	n/a	C. Bursey	17/05/2024

Pattern | Argentia Renewables

FIGURE TITLE:
Plan of aboveground components of Silver Cliff Mine and its "Underground Workings" dated 1925

PROJECT TITLE:
Argentia Renewables

NOTES:
Plan drawing sourced from NL Government Department of Industry, Energy and Technology

REVIEWED BY:

APPROVED BY:

sem

SEM MAP ID: 238-005-GIS-127-Rev0

Despite the generally negative findings of the photographic searches and the lack of supporting documentary information to confirm the full nature and extent of the aboveground mining infrastructure, there are several modern photographs available online that show a variety of dilapidated equipment scattered throughout the area thought to be the location of the former mill situated next to Broad Cove Brook at the upstream end of the facility (see Figure F-3.3.1-2 above and Figures F-3.3.1-3 to F-3.3.1-5 below).[17] Other than the mill, no evidence of buildings such as accommodations, occupational or storage facilities, were identified in any of the modern photographs reviewed for this HROA.

Figure F-3.3.1-3 North View Toward Broad Cove Brook Showing Dilapidated Mining Equipment at the Site of the Former "Mill" (listed as G in the Legend shown on F-3.3-3 and included within the area defined on Figure F-3.3-2 above).

[17] Images for Figures F-3.3-4, F-3.3-5 and F-3.3-6 were taken from the online article Nomadic Newfies: Adventure a la Mine d'Argent available at: https://nomadicnewfies.blogspot.com/2018/08/aventure-la-mine-dargent.html

Figure F-3.3.1-4 View Southeast Along the South Shore of Broad Cove Brook Showing Dilapidated Mining Equipment at the Site of the Former Silver Cliff Mine Mill.

Figure F-3.3.1-5 View Northwest Along the South Shore of Broad Cove Brook Showing Dilapidated Mining Equipment at the Site of the Former Silver Cliff Mine Mill.

3.3.2 The US Naval Air Station Argentia and Fort McAndrew

During the early years of World War II, the United States (US) and other countries were contemplating the possibility of a German invasion in North America. It was suspected at the time that if German forces successfully defeated or bypassed England in the war, the next move could involve the occupation of the British-ruled Island of Newfoundland, whose strategic position in the North Atlantic and relative proximity to Europe made it an ideal stopping-off point for aircraft and warships heading to and from Europe. Consequently, in September 1940, Britian and the US signed a document known as the "Destroyers for Bases Agreement" that would see Britian acquire several destroyers in exchange for 99-year leases of lands in Newfoundland, a large parcel of which included the entire Placentia Peninsula situated in northeastern Placentia Bay, as well as a narrow strip of coastal terrain located on the mainland directly adjacent to the peninsula. These locations were selected by American personnel for the site of the Argentia Naval Air Station and associated defences, as the peninsula was relatively flat and open and had a large and deep, ice-free harbour suitable to accommodate large military vessels.

In October of 1940, surveyors arrived at the Argentia Placentia, along with 1500 construction workers and engineers. To provide adequate space for construction of the base and its mainland defenses, approximately 750 people living in the community of Argentia were given notice to relocate and were provided with some degree of compensation. Those buried in the three local graveyards were exhumed and reinterred in a new cemetery constructed by US forces. Once abandoned, all the homes, out-buildings, and shoreline structures such as stages, wharves, and slipways, were either moved, burned, or levelled by bulldozers. Over a short period of time, three runways measuring roughly 5,500 feet, 5,300 feet, and 7,000 feet were constructed on the peninsula, along with 2,000 feet of wharfing, a floating drydock, hangars, numerous living quarters, and storage space for a massive quantity of fuel and other materials. The US Naval Air Station on the Argentia Placentia was officially opened in July of 1941 (Figure F-3.3.2-1).

Figure F-3.3.2-1 Northeast View of the US Naval Air Station on the Argentia Placentia *Circa* 1945.[18] A Small Section of Fort McAndrew on the Mainland Can be Seen in the Foreground.

In March of 1942, the United States Army established a base on the mainland near the Naval Air Station on terrain formerly encompassed by the community of Marquise. Named Fort McAndrew, its principal purpose was to provide security to the Base through anti-aircraft batteries and other artillery, some of which was positioned on the high ground behind the community at the eastern end of the sector of the Project Area referred to as the Argentia Backlands.[19]

The military facilities on and near the Argentia Peninsula continued to play a role in defense of North America throughout the 1950s and 1960s, though the US Navy continued to operate several buildings in the area until 1994. Eventually, all the buildings and facilities were transferred to the Government of Canada and then to the Government of Newfoundland and Labrador, and many were demolished, and the ground and waterside areas were decommissioned. The site was since developed as an industrial area, with a portion of it currently in use for construction of the West White Rose Project concrete, offshore drilling platform.

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[18] Online image taken by the US Military in 1945. It is unknown where the image is archived.

[19] The information presented in Section 3.3.1 above is not based on a review of original sources by SEM but rather is summarized from the online article *Argentia Naval Air Station and Fort McAndrew* available at: https://www.hiddennewfoundland.ca/argentia-naval-station

3.4 Archaeological Sites Registered for Placentia Bay

There are currently 100 archaeological sites recorded in the PAO site record database in the RAA, 28 of which are situated within the Town of Placentia and throughout the surrounding area. Those 28 sites located in Placentia are discussed in more detail in Section 3.5 below.

When presenting information related to site record data, it is important to note that because many archaeological sites are situated in settings where conditions for encampments and/or various other types of resource-harvesting are particularly favorable, it is not uncommon to find that an area occupied by one cultural group is later used for similar reasons by other individuals or groups, potentially of a different culture. Consequently, many archaeological sites recorded in Newfoundland and elsewhere, including those recorded for Placentia Bay, have more than a single “cultural component” represented (see Linnamae 1971; Mills). For example, a site originally occupied by First Nations Peoples during the Precontact Contact Period may have also been used decades or centuries later as an encampment by Pre-Inuit groups and eventually by Europeans as part of a fishing establishment, with no face-to-face contact between groups necessarily occurring. Therefore, for the purposes of the site record data for Placentia Bay summarized below, while there are a total of 100 archaeological sites registered with the PAO, several contain evidence of more than one cultural group and time-period displayed in the overall artifact assemblage. Thus, the data is summarized according to the number of sites in which a particular cultural group is represented. In so doing, this results in a total of 122 cultural components recorded at the 100 sites.

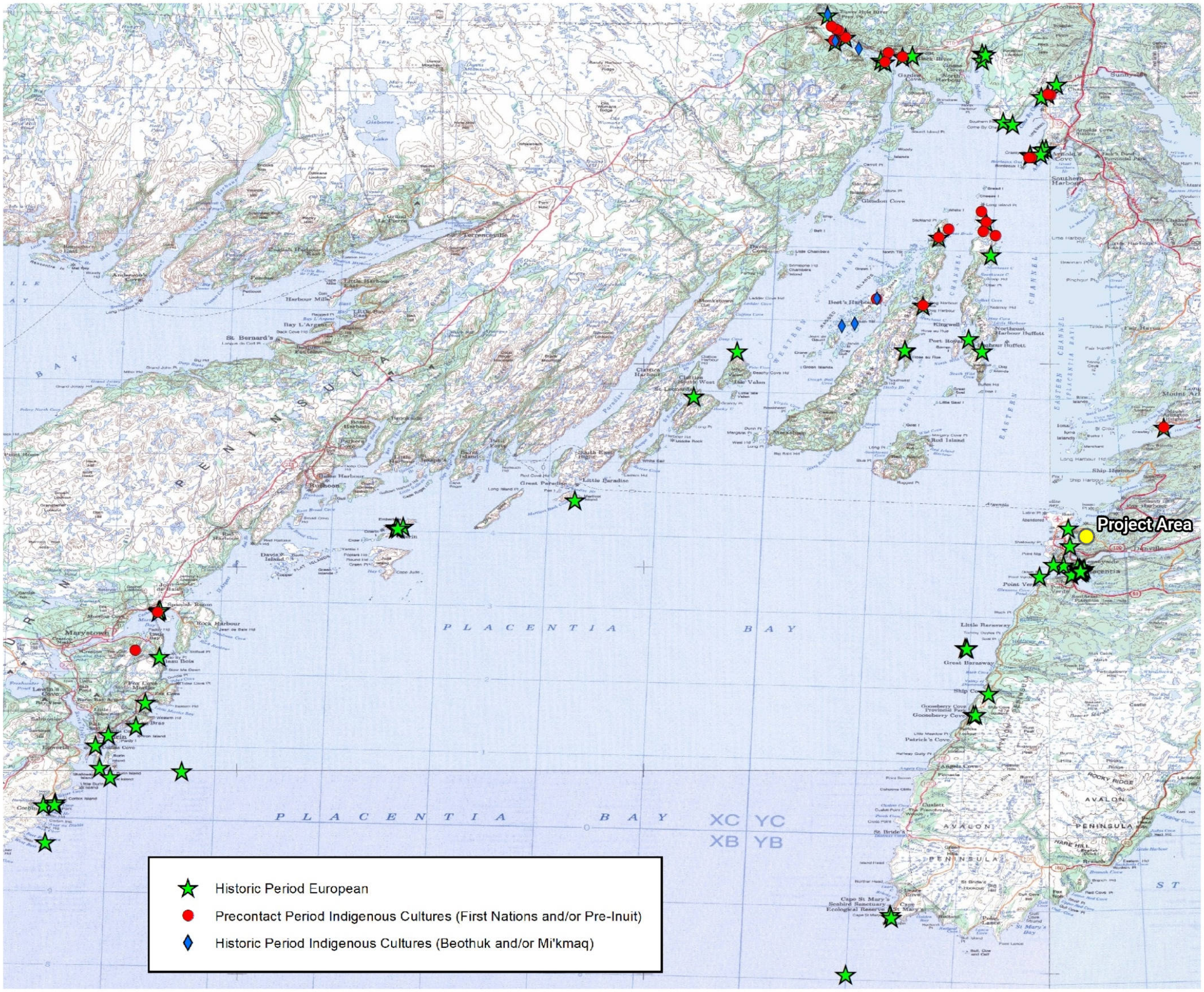
Of the overall 100 sites, there are six dating to the Precontact Period with Maritime Archaic First Nations peoples represented, eight with Pre-Inuit Dorset components (though no sites associated with Pre-Inuit Groswater peoples have been identified), one contains materials associated with First Nations Beaches Complex peoples, two have evidence associated with First Nations Little Passage peoples, and there are a total of a total of 16 sites where Precontact Period materials have been found, but because no diagnostic artifacts or other types of culturally-specific evidence was recorded, the Precontact Period cultural group(s) represented could not be determined.

Regarding the Historic Period archaeological sites recorded to date within Placentia Bay, not surprisingly 81 include materials of European origin such as fragments of ceramic, glass, clay smoking pipes components and possibly the remains of iron objects, thus it is reasonable to conclude that these sites were likely occupied by Europeans or people of European decent. Of the 81 sites, 12 are either shipwrecks or sites where collections of artifacts were gathered from the seabed within Argentia Harbour and Placentia Harbour. Note, however, that during the more recent part of the Historic Period, because Indigenous Peoples such as Beothuk and Mi’kmaq had, for the most part, dispensed with stone tool technology and took up using European made materials at a relatively early time, in some cases it is difficult to establish conclusively from the material culture alone and without other supporting evidence (e.g., historical documentation), whether some sites of this period are in fact European or represent Indigenous occupations (or both).

Over and above the sites listed as European, there are four sites which included evidence of Beothuk occupation and two with materials and/or structural remains thought to represent Mi'kmaq peoples. Additionally, the site record data provided by the PAO listed two sites where cultural materials and/or other physical evidence was recorded, but it was of such a limited nature that the culture affiliated with the occupation could not be confirmed, thus the sites were listed in the category of "undetermined".

As seen in Figure F-3.4-1 below, many of the archaeological sites listed above are situated along the coast in the southwest section of Placentia Bay toward Cape Rosey, while others, notably sites containing materials associated with Precontact and Historic-Period Indigenous cultures, are located on the islands at the north end of the bay, including Merasheen Island and Long Island. Not surprisingly, there is also a cluster of sites, both Indigenous and European, at the northern end of the bay, to the northwest of Swift Current and at and near the mouth of Piper's Hole River, which would clearly have been a favoured location for resource harvesting of maritime and freshwater species at various times of the year. While the number of sites recorded for Placentia Bay is by far dominated by sites with European components, with a total of 81 sites represented, and only 39 having components deriving from Indigenous occupations from both the Precontact and Historic Periods, all these numbers are undoubtedly low and do not necessarily accurately represent the true extent of land-use and occupancy that occurred over time.

Apart from Placentia, where archaeological research has been ongoing at differing degrees of intensity since the 1970s and where many sites have been discovered and investigated (as discussed in more detail below), it is likely that the seemingly low number of sites recorded in Placentia Bay as a whole may in part reflect the relatively limited amount of archaeological survey of coastal and near-coastal locations that has been completed throughout the region thus far. Other factors potentially contributing to the number may be related to disturbances and/or losses of cultural materials caused by the inundation of shorelines due to rising sea-levels (such as occurred at the Pre-Inuit Dorset site at Bordeaux Head - see: Erwin 2017), and to the construction, operation and decommissioning of the military facilities on the Argentia Peninsula and throughout the former community of Marquise, where the environmental setting and historical record suggest that both had been favored settlement and resources-harvesting locations. Unavoidably, other coastal developments undertaken in Placentia Bay may have also resulted in the loss of archaeological sites.



Pattern | Argentia Renewables	FIGURE NUMBER: F - 3.4-1	COORDINATE SYSTEM: n/a	PREPARED BY: C. Bursey	DATE: 17/05/2024
	FIGURE TITLE: Registered Archaeological Sites in Placentia Bay	NOTES: Map provided by NL Provincial Archaeology Office (PAO)	REVIEWED BY:	
			APPROVED BY:	
	PROJECT TITLE: Argentia Renewables		sem	

SEM MAP ID: 238-005-GIS-129-Rev0

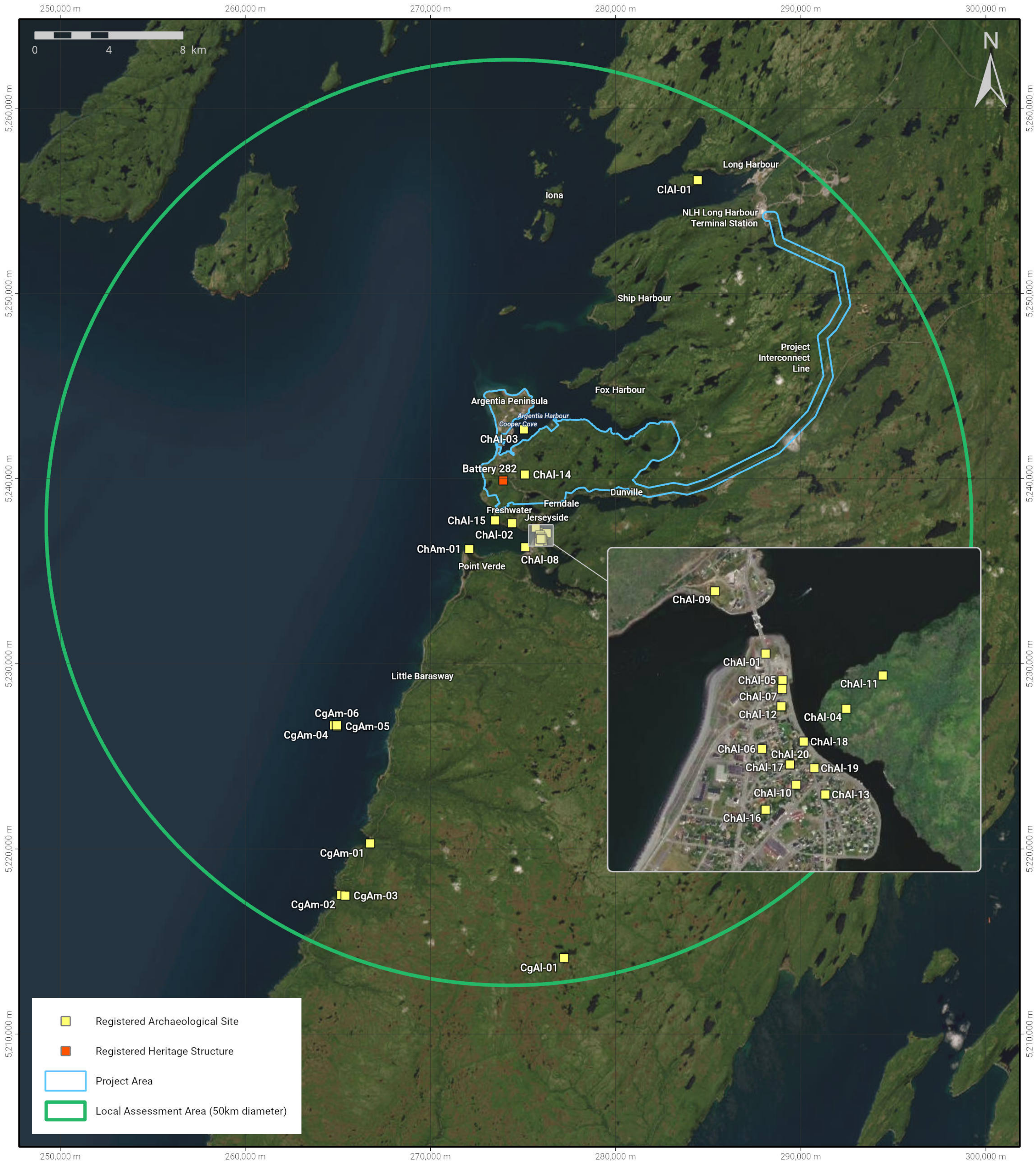
3.5 Archaeological Sites Registered for Placentia and Surrounding Area

A review of the PAO archaeological site record inventory for the LAA indicates the presence of 28 sites (26 of which were included in the discussion of the sites registered for Placentia Bay). Of the 28 sites, seven are either nineteenth or twentieth century shipwrecks or random collections of artifacts retrieved from the bottom of Argentia and Placentia harbours that date to various time-periods, and one is a cemetery thought to contain nine graves of individuals lost on the mid-nineteenth century American vessel the *Free Trader*. One other site – CgAl-01 - is a pond located near the southern boundary of the LAA, where several searches have been conducted since the 1970s for remains associated with the aircraft L'Oiseau Blanc lost in 1927 during an attempted trans-Atlantic flight from Paris to New York (Figure F-3.5-1). Despite the several swimming and electronic investigations, which to date have encompassed a relatively large segment of the pond, no artifacts or mechanical parts definitively associated with an aircraft have been discovered (Skanes 2023).

The 19 terrestrial archaeological sites recorded in the LAA are shown on Figure F-3.5-1. Not surprisingly, the earliest are military facilities dating to the French period of occupation in the seventeenth century, but almost all have later archaeological components deriving from the subsequent English take-over of Placentia following the Treaty of Utrecht in 1713. A site of note in the listing of registered remains includes a structure situated on elevated ground on the east side of the arm that runs along the east side of Placentia. The site, referred to as Mount Pleasant Knoll – ChAl-11 - contained physical remains associated with what was thought to be a seventeenth century French dwelling, and the area where the site is situated likely saw considerable use by English settlers after the French withdrawal from the region. Other evidence recorded at the site includes materials confirming some eighteenth and nineteenth century usage (information taken from the PAO SRF).

Other sites recorded at Placentia include three cemeteries, one of which included several seventeenth century Basque burials that have been the subject of considerable research in recent years. All but one other site recorded for the LAA contain Historic Period material culture and further confirm the intensive European use and occupancy of Placentia and area, starting as early as the sixteenth century and continuing in varying degrees of intensity until current times. The single site that contained a Precontact Period Indigenous component is registered with the PAO as CiAl-01, which is situated to the north of the Project Area at the eastern end of Crawley's Island near Long Harbour (F-3.5-1). The single find included a Recent First Nations, Little Passage Complex (i.e., pre-Beothuk), stone arrow near the shoreline of a small basin referred to as The Pool (see: Penney 2006).

There is one archaeological site registered for the Project Area – ChAl-14. According to the PAO SRF, it is comprised of 13 separate, concrete structures, all of which appear to be associated with the facilities put in place in the 1940s for the defense of the Argentia Naval Air Station. The site is located on the high-ground toward the western end of the Argentia Backlands slightly to the east of the two waterbodies referred to as Shag Ponds (Figure F-3.5-1).



Pattern | Argentia Renewables	FIGURE NUMBER: F - 3.5.1 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 5/17/2024
	FIGURE TITLE: Registered Archaeological Sites and Architectural Resources	NOTES: Registered Archaeological Site data provided by the NL Government's Provincial Archaeology Office (PAO). Registered Heritage Structure provided by Heritage NL. The 'LAA' predates the current Regional Assessment Area (RAA) and covers a 50 km-diameter circle that centers on a point near the community of Placentia.	REVIEWED BY:	
	PROJECT TITLE: Argentia Renewables		APPROVED BY:	

SEM MAP ID: 238-005-GIS-130-Rev0

3.6 Registered Heritage Structure

Over and above the one archaeological site registered with the PAO for the Argentia Backlands (ChAl-14), there are at least three (and possibly more) other locations in that Project sector that have structural remains and/or armaments deriving from the mid-twentieth century US military presence in the area; however, only one complex of ruins is registered with Heritage NL as an architectural resource. The site, known as the 282 Coastal Defense Battery and listed on the mapping below as PA-19, is located on a hill overlooking Placentia Bay and is comprised of a principal underground structure built of concrete and covered with earth, and two large associated anti-aircraft and/or anti-submarine guns. Forming part of the defenses established at Fort McArthur to protect Argentia Harbour and the former Naval Air Station at Argentia, the designation encompasses a portion of the underground and aboveground fortification as well as the two original pieces of heavy artillery.[20] These specific ruins are also recognized by the Town of Placentia as a Municipal Heritage Site. The principal components of the site are shown in Figures F-3.6-1 and F-3.6-2 below.

Figure F-3.6-1 Entrance to Underground Bunker at the 282 Coastal Defense Battery – a Designated Architectural Resource.

[20] For a description of the 282 Coastal Defense Battery and the rationale for it being formally recognized as a Registered Heritage Structure, see: https://heritagenl.ca/heritage-property/argentia-282-coastal-defence-battery-registered-heritage-structure/

Figure F-3.6-2 Heavy Artillery at the 282 Coastal Defense Battery - a Designated Architectural Resource.

Two other undesignated yet related defense facilities situated within the Argentia Backlands are discussed in Section 4.3 below and the location of each is highlighted on the appropriate figures in that section and are indicated as PA-2 and PA-18.

4.0 Historic Resources / Archaeological Potential of the Project Area

4.1 Potential Rating Criteria

Given the longstanding and diverse culture / historic sequence of Placentia Bay, generally, and the portion in the northeast where the Project is located, over and above the WWII archaeological site registered with the PAO as ChAl-14 (see Section 3.5 and Figure F-3.5-1 above), there are other locations of potential historic resources significance within the Project Area. Included, for example, are at least two areas within the Argentia Backlands where similarly aged defense facilities are situated (one of which is referred to as the 281 Coastal Defense Battery and the other is known as the Command Bunker), as well as other places where there are structural remains that may have also served a contemporary military function. Additionally, there is a large parcel of cleared terrain adjacent to Broad Cove Brook where several large and small pieces of dilapidated mining equipment are extant that comprised part of the late-nineteenth and early-twentieth century mineral extraction and processing site referred to as Silver Cliff Mine (see Figures F-3.3-4 to F-3.3-6 above). Given the age and significance of these and potentially other materials associated with the mine, and those that served (or potentially served) a mid-twentieth century military function, it is reasonable to suggest that they too could be considered historic resources that may warrant registration with the PAO, Heritage NL and/or the Town of Placentia. Therefore, for the purposes of this HROA report, these other facilities and materials are considered significant historic properties and the terrain where they are situated is rated as having High potential and is delineated accordingly on the Project mapping presented below.

Other locations within the Project Area considered to have High potential for historic resources (notably archaeological materials) include all coastal shorelines with a beach suitable for landing and deploying small craft, either Precontact or Historic Period vessels, with terrain near the shore that is relatively level and well-drained and generally suitable for human settlement by Indigenous, European and/or European-derived peoples. Also considered High potential is similarly appropriate topography along river systems or streams, and terrain that is situated at the mouths of such watercourses where they empty into the sea. Inland locations considered to have High potential include the shorelines of ponds where the ground is amenable to settlement, particularity along narrow strips of land that form a potential pathway between ponds or along the shorelines of brooks or small rivers connecting waterbodies.

Of course, a key factor in any traditional type land-use involving habitation, either during the Precontact or Historic Periods (but including a twentieth century military use), is the availability of food resources, and while the marine shoreline of the Project Area and the adjacent offshore within Placentia Bay and potentially Northeast Arm were likely bountiful in this regard at certain times of year, resources of the interior portion of the Project Area have almost certainly always been relatively limited. If people did reside in the interior or near-coastal sectors of the Project Area during winter in locations near freshwater where fish, small game, and wood may have been available (i.e., for winter-housing or for temporary encampments), they may have had to expand their range periodically to include locations further inland on the Avalon Peninsula where other food resources may have been more plentiful.

Areas considered to have Medium potential for historic / archaeological resources include locations like those described above, but with physical assets that are less pronounced and apparent. Low potential areas, none of which are mapped for this study, would include all other terrain within the Project Area that is not rated as High or Medium.

Regarding the various potential ratings defined for the Project, a rating of High would mean that there is a strong likelihood that archaeological materials and/or other types of historic resources (known or unknown) exist within the area delineated on mapping. A rating of Medium suggests that the potential for cultural materials is mid-range and is neither High nor Low. While the bulk of the landscape within the Project Area is considered to have Low potential, which is indicated by it not being delineated as either High or Medium, this is not meant to imply that the terrain has no potential whatsoever. It simply suggests that, while there is a possibility that traditional land-use of a type that would have left *in situ* physical evidence on or in the ground occurred, it is not likely. In general, Low potential terrain has topographic and/or hydrographic attributes (such as wet, steeply sloped and/or uneven ground) that is generally considered unsuitable for past human habitation. Additionally, Low potential locations include terrain where ground alterations have occurred to such an extent that any extant evidence of earlier occupations has almost certainly been extensively disturbed or destroyed, such as that which likely occurred on the Argentia Peninsula.

The following three sections of this report summarize the historic resources / archaeological potential of the three separate Project sectors and include tables listing the reference code for each individual Potential Area (identified as PA-1, PA-2 and so on), which Project sector each is located in, a brief description of the physical setting and a general statement regarding the rationale for selection, whether any Project interactions are anticipated, the elevation of the location above sea-level, and the potential rating assigned. Also presented below are figures showing where each Potential Area is located, along with an outline of its full physical distribution.

4.2 Argentia Peninsula

While the peninsula where the former community known as Petit Plaisance, Little Placentia, and eventually Argentia was situated almost certainly had been visited by Indigenous Peoples during the Precontact Period, any evidence of such land-use was probably located near the sea and, therefore, may have been impacted by European settlers in the Early Historic Period and during more recent times. Also, given the vast amount of ground disturbance that unquestionably occurred during the mid-late twentieth century for construction, operation, and subsequent decommissioning of the Argentia Naval Air Station, and for more recent industrial uses, any physical evidence of Precontact and/or Historic-Period occupations by either Indigenous, Europeans or European-derived peoples would almost certainly have been disturbed or destroyed (Figure F-4.2-1). Thus, it is concluded that the archaeological potential of the sector of the Project Area referred to the Argentina Peninsula is Low and the likelihood of the current Project contributing to further disturbances of cultural resources is negligible.

Pattern | Argentia Renewables	FIGURE NUMBER: **F - 4.2 - 1**	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 17/05/2024
	FIGURE TITLE: **Current aerial image of the Argentia Peninsula showing existing infrastructure**	NOTES: The location of proposed project infrastructure is considered preliminary and is subject to change.	REVIEWED BY:	
	PROJECT TITLE: Argentia Renewables		APPROVED BY:	
			sem	

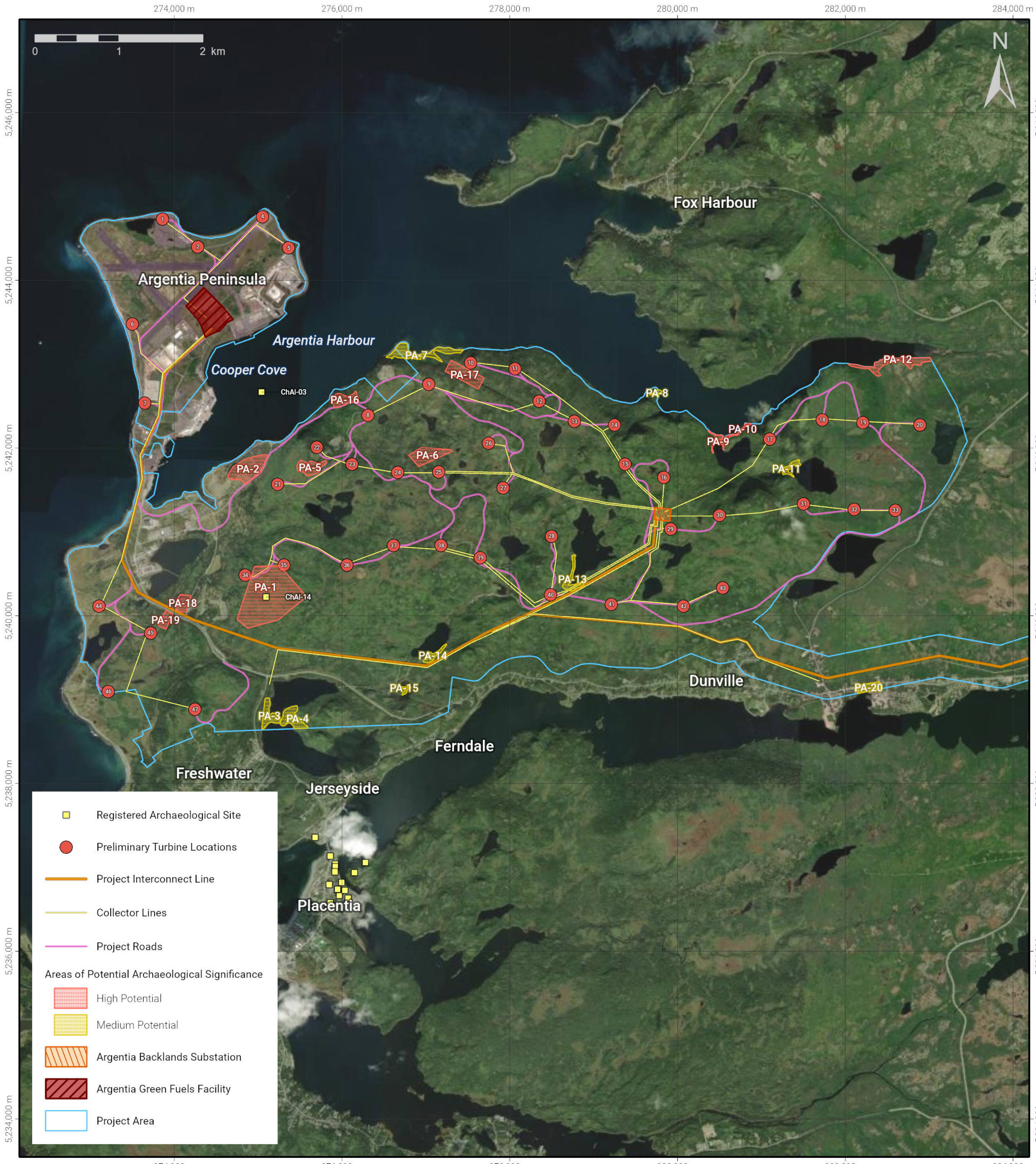
SEM MAP ID: 238-005-GIS-131-Rev0

4.3 Argentia Backlands

Over and above the one archaeological site registered for the Backlands (ChAl-14 - listed here as PA-1 on Figure F-4.3-1), there are at least three other locations with armaments and/or structural remains that appear to derive from the mid-twentieth century US military presence in the area. One location, listed on Project mapping as PA-2 (see Figure F-4.3.1) is comprised of the concrete and steel bases for two large anti-aircraft / anti-submarine guns positioned on the high ground at the western end of the Argentia Backlands overlooking Argentia Harbour. These military ruins, though likely contemporary with the structures comprising ChAl-14, are not registered as an archaeological site with the PAO, nor as an architectural resource with Heritage NL, or as a Municipal Heritage Site with the Town of Placentia. Referred to as the 281 Coastal Defense Battery, the area where they structures are situated is rated as having High potential in a table below and the location is referenced as PA-2 on the associated mapping (Figure F-4.3-1).

In addition to PA-1 and PA-2, there are two other locations within the Argentia Backands where structures known to be associated with the WWII defense of the Naval Air Station at Argentia are situated. One, listed as PA-18 in Table F-4.3-1 and shown on Figure F-4.3-1 below, is referred to as a Command Bunker, and though rated as having High potential in this HROA report, it is not registered or designated in any way as a historic resource with archaeological or architectural significance. The second location, known as 282 Coastal Defense Battery (listed as PA-19 in Table F-4.3-1 and shown on Figure F-4.3-1 below), is registered as an architectural resource with Heritage NL and as a Municipal Heritage Site with the Town of Placentia.

Within the Argentia Backlands sector of the Project Area, there are three (3) other areas suspected of having similar remains as those described above, and these are also rated as having High potential and are listed as PA-5, PA-6, and PA-16 in Table F-4.3.1 and are shown on Figure F-4.3-1. An additional location of High potential situated within the Argentia Backlands is the terrain along Broad Cove Brook, where physical infrastructure associated with the Silver Cliff Mine was established and operated intermittently from the 1880s until the late-1920s. This area, referred to as PA-17, is listed in Table F-4.3-1 below and is delineated on Figure F-4.3-1. Three other areas identified as having High potential within the Argentia Backlands component of the Project Area include sections of coastal shorelines and pond and river frontage, all of which are listed in Table F-4.3-1 below along with their potential rating and other relevant information, and each is shown on Figure F-4.3-1. There are eight locations within the Argentia Backlands listed as having Medium potential for historic / archaeological resources as they too are situated near waterbodies but at locations with less notable landscape features typically associated with past human settlement (see Table F-4.3-1 and Figure F-4.3.1).



Pattern | Argentia Renewables	FIGURE NUMBER: F - 4.3 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 14/06/2024
	FIGURE TITLE: Current aerial image of the Argentia Backlands showing Potential Areas PA-1 - PA-20	NOTES: The location of proposed project infrastructure is considered preliminary and is subject to change.	REVIEWED BY:	
	PROJECT TITLE: Argentia Renewables		APPROVED BY:	
			sem	

SEM MAP ID: 238-005-GIS-132-Rev0

Table F-4.3-1 Areas of Historic Resources Potential within the Argentia Backlands.

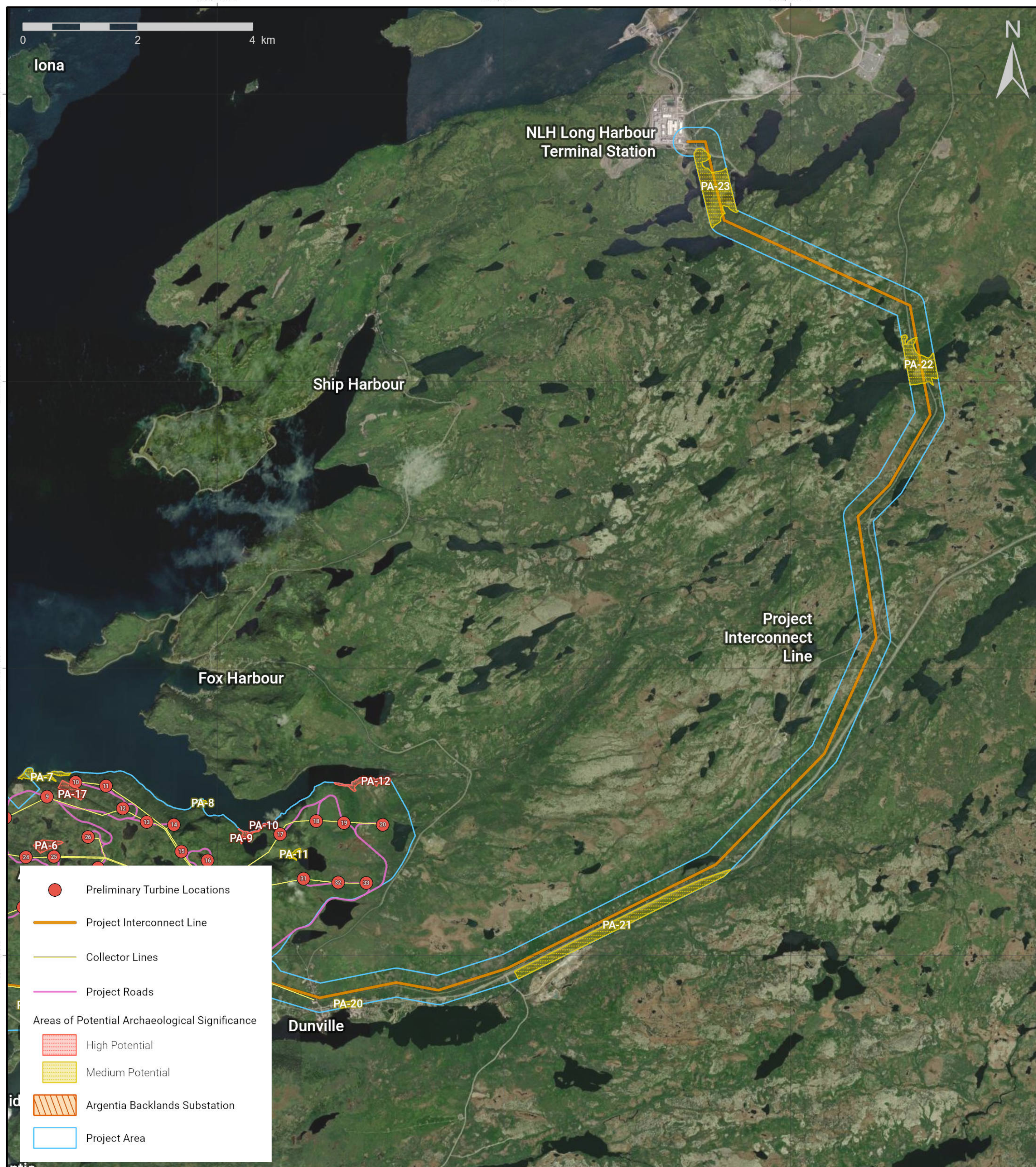
Reference Code	Area Description	Project Interaction	Metres above sea level	Potential Rating
PA-1	Registered archaeological site – ChAl-14 – 13 WWII military bunkers (PAO SRF)	Possibly Turbine 35	120	High
PA-2	WWII military ordnance – 281 Coastal Defense Battery.	No	40	High
PA-3	Pond frontage along waterway between Clarks and Larkins Ponds	No	40	Medium
PA-4	Pond frontage along waterway between Clarks Pond and Larkins Ponds	No	40	Medium
PA-5	Possible WWII military structures	No	110	High
PA-6	WWII Military bunkers (6)	No	110	High
PA-7	Coastal shoreline	No	0–10	Medium
PA-8	Coastal shoreline	No	0-10	Medium
PA-9	Pond frontage along waterway (Outside Shalloway Pond) and coastal shoreline	No	0-10	High
PA-10	Pond frontage along waterway (Outside Shalloway Pond) and coastal shoreline	No	0-10	High
PA-11	Pond frontage along waterway (Big Shalloway Pond)	No	60	Medium
PA-12	Coastal shoreline	No	0-10	High
PA-13	Pond frontage (Gull Pond)	No	120	Medium
PA-14	Pond frontage (Barrows Pond)	No	70	Medium
PA-15	Pond frontage (Barrows Ponds)	No	60	Medium
PA-16	Possible WWII military structure	No	40	High
PA-17	Late-19 – early-20th century, above-ground mining infrastructure associated with Silver Cliff Mine	No	20	High
PA-18	WWII command bunker	No	45	High
PA-19	WWII military ordnance – 282 Coastal Defense Battery (architectural resource)	No	25	High

4.4 Project Interconnect Line

Only four areas considered to have historic resources / archaeological potential have been identified for the Project Interconnect Line sector of the Project Area. These include one on the shoreline of Northeast Arm (PA-20), one on the north shore of Northwest River (PA-21), and two areas of waterfrontage on interior waterbodies (PA-22 and PA-23). Each is listed in Table F-4.4-1 below along with their potential rating and other relevant information, and each is shown on Figure F-4.4-1.

Table F-4.4-1 Areas of Historic Resources / Archeological Potential Along the Project Interconnect Line.

Reference Code	Area Description	Project Interaction	masl	Potential Rating
PA-20	Coastal shoreline – Northeast Arm	No	0-10	Medium
PA-21	River frontage – Northeast River	No	10-60	Medium
PA-22	Pond frontage (Ship Harbour Big Pond and unnamed pond)	Possible (within 500m corridor)	150	Medium
PA-23	Pond frontage (Rattling Brook Big Pond and two unnamed waterbodies)	Possible (within 500m corridor)	110	Medium



Pattern | Argentia Renewables	FIGURE NUMBER: F - 4.4 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Bursey	DATE: 17/05/2024
	FIGURE TITLE: Current aerial image of the Interconnect Line showing Potential Areas PA-20 - PA-23	NOTES: The location of proposed project infrastructure is considered preliminary and is subject to change.	REVIEWED BY:	
	PROJECT TITLE: Argentia Renewables		APPROVED BY:	sem

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5.0 Conclusions and Recommendations

This HROA has researched the cultural / historical sequence of Newfoundland, with particular emphasis on Placentia Bay and the northeast portion of it where the Project Area is situated. The background and contextual data compiled from the information review indicates a human presence in that sector of the Island of Newfoundland extending back into the past at least 3,500 years or more and includes occupations by several different First Nations and Pre-Inuit Indigenous cultures during the Precontact, Early and later Historic Periods, as well as by Europeans and peoples of European decent starting sometime after 1,500 CE. In the late nineteenth century, the discovery of an ore deposit near the north shore of the Argentia Backlands resulted in the short-lived and intermittent operation of what was known as the Silver Cliff Mine. In more recent times, notably in the mid-twentieth century, there was a dramatic influx of people into the region from continental North America for military defense purposes, and activities related to various industrial developments continue to this day. Given the longstanding human usage of the region, as confirmed from the review of archaeological data, historical and current documentation and aerial imagery, there is theoretical potential that other sites and historic properties deriving from one or more of the groups mentioned above could be present within the Project Area.

The primary objective of the HROA was to prepare an initial statement on the historic resources / archaeological potential of the Project Area that could be used as a planning tool to help with decision making as it relates to the positioning of infrastructure throughout the landscape and, in so doing, help reduce the likelihood of any adverse Project interactions with the said resources. To this end, the background data was used to identify and plot on mapping the locations of the one known archaeological site and the one designated architectural resource situated within the Argentia Backlands, along with other WWII structures potentially worthy of registration with the PAO and/or Heritage NL. Also identified and rated for historic resources / archaeological was any terrain within the Project Area where the information review and professional judgement suggested other similar resources might occur.

As discussed, virtually all the terrain situated within the Project Area on the Argentia Peninsula is rated as having Low potential for historic resources and/or archaeological sites or materials due to the nature and extent of ground disturbances that occurred there during construction, operation and decommissioning of the US Naval Air Station in the 1940s CE and later, and use of the peninsula in relatively recent times for various industrial purposes. Though the Argentia Peninsula was undoubtedly occupied periodically by Indigenous Peoples during the Precontact and Historic Periods, and by peoples of European decent during the Early Historic Period and more-or-less continuously until the 1940s CE, the alterations of the ground, both on and below the surface, have likely destroyed, altered and/or dispersed any direct evidence of past human settlement worthy of registration with the PAO, Heritage NL or the Town of Placentia. While there are almost certainly foundations and other physical remains buried on the peninsula that derive from the WWII US military use and are contemporary with the structures comprising the archaeological site ChAl-14 and those associated with the 282 Coastal Defense Battery (the architectural resource registered with Heritage NL), the significance of the material is such that no registration and protection under the **Historic Resources Act (1985)** is warranted or recommended.

Over and above the one archaeological site registered for the Project Area within the sector referred to as the Argentia Backlands – ChAl-14, which the PAO SRF indicates is comprised of 13 buildings associated with the WWII US Naval Air Station and Fort McAndrew - 18 other locations of potential significance were identified, one of which is the aforementioned 282 Coastal Defense Battery registered as an architectural resources of significance with Heritage NL that is rated as having High potential. Six other locations are also rated as having High potential, as they do or could contain structural and or artifactual objects associated with late-nineteenth to early-twentieth century mining activities or military remains dating to the same period and used for similar purposes as those located at ChAl-14. Four locations are also rated as having High potential, as they are situated in environmental settings that may have been used during the Precontact and/or Historic Periods for temporary settlement or other forms of land-use, and seven locations, with similar yet less pronounced and attractive landscape attributes, are rated as having Medium potential. All other terrain within the Argentia Backlands is rated as Low potential.

Although no archaeological sites are registered for the Project Interconnect Line, four locations have been identified as having Medium potential. One is a small section of coastal shoreline situated within Northeast Arm, one is a relatively long stretch of waterfrontage on Northwest River, and two locations are pond frontage on inland waterbodies. All other terrain within the Project Interconnect Line is rated as Low potential.

The principal recommendation of this HROA is the avoidance of: the one known archaeological site situated in roughly the central area of the Argentia Backlands (ChAl-14); the one registered architectural resources (the 282 Coastal Defense Battery) situated to the south of ChAl-14 overlooking Placentia Bay and the Argentia Naval Air Station; as well as all other locations within the Project Area rated as having elevated potential for historic resources, with particular emphasis placed on those rated as being of High potential. If avoidance of these locations is not possible, field assessment and recording in a HRIA may be required prior to commencement of any Project-related ground-disturbing activities. However, if the areas identified as having elevated potential can be avoided, with appropriate buffers established to ensure that no disturbances occur, a HRIA of these areas may not be required. To further reduce the likelihood of any adverse interactions with historic resources, including archaeological and/or other types of heritage sites or materials, once a Final Plan showing the physical layout of the Project is completed for the Argentia Backlands and the terrain comprising the Project Interconnect Line, it should be overlaid on the mapping that shows the areas of potential within these two Project sectors, just to confirm that no interactions are imminent.

An additional recommendation of this HROA is for the development of a detailed Contingency Plan that outlines the measures and procedures to follow and the personnel to be contacted at the PAO if any suspected historic resources or archaeological materials are encountered on the surface or are unearthed during any phase of the Project. It is also recommended that the Contingency Plan be provided to and discussed with all personnel working on the Project, particularly those involved in ground disturbing activities.

As mentioned earlier, fossils are protected under the **Historic Resources Act (1985)** and are inventoried by the PAO. However, no palaeontological resources are registered for the Project Area and the potential of any being present is Low due to the nature of the geology within that area of Placentia Bay (personal communication: Dr. R. Taylor and G. Squires).

6.0 References

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Appendix G

Socio-Economic Baseline

Socio-Economic Baseline

Argentia Renewables Project

Argentia Renewables Wind LP

14 May 2024

→ **The Power of Commitment**

Contents

Contents

Table index

Figure index

Acronyms and Abbreviations

CD	Census Division
CMA	Census Metropolitan Area
CNA	College of the North Atlantic
CSD	Census Subdivision
DFO	Fisheries and Oceans Canada
ERCO	Electric Reduction Company
NAICS	North American Industry Classification System
NHS	National Household Survey
NL	Newfoundland and Labrador
NLNFB	NL nutritious food basket
MV	Marine vessel
RCMP	Royal Canadian Mounted Police
RV	Recreation vehicle
US	United States

Units and Symbols

%	Percent
AM	Ante meridiem (before midday)
B	Billion
ft	Foot
kV	Kilovolt
km	Kilometre
km^2	Square kilometre
m	Metre
m^3	Cubic metre
M	Million
PM	Post meridiem (after midday)
sq. ft	Square foot

1. Introduction

This report provides background information in support of the Registration for the Argentia Renewables Project (the Project) owned by Argentia Renewables LP.

1.1 Scope and Limitations

This baseline report has been prepared in support of the Argentia Renewables Project. The content of the report is socio-economic information on:

- Communities;
- Economy, business and employment;
- Infrastructure and services; and
- Community health and well-being.

1.1.1 Data Limitations

The most recent census of the Canadian population was conducted in June 2021 and is one of the most important sources of data for this report. Even with current census data, some detailed data are not available, particularly at the community level. Limited community data are available through the National Household Survey (NHS), though the Newfoundland and Labrador Statistics Agency (NLSA) publishes some disaggregated data through Community Accounts. Datasets are often limited at the community or regional level, and data may not be released due to privacy concerns regarding small populations.

Due to the COVID-19 pandemic, some 2020 and 2021 data and information are not as useful for identifying general trends. Many indicators were affected by public health emergency measures, including closures, limits on usage and travel restrictions. Thus, data may be misrepresentative of trends that would normally reveal changes and issues in a community.

1.1.2 Study Areas

Study areas have been selected based on available data and known concerns about the Project and the potential for effects on the communities, the region and the province.

1.1.2.1 Project Area

The Project Area for the Argentia Renewables Project is defined as “the area in which Project infrastructure components and activities (e.g., construction, operation and maintenance, decommissioning and rehabilitation) will occur, and within the boundaries of which direct environmental interactions with the Project will likely occur”. Specifically, the Project Area encompassed the collective spatial footprint of the Argentia Wind Facility, the Argentia Green Fuels Facility, ammonia storage infrastructure, electrical substation(s) and power lines, and all associated roads for those various elements of the Project. Within the Argentia Backlands and the Argentia Peninsula, the Project Area boundaries correspond to the PoA Property boundaries. A 250 m (metre) buffer was added to either side of the Project Interconnect Line, which is the transmission line that will connect to the Newfoundland and Labrador Hydro (NLH) electrical grid at the Long Harbour Terminal Station, to account for edge effects of the linear corridor and to provide for alignment adjustments of the transmission line Right of Way (ROW).

1.1.2.2 Local Study Area: Placentia / Local Area 2: Placentia-St. Bride’s Area

The Town of Placentia is the Local Study Area (LSA). Data and information are available from Statistics Canada (Census of Canadian Population) and NLSA Community Accounts for the Town of Placentia, which includes Port of Argentia (PoA) and the communities of Freshwater, Dunville, Southeast Placentia and Jerseyside – amalgamated with Placentia in 1991 (Town of Placentia 2024). Where data are not available specifically for the Town of Placentia, NLSA data are used to represent Local Area 2: Placentia-St. Bride's Area, which includes

Placentia along with Fox Harbour and Ship Harbour to the north and the communities of Point Verde, Big Barasway, Ship Cove, Patrick's Cove-Angels Cove, Cuslett, St. Bride's, Point Lance and Branch to the south.

1.1.2.3 Regional Study Area: Avalon and / or Newfoundland and Labrador

Two geographic areas are used to represent the regional study area (RSA): Avalon and Newfoundland and Labrador. The census provides data for the Avalon Peninsula Economic Region or Census Division (CD) No. 1, Avalon, both of which include the Avalon Peninsula and the Isthmus. Data may also be obtained from NLSA for Economic Zones: 17, 18, 19, 20, which encompass the Avalon Peninsula but not the Isthmus. Where data are not available, the census also supplies data for Eastern Health, which encompasses a larger area including the Avalon Peninsula, Bonavista Peninsula and Burin Peninsula. Avalon is the area anticipated to supply labour for a large construction project at Placentia. For some aspects of the human environment such as economic benefits, Provincial royalties / taxes and effects on gross domestic product, the Regional Study Area is the Province of Newfoundland and Labrador (NL).

2. Communities

The following sections provide an overview of demographic data and trends for Placentia, Avalon and NL. Where relevant data were not available for these jurisdictions, information for the most comparable jurisdictions were used.

2.1 Demographic Profile

With a 2021 population of 3,289 residents, Placentia is one of the 20 largest communities in NL (Statistics Canada 2023a). In 1991, Placentia amalgamated with neighbouring communities, resulting in a population increase - from 2,015 in 1986 to 5,515 in 1991 - within the expanded Municipality (Figure G-2.1-1). Following 1991, the population has been decreasing due to an economic decline. More information on amalgamation is included in Section 1.1.3.2 and more information on the economy is in Section 3.1.

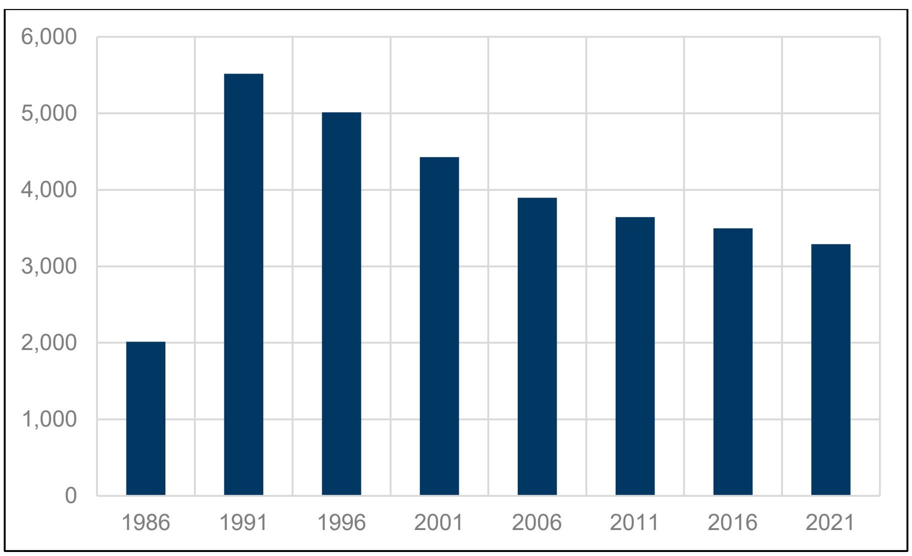

Figure G-2.1-1 Placentia Population: 1986-2021 (NLSA 2002 to 2021)

Placentia experienced a net population loss of 5.9% since 2016 and a net loss of 354 persons in the last decade (Figure G-2.1-2). Avalon had a small population gain of 0.6% since 2016, while NL lost 1.8% of its population in the same period.

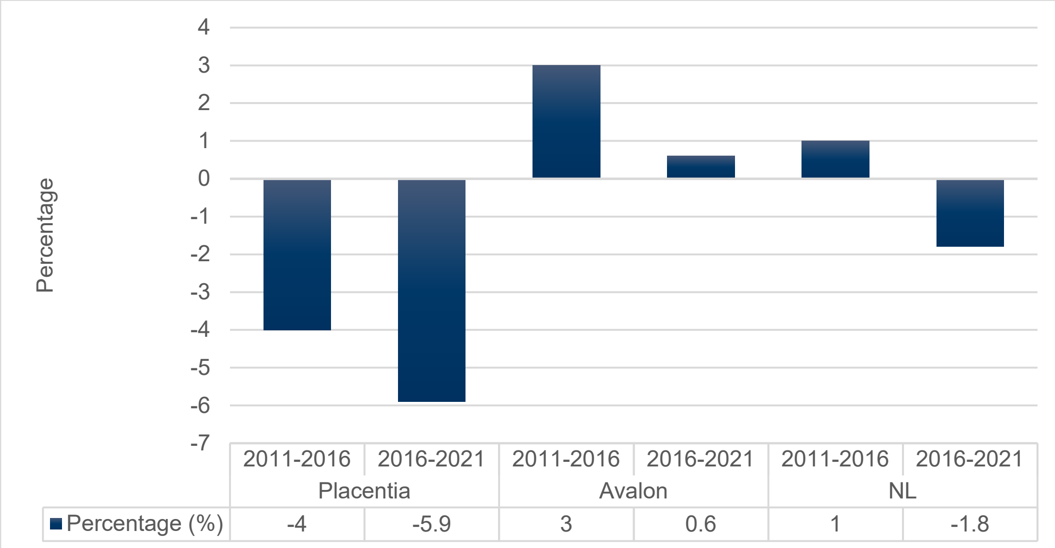

Figure G-2.1-2 Population Change (Statistics Canada 2023a, 2018)

Placentia's population is also aging (Table 2.1). Its median age rose from 50.5 years in 2011 to 56.4 years in 2021 (Statistics Canada 2012). This was roughly 10 years above the median age of the Avalon and Newfoundland populations in 2021. Average household size increased slightly over the past 10 years in all three jurisdictions, despite an overall decline in population. This may be attributable to various factors, such as the rising cost of living, which could influence an increase in cohabitation. Overcrowding is not likely as the three jurisdictions showed small percentages of households (i.e., Placentia: 2.9%, Avalon: 4.5% and NL: 4.2%) with five or more persons in 2021 (Statistics Canada 2023a).

Table 2.1 Population Average / Median Age and Household Size

Indicator	Placentia		Avalon		NL	
	2016	2021	2016	2021	2016	2021
Population	3,496	3,289	270,348	271,878	519,716	510,550
Average age	48.3	50.8	41.9	43.7	43.7	45.5
Median age	53.3	56.4	43	44.8	46	48.4
Average household size	2.2	2.1	2.4	2.3	2.3	2.3

Source: Statistics Canada 2023a, 2018

2.1.1 Working Age Population

Analysis of population age is useful to identify community needs and analyze the availability of potential project and supporting industry workers (generally 15 and 64 years). Table 2.2 shows the percentage of individuals in this age group, as well as for cohorts in this group. The largest cohort for all three jurisdictions is 50 to 64 years.

Table 2.2 Population Cohorts (2021)

Cohort (years)	Placentia	Avalon	NL
15 to 64 (%)	56.2	65.2	63.0
20 to 34 (%)	10.9	17.7	15.4
35 to 49 (%)	15.2	19.7	18.6
50 to 64 (%)	25.8	22.5	24.1

Source: Statistics Canada 2023a

Placentia has the lowest percentages of younger workers among the jurisdictions (Figure G-2.1.1-1), which may be a challenge for attraction and retention of workers.

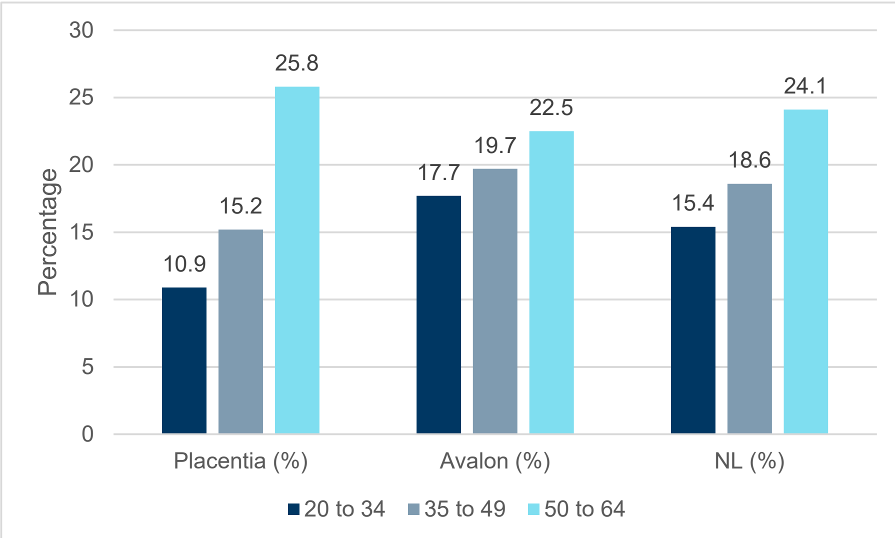

Figure G-2.1.1-1 Population Cohorts: 2021 (Statistics Canada 2023a)

2.1.2 Natural Population Change

Birth and death data are not available for Placentia, but they are for Local Area 2: Placentia-St. Bride's. The number of births in Local Area 2 increased by 10 between 2020 and 2021 (Table 2.3). The number of deaths also increased but by a larger number in the same period, resulting in population decline. The data are indicative of an aging population, out-migration and low birth rate.

Table 2.3 Births versus Deaths, Placentia-St. Bride's Area

Indicator	2020	2021
Births	15	25
Deaths	65	95
Net	-50	-70

Source: NLSA 2023a

2.1.3 Family Life

For each of the three jurisdictions, the proportion of census families[1] in 2021 exceeded that of one-parent families (Table 2.4). Single parents were about four times as likely to be women+[2] than men+. The proportion of couple families was similar across jurisdictions.

Table 2.4 Census Family Private Households (2021)

		Placentia	Avalon	NL
Total couple families (%)		84.2	83.3	84.2
	Total with children (%)	31.1	38.1	34.9
	Total without children (%)	53.0	45.1	49.3

[1] A census family is defined as a married couple (with or without children), a common-law couple (with or without children) or a one-parent family (Statistics Canada 2023a).
[2] "Women+" includes women (and / or girls), as well as some non-binary persons. "Men+" includes men (and / or boys), as well as some non-binary persons (Statistics Canada 2023a).

Table 2.4 Census Family Private Households (2021)

		Placentia	Avalon	NL
Total one-parent families (%)		15.8	16.7	15.8
	In which the parent is a woman+ (%)	12.8%	13.2%	12.3%
	In which the parent is a man+ (%)	3.1%	3.6%	3.5%

Source: Statistics Canada 2023a

In Placentia, 21.1% of persons were reported as not living in census families in 2021, a rate higher than for the other jurisdictions (Table 2.5) and likely reflective of an older population. In each jurisdiction, persons living alone in 2021 were most often identified as women+. In 2022, life expectancy at birth in NL was 81.22 years for women+ and 77.35 for men+ (Statistics Canada 2023b). Life expectancy has increased steadily for both sexes, but a slight decline has been evident in data since 2019, perhaps due to the COVID-19 pandemic.

Table 2.5 Non-Census Family Private Households (2021)

	Placentia	Avalon	NL
Living alone (%)	16.8	12.5	12.4
Living with other relatives (%)	1.9	2.2	2.1
Living with non-relatives only (%)	2.4	4.3	3.3

Source: Statistics Canada 2023a

2.1.4 Mobility

Based on the last two censuses, Placentia, Avalon and NL showed a net increase of in-migration (Table 2.6). Although the proportion of migrants in Placentia remained more or less the same, there was a slight increase (from 2.1% in 2016 to 2.4% in 2021). Many factors such as the Cenovus construction project or retirees returning to NL may have contributed to in-migration in Placentia.

Table 2.6 Migration Status

Jurisdiction	Migrant Status 1 Year Ago			
	2016		2021	
	# people	Movers (%)	# people	Movers (%)
Placentia	70	2.1	75	2.4
Avalon	3,945	5	11,385	4.3
NL	13,095	4.8	20,180	4

Source: Statistics Canada 2023a, 2018

2.1.5 Diversity

Various diversity criteria have been selected for Placentia, Avalon and NL based on the 2021 census (Table 2.7). The data show the population diversity of Placentia was lower than for the other jurisdictions. The largest proportion of individuals in Placentia (indicating diversity) identified as Indigenous and / or with Indigenous ancestries. In 2021, about 30 people (0.9%) in Placentia self-identified as being part of a visible minority; they originated from countries in Asia, Europe, the Americas, Africa and the Philippines.

Table 2.7 Selected Diversity Indicators 2021

Indicator	Placentia		Avalon		NL	
	# people	%	# people	%	# people	%
Mother tongue French	5	0.2[3]	1,105	0.4	2,215	0.4
Non-official languages	15	0.5	8,455	3.1	12,655	2.5
Immigrants[4]	65	2	10,225	3.8	14,250	2.8
Indigenous identity[5]	70	2.2	8,300	3.1	46,545	9.3
Indigenous ancestry (only)[6]	50	1.6	4,315	1.6	31,845	6.3
Indigenous and non-Indigenous ancestries[7]	75	2.4	8,825	3.3	26,945	5.4
Visible minorites[8]	30	0.9	12,955	4.8	16,855	3.4

Source: Statistics Canada 2023a

2.1.6 Education

In 2021, residents of Placentia aged 25 to 64 years were more likely to be trained in trades than those of Avalon and NL, while people in NL were more likely to have a university education (Table 2.8). A higher proportion of Placentia residents had no certificate, diploma or degree, including high school completion or equivalency compared to the other jurisdictions. Women+ had higher high school and university education levels than men+ in the three jurisdictions, yet more so in Placentia. Men+ were four times more likely to hold an apprenticeship or trades certificate or diploma than women+.

Table 2.8 Education (2021)

Indicator	Placentia		Avalon		NL	
	Men+	Women+	Men+	Women+	Men+	Women+
No high school diploma or equivalency certificate (%)	19.1	8.9	12.0	7.8	17.3	11.8
Apprenticeship or trades certificate or diploma (%)	17.8	4.6	13.5	4.8	14.9	5.1
Bachelor’s degree or higher (%)	8.3	13.3	20.1	24.8	14.4	18.8

Source: Statistics Canada 2023a

Major fields of study are shown in Table 2.9. In general, the most favoured field of study in Placentia, Avalon and NL appeared to be architecture, engineering, and related trades, largely dominated by men+. Women+ were more likely to choose education, business, management and public administration and also health studies.

[3] It should be noted that the percentages in this table are calculated based on the total number of people who answered the question related to the criterion in Statistics Canada's 2021 census.
[4] 'Immigrants' includes persons who are, or who have ever been, landed immigrants or permanent residents. Such persons have been granted the right to live in Canada permanently by immigration authorities.
[5] This category includes persons who identify as First Nations (North American Indian), Métis and / or Inuk (Inuit) and / or those who report being Registered or Treaty Indians (that is, registered under the Indian Act of Canada), and / or those who report having membership in a First Nation or Indian band.
[6] 'Indigenous ancestry (only)' includes persons who have First Nations (North American Indian), Métis and / or Inuit ancestry. It excludes persons with non-Indigenous ancestry.
[7] 'Indigenous and non-Indigenous ancestries' includes persons who have First Nations (North American Indian), Métis and / or Inuit ancestry, as well as non-Indigenous ancestry.
[8] 'Visible minority' refers to whether a person is a visible minority or not, as defined by the Employment Equity Act. The Employment Equity Act defines visible minorities as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour." The visible minority population consists mainly of the following groups: South Asian, Chinese, Black, Filipino, Arab, Latin American, Southeast Asian, West Asian, Korean and Japanese.

Table 2.9 Major Field of Study for Population Aged 25-64 Years (2021)

Classification of Instructional Programs (CIP) 2021	Placentia		Avalon		NL	
	Men+	Women+	Men+	Women+	Men+	Women+
Education (%)	3.3	7.7	2.7	6.4	2.6	5.7
Humanities (%)	1.1	1.8	2.0	2.7	1.6	2.0
English language and literature / letters (%)	1.1	0.7	0.5	0.8	0.4	0.6
Social and behavioural sciences and law (%)	1.1	2.8	3.1	6.2	2.1	4.8
Business, management and public administration (%)	2.5	20.0	7.6	18.3	5.5	16.4
Physical and life sciences and technologies (%)	1.1	0.7	2.0	1.9	1.4	1.3
Mathematics, computer and information sciences (%)	0.7	1.4	3.1	2.0	2.1	1.6
Architecture, engineering, and related trades (%)	31.2	3.5	25.7	2.8	25.0	2.3
Agriculture, natural resources and conservation (%)	0.0	0.0	1.0	0.9	1.2	0.8
Health and related fields (%)	2.9	13.7	3.1	13.7	2.7	12.5
Personal, protective and transportation services (%)	9.1	3.5	5.7	3.5	6.9	3.7

Source: Statistics Canada 2023a

2.1.7 Income

Between 2015 and 2020, median household income for Avalon and NL increased by 5% and 6% respectively (Table 2.10). For Placentia, it decreased by 1%. The median total income of households also decreased for Placentia between 2015 and 2020, while it increased in the other jurisdictions. This may be attributable to the aging population in Placentia.

Table 2.10 Median Total Income of Households (2015-2020)

Indicator	Placentia		Avalon		NL	
	2015	2020	2015	2020	2015	2020
Median total income of households ($)	60,352	59,600	74,676	78,500	67,272	71,500

Source: Statistics Canada 2023a, 2018

Changes to income have been inconsistent between women+ and men+. The median income of men+ in Placentia decreased slightly ($1,000) from 2015 to 2020, while it increased by about $5,000 for women+ (Table 2.11). The wage gap for women+ in Avalon and NL was greater, as the median income of women+ was about $10,000 less than men+. Women+ had a higher low-income rate in Placentia, Avalon and NL in 2015 and 2020.

Table 2.11 Income and Low Income (2015-2020)

Indicator	Placentia				Avalon				NL			
	2015		2020		2015		2020		2015		2020	
	Men+	Women+	Men+	Women+	Men+	Women+	Men+	Women+	Men+	Women+	Men+	Women+
Median total income among recipients ($)	41,440	24,928	40,400	30,400	44,192	29,172	44,800	36,400	40,880	25,314	42,000	32,400
Low-income rate (%)	15.9	19.7	15.4	19.0	11.9	14.5	11.9	13.7	13.9	16.9	14.1	16.3

Source: Statistics Canada 2023a, 2018

3. Economy, Business and Employment

This section discusses economy, business and employment in Placentia, Avalon and NL. It begins with an overview of major economic and social changes in the Placentia area beginning in the mid 20th century prior to confederation with Canada.

Historically, Placentia's economy was based on harvesting and processing seafood, but several developments resulted in several key socio-economic changes. Beginning in 1940, United States (US) Argentia Naval Air Station and Fort McAndrew were constructed with about 20,000 service people at peak operations (Canadian Encyclopedia 2015). The last of the American facilities closed in 1994. At its height, approximately 5,000 civilians were also employed at Argentia. The American presence introduced American popular culture, including leisure activities, music and fashions, to wartime and postwar NL (Parks Canada No date-a).

In 1966, construction of the Electric Reduction Company (ERCO) of Canada Industries Limited phosphorous reduction facility began at Long Harbour (Heritage NL 2006). The ERCO facility, which attracted workers and families from Canada, the US and Britain, closed in 1989.

Economic decline began within the five-year period (1989 to 1994) that marked the closure of ERCO, a moratorium on groundfish harvesting (1992) and closure of the Argentia Naval Air Station. Since that time, the ERCO site has been redeveloped as Vale NL's nickel processing facility. The assets and infrastructure of the Argentia Naval Station, now the PoA, are a key component of the Placentia and regional economy.

3.1 Economy and Business

The largest four contributors to NL gross domestic product (GDP) are "Mining and Oil Extraction" (25%) followed by "Real Estate and Rental and Leasing" and "Health Care and Social Assistance" (both 10%) and "Public Administration" (9%) (Table 3.1). Together, these make up 54% of GDP.

Table 3.1 NL 2022 Gross Domestic Product at Basic Prices, By Industry (Millions of Chained 2017 Dollars)

North American Industry Classification System (NAICS) 2017	Value ($)	Percentage (%)
All industries	29,690.1	100%
Agriculture, Forestry, Fishing & Hunting	560.1	2%
Mining and Oil Extraction	7,432.2	25%
Utilities	642.3	2%
Construction	2,141.1	7%
Manufacturing	993.2	3%
Wholesale Trade	646.8	2%
Retail Trade	1,697.4	6%
Transportation and Warehousing	881.1	3%
Information and Cultural Industries	711.9	2%
Finance & Insurance	1,035.5	3%
Real Estate and Rental and Leasing	3,042.5	10%
Professional, Scientific and Technical Services	1,244.8	4%
Management of Companies and Enterprises	19.2	0%
Administrative and Support, Waste Management and Remediation Services	405.8	1%
Education Services	1,779.8	6%
Health Care and Social Assistance	2,849.7	10%

Table 3.1 NL 2022 Gross Domestic Product at Basic Prices, By Industry (Millions of Chained 2017 Dollars)

North American Industry Classification System (NAICS) 2017	Value ($)	Percentage (%)
Arts, Entertainment and Recreation	81.3	0%
Accommodation and Food Services	518.2	2%
Other Service (Except Public Administration)	494.0	2%
Public Administration	2,557.8	9%

Source: NLSA 2023b

3.1.1 Main Economic Sectors

Placentia is a regional hub for government and commercial services. The Town includes secondary and post-secondary educational institutions, health care facilities, seniors' care facilities and Municipal / Provincial / Federal Government offices. Vale NL's Long Harbour Processing Plant and the Cenovus West White Rose Expansion Project are both important in terms of employment and procurement though the latter is a temporary construction project expected to be completed in 2025.

Table 3.1 shows the labour force organized by the North American Industry Classification System (NAICS) 2017 including disaggregated data by gender. In 2021, Placentia's largest economic sectors in terms of employment in 2021 were "Health Care and Social Assistance" (21.2%), "Retail Trade" (10.9%), "Construction" (10.9%), "Transportation and Warehousing" (7.3%) and "Education Services" (7.3%) (Table 3.1). Together, these accounted for more than 57% (nearly 800 positions) of those employed in 2021. A larger proportion of people in Placentia were employed in "Agriculture, Forestry, Fishing and Hunting" and "Transportation and Warehousing" than in the other jurisdictions, which is likely related to the fisheries and transportation and logistics businesses at the PoA. Generally, the Avalon and NL economies are more diversified, with a broader distribution of employment across sectors. "Health Care and Social Assistance" is the leading employment sector in NL, followed by "Retail Trade", "Public Administration" and "Construction".

Table 3.2 Labour Force by Industry (2021)

North American Industry Classification System (NAICS) 2017	Placentia		Avalon		NL	
	Men+	Women+	Men+	Women+	Men+	Women+
Agriculture, forestry, fishing and hunting (%)	7.1	5.3	3.1	1.1	5.8	1.9
Mining, quarrying, and oil and gas extraction (%)	4.3	0.0	4.6	1.1	6.6	1.3
Utilities (%)	2.1	0.0	1.5	0.8	1.7	0.6
Construction (%)	18.4	3.0	13.3	1.8	13.9	1.8
Manufacturing (%)	7.1	1.5	5.7	2.4	6.4	3.1
Wholesale trade (%)	1.4	0.0	3.3	1.2	2.9	1.0
Retail trade (%)	6.4	15.2	11.0	13.1	10.7	14.0
Transportation and warehousing (%)	12.8	1.5	6.9	2.1	7.2	2.4
Information and cultural industries (%)	0.0	0.0	1.6	1.4	1.2	1.0
Finance and insurance (%)	0.0	0.0	1.7	3.2	1.2	2.6
Real estate and rental and leasing (%)	1.4	0.0	1.3	0.9	1.0	0.7
Professional, scientific and technical services (%)	2.8	3.0	7.7	5.5	5.4	4.0
Management of companies and enterprises (%)	0.0	0.0	0.1	0.1	0.1	0.1
Administrative and support, waste management and remediation services (%)	3.5	1.5	4.3	2.7	3.6	2.5

Table 3.2 Labour Force by Industry (2021)

North American Industry Classification System (NAICS) 2017	Placentia		Avalon		NL	
	Men+	Women+	Men+	Women+	Men+	Women+
Educational services (%)	5.0	9.8	5.2	10.3	4.5	9.7
Health care and social assistance (%)	7.8	35.6	5.6	25.2	5.6	27.9
Arts, entertainment and recreation (%)	0.0	0.0	1.7	1.8	1.5	1.6
Accommodation and food services (%)	3.5	6.1	5.6	7.6	4.9	7.8
Other services (except public administration) (%)	3.5	3.0	3.9	4.5	3.8	4.3
Public administration (%)	6.4	9.8	9.3	11.2	8.8	9.1

Source: Statistics Canada 2023a

3.1.2 Port of Argentia

The PoA industrial park has about 40 businesses offering a variety of services (PoA 2023). Along with serving its tenants, PoA is focussed on expansion and new developments in marshalling, renewable energy, aquaculture, offshore energy and critical minerals. Existing port facilities and capabilities include:

– A 3-km ice-free, deep-water harbour with a wide turning basin.
– More than 630 m (2,000 ft) of docking facilities with up to 11 m (36 ft) of draft.
– Pilotage services.
– A 40-hectare secure marine terminal with a quayside storage yard.
– Experienced stevedore crews trained in off-loading numerous types of cargo and certified to handle hazardous material, including explosives.
– Extensive land zoned for industrial use.
– 70 hectares of paved runways dedicated as a monopile marshalling port.

Existing tenants at the industrial park offer a variety of goods and services, many of which are compatible with supporting construction projects and industrial operations. These businesses offer marine transportation, commercial vessel charters, cargo and tug vessel services, remotely operated vehicle services, logistics, stevedoring, warehousing, container trucking, construction, crane services, fabrication of piping and structural steel, supply of mobile office trailers and buildings, concrete products and services, building materials supply, metal salvage and recycling, security systems and services, industrial chemicals and other services.

3.1.3 Businesses and Capacity

The Placentia Area Chamber of Commerce has 106 members (Placentia Area Chamber of Commerce 2023). Many of these companies offer goods and services (e.g., accommodations, cargo and storage, construction, electrical, food services, printing / signage, recruitment, safety, security, telecommunications, waste management) to industry and / or workers, but the capacity of the businesses is unknown. In addition, not all businesses are members of the Chamber of Commerce.

3.1.4 Major Capital Projects

In 2023, the Government of NL identified 40 major capital investments (projects of more than $25 M) ongoing or initiated (Government of NL 2023a). Planned total spending on these projects was approximately $18.3 B, of which most ($8.9 B) was in the 'Mining and Oil & Gas' category. Sixteen projects were on the Avalon and most were in St. John's.

The largest investment is the West White Rose Expansion Project at Argentia (Table 3.2). The Project, which will create a fixed drilling platform to tie back to existing infrastructure at the White Rose offshore oil field, will be completed in 2025 with first oil in 2026. The next nearest project to Placentia is the Braya Renewable Fuels refinery conversion at Come By Chance, about 110 km north of Argentia. Major capital investments under the DFO

Small Craft Harbours Program or for development of health care facilities, municipal infrastructure, bridge and road improvements and utilities are in multiple locations in NL and may affect the economy of Placentia or Avalon.

Table 3.3 Major Capital Projects, Avalon

Project	Description	Value ($M)	Timeline
The Shoppes at Galway, St. John's	590,000 sq. ft of retail buildings	150.0	2017-2027
One Churchill Park, St. John's	Six-storey building with 69 residential units, first floor retail, underground parking	40.0	2020-2023
Memorial University Animal Resource Centre, St. John's	State-of-the-art biomedical research facility to co-locate existing health sciences and biomedical research	39.1	2014-2023
Memorial University Holyrood Marine Base, Holyrood	40,000 sq. ft Ocean Research and Training facility	25.0	2016-2023
Mental health infrastructure, St. John's	Adult mental health and addictions facility	250.0	2018-2024
Health Sciences Centre Emergency Department, St. John's	Redevelopment of the Emergency Department	45.0	2022-2026
Braya Renewable Fuels, Come By Chance	Conversion of refinery to produce bio-fuels from plant-based oils	US$300.0	2021-2023
Marine Service Centre, Fermuse	Marine Service Centre and spool base to support the offshore oil and gas subsea and drilling exploration sectors	100.0	2023-TBD
West White Rose Project, Placentia	Construction of a fixed drilling platform to tie into existing infrastructure at the White Rose offshore oil field	3,400.0 - 3,800.0	2022-2026
Terra Nova Floating Production Storage and Offloading (FPSO) Asset, Offshore	Structural work on the FPSO hull and maintenance and renovation of the topsides facilities and rotating equipment	US$500.0	2022-2023
Galway Living-Phase 1, St. John's	500 home residential community with single family houses, bungalow townhomes, 3-storey executive townhomes, ground-based condominiums, quadraplexes and apartment buildings	200.0	2016-2027
Housing development, St. John's	375-unit development of single detached homes, semi-detached homes, condominiums and townhouses (total of 240 units), and four apartment buildings (total of 135 units)	150.0	2023-TBD
Apartment building, St. John's	196 residential unit apartment development with underground parking	80.0	2023-2026
JAG Hotel Expansion, St. John's	Expansion of hotel and addition of a multipurpose space	67.0	2021-2023
Canada Games Sporting Facility, St. John's	Construction of a Centre of Excellence with athletic training space and teaching space	40.0	2023-2025
St. John's International Airport Authority Asphalt Rehabilitation, St. John's	11 asphalt rehabilitation projects to replace / upgrade airside and groundside asphalt surfaces. 10 airside projects include aprons, taxiways and runways and rehabilitation of the groundside road of the General Aviation area of the airport	28.0	2022-2025

Source: NLDF 2023

3.1.5 Commercial Fishing, Aquaculture and Seafood Processing

The Placentia area was settled based on the fishery and, despite many industrial changes, seafood harvesting and processing still play a notable role in the economy.

3.1.5.1 Fishing Harbours

The Fisheries and Oceans Canada (DFO) Small Craft Harbours Program identifies 22 core fishing harbours in Placentia Bay (Table 3.3). These harbours are critical to the fishing and aquaculture industries. Non-core fishing harbours are in Placentia Bay. Most core fishing harbours have been transferred from the Federal Government to local harbour authorities, which manage operations. The Port of Marystown is currently managed by Transport Canada's Ports Asset Transfer Program (Transport Canada 2019).

Table 3.4 Placentia Bay Core Fishing Harbours

Harbour	Harbour Authority
St. Bride's	St. Brides
Jerseyside	Placentia Area
Placentia	
Fox Harbour	Fox Harbour
Ship Harbour	Ship Harbour
Long Harbour (Mount Arlington Heights)	Mount Arlington Heights
Fair Haven	Fair Haven
Southern Harbour	Southern Harbour
Arnold's Cove	Arnold's Cove
North Harbour	North Harbour
Garden Cove	Garden Cove
South East Bight	South East Bight
Petite Forte	Petite Forte
Baine Harbour	Baine Harbour
Rushoon	
Red Harbour	Red Harbour
Marystown (Little Bay)	No harbour authority
Burin	Burin
St. Lawrence	St. Lawrence
Lawn	Lawn
Point au Gaul	Point au Gaul
Lamaline	Lamaline

Source: DFO 2022, 2021

3.1.5.2 Aquaculture

In 2022, most aquaculture operators in NL produced Atlantic salmon, steelhead trout, blue mussels and American oysters (NLDFFA 2023b). In 2017, the Government of NL identified four shellfish aquaculture sites in Placentia Bay: two at Placentia and two on Merasheen Island (Province of NL 2021). These were likely blue mussel aquaculture sites as 2020 was the first year that American oysters were available.

Grieg Seafood Newfoundland has developed the Placentia Bay Aquaculture Project based at Marystown. Grieg holds eight licences for seawater grow-out sites in four areas of Placentia Bay (Grieg 2024). In October 2023, Grieg harvested its first Atlantic salmon in NL from sea cages at Red Island near Merasheen Island for processing by the Quinlan Brothers Ltd. facility in Bay de Verde (CBC 2023a).

3.1.5.3 Seafood Processors

In 2023, the NL Government identified three licenced seafood producers in Placentia Bay (Table 3.4). Species processed in Placentia Bay included lobster, skate, groundfish (e.g., Atlantic cod) and pelagic species such as capelin, herring and mackerel. Dandy Dan's Seafood also has a processing facility for Atlantic cod, herring, flounder, snow crab, lobster and halibut at Ship Harbour with a secondary processing facility at Argentia (Dandy Dan's Seafood 2024).

Table 3.5 Placentia Bay Seafood Processors (2023 licences)

Producer	Location	Species Processed
Avalon Ocean Products Limited	Arnold's Cove	Lobster, skate
Icewater Seafoods Inc.	Arnold's Cove	Atlantic cod
Quin-Sea Fisheries Ltd. (Royal Greenland)	Southern Harbour	Capelin, herring, mackerel, lobster, groundfish

Source: NLDFFA 2023a; Association of Seafood Producers 2022; Royal Greenland 2024

3.1.6 Culture and Tourism

Placentia Bay has a long history of Indigenous, Basque, French, British and Irish occupancy. The history and archaeology of the Placentia area are described in the Historic Resources Overview Assessment prepared for the Project. This section focusses on the tourism industry.

3.1.6.1 Historic Sites and Events

Nationally, Provincially and / or Municipally recognized heritage sites, structures and events in the Placentia area are listed in Table 3.5. Most of these sites or structures are designated by the Municipally and / or the Province. One of these, the Argentia 282 Coastal Defence Battery, is on lands managed by the PoA.

Table 3.6 Designated Historic Sites, Structures and Events, Local Area 2: Placentia-St. Bride's Area

Site / Recognition	Date	Description
Role of Placentia / National Historic Event 1951	As early as the 16th Century	Noted as an important fishing station in the migratory fishery as early as the 16th century, Placentia became the capital of the French fishing operations in 1662. The French ceded Newfoundland to Great Britain through the Treaty of Utrecht in 1713. As St. John's was the new British capital of Newfoundland, the British garrison left Placentia at the beginning of the 19th century and the colony reverted to its role as a fishing station.
Castle Hill National Historic Site of Canada / National Historic Site of Canada 1968	Constructed 1692 to 1762	The remains of French (1692-1713) and British (1713-1811) fortifications containing defensive walls and military works. The site was used to defend Placentia and the larger economic and strategic interests of France and Britain in Atlantic Canada. The remnants of the wall, Fort Royal, Gaillardin Redoubt, Detached Redoubt and pathway were stabilized by Parks Canada (with interpretative facilities and programs developed) between 1962 and 1968.
Fort Frederick / Municipal Heritage Building, Structure or Land 1972	Constructed 1715 to 1717	The site of an 18th century English fort consisting of a semi-circular redoubt mounting 12 guns, a guard house, barracks and storehouse surrounded by a palisade erected to protect English interests in the seasonal fishery. Served as Newfoundland military headquarters from 1721-1746 and abandoned in 1811. A battery was constructed near this site in 1813 as protection against American privateers. Much of the Portland stone facing of the redoubt was incorporated in the Presentation convent. An archaeological excavation in 2000-2002 revealed artifacts from as early as 1630.

Table 3.6 Designated Historic Sites, Structures and Events, Local Area 2: Placentia-St. Bride's Area

Site / Recognition	Date	Description
Our Lady of Angels, Presentation Convent / NL Registered Heritage Structure 1991 / Municipal Heritage Building 2006	Constructed between 1858 and 1864	The only remaining stone building in Placentia and the last structure of a five-building ecclesiastical complex located in Town Square. Built mainly out of locally quarried stone and possibly imported limestone in the style of French Colonial architecture. Housed the Irish Presentation Sisters of the Roman Catholic Church (in Placentia from 1864 to 1989) and included the first teacher training school in Newfoundland in a building attached to the convent.
Cape St. Mary's Light Tower / Recognized Federal Heritage Building 2007	Constructed 1859 - 1860	As the only existing remnant of the 19th-century light station at Cape St. Mary's, it illustrates the importance of maritime traffic in the history of Newfoundland and Canada. Construction of the light tower enabled establishment of communities and the fishing industry along the Cape Shore.
Anglo American Telegraph Office / NL Registered Heritage Structure 2005 / Municipal Heritage Building, Structure or Land 2006	Constructed around 1876	Reminiscent of a simple architectural style and design used for company-owned structures in outport Newfoundland. The building played a role in transatlantic communications for around 60 years during the late 19th and early 20th centuries. It was connected by a land line to the Heart's Content cable station, the main cable station in Newfoundland constructed in 1873 by the Anglo American Telegraph Company. The Placentia cable station was connected to St. Pierre and Nova Scotia via a submarine cable relaying messages between Europe, North America, St. Pierre and Heart's Content. During the 1940s and 1950s, the building housed American servicemen and families waiting for housing on the Argentia base and later converted into a convenience store.
O'Reilly House / NL Registered Heritage Structure 1999 / Municipal Heritage Building 2006	Constructed 1902	A good and well-preserved example of a Victorian house constructed in the Bracketed style. This upper-class residence features large, double-bay windows, dentil mouldings, eaves brackets, stained glass windows and the entablature above the front door with fine hand-crafted details such as mouldings and staircase. The home of Placentia magistrates from 1902 to 1984.
St. Luke's Anglican Church / NL Registered Heritage Structure 2000 / Municipal Heritage Building, Structure or Land 2006	Constructed between 1906 and 1908	Gothic Revival style church built on the site of at least two previous churches. The grounds include a Basque gravesite and headstones dated in the 17th century.
Wakeham Sawmill / NL Registered Heritage Structure 2005 / Municipal Heritage Building 2006	Constructed in Petite Forte in 1912, reconstructed in Placentia in 1942	A two-storey, hand-cut wooden sawmill and the only building of its type remaining in Placentia. Sits on the former route of the Orcan River, which once ran under the building and was important to its operations.
American Military Presence in Newfoundland / National Historic Event 1988	Began in 1940	In 1940, the United Kingdom granted the US 99-year leases for military bases at Argentia, St. John's and Stephenville. Construction and operations created employment for thousands of local people and stimulated local economies. The presence of thousands of Americans during and after World War II affected Newfoundland economically and socially and created a cultural focus from Europe toward North America.
Argentia 282 Coastal Defence Battery / NL Registered Heritage Structure 2005 / Municipal Heritage Building, Structure or Land 2006	Constructed 1941	The underground fortification at Fort McAndrew Air Force Base is likely the only one of its kind remaining with original artillery guns in place. Part of the defence system at the former Argentia Naval Air Station, which played a key role in the Battle of the Atlantic and served as a communications centre and part of the early warning system instigated by the US to monitor Soviet activity.
Atlantic Charter / National Historic Event 1973	Occurred in 1941	In 1941, British Prime Minister Winston Churchill and US President Franklin Roosevelt secretly met (anchored off Ship Harbour Point) and drafted the Atlantic Charter, which became the basis of the United Nations Charter endorsed by the 26 Allied powers in 1942.

Source: Parks Canada 2023, No date-a, No date-b

Placentia has other historic sites, including the remains of 12 historic forts (e.g., Fort Louis and the British New Fort) that present artifacts from French and English settlers dating to the 1600s (Town of Placentia 2024, 2015). Undesignated historic architecture assets include the Sacred Heart Roman Catholic Church and the old courthouse.

3.1.6.2 Cultural Facilities and Activities

Placentia's Town Square is bordered by key architectural landmarks and includes Town Hall and the Placentia Bay Cultural Arts Centre, a venue used for community gatherings, workshops and conferences, special events and live performances (Town of Placentia 2024).

The Placentia Cultural Interpretation Centre includes *Voices of Placentia Bay* and *Placentia Uncovered* cultural and historic exhibits. *Voices of Placentia Bay* is an interactive, multimedia exhibit that celebrates the history and oral traditions of Placentia Bay through songs and stories from past and present performers (Town of Placentia 2024). Themes include Placentia Bay resettlement and American influence in the Placentia area. *Placentia Uncovered* archaeological exhibit displays and explains thousands of artifacts from Fort Louis, Fort Fredrick and several other sites occupied by French military and settlers in the 16th century.

The Placentia Theatre Festival stages plays and musical shows that present the social, cultural and historical context of Placentia and NL (Placentia Theatre Festival 2023). Productions are held at the Placentia Bay Cultural Arts Centre, St. Luke's Church, Castle Hill National Historic Site and others.

3.1.6.3 Parks and Protected Areas

NL has various Provincial and Federal parks and protected areas, though no National Parks of Canada are in Avalon. Provincial wilderness and ecological reserves on the Avalon protect unique species, habitat or landscapes (Table 3.6). Most wilderness and ecological reserves in NL, except Cape St. Mary's and Mistaken Point, have little infrastructure or services for visitors. Some reserves offer outfitting (e.g., hunting and fishing) and adventure touring (e.g., snowmobiling and backcountry hiking).

Table 3.7 Provincial Parks and Protected Areas, Avalon

Park or Protected Area	Description
Avalon Wilderness Reserve	Protects 1,070 km^2 of barrens and forests and habitat for the Avalon Woodland Caribou herd – the most southerly caribou herd in Canada.
Baccalieu Island Ecological Reserve	The largest protected seabird island in NL. In summer, it has more types of breeding seabirds than any other seabird colony in NL. With 3,360,000-plus pairs of Leach's storm petrels, it is the largest Leach's storm petrel colony in the world.
Bellevue Beach Provincial Park Reserve	A cobble and sand beach complex with salt marsh, sand dunes, bar lagoons and habitat for migrating shorebirds.
Butter Pot Provincial Park	Geological features include 600-million-year-old rocks from the Precambrian era and large boulders deposited by receding glaciers 10,000 years ago. More than 230 plant species have been identified.
Cape St. Mary's Ecological Reserve	A major NL seabird colony. During breeding season, it is home to 30,000 Northern gannets, 20,000 black-legged kittiwakes, 20,000 common murres and 2,000 thick-billed murres. Also, a nesting site for more than 100 pairs of razorbills, more than 60 pairs of black guillemots along with double-crested and great cormorants and Northern fulmars. Interpretation and visitor services available.
Cataracts Provincial Park	Features two cascading waterfalls surrounded by rock walls. Plant life includes 121 species of moss and 63 species of liverwort believed to represent about one third of known bryophytes in NL.
Chance Cove Provincial Park	A barachois important for migrating shorebirds. The coastal barrens include blanket and plateau bogs. Patches of forests modified by the ocean climate result in patches of stunted balsam fir called tuckamore. Plant life includes arctic-alpine plants (e.g., alpine azalea) and abundant blueberries, partridgeberries and bakeapples.
Fitzgerald's Pond Provincial Park Reserve	Includes a population of a rare boreal felt lichen: Erioderma pedicellatum.

Table 3.7 Provincial Parks and Protected Areas, Avalon

Park or Protected Area	Description
Gooseberry Cove Provincial Park	Features a sandy beach with a grassy bluff.
Hawke Hill Ecological Reserve	The most easterly alpine barrens in North America. Protects a variety of arctic-alpine plants rarely encountered this far east and south in North America.
Jack's Pond Provincial Park Reserve	Habitat of some of the province's rarest plants.
LaManche Provincial Park	Contains a variety of habitats including bog, marsh and boreal forest. Mixed forests are dominated by balsam fir. Many species of shrubs and wildflowers such as honeysuckle, Labrador tea and tall meadow-rue.
Marine Drive Provincial Park Reserve	A small portion of coastal features characteristic of the Maritime Barrens, Northeastern Barrens subregion.
Mistaken Point Ecological Reserve	One of the world's most significant fossil sites. Protects fossils of the oldest, large, complex life-forms found anywhere on Earth. The Ediacara biota lived from 580 to 541 million years ago, when all occurrences of life was in the sea. The 5.7 km^2 reserve extends along 17 km of coastline. The coastline of the reserve was inscribed as a World Heritage Site in 2016. Interpretation and visitor services available.
Witless Bay Ecological Reserve	Contains North America's largest Atlantic Puffin colony with more than 260,000 pairs nesting during the late spring and summer. Also hosts the second-largest (after Baccalieu Island Ecological Reserve) Leach's storm-petrel colony in the world -- more with than 620,000 nesting pairs. In addition, hosts thousands of black-legged kittiwakes and common murres.

Source: NLDECC 2024, Parks NL 2023

The Government of NL has proposed additional protected areas, of which three are in Avalon (WERAC 2020). These are described in Table 3.7. The Wilderness and Ecological Reserves Advisory Council conducted public consultation on the Protected Areas Plan in 2020.

Table 3.8 Proposed Protected Areas, Avalon

Potential Protected Area	Description
Halls Gullies Ecological Reserve	The 19 km^2 area southeast of Whitbourne is one of two locations in NL with populations of, and critical habitat for, the endangered Vole Ears Lichen. This habitat is considered key to the survival of this species in NL and Canada.
Ripple Pond Ecological Reserve	This 70 km^2 area, west of Salmonier Line in central Avalon, includes the largest intact undisturbed portion of the Avalon Forest natural region with examples of all representative features: ribbed moraines, balsam fir with yellow birch forests on northern slopes and scrubby balsam fir and black spruce forests with Canada Yew on southern slopes. The forest is rich in lichens including rare species. Includes a significant portion of the Colinet River watershed and wetlands.
St. Shotts Ecological Reserve	Includes 53 km^2 north of St. Shotts on the east side of St. Mary's Bay, representative of the Eastern Hyper-Oceanic Barrens a natural region found only along some coasts in eastern Newfoundland. The rolling terrain is mainly covered by mosses, lichens and heaths with patches of tuckamore. Large blanket bogs are found in the upper reaches while exposed coastal areas are mainly covered in arctic-alpine plants normally found much farther north or at higher elevations.

Source: WERAC 2020

3.1.6.3.1 Camping and Day Use Parks

Nine Provincial parks and park reserves in Avalon are available for camping and / or day use (Table 3.8). The nearest Provincial camping sites are at Fitzgerald's Pond Provincial Park Reserve (on Route 100), which has 24 camp sites (Campendium 2023).

Table 3.9 Provincial Parks in the Avalon Region

Name	Facilities / Activities
Bellevue Beach Provincial Park Reserve	Privately-owned camping facilities
Butter Pot Provincial Park	Day use and camping facilities
Cataracts Provincial Park	Day use
Chance Cove Provincial Park	Day use
Fitzgerald's Pond Provincial Park Reserve	Privately-owned camping facilities
Gooseberry Cove Provincial Park	Day use
Jack's Pond Provincial Park Reserve	Privately-owned camping facilities
LaManche Provincial Park	Day use and camping facilities
Marine Drive Provincial Park Reserve	Privately-owned camping facilities

Source: Parks NL 2023

The Argentia Sunset RV Park is located 2.5 km from the Marine Atlantic Ferry Terminal (PoA 2024). Seasonally operated by PoA, the RV park features 40 serviced sites with water, sewer, electrical hookups along with two unserviced lots and washrooms, showers and a picnic area (NL Tourism 2023).

3.1.6.4 Marine Ferry

The marine vessel (MV) Atlantic Vision operates seasonally from June to September between Argentia and North Sydney, Nova Scotia (Marine Atlantic 2024). The ferry is an important component of the tourism sector in Placentia, both as a service to tourists and supporting business opportunities such as accommodations and food services.

3.1.6.5 Hiking Trails

The Argentia Backlands Trail is 16 km of prepared walking trails and roads developed in 1996 on lands controlled by the PoA. The trailhead and parking area are at the Pavillion Picnic Site. The various trail segments are identified in Table 3.9.

Table 3.10 Argentia Backlands Trails

Trail	Length (m)
Argentia Pond Road	1,200
Churchill Sprint	500
Roosevelt Walk	300
Greer Trail	1,200
Decatur Road	650
Dickerson Traipse	350
McCormick Trek	1,700
Ellis Path	750
Backland Road	4,170
Silver Mine Road	610
Peck Rove	1,320
Bunker Alley	1,140

Source: PoA 2022

Hike Placentia Inc. (HPI) has proposed to improve (upgrade infrastructure such as lookouts) and link the Backlands Trail to a larger network for the Placentia area (Hike Placentia Inc. 2023, Atlantic Business Magazine 2023). The proposed Placentia Area Hiking Trail would be a 22 km network including Townside Placentia and the

Point Verde lighthouse. The trails project, which is a collaboration of local groups, including Placentia Chamber of Commerce, the Placentia Lions Club and PoA, was released from the Provincial EA process in September 2023.

3.1.6.6 Accommodations

Placentia has various short-term accommodations, including hotels, efficiency apartments and bed and breakfast guest homes totalling more than 50 rooms (NL Tourism 2023; Town of Placentia 2021; Placentia Area Chamber of Commerce 2023; Castle Landing 2018; Rosedale Manor 2023). Short-term vacation rentals are also available; approximately 20 with a total of more than 50 rooms were promoted on web applications at time of writing (Airbnb 2023; Baycation 2023; Bay Chalets 2023).

3.2 Employment

This section discusses labour force characteristics, level of post-secondary achievement, employment by sector, work commuting, availability of skilled and unskilled labour and employment equity and diversity.

3.2.1 Labour Force Characteristics

In 2020, the employment rate in Placentia was similar for men+ and women+, the unemployment rate for women+ was 7% lower than for men+ (Table 3.10). Men+ were more likely to be engaged in part-time, casual, short-term or seasonal work and women+ were more likely to be employed in full-time, year-round and permanent positions. This could be attributed to men+'s higher participation in the construction (short-term) and fishing (seasonal) industries. The rate of self-employment is relatively low for the overall population but remains three times higher for men+ than women+.

Table 3.11 Labour Force and Employment (2021)

Indicator	Placentia		Avalon		NL	
	Men+	Women+	Men+	Women+	Men+	Women+
Labour force participation rate (%)	51.4	46.7	63.0	57.6	58.6	53.7
Employment rate (%)	40.9	40.7	53.9	51.9	48.1	47.0
Unemployment rate (%)	19.7	12.8	14.5	10.0	18.0	12.4
Worked full year full time (%)	21.4	23.2	33.5	30.7	28.2	26.8
Worked part of year and / or part time (%)	30.4	23.9	30.2	27.4	32.2	28.2
Permanent position (%)	55.3	66.7	63.0	68.3	59.8	66.5
Casual, seasonal or short-term position (less than 1 year) (%)	26.2	23.5	18.4	15.3	23.0	18.3
Self-employed (%)	9.2	3.0	10.4	7.3	9.4	6.5

Source: Statistics Canada 2023a

3.2.2 Work Commuting

In 2021, most employed residents of Placentia worked within the census subdivision (CSD) of residence (i.e., Placentia) compared to those in the Avalon or NL, as shown in Table 3.11. A higher proportion of workers in the Avalon and NL commuted to another municipality within the CD, which likely indicates the large population in the Northeast Avalon Region (St. John's and surrounding areas) that commutes daily from suburban communities to urban employment centres such as St. John's and Mount Pearl. Small proportions of workers in each jurisdiction commuted to a different CS and CD within NL, to a different province or territory or worked outside of Canada. Around 80% of workers in Placentia, Avalon and NL experienced commute times of 30 minutes or less in 2021. A larger proportion of workers living in Placentia (12.3%) experienced commute times of 60 minutes or greater compared to the Avalon (5.4%) or NL (5.8%), which may indicate a tendency for some to accept longer commutes.

Table 3.12 Work Commuting (2021)

Commuting Location / Time	Placentia	Avalon	NL
Commute within CSD of residence (%)	77.5	50.3	55.6
Commute to a different CSD within CD of residence (%)	17.8	47.1	38.3
Commute to a different CSD and CD within province or territory of residence (%)	1.8	1.5	4.4
Commute to a different province or territory (%)	1.8	1.1	1.8
Worked outside Canada (%)	0	0.3	0.2
Less than 15 minutes (%)	59.4	42.7	51.4
15 to 29 minutes (%)	18.9	40.3	31.1
30 to 44 minutes (%)	7.1	9.1	8.8
45 to 59 minutes (%)	2.4	2.5	2.8
60 minutes and over (%)	12.3	5.4	5.8

Source: Statistics Canada 2023a

A combined total of about 91% of employed men+ in Placentia worked within the CSD of residence (i.e., 64.5% in Placentia) or commuted to another municipality within the CD (i.e., 26.3% in CD No. 1, Avalon) in 2021 (Statistics Canada 2023a). For women+, a total of 99% worked within the CSD of residence (i.e., 88.2% in Placentia) or within the CD (i.e., 10.8% in Avalon). The difference may be associated with traditional gender roles in employment. As noted in Section 3.1.1, a higher proportion of women+ worked in sectors that provide health services, as well as education and public administration sectors, which are available in Placentia. Men+ tended to work in traditional sectors including construction, transportation and warehousing, fishing and manufacturing.

Most workers in each of the jurisdictions experienced commute times of less than 30 minutes in 2021, with a proportion of 45% for men+ and 73% for women+. Commute times were shorter for Placentia residents than for the other jurisdictions (Statistics Canada 2023a). Around half of the working population in each of the jurisdictions traveled less than 15 minutes for work, though the gender difference was less pronounced for NL generally. The proportion of men+ commuting more than an hour for work was twice as high in Placentia compared to NL, which may be linked to certain traditional work sectors for men+ (e.g., construction or industrial sites).

3.2.3 Availability of Skilled and Unskilled Labour

Due to low birth rates and out-migration of young people, the populations of the jurisdictions examined are aging and showing little growth, except for the population of Avalon. Natural population growth is declining as the number of deaths exceeds the number of births. Population stability is sustained by immigration and international students along with migrants (e.g., post-secondary students, retirees and remote workers) from other provinces (BuildForce Canada 2023).

An aging and retiring workforce along with continued economic growth and a transition from a resource-based to a knowledge-based economy are contributing to labour shortages (Public Policy Forum 2020), as well as to low unemployment rates of 10% in summer months (BuildForce Canada 2023).

Information on the types of occupations required from 2018 to 2027 in NL describes demand based on educational and training requirements (Table 3.12). Natural resources industries with occupations in processing, manufacturing and machine operating are expected to continually require workers. Occupations in the knowledge economy, such as highly skilled managers in financial and business services, will also likely be in high demand; this shift can contribute to early retirement as older workers may have more difficulty adapting. NL will be especially challenged to fill jobs in areas such as computer engineering, information technology, sustainable food safety, healthcare, social work and bilingual services, especially in rural communities.

Table 3.13 Occupational Ratings for 2018-2027, NL (adapted from Public Policy Forum 2020)

Indicator	Occupations that usually require university education	Occupations that usually require college education or apprenticeship training	Occupations that usually require secondary school and/or occupation-specific training	Occupations where on-the-job training is usually provided
Competition for qualified labour will be strong	Managers in health, education, social and community services, sales, natural resources production and fishing	Control operators		
New labour supply will be required to meet anticipated job openings	Managers in all fields Professionals in business and finance	Technical occupations Professionals in business, finance and administration Supervisors in manufacturing and utilities	Machine operators Administrative support occupations Tourism and security related occupations	Labourers in processing, manufacturing and utilities, and some elementary service occupations Cleaners

Source: BuildForce Canada 2023

BuildForce Canada indicates the 2022 NL construction labour force consisted of 19,400 individuals. BuildForce's 10-year (2023-2032) construction workforce outlook for NL forecasts 5,700 retirements and 3,400 new entrants in the construction industry for a loss of 900 (-6.2%) workers (BuildForce 2023). BuildForce provides information for the residential and non-residential construction markets.

Table 3.13 describes the non-residential market by trade or occupation. Employment in the NL non-residential construction sector increased in 2022 over 2021 due to a post-pandemic commercial recovery, ongoing institutional projects and the restart of construction at the West White Rose project (BuildForce 2023). Some capital investment eased in 2023, resulting in a more balanced situation for many trades and occupations. Weaker markets are anticipated in 2024 and 2025 for some trades, though those engaged in heavy-industrial activities could experience tight labour markets in 2025. Labour markets for all trades are expected to weaken by 2031. However, several proposed large-scale resource projects (e.g., hydrogen, mining) could be under development at that time.

Table 3.14 Non-Residential Construction Market Rankings, NL (adapted from BuildForce 2023)

Trades and Occupations	2022-2032										
	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31	'32
Boilermakers	4	3	3	4	3	3	3	3	3	2	3
Carpenters	4	4	3	2	3	3	3	3	3	2	3
Construction managers	4	4	3	4	3	4	4	4	3	3	3
Construction millwrights and industrial mechanics	3	3	3	4	3	4	3	3	3	2	2
Contractors and supervisors	4	4	3	4	3	4	4	4	3	2	3
Crane operators	3	3	3	4	3	4	3	3	2	2	3
Electricians	4	3	3	4	3	3	3	3	2	2	3
Heavy equipment operators (except crane)	4	3	3	4	3	3	3	3	3	2	3
Heavy-duty equipment mechanics	3	3	3	4	3	3	3	3	3	2	2
Insulators	4	3	3	4	3	3	3	3	3	2	3
Ironworkers and structural metal fabricators	4	4	3	2	3	3	3	3	3	2	3
Painters and decorators (except interior decorators)	4	3	2	2	3	3	3	3	3	3	3
Plumbers	4	4	3	4	3	4	4	4	3	2	4
Refrigeration and air conditioning mechanics	4	4	2	3	3	3	3	3	3	3	3

Table 3.14 Non-Residential Construction Market Rankings, NL (adapted from BuildForce 2023)

Trades and Occupations	2022-2032										
	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31	'32
Residential and commercial installers and servicers	4	3	2	3	3	3	3	3	3	3	3
Sheet metal workers	4	4	3	2	3	4	4	3	3	2	3
Steamfitters, pipefitters and sprinkler system installers	3	3	3	4	3	3	3	3	3	2	3
Trades helpers and labourers	4	4	2	2	3	3	3	3	3	2	3
Truck drivers	4	3	3	4	3	3	3	3	3	2	3
Welders and related machine operators	4	4	3	2	3	3	3	3	3	2	3

Source: BuildForce 2023

1. Workers meeting employer qualifications are available in local markets to meet an increase in demand at the current offered rate of compensation and other current working conditions. Excess supply is apparent and there is a risk of losing workers to other markets.
2. Workers meeting employer qualifications are available in local markets to meet an increase in demand at the current offered rate of compensation and other working conditions.
3. The availability of workers meeting employer qualifications in the local market may be limited by large projects, plant shutdowns or other short-term increases in demand. Employers may need to compete to attract needed workers. Established patterns of recruiting and mobility are sufficient to meet job requirements.
4. Workers meeting employer qualifications are generally not available in local markets to meet any increase. Employers will need to compete to attract additional workers. Recruiting and mobility may extend beyond traditional sources and practices.
5. Needed workers meeting employer qualifications are not available in local markets to meet current demand so that projects or production may be delayed or deferred. There is excess demand, competition is intense, and recruiting reaches to remote markets.

As the retirement rate increases over the next decade in NL, it is anticipated competition for younger workers will be intense (BuildForce Canada 2023). The construction industry and other sectors will need to expand recruitment programs to succeed in attracting workers. Recruitment of individuals from groups (e.g., women, Indigenous people and immigrants) who have been traditionally under-represented in the construction sector will have a positive impact on labour supply.

In 2022, approximately 1,780 women (about 10% of total workers) were employed in the NL construction industry, of which 60% worked directly on construction projects and the remaining 40% worked off site, primarily in administrative and management roles (BuildForce Canada 2023). Women made up only 7% (1,070) of the 15,200 tradespeople employed in the construction industry. They were represented across all sectors of construction but had higher participation in non-residential construction. Women in the industry were most often employed as electricians (22% of total women), trade helpers and labourers (19%), construction managers (7%), painters and decorators (6%) and heavy-duty equipment mechanics (5%).

In 2021, Indigenous workers accounted for approximately 9% of the NL construction labour force (BuildForce Canada 2023), which was consistent with 2016 employment in construction. However, the general labour force increased its share of Indigenous workers from 2016 to 2021.

As of 2021, new Canadians accounted for approximately 8% of NL's workforce. While NL has been successful in attracting and integrating immigrants into the labour force, the share of immigrants in the NL workforce is below that of Canada (BuildForce Canada 2023). In 2021, the proportion of immigrants (1.9%) in the NL construction labour force was less than one-quarter of the immigrant share in the general NL labour force. NL is anticipated to receive 37,700 new immigrants between 2023 and 2032, who will make up an increasing share of the NL working-age population.

4. Infrastructure and Services

The introduction of development projects can affect community infrastructure and services. Generally, permanent population increases, with a higher number of families, result in increased demand for housing, education, health care, child care and recreation, as well as usage and capacity of water, sewerage, solid waste, communications and utilities. Temporary population increases (e.g., for a large-scale construction project) also result in increased demand for infrastructure and services, but mainly for water, sewerage, solid waste, communications and utilities, though they may also affect housing and transportation infrastructure and services depending on how non-resident workers are housed and transported during construction.

4.1.1 Housing

In 2016, Placentia had 1,852 total private dwellings with 1,559 occupied by usual residents[9] (Statistics Canada 2018). Five years later, private dwellings totalled 1,827 (-25) with 1,543 occupied by usual residents (-16) (Statistics Canada 2023a). It is challenging to identify the exact reason for the decrease in private dwellings. Possibilities include changes in the population or housing, or changes in the classification of dwellings – meaning a private dwelling in one census might be classified as a collective dwelling (e.g., rooming or boarding house) in another census. Regions with a higher number of temporary residents may experience more fluctuations.

Placentia has a high rate of homeownership with a proportion of just over 80% in 2016 and 2021 (Table 4.1). The 2021 data show a higher rate than for Avalon and NL, both of which decreased since the last census. Consequently, the rate of household renters was lower in Placentia compared to Avalon and NL. For each of the three jurisdictions, a high proportion of housing was considered suitable and not in need of major repairs.

Table 4.1 Selected Housing Indicators

Indicator	Placentia		Avalon		NL	
	2016	2021	2016	2021	2016	2021
Household owner (%)	81	81.5	74.1	73.3	81	75.7
Household renter (%)	19.3	18.5	25.9	26.7	23.1	24
Suitable housing (%)	99.4	98.4	98.2	98.2	98.2	98.3
Unsuitable housing (%)	0.6	1.9	1.8	1.8	1.8	1.7
In need of major repairs (%)	7.4	4.9	5.1	4.6	6.5	5.5
Average household size (people) (%)	2.2	2.1	2.4	2.3	2.3	2.3
Multigenerational households (%)	NA	1.3	NA	2	NA	2

Source: Statistics Canada 2023a, 2018

Households in core housing need[10] live in unsuitable, inadequate or unaffordable dwellings and cannot afford alternative housing in their community (Statistics Canada 2023a). Renters in Canada are more than four times as likely to be in core housing need than homeowners, core housing needs are higher in urban areas and more than one in 10 households has more than one housing challenge (e.g., financial, repairs, crowding) (Statistics Canada 2022a). In NL, 8% of households were in core housing need in 2021.

In 2021, the average household size in Placentia was 2.1 people, almost the same as in 2016 (Table 4.2). This small decrease is similar to the household size trend in NL, which remained at 2.3 between 2016 and 2021. Information on multigenerational households was not available for 2016, but the 2021 rate for Placentia (1.3%) was lower than for Avalon and NL, both at 2% of total households. For the parameters examined, Placentia is generally more affordable from a housing perspective, probably because the Avalon and NL both include the Northeast Avalon, which encompasses the St. John’s urban region and suburbs, where housing values are higher. The exception is that a higher percentage of tenant households in Placentia live in subsidized housing.

[9] Private dwelling in which a person or group of persons are permanently residing residents, as opposed to unoccupied private dwellings or dwellings occupied solely by foreign residents or temporary residents.
[10] “Core housing need refers to whether a private household's housing falls below at least one of the indicator thresholds for housing adequacy, affordability or suitability, and would have to spend 30% or more of its total before-tax income to pay the median rent of alternative local housing that is acceptable (attains all three housing indicator thresholds)” (Statistics Canada 2022a).

Table 4.2 Housing Value and Costs

Indicator	Placentia		Avalon		NL	
	2016	2021	2016	2021	2016	2021
Owner households with a mortgage (%)	36.9	33.1	57.5	55.9	49	47.4
Owner households spending 30% or more of income on shelter (%)	10.4	7.6	12.7	11.2	10.6	8.9
Owner households in core housing need (%)	NA	3.2	NA	3.7	NA	3.4
Median monthly shelter costs for owned dwellings ($)	535	520	1,056	1,070	743	750
Average monthly shelter costs for owned dwellings ($)	741	738	1,201	1,240	984	1,014
Median value of dwellings ($)	149,875	150,000	299,072	300,000	219,228	240,000
Average value of dwellings ($)	176,876	173,200	308,833	305,600	243,157	246,800
Tenant households in subsidized housing (%)	33.3	33.3	20.8	18.6	22.2	19.6
Tenant households spending 30% or more of income on shelter (%)	36.7	24.6	41	33.8	39.4	32.5
Tenant households in core housing need (%)	NA	12.3	NA	21.8	NA	20.8
Median monthly shelter costs for rented dwellings ($)	571	665	880	930	802	870
Average monthly shelter costs for rented dwellings ($)	661	670	905	970	836	903

Source: Statistics Canada 2023a, 2018

There was a slight decrease in the percentage of owner household with a mortgage in Placentia, Avalon and NL between 2016 and 2021 (Table 4.3). The proportion of owner households with a mortgage was lower in Placentia than in Avalon and NL, partially owing to the lower value of dwellings in Placentia (Statistics Canada 2023a). The older population may also explain the lower rate of homeowners with a mortgage in Placentia, as purchasing a home is generally associated with early adulthood, and mortgage repayment typically occurs by retirement age.

As shown in Table 4.3, the median value of dwellings in Placentia was lower than for the other jurisdictions in 2021. Median value increase was limited between the last two censuses for Placentia (+0.08%) and Avalon (+0.31%) (Statistics Canada 2018). For NL, housing prices increased by 9.48% between 2016 and 2021 and by 26% between 2011 and 2016 (Statistics Canada 2018, 2012). In 2021, nearly 90% of dwellings in Placentia were single-detached houses, while a total of 2.2% were apartments. This trend appears somewhat representative of NL where single-detached houses make up around 75% of households and dwellings, and apartments constitute nearly 20%.

Table 4.3 Household and Dwelling Characteristics (2021)

Indicator	Placentia	Avalon	NL
Single-detached house (%)	89.6	63.6	72.3
Semi-detached house (%)	3.6	3.9	3.9
Row house (%)	4.9	5.8	4.8
Apartment or flat in a duplex (%)	0.6	19.3	12.3
Apartment in a building that has fewer than five stories (%)	1.6	6.6	5.5

Source: Statistics Canada 2023a

4.1.2 Education and Training

NL English School District (ESD) operates 91 schools in the Avalon Region with a 2022-2023 enrolment of 35,269 students (NLDE 2023a). The Conseil scolaire francophone has six schools (two in Labrador, two on the west coast of Newfoundland and two in St. John's) with a total enrolment of 356 students. Placentia has two schools: St. Anne's Academy with a 2022-2023 enrolment of 212 from Kindergarten to Grade 6 and Laval High School with an enrolment of 226 from Grade 7 to completion (total enrolment 438). These schools had a total enrolment 433 in the 2021-2022 school year, representing a net gain of five students in 2023.

The College of the North Atlantic (CNA) has 17 campuses, including Placentia, Carbonear, Seal Cove and two campuses in St. John's (CNA 2023a). The Placentia campus offers programs in Early Childhood Education, Heavy Duty Equipment Technician / Truck and Transport Mechanic, Heavy Equipment Operator, Machinist, Industrial Mechanic (Millwright), Personal Care Attendant and Welder. As of September 2023, CNA is offering a two-year diploma program in Hydrogen Technician at the Corner Brook campus and a one-year certificate program in Wind Turbine Technician at the Bay St. George campus (CNA 2023b).

4.1.3 Child Care

Child care is important to economic development, especially for facilitating women's career engagement. Placentia has limited registered child care providers; one Family Child Care Provider with six spaces is listed in the NL Department of Education's Early Learning and Child Care Directory (NLDE 2023b). Placentia has a Family Resource Centre, which provides support services to children accompanied by parents. It is likely that informal child care arrangements exist.

A pre-kindergarten program is planned for St. Anne's Academy in Placentia (YMCA NL 2023). The program is still under development and recruiting early childhood education workers.

4.1.4 Health Services and Social Programs

NL Health Services operates Community Health Clinics, including the Placentia Health Centre (Eastern Health 2023a). The facility offers in-patient and out-patient services with 10 in-patient beds, including a palliative care room and three emergency care beds. The Centre provides a Child Health Clinic, diagnostic services, such as blood collection, radiography, ultrasound, blood pressure monitoring and electrocardiogram / Holter monitoring. Treatment includes ambulatory care services, intravenous medications and chemotherapy. Patients are referred to regional or Provincial facilities in Carbonear or St. John's for emergency care that cannot be provided at the Health Centre, surgery, pediatric care, mental health care or rehabilitation hospital.

Services are also available for seniors and those with disabilities at the Placentia Health Centre (Eastern Health 2023a). Long-term care is provided at the Lions Manor Nursing Home, which has 75 beds. Two rooms are available for respite care. Supportive housing is available to seniors and individuals with disabilities over the age of 50 in 40 accessible cottages. Beachside Manor offers support in a personal care home setting. The Government of NL also provides community support services for seniors who wish to remain in their own homes.

The NL Department of Health and Community Services programs focus on diseases and conditions that affect a large portion of the population (NLDHCS 2023). Chronic diseases, which often share risk factors (e.g., tobacco use, physical inactivity, unhealthy eating, excessive alcohol use), include:

- Arthritis
- Cancer
- Chronic pain
- Diabetes
- Heart disease
- Kidney disease
- Lung disease
- Stroke

The Department provides prenatal and postnatal services for new parents, children, services such as adoptions, child protection and youth corrections for families and youths (NLDHCS 2023). General services and programs include: Development & Behavioural Services for Persons with Disabilities, Mental Health Services, Medical Care Plan, Dental Services, Eye See Eye Learn (pre-kindergarten eye examinations and prescription eyeglasses for those not covered by private insurance), Prescription Drug Plan (for those not covered by private insurance), Communicable Diseases / Immunization, Help Lines (support via telephone with referrals to health services) and Youth Treatment Centres (complex mental health needs).

The Community Supports Program is delivered through the Eastern Health Placentia District Office (Eastern Health 2023b). Services and programs include financial assessment services, home support program, intervention services, residential services programs, special assistance program, special child welfare allowance and supports for adults who may need protection. Service organizations also provide social support programs for those in need.

4.1.5 Water and Sewer Services

Placentia has permits to operate drinking water treatment facilities and distribution systems (NLDECC-W 2023). A chlorine gas disinfection system treats a gravity flow surface water supply from Clarke's Pond that services Dunville, Freshwater and Argentia. This facility includes an in-ground storage reservoir (650 m^3) and two sodium hypochlorite booster stations in Dunville, two in-ground storage reservoirs (1,894 m^3 and 1,364 m^3) in Argentia and a storage reservoir (237 m^3) and booster pump station in Freshwater. The Larkin's Pond gravity flow surface water supply, which is also chlorine-gas treated, serves Placentia, Jerseyside and Southeast Placentia. This system has a storage reservoir (325 m^3) in Jerseyside, a booster pumping and sodium hypochlorite disinfection system in Placentia and an in-ground storage reservoir (360 m^3) in Southeast Placentia.

In the 2024 fiscal year, the Town of Placentia is focused on infrastructure improvements such as the Dunville Water Line Project ($7,350,000), Jerseyside storm water assessment and repairs ($1,998,772), Station Road erosion control project ($639,411), Dunville sanitary storm water system ($1,174,135) and Battery Road water and sewer upgrades ($435,384) (Town of Placentia 2023a). Eighty percent of costs are covered by other levels of government or through Canada Community-Building Fund (formerly the Gas Tax Fund).

Waste water and storm water are collected in a sewerage system with multiple coastal outfalls, but Placentia does not have a sewage treatment facility. Studies and proposals have been initiated to address sewage treatment but show little progress.

4.1.6 Solid and Hazardous Waste

The Municipality provides curbside collection of household solid waste (weekly), recycling (biweekly) and bulk garbage (twice annually) (Town of Placentia 2023b). It occasionally offers free household hazardous waste collection. Eastern Waste operates a local waste recovery facility for residential drop-off of non-recyclable waste materials three days per week (ERSB 2023).

Businesses are expected to deliver their own waste or use contracted services. All solid waste and materials diverted for recycling in Placentia are delivered to Robin Hood Bay Regional Waste Management Facility in St. John's (by permitted waste haulers) where differential tipping fees are charged (Table 4.4).

Table 4.4 Robin Hood Bay Waste Disposal Fees (April 1, 2024)

Waste Type	Tipping Fees per Metric Tonne
Regular Waste Disposal	$90.75
Commingled Recyclables	$28.75
Rejected Wastes or Recycling, or Mixed Waste	$170.75

Source: Robin Hood Bay 2024

4.1.7 Transportation

Placentia is accessed via Route 100 from the Trans-Canada Highway. The nearest airport is St. John's International. The seasonal Argentia – North Sydney ferry service operates from mid-June to late September (Marine Atlantic 2024).

Placentia Bay is one of seven Canadian Coast Guard vessel traffic services zones in Atlantic Canada (CCG 2022). The Coast Guard's Marine Communications and Traffic Services (MCTS) monitors marine traffic in Placentia Bay from Argentia.

4.1.8 Utilities and Communications

Newfoundland and Labrador Hydro (NLH), the primary generator of electricity in NL, supplies Newfoundland Power with 93% of the electricity it distributes to customers on the island of Newfoundland (Newfoundland Power 2023). Placentia is served by the Clarke's Pond Terminal Station, which is connected by a 69-kV transmission line to the Holyrood Thermal Generating Station (NLH 2022). Nearby Long Harbour is served by a Terminal Station, which is connected to TL208, a 230-kV transmission line connected to the Muskrat Falls Generating Station via the Western Avalon Terminal Station (NLH 2022; NLH 2023).

Three major service providers (Bell Aliant, Rogers and Eastlink) offer mobile and landline telephone services, as well as Internet, wireless networking, cable or satellite television and home security in NL (Bell Aliant 2023; Rogers 2023a). Other providers (e.g., Telus, Koodoo, Virgin Mobile), supply mobile phone services.

Cellular service is insufficient in parts of rural NL, including within the Regional Study Area, which creates an issue for mobile customers as well as for emergencies. The Government of NL's 2023 Cellular Service Improvement Initiative aims to improve coverage especially for communities with no or limited cellular access (NLIET 2023). Meanwhile, alternative communication services (e.g., satellite phone, InReach) are available for use in low or no-service areas. In December 2023, Rogers performed Canada's first successful satellite-to-mobile phone call (also testing text, data and emergency alerts) through Lynk's low-earth orbit satellites and Rogers national wireless network (Rogers 2023b [satellite-to-mobile]). Access to Lynk's services is expected to provide customers of mobile networks with consistent cellular access in rural and remote areas.

4.1.9 Prevention and Emergency Services

Prevention of crime and safety issues and timely response to incidents require sufficient capacity in services such as policing, fire and emergency medical services. A major construction project with a large worker population may have the ability to adversely affect capacity in such services by increasing demand due to traffic issues, a safety incident or worker behaviour, especially if time is spent in nearby communities.

4.1.9.1 Policing

The Royal Canadian Mounted Police (RCMP) has 43 detachments in NL (RCMP 2024). In Avalon, these include NL headquarters in St. John's and seven detachments. The RCMP reports that the Placentia detachment is fully staffed and supported by officers from the Whitbourne detachment (40 km away) when required.

Concerns about violent crime have escalated in Placentia following incidents, such as several home invasions, violent assaults and an attempted murder (CBC 2023b). Some of these incidents have been attributed to drug activity and individuals with criminal backgrounds moving into the community.

While detailed data on police-reported incidents are not available for Placentia or Avalon, NL experienced an increase in the crime severity index between 2021 and 2022 (Table 4.4). Between 2021 and 2022, NL experienced a nearly 20% increase in violent crime, which includes violent offences such as homicide, attempted murder, assault, sexual assault and robbery, the latter of which is theft involving use or threat of violence (Statistics Canada 2022b). It is important to note that the St. John's Census Metropolitan Area (CMA) is responsible for a large number of police-reported crimes in NL. Based on Statistics Canada data, approximately 88% (6,061 / 6,865) of police-reported crimes in NL were attributed to the St. John's CMA (Statistics Canada 2023c), indicating the crime rate is generally much lower outside of the St. John's area.

Table 4.5 NL Police-Reported Crime Severity Index - 2022

Indicator	NL	Canada
Total Crime Severity Index (per 100,000)	82.2	78.1
Percentage change 2021-2022 (%)	6	4
Percentage change 2012-2022 (%)	21	3

Source: Statistics Canada 2023c

The NL Crown Attorneys Association indicates there has been an increase in violent offences, gun crime and homicides at a time when the number of public prosecutors has decreased due to attraction and retention issues. (CBC 2023c). In January 2023, there were 5,012 outstanding criminal files in the Eastern Region compared to 3,943 in February 2020, meaning the justice process is slower for victims and their families as well as those accused of crimes.

4.1.9.2 Fire Prevention and Response

Placentia provides fire protection and response services through prevention, public education and emergency response (Town of Placentia 2024). A 2015 report on municipal fire protection services in NL rated Placentia Volunteer Fire Department as Acceptable (includes the ability to have a minimum of six firefighters on scene within 14 minutes, 80% of the time) for offensive interior fire suppression / rescue, meaning firefighters have the training, equipment and resources required to enter the structure and provide search and rescue operations as well as interior fire suppression. Placentia Volunteer Fire Department was also rated Acceptable (the ability to safely commence attack within two minutes after assembling necessary resources on scene, 90% of the time, minimum of four firefighters) for defensive exterior. Defensive exterior means firefighters do not enter the structure to attempt to put the fire out or rescue anyone trapped inside (NLFES 2015).

4.1.9.3 Emergency Medical Response

Emergency health services are available at the Placentia Health Centre, Carbonear and St. John’s (Province of NL 2023b). Power’s Ambulance Service Ltd. is in Placentia.

4.1.10 Recreation

As a Municipality, Placentia offers a variety of sports and recreation facilities for indoor and outdoor activities (Table 4.5). Other non-profit and for-profit organizations provide programs and activities.

Table 4.6 Recreation Facilities, Placentia

Facility	Infrastructure and Activities
Unity Parc Arena	Indoor ice arena and stadium. Sports and recreation (e.g., hockey, curling, figure skating, power skating, power walking) and entertainment / public events
Freshwater Skate Park	Skate park, playground, basketball court
Regatta Grounds	Site of the Annual Placentia Regatta organized by the Placentia Rowing Club Inc. (founded in 1963)
Wayne John Searle Memorial Recreation Complex	Accessible playground and park
Willard Hatfield Memorial Ball Field	Minor softball field with 2 dugouts used for summer recreation programs and softball tournaments
William Hogan Ball Field	International class softball facility offers local programs and hosts provincial and national softball tournaments
Jeff Jones Memorial Soccer Pitch	Soccer facility and accessible park
Coalyard Playground	Playground, tennis court and basketball court
Ferndale Veterans’ Park Playground	Day use park with picnic tables, playground
Mount Pleasant Playground	Playground and basketball court

Table 4.6 Recreation Facilities, Placentia

Facility	Infrastructure and Activities
William Hynes Memorial Playground	Playground
Great Beach Boardwalk	1.4-km boardwalk with view of Placentia Bay

Source: Town of Placentia 2024

5. Community Health and Well-Being

Community health and well-being encompasses the holistic nature of community health / well-being and the many factors within a community that may affect health and well-being. This section includes an analysis of community health and well-being within the analytical frameworks of social determinants of health and intersectionality.

Many factors including individual genetics and lifestyle choices, along with where one is born, grows, lives, works and ages, all influence health (Government of Canada 2023). Social determinants of health are a broad range of personal, social, economic and environmental factors that determine individual and population health. More specifically, they refer to social and economic factors (e.g., income, education or employment) that relate to an individual's place in society and thus influence health. In addition, experiences of discrimination, racism and historical trauma are important social determinants for certain groups of people (e.g., Indigenous Peoples, 2SLGBTQIA+ and Black Canadians).

Intersectionality identifies distinct groups of a community that may experience multiple and simultaneous forms of oppression. It also considers these groups within social, economic and political systems (e.g., colonialism, patriarchy) that result in systemic disadvantage or privilege based on social identity factors. Intersectionality is also known as Gender-based Analysis Plus (GBA+) within the Government of Canada’s approach to addressing systemic-based inequality and inequity.

5.1 Selected Determinants of Health

Considering the preceding information and the socio-economic profile captured in Sections 2 to 4 of this report, particular social determinants of health have been chosen as most likely to affect the health and well-being of people in Placentia, Avalon and NL, namely:

- Education
- Income
- Housing
- Food security
- Access to health services
- Gender
- Race

These determinants are presented with a focus on determinants of health and intersectionality to help identify issues and opportunities as relevant to the Project.

5.1.1 Education

Education facilitates full-time, longer-term employment and higher income, which in turn results in better housing and food security. As shown in Section 2.1.6, the population of Placentia has a higher rate of individuals without a high school diploma or equivalent compared to Avalon or NL and a lower rate of individuals with a university degree. On the other hand, Placentia has a higher proportion of residents with an apprenticeship diploma, which is often suitable for employment in rural areas.

5.1.2 Income

The 2020 median after-tax income of individuals and households in Placentia was lower than in the other jurisdictions and of Canada (Table 5.1). This is likely indicative of rural areas generally and of Placentia's and NL's older population, many of whom would have retirement income only.

Table 5.1 Median After-Tax Income (2020)

Median Income	Placentia	Avalon	NL
After-Tax Among recipients ($)	31,400	35,600	33,200
After-Tax Household ($)	53,600	68,000	63,200

Source: Statistics Canada 2023a

As discussed in Section 2.1.7, the low-income rate is higher for women+ in Placentia (19%), Avalon (13.7%) and NL (16.3%) compared to men+. The same is true for Canada with 11.6% women+ having low income (Statistics Canada 2023a). In Placentia, women+ aged 65 and older were most likely to experience low income in 2020.

5.1.3 Housing

Safe and affordable housing is essential for health and well-being. People who have stable housing are more likely to achieve higher education, experience stable employment and more fully participate in society. Canada Mortgage and Housing Corporation estimates that 1.4 million households in Canada do not have access to quality housing (CMHC 2022).

Despite the increase in housing value (Section 4.1.1) and rents in NL and across Canada, the proportion of people spending 30% or more of their income in housing decreased between 2016 and 2021 in all three jurisdictions. This may be attributed to various factors such as the higher rate of homeownership in Placentia (81.5%), Avalon (73.3%) and NL (75.7%) compared to Canada (66.5%) in 2021 (Statistics Canada 2023a). Household income generally increased in NL between 2015 and 2020 (Section 2.1.7).

5.1.4 Food Security

Food prices have increased and demand at Canada's food banks has increased to levels not experienced since 1989. Food bank usage increased by 32% in 2023 over the same date in 2022 and by more than 78% since 2019. Specifically for NL, an increase of 12.4% has been observed since 2022 and more than 44% since 2019 (CBC 2023d).

Between 2021 to 2022, the total cost of the NL nutritious food basket (NLNFB) increased by 12% generally for NL (NLSA 2021). In 2021, the NLNFB cost the least in Eastern NL (including Placentia and Avalon), though it was higher in rural areas.

The Placentia Area Food Bank serves residents of communities from Ship Harbour to Branch (Canada Helps 2024). The food bank is supported by corporate and private donations (Placentia Area Food Bank 2023). Usage data or changes were not available, but food security is most often attributed to low income and increased cost of living.

5.1.5 Access to Health Services

Appropriate access to health care services means getting care at the right time, without financial, organizational or geographic barriers (Canadian Institute for Health Information 2024). Health care access data were not available for Placentia or Avalon, but data are available for several parameters to compare NL to Canada.

NL performance on availability of a regular health care provider and hip fracture surgery are on par with the Canadian average (Table 5.2). The self-harm hospitalization rate is higher than for Canada. Self-harm hospitalizations in NL have declined by 20% from 2022-2023 to 2016-2017, possibly due to increased services and reduction of stigma on seeking support for mental health issues. The Canadian rate has remained between 60 and 65 per 100,000 (Canadian Institute for Health Information 2024). Available data show self-harm hospitalizations in NL were highest in western NL, followed by Labrador, eastern NL and central NL. Men were most likely to be hospitalized for self harm in western NL and women were more likely in Labrador.

Table 5.2 Health Care Access

Indicator	NL	Canada	Rating
Has a regular health care provider 2019 to 2020 (%)	87.1	85.6	Same as average performance
Hip fracture surgery within 48 hours 2022-2023 (%)	81.2	81.9	Same as average performance
Self-harm hospitalizations 2022–2023 (per 100,000)	81	62	Below average performance

Source: Canadian Institute for Health Information 2024

5.1.6 Gender

In 2023, Canada rated 30 out of 146 countries on the Global Gender Gap Index (Canadian Women's Foundation 2023). Despite continual progress, women in Canada are still disadvantaged compared to their male counterparts. In 2022, 184 women and girls were killed by violence. In 2019, 1.5 million women lived in poverty and 10 times more women than men left the labour force since 2020. In 2022, women (working full and part-time) earn 89 cents for every dollar earned by men. Further it has been estimated that accelerated progress on gender equality could result in $150 million in incremental GDP growth.

Gender equality can be defined as equal rights, responsibilities and opportunities regardless of gender or gender identity. Equality is a human rights issue and implies that the interests, needs and priorities of both women and men are taken into consideration, recognizing the diversity of different groups of women and men (UN Women no date).

In Canada, the gender wage gap is $7,200 (Statistics Canada 2023a). Data for each of the three jurisdictions show an after-tax wage gap between men+ and women+: Placentia ($7,800), Avalon ($6,400) and NL ($7,400). While the wage gap remains a major issue for women+, especially in industries and areas of business dominated by men+, gender discrimination is present in every field and many occupations (Canadian Labour Relations 2024).

Women+ are often overlooked for job advancement, even when they are more qualified than their male competitors, because employers fear that they will be more committed to their current or future family obligations than to their work and / or they cannot be as hard-nosed or unemotional when in positions of power (Canadian Labour Relations 2024). This can require women+ to work harder and longer to reach the same positions as their male co-workers. It also results in lower income and fewer benefits, including for retirement income.

5.1.7 Race

Racism is a form of prejudice that generally includes negative attitudes towards members of a group that result in perpetuation of stereotypes, discrimination against groups or individuals and race motivated violence. The Canadian *Human Rights Act* protects against discrimination based on race, national or ethnic origin, colour and religion as well as other attributes (Canadian Human Rights Commission 2021).

Hate crimes are committed by people motivated by extreme bias or hatred directed at a social group and can negatively affect physical and psychosocial well-being (Justice Canada 2023). The number of race or ethnically motivated police-reported hate crimes in Canada increased by 6% (1,723 incidents) between 2020 and 2021, following an 83% increase in 2020 (Statistics Canada 2023d). Black people were most subjected to hate crimes (by at least 50% more compared to other groups). Fewer than 10 hate crimes were reported in NL in 2020 (Justice Canada 2023). The small number of hate crimes is positive though it is likely that unreported incidents occur. The Anti-Racism Coalition of NL believes racist incidents have increased (CBC 2022).

Section 2.1.5 describes diversity in Placentia, Avalon and NL, though data are not available for all grounds of discrimination. The three jurisdictions have small proportions of people whose mother tongue is French or a non-official language. Small percentages of people identify as immigrants, visible minorities or of Indigenous identities. Nonetheless, discrimination may occur and can result in individuals or groups being excluded from employment opportunities or given unfavourable work assignments, limited employment benefits and / or exclusion from community or social activities. In 2022, the Government of NL established the Ministerial Committee on Anti-Racism to help address systemic racism (e.g., in education, justice, child protection, policies, legislation, public service) as well as to reduce the influences of racism / colonialism in public awareness and the presentation of culture and history (NL Executive Council 2022).

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ghd.com

The Power of Commitment

Appendix H

Energy and Emissions Study

APPENDIX H
Energy & Emissions Study

Table of Contents

List of Figures

List of Tables

List of Appendices

List of Abbreviations

Acronym	Definition
3-D	three-dimensional
APCR	Air Pollution Control Regulations
BPIP	Building Profile Input Program
Btu	British thermal unit
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CDEM	Canadian Digital Elevation Model
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
dwt	deadweight tonnage
ECCC	Environment and Climate Change Canada
EF	emission factor
EOSD	Earth Observation for Sustainable Development of Forests
g	gram
GHG	greenhouse gas
GHGRP	Greenhouse Gas Reporting Program
GJ	gigajoule
GWP	global warming potential
hr	hour
hp	horsepower
ISR	in-stack ratio
kg	kilogram
km	kilometre
kWh	kilowatt hour
L	litre
LAA	Local Assessment Area
LPG	liquified petroleum gas
NH_3	ammonia
NL AQS	Newfoundland and Labrador Air Quality Standards
NL DECC	Newfoundland and Labrador Department of Environment and Climate Change
NLH	Newfoundland and Labrador Hydro
NL MGGA	Newfoundland and Labrador Management of Greenhouse Gas Act
nm	nautical mile

NOx	oxides of nitrogen
NO	nitrogen oxide
N_2O	nitrous oxide
NPRI	National Pollutant Release Inventory
NRCan	Natural Resources Canada
MW	megawatt
M	metres
m^2	square metres
m^3	cubic metres
OLM	ozone limiting method
PAH	polycyclic aromatic hydrocarbons
PM	particulate matter
PM_{10}	particulate matter less than 10 microns
$PM_{2.5}$	particulate matter less than 2.5 microns
POA	Port of Argentia
RAA	Regional Assessment Area
SEM	Sikumiut Environmental Management Ltd.
SO_2	sulfur dioxide
t	metric tonnes
TSP	total suspended particulate
US EPA	United States Environmental Protection Agency
VKT	vehicle kilometres travelled
VOC	volatile organic compound
WRF	Weather Research Forecasting

1.0 Introduction

The Argentia Renewables Project will produce green hydrogen using locally produced wind-generated electricity. Green hydrogen will be produced at the Green Fuels Facility on the Argentia Peninsula where it will also be converted to ammonia for shipment by vessels. The associated Argentia Wind Facility will be comprised of approximately 300 MW of installed capacity from up to 46 wind turbines located throughout private lands owned by the Port of Argentia (POA) (i.e., the POA Property) as described in Chapter 2. The current wind turbine design for the Project is expected to have a nominal power with an anticipated range of 6.8-7.2 megawatt (MW), a hub height of approximately 100 to 119 metres (m) and a rotor diameter of up to 170 m. For the purposes of this Environmental Assessment Registration, a nominal power of 6.8 MW and a hub height of 119 m is conservatively assumed. Electrical infrastructure will be required to connect wind power generated by the Argentia Wind Facility to the Argentia Green Fuels Facility, as well as to connect the Argentia Green Fuels Facility to the Newfoundland and Labrador Hydro (NLH) grid as described in Chapter 2. The Project is expected to produce up to 400 metric tonnes per day (tpd) of green ammonia, equivalent to up to 146,000 metric tonnes (t) of ammonia per year which will be stored and exported to international markets by ship from a marine terminal in the POA. The Project will require between 170 to 200 MW of renewable energy and 1,185 cubic metres (m^3) (313,045 US gallons) of freshwater daily.

1.1 Objectives

Argentia Renewables retained Sikumiut Environmental Management Ltd. (SEM) to develop greenhouse gas (GHG) and air release inventories for the construction and operation phases of the Project, as detailed below. Project decommissioning was not considered in this study.

1.1.1 Greenhouse Gas Inventory

The GHG inventory includes emissions produced from direct and indirect sources including, but not limited to, stationary combustion, mobile equipment, explosive use, electricity consumption, and marine transport. Annual operational phase emission estimates were compared to the threshold of 15,000 tonnes of carbon dioxide equivalents (CO_2e) set out in the **Newfoundland and Labrador Management of Greenhouse Gas Act** (NL MGGA) to determine whether Act and associated regulations, as well as the provincial carbon pricing system, are applicable to the Project. Furthermore, annual operational phase emission estimates were assessed to determine the applicability of the Greenhouse Gas Reporting Program (GHGRP), a mandatory reporting program for Canadian facilities that surpass the 10,000 tonnes of CO_2e emissions threshold

1.1.2 Air Release Inventory & Dispersion Modelling

The air release inventory includes emissions generated by combustion and non-combustion processes including, but not limited to, stationary combustion, mobile equipment, blasting, wind erosion of exposed surfaces, material handling, flare stacks, and marine transport. Air releases were computed in terms of annual emissions for the construction and operation phase, and as emission rates for the operation phase of the Project. Emission rates were used in an air dispersion modelling exercise via the CALPUFF dispersion modelling system. Modelling was performed to predict maximum ground level concentrations of air contaminants regulated by the **Air Pollution Control Regulations, 2022** (APCR) during operation of the Argentia Green Fuels Facility; steady air releases are not anticipated during operation of the Argentia Wind Facility. Concentrations, modelled as maximum hourly, maximum daily and annual average emissions, were predicted in relation to ambient air quality in the Local Assessment Area (LAA) and Regional Assessment Area (RAA) during normal operation of the Project. Modelled concentrations of air contaminants of interest were compared to the Newfoundland and Labrador Air Quality Standards (NL AQS) per the APCR, and the Canadian Ambient Air Quality Standards (CAAQS), as developed by the Canadian Council of Ministers of the Environment (CCME).

2.0 Greenhouse Gas Inventory

The GHG inventory for the Project was developed in consideration of requirements and recommendations of the NL Department of Environment and Climate Change (NL DECC) in place for reporting under the MGGA and its regulations (Newfoundland and Labrador Office of Climate Change, 2017), as well as federal guidance for reporting under the GHGRP. Requirements of NL DECC's Guidance for Registration of Onshore Wind Energy Generation and Green Hydrogen Production were also considered during GHG inventory development.

2.1 Methodology

2.1.1 GHG Emission Sources

The GHG inventory accounts for emissions from Scope 1, 2 and 3 sources during construction and operation of the Project. Scope 1 accounts for emissions from onsite sources (also referred to as direct emissions). Direct emissions typically arise from fuel combustion sources (e.g., mobile equipment, boilers, generators, etc.). Indirect emissions arise from Scope 2 and 3 sources. Scope 2 accounts for emissions that arise from onsite energy use that is generated offsite (e.g., purchased electricity), while Scope 3 accounts for all other indirect emissions. Such emissions occur as a result of Project activities but are generated by sources not associated with the Project (e.g., marine transportation of product). Scopes and sources of Project GHG emissions are outlined in Table H-2.1.1-1.

Table H-2.1.1-1 GHG Emission Scopes and Sources by Project Phase.

Phase	Scope	Source(s)
Construction	1 (Direct)	Blasting, Stationary Combustion, Mobile Equipment
	3 (Indirect)	Marine Transport of Supplies
Operation	1 (Direct)	Mobile Equipment, Flare Stacks, Stationary Combustion
	2 (Indirect)	Electricity Consumption
	3 (Indirect)	Marine Transport of Product

During Project construction, Scope 1 emissions will arise from explosive use to develop new roads and wind turbine foundations, as well as diesel equipment (both stationary and mobile) used to develop the Argentia Green Fuels Facility and Argentia Wind Facility. Indirect construction phase emissions will arise from marine transport of supplies such as wind turbine components (i.e., Scope 3 only). Scope 1 emissions during Project operation will arise from diesel equipment (both stationary and mobile) used to service the Argentia Green Fuels Facility and Argentia Wind Facility, and flare stacks to support the Argentia Green Fuels Facility. Indirect operation phase emissions will arise from electricity consumption (Scope 2) and marine transport of product to the global market (Scope 3).

Project emissions were estimated based on preliminary engineering details, publicly available emission factors and good practice guidelines. It is anticipated that Project details will change as engineering and procurement progress. The GHG inventory detailed herein serves as a conservative estimate of Project emissions.

2.1.2 GHG Inventory Development

The MGGA stipulates that GHG emissions are reported in terms of CO_2e, thus concentrations of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) were converted using global warming potentials (GWPs). The use of GWPs, which measure the amount of energy a GHG will absorb relative to CO_2, enables accurate comparison of emissions from different GHGs. Relevant GHGs and respective GWPs are provided in Table H-2.1.2-1.

Table H-2.1.2-1 Global Warming Potentials.

Greenhouse Gas	Global Warming Potential*
Carbon dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous Oxide (N_2O)	265
*100 year Source: Intergovernmental Panel on Climate Change, 2014	

In addition to GWPs, emissions were calculated using emission factors (EFs), which relate to a quantity of substance (e.g., CO_2, CH_4, N_2O) released and emitted per unit of energy. Relevant EFs by activity and phase are provided in Table H-2.1.2-2.

Project emissions were calculated by inputting GWPs (Table H-2.1.2-1), where required, and EFs in equations provided in Section 2.1.3. Data for the GHG inventory were retrieved from preliminary design specifications, reports, and email correspondence.

Table H-2.1.2-2 GHG Inventory Emission Factors.

Activity (Phase)	Units	Emission Factors			Source
		CO_2	CH_4	N_2O	
Blasting (Construction)					
Fossil-fuel based explosive use	$\frac{kg\ CO_2}{kg\ explosives}$	0.189	-	-	(The Mining Association of Canada, 2014)
Diesel Combustion (Construction, Operation)					
Stationary Combustion	$\frac{g}{L}$	2681	0.078	0.022	(Environment and Climate Change Canada, 2023b)
Mobile Equipment (off road diesel, ≥19 kW Tier 4)		2680.5	0.073	0.227	
Mobile Equipment (light-duty diesel trucks, advanced control)		2680.5	0.068	0.22	
Marine Transport (Construction, Operation)					
Origin to Port (5,000-9,999 dwt vessel)	$\frac{g\ CO_2e}{dwt \cdot nm}$	19.4	-	-	(International Maritime Organization, 2021)
Origin to Port (10,000-19,999 dwt vessel)		17.1	-	-	
Vessel Hotelling (marine diesel)	$\frac{g}{L}$	2680.5	0.25193	0.07198	(Environment and Climate Change Canada, 2023b)
Flare Stacks (Operation)					
Flaring [1]	$\frac{kg}{GJ}$	62.4	0.00083	0.0005	(Environment and Climate Change Canada, 2023a)
Electricity Consumption (Operation)					
NLH Grid Consumption	$\frac{g\ CO_2e}{kWh\ electricity}$	17	-	-	(Environment and Climate Change Canada, 2023c)

NOTES
kg=kilogram; g=gram; L=liter; dwt=deadweight tonnage; nm=nautical mile; GJ=gigajoule; kWh=kilowatt hour
[1] Flaring for continuously lit pilot flare

2.1.3 GHG Inventory Equations

Emissions were calculated based on the methodology set out in Equation H-2.1.3-1. However, slight deviations were required to suit data availability and perform sufficient unit conversions. Calculation methodology deviations were required to calculate emissions generated during marine transport (origin to port) and from flare stacks. Such deviations are detailed in Equations H-2.1.3-2 and H-2.1.3-3 through H-2.1.3-6, respectively.

Equation H-2.1.3-1: General Emissions

$$\text{Emissions}\left(\frac{\text{tonnes}}{\text{year}}\right) = A \times EF \times GWP$$

where: A = activity rate (e.g., fuel consumption, electricity use)

EF = emission factor

GWP = global warming potential

Equation H-2.1.3-2: Marine Transport Emissions

$$\text{Emissions}\left(\frac{\text{tonnes } CO_2e}{\text{year}}\right) = D\ (\text{nm}) \times VT\ (\text{tonnes}) \times TPY \times EF\left(\frac{\text{g } CO_2e}{\text{dwt}\cdot\text{nm}}\right) \times \frac{\text{tonne}}{10^6\ \text{g}}$$

where: D = shipping distance in nautical miles (nm)

VT = vessel tonnage

TPY = trips per year

EF = emission factor in units of grams of carbon dioxide equivalents (CO_2e) per deadweight tonnage nautical mile (dwt·nm)

Equation H-2.1.3-3: Flare Stack CO_2 Emissions

$$CO_2\left(\frac{\text{tonnes}}{\text{year}}\right) = \text{Fuel}\ (m^3) \times \frac{MW_{\text{flare gas}}\left(\frac{\text{kg}}{\text{kg}\cdot\text{mol}}\right)}{MWC\left(\frac{m^3}{\text{kg}\cdot\text{mol}}\right)} \times CC\left(\frac{\text{kg C}}{\text{kg flare gas}}\right) \times CE \times 3.664 \times \frac{\text{tonne}}{10^3\ \text{kg}}$$

where: Fuel = annual fuel consumption (m^3)

$MW_{\text{flare gas}}$ = average molecular weight of flare gas combusted at reference conditions (15 degrees Celsius (°C) and 101.325 kilopascals (kPa))

MWC = molar volume conversion factor at reference conditions [Equation H-2.1.3-4]

CC = average carbon content of flare gas

CE=combustion efficiency

3.664 = ratio of molecular weights, carbon dioxide (CO_2) to carbon (C)

Equation H-2.1.3-4: Molar Volume Conversion Factor at Reference Conditions

$$MVC\left(\frac{m^3}{kg\cdot mol}\right) = 8.3145 \times \left(\frac{[273.16 + \text{reference temperature (°C)}]}{[\text{reference pressure (kPa)}]}\right)$$

where: MWC = molar volume conversion factor at reference conditions

reference temperature = 15°C

reference temperature = 101.325 kPa, respectively.

Equation H-2.1.3-5: Flare Stack CH_4 Emissions

$$CH_4\left(\frac{\text{tonnes}}{\text{year}}\right) = \left(CO_2 \times \frac{EF_{CH4}}{EF}\right) + \left(CO_2 \times \frac{1 - CE}{CE} \times \frac{16}{44} \times f_{CH4}\right)$$

where: CO_2 = emissions of CO_2 from flared gas (tonnes; calculated from Equation H-2.1.3-3)

EF_{CH4} = emission factor for methane in units of kilograms per gigajoule (kg/GJ)

EF = CO_2 emission factor for flare gas in units of kg/GJ

CE=combustion efficiency

$\frac{16}{44}$ = ratio of molecular weights, CH_4 to CO_2

f_{CH4} = weight fraction of carbon in the flare gas prior to combustion that is contributed by methane

Equation H-2.1.3-6: Flare Stack N_2O Emissions

$$N_2O\left(\frac{\text{tonnes}}{\text{year}}\right) = \left(CO_2 \times \frac{EF_{N2O}}{EF}\right)$$

where: CO_2 = emissions of CO_2 from flared gas (tonnes; calculated from Equation H-2.1.3-3)

EF_{N2O} = emission factor for nitrous oxide in units of kg/GJ

EF = CO_2 emission factor for flare gas in units of kg/GJ

2.2 GHG Inventory Results

Annual Project construction and operation emission estimates are presented in Table H-2.2-1. Assumptions used in calculations are provided in Appendix H.1. Calculation details are provided in Appendix H.2.

Table H-2.2-1 Annual GHG Emissions Estimate Summary.

Phase	Source	Annual GHG Emissions (t CO_2e)			
		Scope 1 (Direct)	Scope 2 (Indirect)	Scope 3 (Other Indirect)	Total Scope 1 + Scope 2
Construction	Blasting	24			24
	Stationary Combustion	1,531			1,531
	Mobile Equipment	6,426			6,426
	Marine Transport of Supplies			172,616	0
	Total Annual Construction [1]	**7,981**	**0**	**172,616**	**7,981**
Operation	Mobile Equipment	48			48
	Flare Stacks	228			101
	Emergency Generator	826			860
	Marine Transport of Product			19,587	0
	Electricity Consumption		1,489		1,489
	Total Annual Operation [2]	**1,102**	**1,489**	**19,587**	**2,591**

NOTES
[1] Project construction scheduled to occur over a two-year period, marine transport of supplies to occur in a single calendar year.
[2] Operational lifetime of the Project is 30 years.

Scope 1 emissions were estimated to be 7,981 tonnes CO_2e per year across the two-year Project construction period. This estimate is considered conservative as it is anticipated that explosive use will be reduced upon completion of the geotechnical program, scheduled to commence in Spring 2024. Scope 3 emissions were estimated to be 172,616 tonnes CO_2e during the one-year supply delivery timeline. It was conservatively assumed that supplies would depart from the furthest port possible (in terms of nm) from Argentia.

Annual Scope 1 emissions were estimated to be 1,102 tonnes CO_2e per year over the 30-year operational lifetime of the Project. This estimate is conservative as emissions from emergency generator use calculated based on wort-case scenario of 100 hours of use per year. It is unlikely that the emergency generator will be used consistently throughout the year, if at all, thus annual emissions for emergency generator use are likely an overestimation. Annual Scope 2 emissions were estimated to be 1,489 tonnes CO_2e per year based on the current configuration of the NLH grid. It is possible that the NLH grid will become fully renewable during the operational lifetime of the Project. The eventual integration of Muskrat Falls is anticipated to eliminate the requirement of supplemental fossil-fuel fired infrastructure for electricity generation, thereby eliminating emissions associated with electricity consumption. Scope 3 emissions were estimated to be 19,587 tonnes CO_2e per year over the 30-year operational lifetime of the Project. It was assumed that product will be shipped to a major European port (i.e., Hamburg, Germany).

Scope 1 annual operational emissions do not exceed the threshold of 15,000 tonnes of CO_2e prescribed by the NL MGGA. As such, the Project is not anticipated to be subject to Section 4 and/ or 5 of the NL MGGA, the provincial carbon pricing system, nor the GHGRP. Although the Project is subject to the NL

MGGA, the Project will be subject to the Federal Fuel Charge, which is applicable regardless of annual operational GHG emissions. If at any point emissions generated at the Argentia Green Fuels Facility and Argentia Wind Facility surpass the emissions thresholds, the NL MGGA and/or GHGRP will apply, and the Project will be regulated.

3.0 Air Release Inventory

The air release inventory for the Project was developed in consideration of the APCR set forth by the NL DECC. Guidance and requirements of Environment and Climate Change Canada's (ECCC) National Pollutant Release Inventory (NPRI) and NL DECC's Guidance for Registration of Onshore Wind Energy Generation and Green Hydrogen Production were also considered.

3.1 Methodology

3.1.1 Air Emission Sources

The air release inventory accounts for emissions from combustion and non-combustion processes during construction and operation of the Project, as outlined in Table H-3.1.1-1.

Table H-3.1.1-1 Air Release Sources by Project Phase.

Phase	Source Type	Source(s)
Construction	Point	Stationary Combustion, Mobile Equipment
	Fugitive	Blasting, Stockpile Erosion, Aggregate Handling and Transfers, Crushing and Screening, Laydown Areas
	Unpaved Roads	Turbine Component Transportation
Operation	Point	Flare Stacks, Stationary Combustion, Mobile Equipment, Marine Transport of Product

During Project construction, point source emissions will arise from diesel equipment (both stationary and mobile) used to develop the Argentia Green Fuels Facility and Argentia Wind Facility. Fugitive releases will occur as a result of explosive use to develop new roads and wind turbine foundations as well as wind erosion of exposed surfaces and material handling. Transportation of turbine components on unpaved roads will generate particulate matter (PM) emissions within the Project Area. During Project operation, point source emissions will arise from diesel equipment (both stationary and mobile) used to service the Argentia Green Fuels Facility and Argentia Wind Facility, and flare stacks to support the Argentia Green Fuels Facility. Point source emissions will also be generated as a result of marine transport of end product to the global market.

Air releases were estimated based on preliminary engineering details, publicly available emission factors and good practice guidelines. It is anticipated that Project details will change as engineering and procurement progress. The air release inventory detailed herein serves as a conservative estimate of Project emissions.

3.1.2 Air Release Inventory Development

Point sources will generate emissions of carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen (NOx), PM, volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs). Fugitive sources and unpaved roads will generate emissions of PM only. In the context of this study, PM refers to all three size fractions of PM: total suspended particulate (TSP), particulate matter less than 2.5 microns ($PM_{2.5}$), and particulate matter less than 10 microns (PM_{10}). Air contaminants included in the air release inventory are those on the NPRI substance list, which may pose a risk to the environment or to health.

Air releases were estimated based on the methodology set out in Equation H-3.1.2-1. Due to the wide range of air release sources considered, calculation methodology for emissions and EFs varied by source should the approach vary from Equation H-3.1.2-1. Calculation methodology by air release is provided in Sections 3.1.2.1 through 3.1.2.11. Relevant EFs by activity and phase are summarized in Section 3.1.3. Data for the air release inventory were retrieved from preliminary design specifications, reports, and email correspondence. It was assumed that diesel used for the Project will comply with **Sulphur in Diesel Fuel Regulations**, which stipulate that sulfur content in diesel will not exceed 0.1%.

Equation H-3.1.2-1: General Emissions

$$E\left(\frac{\text{tonnes}}{\text{year}}\right) = A \times EF \times \text{Conversion Factors}$$

where: E = emissions
A = activity rate (e.g., fuel consumption, electricity use)
EF = emission factor

3.1.2.1 Blasting

Approximately 200,000 m^3 of rock will be required to be blasted for construction of the Argentia Wind Facility. It was assumed that approximately 1.2 to 1.4 kilograms (kg) of pumped emulsion explosives will be required per m^3 of rock, thus the total explosive requirement for Argentia Wind Facility construction will be 250,000 kg. Blasting is not anticipated for construction of the Argentia Green Fuels Facility. It was assumed that the horizontal area of each blast will be 500 square metres (m^2), and that blasting will occur approximately once weekly for two years (i.e., 50 blasts per year, 100 blasts total). Emissions were estimated following Equation H-3.1.2-1, where the activity rate for PM is based on the number of blasts per year, while for other air releases, it is based on the quantity of explosives used (tonnes per year).

To facilitate calculation of air releases from blasting, PM EFs were calculated according to horizontal area of each blast (i.e., 500 m^2) (Environment and Climate Change Canada, 2017). EF calculation methodology for TSP, PM_{10} and $PM_{2.5}$ is provided in Equation H-3.1.2-2 (A-C).

Equation H-3.1.2-2 (A-C): Blasting PM EFs

(A) $EF_{TSP} = 0.00022(A)^{1.5}$

(B) $EF_{PM10} = \left(0.00022(A)^{1.5}\right) \times 0.52$

(C) $EF_{PM2.5} = (0.00022(A)^{1.5}) \times 0.03$

where: EF = emission factor for corresponding PM (kg/blast)

A = horizontal area (m^2) of the conical stockpile

3.1.2.2 Stockpile Erosion

Materials for construction of the Argentia Wind Facility and Argentia Green Fuels Facility will be stockpiled over the two-year construction period. Stockpiles will be subject to wind erosion, thereby resulting in the potential to emit fugitive PM emissions. It was assumed that stockpiles will be composed of gravel, conical and not exceed a pile height of 10 metres (m). Approximately 142,740 m^3 of material will be required for the Argentia Wind Facility while 5,831 m^3 will be required for the Argentia Green Fuels Facility during Project construction. Only PM will be released as a result of stockpile erosion. Per NPRI guidance, annual wind erosion emissions from stockpile surfaces were estimated using custom EFs using methodology outlined in Equation H-3.1.2-3 (Environment and Climate Change Canada, 2023h).

Equation H-3.1.2-3: Wind Erosion PM EFs

$$EF = 1.12 \times 10^{-4} \times J \times 1.7 \times \left(\frac{s}{1.5}\right) \times 365 \times \left(\frac{365 - P}{235}\right) \times \left(\frac{I}{15}\right)$$

where: EF = emission factor for corresponding PM (kg/m^2)

J = particulate aerodynamic factor

- $J_{TSP} = 1.0$
- $J_{PM10} = 0.5$
- $J_{PM2.5} = 0.075$

s = average silt loading of storage pile in percent (%)

P = number of days during the year with at least 0.254 mm of total precipitation (sum of total rainfall and the water equivalent of the total snowfall in mm) and days with snow on the ground.

I = percentage of time with unobstructed wind speed > 19.3 km·hr^{-1} in percent (%).

The average silt loading of storage piles was assumed to be 0.5% (limestone) (Mojave Desert Air Quality Management District, 2013). Values of P and I were obtained from historical weather data collected at the ECCC meteorological station in Argentia in 2023, as well as Canadian Climate Normals (Government of Canada, 2023b, 2023a).

3.1.2.3 Material Handling and Transfers

Handling and transferring of stockpiled materials will generate PM emissions during the construction period. It was assumed that each stockpile will contain 1,545 tonnes of gravel based on stockpile assumptions provided in Section 3.1.2.2. Per NPRI guidance, annual material handling and transfer emissions were estimated using custom EFs with methodology outlined in Equation H-3.1.2-4 (Environment and Climate Change Canada, 2017).

Equation H-3.1.2-4: Material Handling and Transfers PM EFs

$$EF = k \times (0.0016) \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

where: EF = emission factor for corresponding PM (kg/tonne)

k = particle size multiplier

- k_{TSP} = 0.74
- k_{PM10} = 0.35
- $k_{PM2.5}$ = 0.053

U = mean wind speed (in metres per second, m·s^{-1})

M = material moisture content (%)

The mean wind speed was obtained from historical weather data collected at the ECCC meteorological station in Argentia in 2023 (Government of Canada, 2023). The material moisture content for crushed limestone (0.7%) for the stone quarrying and processing industry was used in calculations.

3.1.2.4 Crushing and Screening

Air release estimates due to crushing and screening were calculated using Equation H-3.1.2-1, where activity is annual throughput. As a conservative estimate, it was assumed that all required material (i.e., gravel) for the construction period will be crushed and screened on-site. The moisture content of crushed / screened materials will be less than 1.5%, thus emissions were assumed to be uncontrolled (Environment and Climate Change Canada, 2017).

3.1.2.5 Laydown Areas

Laydown areas will be required during construction of the Argentia Wind Facility and Argentia Green Fuels Facility. Two laydown areas will be required for the Argentia Wind Facility: (1) Port Laydown & Storage Area (60,000 m^2); and (2) Backlands Laydown (50,000 m^2). There will be four laydown areas during construction of the Argentia Green Fuels Facility: each covering an area of 2,400 m^2, 500 m^2, 840 m^2, and 3,000 m^2 respectively. Laydown areas are essentially flat stockpiles and will be subject to wind erosion. As such, custom EFs were calculated as per Equation H-3.1.2-3 (Section 3.1.2.2).

3.1.2.6 Unpaved Roads

Project roads, particularly in the Argentia Wind Facility, will be unpaved and thus fugitive dust (i.e., PM) will be emitted in the presence of vehicular traffic. Per NPRI guidance, annual unpaved road PM releases were estimated using custom EFs based on the methodology outlined in Equation H-3.1.2-5 (Environment and Climate Change Canada, 2017). EFs were calculated in units of kg per vehicle kilometres travelled (VKT). VKT was calculated using road segment distances, number of turbines accessed per segment, and estimates of annual trips required during Project operation and maintenance.

Equation H-3.1.2-5: Unpaved Road PM EFs

$$EF = k \left(\frac{s}{12} \right)^{a} \times \left(\frac{W}{2.72} \right)^{b}$$

where: EF = emission factor for corresponding PM (kg/VKT)

s = surface material silt content (8.5%)

W = mean vehicle weight (tonnes)

k, a, b = numerical constants [Table H-3.1.2-1]

Table H-3.1.2-1 Numerical Constants: Unpaved Road PM EF Calculations.

Species	Units	TSP	PM_{10}	$PM_{2.5}$
k	kg/VKT	1.381	0.423	0.042
a	-	0.700	0.900	0.900
b	-	0.450	0.450	0.450

Releases of PM associated with vehicular traffic on unpaved roads were estimated using methodology in Equation H-3.1.2-6. Equation H-3.1.2-6 considers control efficiency associated with dust control methods such as watering twice a day, watering more than twice a day, and chemical suppressants. It was assumed that unpaved roads will be watered twice per day, which provides a control efficiency of 55%, and a resulting control adjustment of 45%.

Equation H-3.1.2-6: Unpaved Road PM Emissions

$$E = EF\left(\frac{kg}{VKT}\right) \times VKT \times (1 - CE) \times \left(\left(\frac{\text{Operational Days - Days with Snow or Rain}}{\text{Operational Days}}\right) \times 100\right) \times \text{Conversion Factor}$$

where: E = emissions (tonnes per year)
VKT = vehicle kilometres travelled (km)
CE = control efficiency
Conversion Factor = kg to tonnes

3.1.2.7 Mobile Equipment

Air releases (NOx, CO, TSP, SO_2) will be generated from fossil fuel combustion (i.e., diesel) in mobile equipment during construction as well as operation and maintenance of the Project. Estimates of air releases from mobile equipment were developed using equipment lists provided in preliminary design specifications, reports, and email correspondence, and EFs according to engine tier and horsepower (hp). It was assumed that all engines in mobile equipment will be Tier 4, and that mobile equipment usage is evenly distributed across the entire construction period (i.e., two years) for the Argentia Wind Facility and Argentia Green Fuels Facility. Emissions were estimated using methodology in Equation H-3.1.2-7.

Equation H-3.1.2-7: Mobile Equipment Emissions

$$E = EF\left(\frac{g}{hp \cdot hr}\right) \times \text{Engine power (hp)} \times \text{Usage (hours)} \times \text{\# of units} \times \text{Conversion Factor}$$

where: E = emissions (tonnes per year)
EF = emission factor (grams (g) per hp·hour (hr))
Conversion Factor = g to tonnes

3.1.2.8 Stationary Combustion

Fossil fuel combustion in stationary equipment will generate air releases during Project construction. Estimates of air releases from mobile equipment were developed using fuel consumption estimates and equipment lists provided in preliminary design specifications, reports, and email correspondence, and EFs for diesel fuel generators up to 600 hp (Environment and Climate Change Canada, 2023d). Air releases, assumed to be evenly distributed across the two-year construction period, were estimated using Equation H-3.1.2-1.

3.1.2.9 Emergency Generator

Operation of the emergency generator will release air emissions should backup power be required. It was assumed that a single diesel-powered generator will be required to provide approximately 8 MW of emergency power for a maximum of 96 hours per year (i.e., 24 hours per quarter) over the operational lifetime of the Project. Air releases were estimated using Equation H-3.1.2-1 and EFs for large stationary diesel engines (> 600 hp) (Environment and Climate Change Canada, 2023f).

3.1.2.10 Flare Stacks

The Argentia Green Fuels Facility will be equipped with two flares: one for the ammonia plant (the “process flare”) and one for the ammonia storage tank (the “tank flare”). Both flares will have continuously lit pilots using propane, ready to combust intermittent releases of gaseous streams in the event of process upsets. Air releases were estimated for continuous pilots and intermittent releases, as detailed further below.

Continuous Pilots

The combustion of propane in flare pilots will release thermal NOx, PM, CO, and residual propane. Fuel NOx releases are not anticipated since propane does not contain nitrogen. It was assumed that the volumetric flow rates of pilot will be 3% of the flare flow rate, as per preliminary design specifications and the United States Environmental Protection Agency’s (US EPA) ‘Parameters for Properly Designed and Operated Flares’ (US EPA Office of Air Quality Planning and Standards (OAQPS), 2012). Emissions from continuous pilots were estimated per methodology outlined in Equation H-3.1.2-8 through H-3.1.2-10.

Equation H-3.1.2-8: Continuous Pilot NOx (thermal) and CO Emissions

$$E = \text{Flow}\left(\frac{\text{kg}}{\text{hr}}\right) \times \text{HHV}\left(\frac{\text{MJ}}{\text{kg}}\right) \times \text{EF}\left(\frac{\text{lb}}{\text{Btu}}\right) \times \text{Usage}\left(\frac{\text{hr}}{\text{yr}}\right) \times \text{Conversion Factors}$$

where: E = emissions (tonnes per year)
Flow = volumetric flow rate of pilot (kg per hr)
HHV = high heating value of pilot fuel (Megajoules (MJ) per kg))
EF = emission factor (pounds (lb) per British thermal unit (Btu))
Usage = annual operational hours (i.e., 8,760 hours)
Conversion factors = for lb to kg, MJ to Btu, and kg to tonnes.

Equation H-3.1.2-9: Continuous Pilot PM Emissions

$$E = \text{Flow}\left(\frac{kg}{hr}\right) \times \frac{1}{\rho_{fuel}}\left(\frac{m^3}{kg}\right) \times EF\left(\frac{kg}{10^3\ m^3\ fuel}\right) \times \text{Usage}\left(\frac{hr}{yr}\right) \times \text{Conversion Factor}$$

where: E = emissions (tonnes per year)

Flow = volumetric flow rate of pilot (kg per hr)

ρ_{fuel} = density of pilot fuel (kg per m^3)

EF = emission factor (kg per m^3 of pilot fuel)

Usage = annual operational hours (i.e., 8,760 hours)

Conversion factor = kg to tonnes.

Equation H-3.1.2-10: Continuous Pilot Residual Propane Emissions

$$E = \text{Flow}\left(\frac{kg}{hr}\right) \times (1 - DE) \times \text{Usage}\left(\frac{hr}{yr}\right) \times \text{Conversion Factor}$$

where: E = emissions (tonnes per year)

Flow = volumetric flow rate of pilot (kg per hr)

Usage = annual operational hours (i.e., 8,760 hours)

Conversion factors = kg to tonnes.

The destruction efficiency (DE) of the flare was assumed to be 98%, thus 0.98 was used in Equation H-3.1.2-10 (Texas Commission on Environmental Quality, 2023).

Intermittent Releases

The combustion of intermittently released ammonia (NH_3) will emit thermal and fuel NOx as well as residual NH_3. Thermal and fuel NOx were summed to estimate emissions of total NOx during intermittent releases. It was conservatively assumed that one hour worth of production will be released over a one-hour period annually (i.e., 16,667 kg per hour). Emissions from intermittent releases were estimated based on the methodology outlined in Equation H-3.1.2-11 and H-3.1.2-12.

Equation H-3.1.2-11: NOx Emissions from Intermittent Releases

E = [Thermal NOx] + [Fuel NOx]

$$E = \left[\text{Flow}\left(\frac{kg}{hr}\right) \times HHV\left(\frac{MJ}{kg}\right) \times EF\left(\frac{lb}{Btu}\right) \times \text{Usage}\left(\frac{hr}{yr}\right) \times \text{Conversion Factors}\right]$$
$$+\left[\text{Flow}\left(\frac{kg}{hr}\right) \times EF\left(\frac{kg\ NO_x}{kg\ NH_3}\right) \times \text{Usage}\left(\frac{hr}{yr}\right) \times \text{Conversion Factors}\right]$$

where: E = emissions (tonnes per year)

Flow = volumetric flow rate of pilot (kg per hr)

EF = emission factor (thermal: lb per Btu; fuel: kg NOx per kg NH_3)

Usage = annual operational hours (i.e., 8,760 hours)

Conversion factors = for lb to kg, MJ to Btu, and kg to tonnes.

3.1.2.11 Marine Transport

The end product will be transported to the global market by marine shipping routes. Per preliminary design specifications, the end product will be shipped in a small to medium ammonia ship carrier, with offtake occurring once monthly for the 30-year operational lifetime of the Project. Based on offtake frequency, the ammonia carrier should have a capacity of approximately 20,000 m^3. It was assumed that the Clipper Eirene, a liquified petroleum gas (LPG) tanker with 21,220 m^3 NH_3 capacity will be used to transport end product to the global market (Solvag ASA, 1998). Air releases associated with marine transport will be generated when the Clipper Eirene maneuvers to the loading facility, as well as when the loading arms are filling the tanker (referred to as hotelling). It was assumed that maneuvering will take one hour per month and hotelling will take 15 hours. The main and auxiliary engines will be operational during maneuvering, while only the auxiliary engine will be operational during hotelling. The boiler unit on the Clipper Eirene will be operational for both maneuvering and hotelling. Air releases associated with marine transport will be the sum of emissions from the main and auxiliary engines (i.e., maneuvering and hotelling), as well as boilers. Emissions from marine transport were estimated using methodology outlined in Equation H-3.1.2-12 and H-3.1.2-13.

Equation H-3.1.2-12: Emissions from Maneuvering and Hotelling

$$E = \text{Engine Power (kW)} \times \text{Load Factor (\%)} \times \text{EF} \times \text{Usage} \left(\frac{\text{hr}}{\text{yr}}\right) \times \text{Conversion Factor}$$

where: E = emissions (tonnes per year)

Engine Power = power of engine (kilowatts (kW))

Load Factor = engine load factor during activity (i.e., maneuvering or hotelling)

EF = emission factor (g or kg per kilowatt hour (kWh))

Usage = time per mode (i.e., 12 hours maneuvering; 180 hours hotelling)

Conversion factor = g to tonnes

Equation H-3.1.2-13: Emissions from Boilers

$$E = \text{Fuel} \left(\frac{\text{m}^3}{\text{hr}}\right) \times \text{EF} \left(\frac{\text{kg}}{\text{m}^3}\right) \times \text{Usage} \left(\frac{\text{hr}}{\text{yr}}\right) \times \text{Conversion Factors}$$

where: E = emissions (tonnes per year)

Fuel = fuel consumption (m^3 per hour)

EF = emission factor (kg per m^3)
Usage = time per mode (i.e., 12 hours maneuvering; 180 hours hotelling)
Conversion factor = kg to tonnes.

3.1.3 Air Release Inventory Emission Factors

The emission factors used, and in some instances generated, for the calculations detailed in Section 3.1.2 are provided in Table H-3.1.3-1 (NOx, CO, SO_2 and PM) and Table H-3.1.3-2 (speciated organics and PAHs).

Table H-3.1.3-1 Air Release Inventory Emission Factors: NOx, CO, SO_2 and PM.

Activity (Phase)	Units	Emission Factors						Source
		NOx	CO	SO_2	TSP	PM_{10}	$PM_{2.5}$	
Blasting (Construction)								
Fossil-fuel based explosive use	$\frac{kg}{Mg}$	8	34	1	-	-	-	(Environment and Climate Change Canada, 2017)
	$\frac{kg}{Blast}$	-	-	-	2.46	1.28	0.07	
Wind Erosion (Construction)								
Stockpiles & Laydown Areas	$\frac{kg}{m^2}$	-	-	-	4.93E-02	2.46E-02	3.70E-03	(Environment and Climate Change Canada, 2023h; Mojave Desert Air Quality Management District, 2013)
Aggregate Handling & Transfers (Construction)								
Handling and transfer of stockpiled material	$\frac{kg}{tonne}$	-	-	-	0.02258	0.01068	0.00162	(Environment and Climate Change Canada, 2023e)
Crushing & Screening (Construction)								
Primary Crushing (Uncontrolled)	$\frac{kg}{tonne}$	-	-	-	0.0027	0.0012	0.0006	(Environment and Climate Change Canada, 2017)
Secondary Crushing (Uncontrolled)		-	-	-	0.0027	0.0012	0.0006	
Screening (Uncontrolled)		-	-	-	0.0125	0.0043	-	
Conveyor Transfer Point		-	-	-	0.0015	0.00055	-	
Unpaved Roads (Construction)								
Wind turbine component transportation	$\frac{kg}{VKT}$				3.642	1.043	0.104	(Environment and Climate Change Canada, 2024)
Stationary Combustion (Construction)								
Diesel fuel generator (≤600 hp)	$\frac{kg}{m^3}$	72.400	15.600	4.761	5.089	5.089	5.089	(Environment and Climate Change Canada, 2023d)
<u>NOTES</u> kg=kilogram; Mg=megagram; m^2=square metre; VKT=vehicle kilometre travelled; m^3=cubic metre; hp=horsepower; hr=hour; BTU=British thermal unit; kWh=kilowatt hour								
Mobile Equipment (Construction & Operation)								
≥75 to <100 hp engine	$\frac{g}{hp\cdot hr}$	0.3	-	0.00205	0.01	-	-	(United States Environmental Protection Agency, 2000, 2018)
≥100 to <175 hp engine		0.3	3.7	0.00205	0.01	-	-	

≥175 to <300 hp engine		0.3	2.6	0.00205	0.01	-	-	
≥300 to <600 hp engine		0.3	2.6	0.00205	0.01	-	-	
≥600 to <750 hp engine		0.3	2.6	0.004045	0.01	-	-	(United States Environmental Protection Agency, 1996, 2018)
≥750 hp engine		2.6	2.6	0.004045	0.03	-	-	
Stationary Combustion (Operation)								
Large Stationary Diesel Engines (>600 hp)	$\frac{kg}{m^3}$	52.532	13.954	1.658	1.018	0.814	0.786	(Environment and Climate Change Canada, 2023f)
Flare Stacks (Operation)								
Operation of continuous pilots and intermittent releases	$\frac{lb}{10^6 Btu}$	0.068 [1]	0.5496	-	-	-	-	(Texas Commission on Environmental Quality, 2023)
	$\frac{kg}{10^3 m^3\ fuel}$	-	-	-	0.82312	-	-	(McEwen & Johnson, 2012)
	$\frac{kg\ NO_x}{kg\ NH_3}$	0.005 [2]	-	-	-	-	-	(Texas Commission on Environmental Quality, 2021)
Marine Transport (Operation)								
Maneuvering - Main Engine	$\frac{g}{kWh}$	14.4	1.40	0.36	0.19	0.19	0.14	(ICF International, 2009)
Maneuvering - Auxiliary Engine		9.7	1.1	0.42	0.18	0.18	0.17	
Hotelling - Auxiliary Engine		9.7	1.1	0.42	0.18	0.18	0.17	
Boiler	$\frac{kg}{m^3}$	2.4	0.6	1.7	0.12	0.12	0.03	(United States Environmental Protection Agency, 2010)

NOTES
kg=kilogram; Mg=megagram; m^2=square meter; VKT=vehicle kilometre travelled; m^3=cubic metre; hp=horsepower; hr=hour; Btu=British thermal unit; kWh=kilowatt hour
[1] Thermal NOx calculation
[2] Fuel NOx calculation

Table H-3.1.3-2 Air Release Inventory Emission Factors: Speciated Organics and PAHs.

Air Contaminant	Emission Factors		
	Stationary Combustion (kg/m^3)		*Marine Transport – Boilers (g/kWh)*
	Construction [1]	**Operation [2]**	**Operation [3]**
1,3-Butadiene	3.21E-04	-	-
Acenaphthene	1.17E-05	7.68E-05	7.26E-09
Acenaphthylene	4.15E-05	1.52E-04	1.43E-08
Acetaldehyde	1.26E-02	4.14E-04	3.91E-08
Acrolein	7.59E-04	1.29E-04	1.22E-08
Anthracene	3.07E-05	2.02E-05	1.91E-09
Benz[a]anthracene	2.76E-05	1.02E-05	9.65E-10
Benzene	1.53E-02	1.27E-02	1.2E-06
Benzo[a]pyrene	1.54E-06	2.11E-06	3.99E-10
Benzo[b] fluoranthene	8.13E-07	1.82E-05	1.72E-09
Benzo[ghi]perylene	4.01E-06	4.56E-06	8.62E-10
Benzo[k]fluoranthene	1.27E-06	1.79E-06	3.38E-10
Chrysene	5.79E-06	2.51E-05	2.37E-09
Dibenz[a,h]anthracene	4.79E-06	2.84E-06	5.37E-10
Fluoranthene	1.25E-04	6.62E-05	6.25E-09
Fluorene	4.79E-04	2.10E-04	1.99E-08
Formaldehyde	1.94E-02	1.30E-03	1.22E-07
Inden[1,2,3-cd]pyrene	3.08E-06	3.40E-06	6.42E-10
Naphthalene	1.39E-03	2.13E-03	2.02E-07
Phenanthrene	4.83E-04	6.70E-04	6.33E-08
Propylene	4.24E-02	4.58E-02	4.33E-06
Pyrene	7.85E-05	6.09E-05	5.75E-09
Toluene	6.71E-03	4.61E-03	4.36E-07
Total PAHs	-	-	3.29E-07
Total VOCs	5.91E+00	1.34E+00	-
Xylene (all isomers)	4.68E-03	3.17E-03	2.99E-07

[1] Diesel fuel generator (up to 600 hp) (Environment and Climate Change Canada, 2023d)
[2] Large Stationary Diesel Engines (>600 hp) (Environment and Climate Change Canada, 2023f)
[3] Large Uncontrolled Stationary Diesel Engines (United States Environmental Protection Agency, 1996)

3.2 Air Release Inventory Results

Annual Project construction and operation air release estimates are presented in Table H-3.2-1. Air contaminants that were estimated to be less than 0.1 tonnes per year across all sources were omitted from Table H-3.2-1 and provided in Appendix H.3. Calculation details are provided in Appendix H.4.

The predominant air contaminant estimated to be released during Project construction is CO at 121.306 tonnes per year, the majority of which was estimated to arise from fossil fuel combustion in mobile equipment. Other notable emissions estimated to arise from fossil fuel combustion will be in the form of SO_2 (40.745 tonnes per year) and NOx (28.080 tonnes per year).

Project operation emissions are estimated to be significantly lower than construction emissions. NOx is estimated to be the predominant air contaminant released. Since the estimate of NOx is driven by emergency generator use, actual air releases during Project operation may be significantly less. It is unlikely that the emergency generator will be used consistently throughout the year, if at all, thus annual emissions for emergency generator use are likely an overestimation.

Table H-3.2-1 Annual Air Release Estimate Summary.

Phase	Source	Annual Air Releases (tonnes)								
		CO	**SO_2**	**NOx**	**VOCs (total)**	**TSP**	**PM_{10}**	**$PM_{2.5}$**	**Propane**	**NH_3**
Construction	Blasting	4.250	0.125	1.000		0.123	0.064	0.004		
	Stockpile Erosion					1.568	0.784	0.118		
	Aggregate Handling and Transfers					2.494	1.180	0.179		
	Crushing and Screening					2.126	0.794	0.131		
	Laydown Areas					5.754	2.877	0.432		
	Unpaved Roads					2.254	0.645	0.065		
	Mobile Equipment	114.204	39.749	13.842		0.426				
	Stationary Combustion	2.852	0.871	13.238	1.081	0.931	0.931	0.931		
	Total Annual Construction	**121.306**	**40.745**	**28.080**	**1.081**	**15.676**	**7.275**	**1.860**		
Operation	Emergency Generator	4.287	0.509	16.138	0.413	0.313	0.250	0.242		
	Flare Stacks	0.767		0.283		0.031			1.299	0.667
	Marine Transport	0.248	0.106	2.171			0.040	0.037		
	Mobile Equipment	1.885	0.676	0.218		0.007				
	Total Annual Operation	**7.187**	**1.291**	**18.810**	**0.413**	**0.351**	**0.290**	**0.279**	**1.299**	**0.667**

4.0 Air Dispersion Modelling

The CALPUFF dispersion modelling system ("the modelling system" or "CALPUFF") was used to predict maximum ground level concentrations of air contaminants during operation of the Argentia Green Fuels Facility. The modelling system is comprised of three main components: CALMET, CALPUFF, and CALPOST. CALMET is a meteorological model that processes meteorological and geophysical data to develop three-dimensional meteorological fields of wind speed, wind direction, temperature, and other meteorological variables. CALPUFF is a non-steady state Gaussian puff dispersion model that incorporates simple chemical transformations, coastal effects, overwater transport, building downwash and complex terrain. In conjunction with meteorological fields developed by CALMET, CALPUFF simulates the effect of time- and space-varying meteorological conditions on air contaminant transportation and removal. CALPOST, a post processor model, reports concentrations of air contaminants of interest using emission rates and CALPUFF results. CALPUFF was selected over other modelling systems (i.e., AERMOD) since it has better algorithms to handle complex terrain, changing weather patterns, and non-steady state scenarios (e.g., coastal interaction effects) that commonly occur in the province. Furthermore, CALPUFF is the preferred model by NL DECC.

4.1 Air Dispersion Modelling Methodology

4.1.1 CALMET

Meteorological modelling is an essential component of air dispersion modelling, mainly due to turbulence. The dispersion of atmospheric emissions is governed by turbulence that exists in the mixing layer. Both thermal (e.g., vertical temperature stratification) and mechanical effects (e.g., topography, surface roughness) can impact turbulence levels in the mixing layer. The extent of emission diffusion in the atmosphere is dictated by the height of the mixing layer (i.e., the mixed layer of air in contact with the ground surface).

The CALMET model ("CALMET") was initialized using three-dimensional (3-D) Weather Research Forecasting (WRF) modelled data at various levels of the atmosphere. WRF data incorporates surface meteorological parameters (i.e., wind speed and direction, temperature, cloud cover, ceiling height, pressure, relative humidity, precipitation rate) and upper air meteorological parameters (wind speed and direction, temperature, pressure, altitude) required by CALPUFF to predict plume dispersion and transport. Initialization was performed to generate an initial guess of meteorological conditions within the modelling domain prior to introducing terrain and geophysical surface characteristics (i.e., albedo, Bowen ratio, surface roughness).

The latest version of CALMET (version 6.5.0) was used for this study. The initial guess of meteorological conditions within the modelling domain were generated using WRF data purchased from Lakes Environmental (Environmental, 2024). WRF data can be supplemented with surface meteorological data to refine site-specific meteorology for use in the modelling system. Due to the sporadic nature of measurements collected at the meteorological station in Argentia, only WRF data were used. Ready for input to CALMET, the purchased WRF data covered a three-year period (2021-2023) to align with modelling requirements for environmental assessment as per the NL DECC Guideline for Plume Dispersion Modelling (Government of Newfoundland and Labrador Department of Environment and Conservation, 2012). The WRF data consisted of a 4 km resolution, 50 by 50 km grid centered on the Argentia Green Fuels Facility to allow for sufficient overlap with the LAA/RAA. A horizontal grid spacing of 500 m was selected for CALMET modelling. The WRF data contained 35 vertical levels of meteorological data, which was converted to 10 vertical layers by CALMET for model initialization. Land use data was obtained from the NL DECC, who derived a land use dataset from the Canadian Forest Service's Earth Observation for Sustainable Development of Forests (EOSD) to be compatible with the US Geological Survey Land Use and Land Cover Classification System. Terrain data was obtained from the Natural Resources Canada's (NRCan) Canadian Digital Elevation Model (CDEM).

The CALMET model predicted winds at the Argentia Green Fuels Facility between 2021 and 2023. The wind rose generated by CALMET (Figure H-4.1.1-1) indicates that winds were predicted to occur most frequently from the southwest direction, with less dominant occurrences from the southeast. The larger proportion of strong wind speeds were predicted to be from the southwest direction.

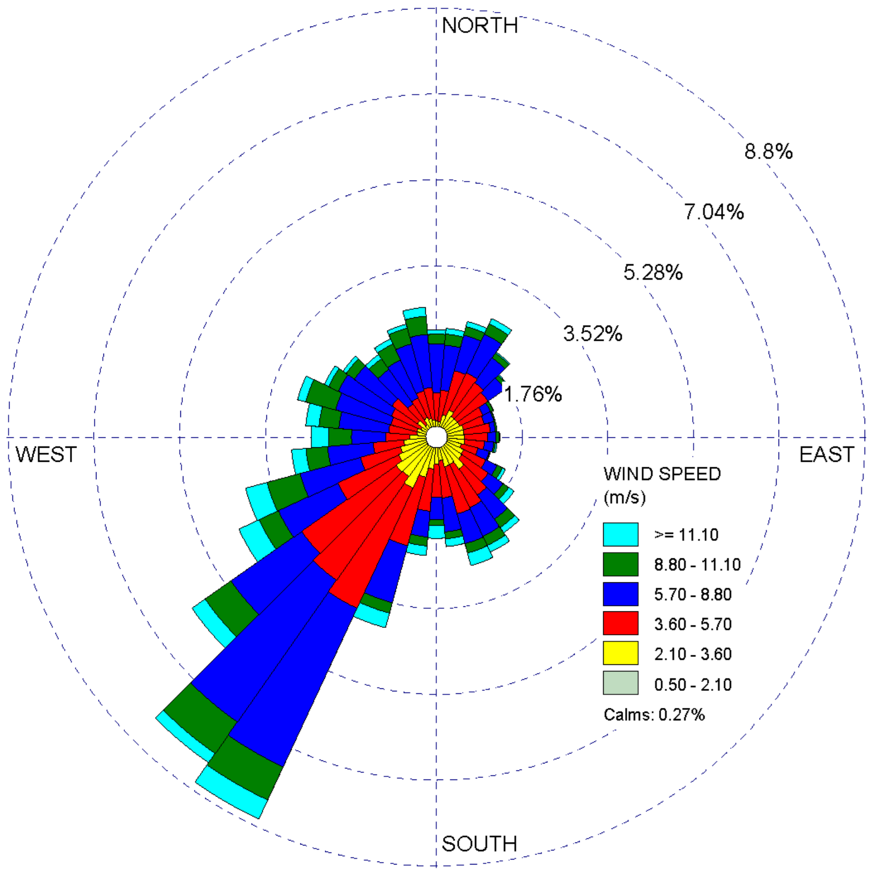

Figure H-4.1.1-1 CALMET Predicted Winds at the Argentia Green Fuels Facility (2021-2023).

Winds predicted by CALMET were compared to those measured in 2023 at the meteorological station in Argentia (Government of Canada, 2023b). The wind rose presented in Figure H-4.1.1-2 shows that wind speeds most frequently occurred from the southeast direction. Predominant wind directions were from the southeast and northwest, with a larger proportion of strong wind speeds occurring from the southeast.

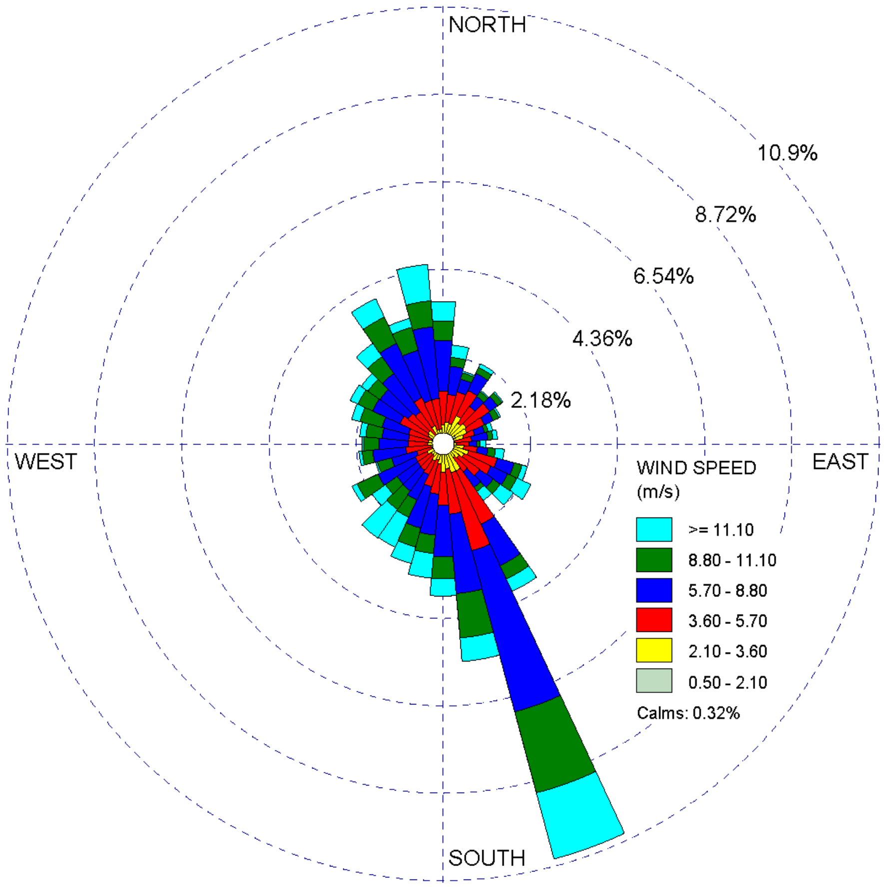

Figure H-4.1.1-2 Winds at the Meteorological Station in Argentia, NL (2023).

Wind speed and direction measured in Argentia in 2023 was partially consistent with that predicted by CALMET. Noted inconsistencies may be attributable to terrain differences and geographical features; the meteorological station site in Argentia is located in a less sheltered area of the Peninsula and at a slightly higher elevation than the Argentia Green Fuels Facility. Additionally, the data collected at the meteorological station in Argentia is for a single year, thus annual variability that may be incorporated in CALMET predictions is not captured.

4.1.2 CALPUFF

The latest version of the CALPUFF dispersion model (version 7.2.1) was used to predict ground-level concentrations of air contaminants anticipated to be released during Project operation. Modelling was conducted to assess annual and daily atmospheric discharges from the Argentia Green Fuels Facility, particularly those associated with emergency generator use, flare stacks, and ammonia ship carrier during offtake at the loading facility (referred to herein as marine transport). Emissions were predicted in relation to ambient air quality in the LAA and RAA during normal operation of the Project. The primary modelling area consisted of a 50 by 50 km area centered on the Argentia Green Fuels Facility. The modelling area was expanded to include discrete receptors in the RAA. To run the CALPUFF model, the following inputs were required:

- Emission rates of air contaminants (Section 4.1.2.1);
- Physical properties (e.g., release height, exit diameter) of emission sources (Section 4.1.2.2);
- Locations, and surrounding buildings and structures, of emission sources (Section 4.1.2.2); and
- Locations of receptors (Section 4.1.2.3).

Additional model inputs and parameters are provided in Section 4.1.2.4.

4.1.2.1 Emission Rates

Air releases were modelled as maximum hourly and daily, as well as annual average emissions to determine resulting maximum ground-level concentrations for the same averaging periods. This approach was used to facilitate comparison with relevant air quality standards (i.e., NL AQS, CAAQS). Furthermore, maximum emission rates were computed to determine the maximum possible concentration over a given hour or day (i.e., 24-hour period). Emission rates were prorated based on the projected operational time for activities occurring less than 24 hours per day. Maximum hourly, maximum daily, and annual average emission rate calculation methods are detailed by activity (i.e., emergency generator, flare stacks, marine transport) below. Emission rates used in CALPUFF are summarized in Appendix H.5. It should be noted that marine transport emissions were not modelled and are thus provided below for illustrative purposes.

Emergency Generator

As detailed in Section 3.1.2.9, it was conservatively assumed that emergency generator use will be limited to 96 hours per year, which equates to one 24-hour period per quarter. As such, maximum daily and hourly emission rates will be equivalent. Daily and hourly emission rates are calculated per methodology in Equation H-4.1.2-1 and H-4.1.2-2. The annual average emission rate was calculated per methodology in Equation H-4.1.2-3.

Equation H-4.1.2-1: Emergency Generator Daily and Hourly Emission Rate

$$ER_{daily,\ hourly} = EF\left(\frac{lb}{MMBtu}\right) \times HIR\left(\frac{MMBtu}{hr}\right) \times \text{Conversion Factors}$$

where: $ER_{daily,\ hourly}$ = daily / hourly emission rate (grams (g) per second (s))
EF = emission factor (pounds (lb) per one million British thermal units (MMBtu))
HIR = heat input rate of emergency generator (MMBtu per hour) [Equation H-4.1.2-2]
Conversion factors = for lb to g, and hr to s.

Equation H-4.1.2-2: Emergency Generator Heat Input Rate

$$HIR = Fuel\left(\frac{m^3}{yr}\right) \times HHV\left(\frac{GJ}{m^3}\right) \times \frac{1}{Usage}\left(\frac{yr}{hr}\right) \times \text{Conversion Factor}$$

where: HIR = heat input rate of emergency generator (MMBtu per hour)
Fuel = fuel consumption (m^3 per hour)
HHV = high heating value for diesel (gigajoules (GJ) per m^3)
Usage = operational hours per year (i.e., 96 hours)
Conversion factor = for GJ to MMBtu

Equation H4.1.2-3: Emergency Generator Annual Average Emission Rate

$$ER_{annual} = ER_{daily,\ hourly}\left(\frac{g}{s}\right) \times \frac{\text{operational time (hours)}}{\text{total time (hours)}}$$

where: ER_{annual} = annual average emission rate (grams (g) per second (s))
$ER_{daily,\ hourly}$ = daily / hourly emission rate (grams (g) per second (s))
Operational time = 96 hours
Total time = 8,760 hours

Flare Stacks

As detailed in Section 3.1.2.10, both flares required for safe and efficient operation of the Argentia Green Fuels Facility will generate emissions from continuous pilots and intermittent releases. Emission rate calculation details follow.

CONTINUOUS PILOTS

Pilots operate continuously, thus maximum hourly and daily, and average annual emission rates will be equivalent. Emission rates were calculated per methodology outlined in Equation H-4.1.2-4 (CO and NOx), H-4.1.2-5 (PM), and H-4.1.2-6 (residual propane).

Equation H-4.1.2-4: Continuous Pilots CO and NOx Emission Rate

$$ER = Flow\left(\frac{kg}{hr}\right) \times HHV\left(\frac{MJ}{kg}\right) \times EF\left(\frac{lb}{10^6\ Btu}\right) \times \text{Conversion Factors}$$

where: ER = daily / hourly / annual average emission rate (g per s)
Flow = flow rate of pilot (kg per hr)
HHV = high heating value for propane (MJ per kg)
EF = emission factor (lb per Btu)
Conversion factors = for MJ to Btu, lb to g, hr to s

Equation H-4.1.2-5: Continuous Pilots PM Emission Rate

$$ER = Flow\left(\frac{kg}{hr}\right) \times \frac{1}{\rho_{fuel}}\left(\frac{m^3}{kg}\right) \times EF\left(\frac{kg}{10^3\ m^3 fuel}\right) \times \text{Conversion Factors}$$

where: ER = daily / hourly / annual average emission rate (g per s)
Flow = flow rate of pilot (kg per hr)
ρ_{fuel} = density of propane (kg per m^3)
EF = emission factor (kg per 10^3 m^3 fuel)
Conversion factors = for kg to g, hr to s

Equation H-4.1.2-6: Continuous Pilots Residual Propane Emission Rate

$$ER = Flow\left(\frac{kg}{hr}\right) \times (1\text{-}DE) \times \text{Conversion Factors}$$

where: ER = daily / hourly / annual average emission rate (g per s)
Flow = flow rate of pilot (kg per hr)
DE = destruction efficiency of flare (unitless)
Conversion factors = for kg to g, hr to s

INTERMITTENT RELEASES

Intermittent releases will generate emissions of residual NH_3 and NOx (thermal and fuel). Hourly emission rates for residual NH_3 and NOx were calculated per methodology in Equation H-4.1.2-7 and H-4.1.2-8, respectively. Hourly emission rates were converted to daily and annual emission rates per methodology outlined in Equation H-4.1.2-9 and H-4.1.2-10, respectively.

Equation H-4.1.2-7: Intermittent Releases Hourly Residual NH_3 Emission Rate

$$ER_{hourly\ residual\ NH_3} = Flow\left(\frac{kg}{hr}\right) \times (1\text{-}DE) \times Conversion\ Factors$$

where: ER = hourly emission rate (g per s)

Flow = flow rate of intermittent release (kg per hr)

DE = destruction efficiency of flare (unitless)

Conversion factors = for kg to g, hr to s

Equation H-4.1.2-8: Intermittent Releases Hourly NOx Emission Rate

$$ER_{hourly\ NOx} = Thermal\ NO_x + Fuel\ NO_x$$

$$E = \left[Flow\left(\frac{kg}{hr}\right) \times HHV\left(\frac{MJ}{kg}\right) \times EF\left(\frac{lb}{Btu}\right) \times Conversion\ Factors\right] + \left[Flow\left(\frac{kg}{hr}\right) \times EF\left(\frac{kg\ NO_x}{kg\ NH_3}\right) \times Conversion\ Factors\right]$$

where: ER = hourly emission rate (g per s)

Flow = volumetric flow rate of pilot (kg per hr)

EF = emission factor (thermal: lb per Btu; fuel: kg NOx per kg NH_3)

Conversion factors = for lb to kg, MJ to Btu, kg to tonnes, and hr to s.

Equation H-4.1.2-9: Intermittent Releases Daily NH_3 and NOx Emission Rate

$$ER_{daily} = ER_{hourly} \times \frac{1\ hr}{24\ hr}$$

where: ER_{daily} = daily emission rate (g per s)

ER_{hourly} = hourly emission rate (g per s)

Equation H-4.1.2-10: Intermittent Releases Annual NH_3 and NOx Emission Rate

$$ER_{annual} = ER_{daily} \times \frac{1\ d}{365\ d}$$

where: ER_{annual} = annual emission rate (g per s)

ER_{daily} = daily emission rate (g per s)

Marine Transport

As detailed in Section 3.2.1.11, the end product will be transported to the global market once monthly via marine vessels. Maximum hourly and daily, as well as annual average emission rates were computed for when the marine vessel is at the loading facility. Hourly emission rates for marine transport were calculated per methodology in Equation H-4.1.2-11. Hourly emission rates were converted to daily and annual emission rates per methodology outlined in Equation H-4.1.2-12 and H-4.1.2-13, respectively.

Equation H-4.1.2-11: Marine Transport Hourly Emission Rate

$$ER_{marine\ vessel} = ER_{maneuvering} + ER_{hotelling} + ER_{boilers}$$

$$ER_{hotelling} = \text{Power (kW)} \times \text{Load Factor} \times \text{EF}\left(\frac{kg}{kWh}\right) \times \text{Conversion Factors}$$

$$ER_{maneuvering} = \text{Power (kW)} \times \text{Load Factor} \times \text{EF}\left(\frac{kg}{kWh}\right) \times \text{Conversion Factors}$$

$$ER_{boilers} = \text{Fuel}\left(\frac{m^3}{hr}\right) \times \text{Load Factor} \times \text{EF}\left(\frac{kg}{m^3}\right) \times \text{Conversion Factors}$$

where: ER= emission rate (g per s)

Power = main / auxiliary engine power (kW)

Load Factor = engine load factor during activity (i.e., maneuvering or hotelling)

EF = emission factor (kg per kWh or kg per m^3)

Fuel = fuel consumption (m^3 per hour)

Conversion Factors = hr to s, kg to g.

Equation H-4.1.2-12: Marine Transport Daily Emission Rate

$$ER_{daily} = ER_{hourly} \times \frac{16\ hr}{24\ hr}$$

where: ER_{daily} = daily emission rate (g per s)

ER_{hourly} = hourly emission rate (g per s)

16 hr = sum of hotelling and maneuvering time

Equation H-4.1.2-13: Marine Transport Annual Emission Rate

$$ER_{annual} = ER_{daily} \times \frac{12\ d}{365\ d}$$

where: ER_{annual} = annual emission rate (g per s)

ER_{daily} = daily emission rate (g per s)

4.1.2.2 Emission Source Details

Emission Source Characteristics

Emission source characteristics used to develop model inputs are provided in Table H-4.1.2-1. It was assumed that all releases occurred through vertical stacks.

Table H-4.1.2-1 Emission Source Characteristics.

Activity	Value
Emergency Generator	
Standby Power Requirement (MW)	8
Fuel Type	Diesel
Fuel Sulfur Content (%)	0.1
Annual Operating Hours	96
Flares	
Propane pilot flow rate (m3/hr)	2.18
NH_3 intermittent release (kg)	16,667
Duration of NH_3 intermittent release (hours)	1

Building Profile Input Program

Modelling the dispersion of air contaminants requires the consideration of buildings and structures. The presence of buildings and structures nearby emission sources can affect how air contaminants are dispersed. Building downwash, which occurs when wind flows over and around buildings, can limit plume rise and pull air contaminants towards the ground. This effect was considered in the Building Profile Input Program (BPIP) module of CALPUFF, which allowed for downwash of buildings to be modelled. Figure H-4.1.2-1 illustrates the building layout for the Argentia Green Fuels Facility, which was developed using a preliminary concept plot plan for the Project.

Pattern | Argentia Renewables	FIGURE NUMBER: H - 4.1.2 - 1	COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 22N	PREPARED BY: C. Burke	DATE: 24/07/25
	FIGURE TITLE: Argentia Green Fuels Facility Building Layout	NOTES: The location of proposed project infrastructure is considered preliminary and is subject to change.	REVIEWED BY:	
			APPROVED BY:	
	PROJECT TITLE: Argentia Renewables		sem	

SEM MAP ID: 238-005-GIS-147-Rev0

4.1.2.3 Receptor Grid

The receptor grid for the model was developed in consideration of the NL DECC Guideline for Plume Dispersion Modelling (Government of Newfoundland and Labrador Department of Environment and Conservation, 2012). Receptor grid spacing used in the model is as follows:

- 20 m spacing along the Project Area boundary;
- 50 m spacing from the centre of the Argentia Green Fuels Facility out to 500 m;
- 100 m spacing from 500 m out to 1,000 m;
- 200 m spacing from 1,000 m out to 2,000 m; and
- 500 m spacing from 2,000 m out to 12,000 m (to ensure coverage of the RAA).

Gridded receptors within the Project Area were removed from the model, thus maximum air contaminant concentrations for comparison with NL AQS and CAAQS were predicted outside of the Project Area. Sensitive receptors (e.g., hospitals, schools, recreational areas, etc.) were also included, as detailed in Table H-4.1.2-2. Modelling was conducted at a flagpole height of 0.0 m.

Table H-4.2.1-2 Sensitive Receptor Locations.

Receptor ID	Easting (m)	Northing (m)	Description
DR001	280777.37	5239322.59	St. Anne's Academy
DR002	275479.26	5236304.15	Laval High School
DR003	275376.92	5236170.49	CNA Placentia
DR004	275709.2	5236406.38	Registered Childcare Centre
DR005	275486.4	5236253.8	Beachside Manor
DR006	275870.3	5235886.2	Lions Club Manor Nursing Home
DR007	275877.29	5235804.02	Placentia Health Centre
DR008	274569.84	5240135.39	Sunset RV Park
DR009	275262.89	5235757.83	Unity Parc Arena
DR010	274680.64	5237733.03	Freshwater Skate Park
DR011	275420.54	5234650.16	Regatta Grounds
DR012	275702.21	5236088.86	Wayne John Searle Memorial Recreation Complex
DR013	275702.21	5236088.86	William Hatfield Memorial Ball Field
DR014	281009.53	5238892.11	William Hogan Ball Field
DR015	280854.55	5238836.67	Jeff Jones Memorial Soccer Pitch
DR016	276059.75	5238106.36	Coalyard Playground
DR017	277212.15	5238564.24	Ferndale Veterans' Park Playground
DR018	276130.99	5236611.84	Mount Pleasant Playground
DR019	281072.99	5239079.79	William Hynes Memorial Playground
DR020	276237.63	5236168.39	Great Beach Boardwalk
DR021	284146.9	5243360.19	Fox Harbour Trail & Park
DR022	275162.53	5237333.81	Castle Hill National Historic Site
DR023	276068.84	5235969.58	Mount Carmel RC Cemetery

DR024	280219.25	5244969.59	Fox Harbour Community Center
DR025	279487.28	5244151.69	Fox Harbour Cemetery
DR026	280204.4	5239263.57	Our Lady of Angels Parish & Cemetery
DR027	274369.45	5237592.22	Freshwater Cemetery

4.1.2.4 Additional Model Inputs and Parameters

Conversion of Oxides of Nitrogen to Nitrogen Dioxide

The ozone limiting method (OLM) was used to facilitate the prediction of ground level NO_2, the primary contaminant of concern of NOx (predominantly nitrogen oxide (NO) and NO_2). Since guidelines (i.e., NL AQS, CAAQS) only exist for NO_2, the conversion of NOx to NO_2 must be estimated for comparison purposes. The conversion can be estimated using the OLM since the formation of NO_2 is driven by ambient levels of ozone (O_3) in the atmosphere. This approach facilitates the prediction of ground-level concentrations based on the model results for NOx (i.e., the species for which emission rates were developed). The ozone concentrations used in the OLM are based on hourly concentrations measured at the Mount Pearl NAPS station between 2020 and 2022 (Environment and Climate Change Canada, 2023g). Concentrations of ground-level NO_2 were determined using the relationship identified in the Alberta Air Quality Model Guidance (Government of Alberta, 2021), which indicates that if the concentration of O_3 is greater than 0.8 times the concentration of NOx, then the concentrations of NO_2 and NOx are equal. Otherwise, the following methodology must be used: NO_2 concentration = O_3 concentration + 0.2 × NOx concentration. Values of 0.8 and 0.2 were derived from the in-stack ratio (ISR) for diesel power generating units (Government of Newfoundland and Labrador Department of Environment and Conservation, 2012). The ISR for diesel power generating units is 0.2, and the value of 0.8 is derived by subtracting the ISR from 1, as per the Alberta Air Quality Model Guidance (Government of Alberta, 2021).

Removal of Meteorological Anomalies

To ensure comparison with NL AQS and mitigation of model over-prediction, meteorological anomalies were removed per guidance developed by the NL Department of Environment and Conservation (now NL DECC) to determine compliance with ambient air quality standards (Newfoundland and Labrador Department of Environment and Conservation, 2012). Owing to overpredictions due to adverse meteorological conditions, some of the maximum modelled values at each receptor can be removed. As such, modelled impacts are based on the:

- 9th highest level at any given receptor for a 1-hour averaging period;
- 6th highest level at any given receptor for a 3-hour averaging period;
- 3rd highest level at any given receptor for an 8-hour averaging period; and
- 2nd highest level at any given receptor for a 24-hour averaging period.

4.2 Air Dispersion Modelling Results

CALPUFF was used to assess cumulative effects of the Project by predicting ground level concentrations of air contaminants of concern relative to background concentrations. This approach allowed for consideration of ambient air quality in addition to air releases generated by operation and maintenance of the Project. Concentrations of air contaminants processed to statistical metrics required by the CAAQS in the Atmospheric Environment Baseline Study (Appendix A) were considered to be representative background concentrations in the Project Area. Background concentrations were only available for SO_2, NO_2, CO, $PM_{2.5}$, and PM_{10} as they were obtained from monitoring data. Since TSP is not measured, it was assumed that background concentrations of TSP are equivalent to PM_{10} concentrations. Additionally, it was assumed that background concentrations of all other air contaminants of interest were negligible. For NO_2, CO, $PM_{2.5}$, and PM_{10}, 1-hour background concentrations used in dispersion modelling were based on the 90th percentile of 1-hour average concentrations. The 24-hour background concentrations were maximum 24-hour concentrations excluding hourly values greater than the 90th percentile. A different approach was used for CO, which has an 8-hour averaging period. The 8-hour CO background concentration is the maximum 8-hour rolling average following data refinement to exclude potentially anomalous values. This approach provides a more stable, representative background concentration without being skewed by extreme short-term spikes. Data refinement was conducted by removing values greater than the 90th percentile of the 3-hour rolling average. The 3-hour rolling average captures peak pollution periods over a short duration that may not otherwise be detected in the 8-hour rolling average. The background concentration for annual average, where required, is the maximum annual average. Background concentrations used in dispersion modelling are provided in Table H-4.2-1 and H-4.2-2.

Table H-4.2-1 outlines results of air dispersion modelling (i.e., maximum predicted ground level concentrations) at the Argentia Green Fuels Facility boundary (i.e., fenceline), while Table H-4.2-2 presents results at the nearest sensitive receptor, Sunset RV Park. Predicted plus (+) background concentrations were compared to NL AQS and CAAQS, and the percentage of NL AQS were also computed. Air contaminants that do not have NL AQS guidelines or have negligible emission rates were omitted from modelling. Per results provided in Table H-4.2-1 and H-4.2-2, $PM_{2.5}$ was the only air contaminant with maximum ground level concentrations (annual) greater than 50% of the NL AQS. Results from air dispersion modelling are considered conservative, as estimates were based on assumptions detailed in Section 3.0.

Table H-4.2-1 Air Dispersion Modelling Results at Fenceline: Project Operation.

Air Contaminant	Averaging Period	Concentrations (µg/m³)			Guidelines (µg/m³)			% of NL AQS
		Background	Predicted	Predicted + Background	NL AQS	2020 CAAQS	2025 CAAQS	
CO	1-hour	263	43.3	306	35,000	-	-	0.88%
	8-hour	252	27.3	279	15,000	-	-	1.86%
SO_2	1-hour	0.8	5.1	5.9	900	183.4	170	0.66%
	3-hour	0.8	4.4	5.2	600	-	-	0.87%
	24-hour	0.5	2.3	2.8	300	-	-	0.93%
	Annual	0.8	0.2	1.0	60	13.1	10.5	1.59%
NO_2	1-hour	4	108	112	400	112.9	79	28.10%
	24-hour	2	64	66	200	-	-	32.83%
	Annual	2	6	8	100	32	28.2	7.61%
TSP	24-hour	16	1.4	17	120	-	-	14.46%
	Annual	11	0.11	11	60	-	-	18.51%
PM_{10}	24-hour	16	1.1	17	50	-	-	34.24%
$PM_{2.5}$	24-hour	8	1.1	9	25	27	27	36.40%
	Annual	5	8.42E-02	5	8.8	8.8	8.8	57.77%
NH_3	24-hour	NA	0.48	0	100	-	-	0.48%

NOTES
µg = microgram, m³=cubic metre; NL AQS = Newfoundland and Labrador Air Quality Standards; CAAQS = Canadian Ambient Air Quality Standards

Table H-4.2-2 Air Dispersion Modelling Results at Sensitive Receptor: Project Operation.

Air Contaminant	Averaging Period	Concentrations (µg/m³)			Guidelines (µg/m³)			% of NL AQS
		Background	Predicted	Predicted + Background	NL AQS	2020 CAAQS	2025 CAAQS	
CO	1-hour	263	1.45	264	35,000	-	-	0.76%
	8-hour	252	0.44	252	15,000	-	-	1.68%
SO_2	1-hour	0.8	0.14	1	900	183.4	170	0.10%
	3-hour	0.8	7.12E-02	1	600	-	-	0.15%
	24-hour	0.5	1.87E-02	1	300	-	-	0.18%
	Annual	0.8	8.44E-04	1	60	13.1	10.5	1.31%
NO_2	1-hour	4	5	9	400	112.9	79	2.30%
	24-hour	2	1	3	200	-	-	1.35%
	Annual	2	0	2	100	32	28.2	2.04%
TSP	24-hour	16	6.61E-03	16	120	-	-	13.34%
	Annual	11	5.12E-04	11	60	-	-	18.33%
PM_{10}	24-hour	16	1.10E-02	16	50	-	-	32.02%
$PM_{2.5}$	24-hour	8	1.12E-02	8	25	27	27	32.04%
	Annual	5	5.99E-04	5	8.8	8.8	8.8	56.82%
NH_3	24-hour	NA	1.70E-02	0	100	-	-	0.02%

NOTES
µg = microgram, m³=cubic metre; NL AQS = Newfoundland and Labrador Air Quality Standards; CAAQS = Canadian Ambient Air Quality Standards

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Appendix H.1
GHG Inventory Calculation Assumptions

Table H.1-1 List of Calculation Assumptions – Construction.

Phase	Activity	Assumptions
Construction	Blasting	No emissions of CH_4 or N_2O will be generated from blasting
		Explosive use (required for wind energy generation facility only) will be evenly distributed across the two-year construction period
	Stationary Combustion (Argentia Wind Facility)	Approximately 7.5% of total fuel burn anticipated for the construction period will be used in stationary combustion
		Stationary equipment fuel consumption will be evenly distributed across the two-year construction period
	Stationary Combustion (Argentia Green Fuels Facility)	Stationary equipment to be used on site shall be generators and vibratory hammers per FEL-1 noise analysis
		Stationary equipment fuel consumption will be evenly distributed across the two-year construction period
	Mobile Equipment (Argentia Wind Facility)	Approximately 92.5% of total fuel burn anticipated for the construction period will be used in stationary combustion
		Mobile equipment fuel consumption will be evenly distributed across the two-year construction period
	Mobile Equipment (Argentia Green Fuels Facility)	All mobile equipment is fueled by diesel
		All mobile equipment is Tier 4
	Marine Transport (Components)	All wind turbine components will be delivered in the same calendar year
		Wind turbine towers will be shipped in five segments
		Each shipment will contain eight units
		Empty weight is 50% of deadweight tonnage
		Components will be shipped from furthest port possible
	Marine Transport (Supplies)	All wind turbine components will be delivered in the same calendar year

Table H.1-2 List of Calculation Assumptions – Operation.

Phase	Activity	Assumptions
Operation	Mobile Equipment	Approximately half of the light vehicle requirement estimated for the construction phase will be required for operations (amounts to ~8 hr/day, 365 day/yr)
		All mobile equipment is fueled by diesel
	Flare Stacks	Mass flow rates for flare and tank flare are 3% of rates provided in FEL-1 study
		Combustion efficiency of pilot gas (propane) is 98%
	Stationary Combustion (Emergency Generator)	8 MW of standby power will be supplied by one emergency generator; usage will not exceed 100 hours per year (approx. one day per quarter)
		The diesel generator will consume 0.4 L of fuel per kWh
		Sulfur content of diesel will not exceed 0.1%
	Marine Transport (Product)	Ammonia will be transported by standard liquified petroleum/natural gas (LPG/LNG) capable vessels
		One vessel per month will be required
		Clipper Eirene gas carrier will transport product to global market
		Ammonia will be shipped to a major European port (assume Hamburg, Germany)
		During vessel hotelling (i.e., filling of vessel tanks), only one loading arm will be available to fill tanks (i.e., tanks will be filled consecutively)
		Vessel hotelling will take 15 hours per visit, 180 hours annually (12 visits per year assumed)
	Electricity Consumption	The requirement of 10 MW of firm power will be 24/7/365 (i.e., 8760 hours)

Appendix H.2
GHG Inventory Calculation Details

CONSTRUCTION - MOBILE EQUIPMENT

CPL - Argentia Wind Facility

CPL has indicated that approximately 4.5 million liters will be required for the construction period; approx. 7.5% (5-10% estimated) will be used in stationary equipment. The remaining 92.5% will be burned in mobile equipment

Per provided schedule, construction of the Argentia Wind Facility, inclusive of tree clearing and grubbing, road construction, foundation works, turbine installation, and mechanical completion, is scheduled to commence in Q2 2025 (June 2025) and is anticipated to finish in Q4 2026 (December 2026).

Assume that fuel burn is split evenly across the two years (i.e., 2025 and 2026)

Fuel Details

Fuel Type	Diesel
Total fuel burn (L)	4,500,000
Mobile fuel burn (L)	4,162,500
Annual mobile fuel burn	2,081,250

Emissions

Year	Consumption (L)	Emission Factors (g/L)			Actual GHG Emissions (tonnes)			GHG Emissions (tonnes CO2e)			Total GHG Emissions (tm/yr)
		CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	
Off-road Diesel (≥19 kW, Tier 4)											
Year 2 (2026)	2,081,250	2680.5	0.073	0.227	5578.79	0.15	0.47	5578.79	4.25	125.20	5,708
Year 3 (2026)	2,081,250	2680.5	0.073	0.227	5578.79	0.15	0.47	5578.79	4.25	125.20	5,708
Construction Period	4,162,500	2680.5	0.073	0.227	11157.58	0.30	0.94	11157.58	8.51	250.40	11,416

[1] As a conservative approach, it was assumed that all vehicles would be Tier 4 (EF for N2O is higher than Tier 1-3; all other EFs are equivalent)

[2] EFs retrieved from Canada's NIR (2021) Table A6.1–14 (part 2): Emission Factors for Energy Mobile Combustion Sources (Off-road)

SNC - Argentia Green Fuels Facility

Assume that all mobile equipment is fueled by diesel

Equipment Details

Equipment	Model	Net Power (output; hp)	Units	Operating Hours	Fuel Burn Rate	Units	Fuel Consumption (L)	Total	Per year
Backhoe	CAT 440	104	4	3,920	2.15	gal/hr	31,858	523,324	261,662
Compactor	CS56 Roller	157	4	1,960	2.91	gal/hr	21,560		
Bulldozers	D6 Dozer	215	2	3,920	5.9	gal/hr	87,424		
Pickup Truck		250	4	3,920	0.15	L/km	23,520		
Impact Pile Driver	Liebherr LRH 100.	335	2	1,960	2.56	gal/hr	18,967		
Hyd. Rock Breakers	PC490LC-11 w/ br	359	2	3,920	8.61	gal/hr	127,580		
Vibratory Hammer (HPSI 500)	PC490LC-11 w/ ha	359	2	1,960	8.61	gal/hr	63,790		
Flat Bed Truck		360	4	3,920	0.15	L/km	23,520		
Concrete Truck		425	10	3,920	4.5	gal/hr	66,679		
Concrete Pump Truck		485	2	1,960	4.5	gal/hr	33,340		
Crane*	Liebherr LTM 1250	544	4	1,568	16	L/hr	25,088		

[1] high fuel consumption selected, where available

[2] https://www.liebherr.com/en/deu/specials/fuel-savings-calculator/tool/calculator.html#page=3&catid=10&id=LRH%20100.1&v1=&v2=&v3=&ca=g&cu=EUR

[3] fuel burn for PC491LC-11 could not be found; Cat 340-08 used as comparable model

[4] *Not available. Comparable SANY SAC2500S burns <80 L/100 km. Assume that crane moves 20 km/hr (40 km/hr in transit; 0 km/hr while stopped)

[5] Based on Ready-Mix trucks, assume the same for concrete pump trucks

[6] Flat bed truck fuel burn = pickup truck fuel burn?

Emissions

Year	Consumption (L)	Emission Factors (g/L)			Actual GHG Emissions (tonnes)			GHG Emissions (tonnes CO2e)			Total GHG Emissions (tm/yr)
		CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	
Off-road Diesel (≥19 kW, Tier 4)											
Year 2 (2026)	261,662	2680.5	0.073	0.227	701.38	0.02	0.06	701.38	0.53	15.74	718
Year 3 (2026)	261,662	2680.5	0.073	0.227	701.38	0.02	0.06	701.38	0.53	15.74	718
Construction Period	523,324	2680.5	0.073	0.227	1402.77	0.04	0.12	1402.77	1.07	31.48	1,435

[1] As a conservative approach, it was assumed that all vehicles would be Tier 4 (EF for N2O is higher than Tier 1-3; all other EFs are equivalent)

CONSTRUCTION - WIND TURBINE COMPONENT TRANSPORTATION

These calculations were performed under the assumption that all wind turbine components will be delivered in the same calendar year.
This assumption aligns with the fact that Argentia Renewables' schedule: WTG delivery start (May 2026) and WTG delivery complete (July 2026).
What about deliveries for other components? Is it practical to assume that those will come by boat too?

Vessel	Vessel Type	Components	# Units	# trips per year [1]	Tonnage Deadweight (tonnes)	Tonnage Empty (tonne) [2]	Emission Factor (g CO2e/dwt·nm)
Rotra Vente	RoRo	Nacelles	45	6	8929	4465	19.4
Vestvind	Cargo	Hubs	45	6	10238	5119	17.1
Vestvind	Cargo	Blades	135	17	10238	5119	17.1
Boldwind	Cargo	Towers	225	29	10000	5000	17.1

[1] Assume 8 units per trip
[2] Assume empty weight is 50% of DWT
[3] Rotra Vente is a general cargo with 5,000-9,999 dwt while Vestvind and Boldwind are general cargo vessels with 10,000-19,999 dwt
[4] EFs retrieved from IMO 2020

Component	Origin	Probable Port	One-way trip (nm)	Emissions CO_2e (tonnes/yr)		
				FULL (one way)	EMPTY (one way)	Project
Nacelles	China	Tiajin, CN	11,453	11,904	5,952	17,855
Nacelles	Europe	Aarhus, DE	2,581	2,683	1,341	4,024
Hubs	China	Tiajin, CN	11,453	12,030	6,015	18,046
Hubs	Europe	Aarhus, DE	2,581	2,711	1,356	4,067
Hubs	India	Kandla, IMD	7,209	7,572	3,841	11,413
Blades	China	Tiajin, CN	11,453	34,086	17,043	51,129
Blades	Europe	Aarhus, DE	2,581	7,682	3,841	11,522
Blades	Mexico	Tampico, MX	2,838	8,446	4,223	12,670
Blades	India	Kandla, IMD	7,209	21,455	10,728	32,183
Towers	China	Tiajin, CN	11,453	56,795	28,398	85,193
Towers	Europe	Aarhus, DE	2,581	12,799	6,400	19,199

https://www.vestas.com/en/about/our-locations/production
https://sea-distances.org/
nm=nautical miles

Shipping Options

Nacelles	Hubs	Blades	Towers
Nacelles (China)	Hubs (China)	Blades (China)	Towers (China)
Nacelles (Europe)	Hubs (Europe)	Blades (Europe)	Towers (Europe)
	Hubs (India)	Blades (Mexico)	
		Blades (India)	

EMISSIONS [WORST CASE SCENARIO: Furthest Ports]

Component	Origin	Probable Port	One-way trip (nm)	Emissions CO_2e (tonnes/yr)		
				FULL (one way)	EMPTY (one way)	Project
Nacelles	China	Tiajin, CN	11453	11903.5106	5951.75531	17855.3
Hubs	China	Tiajin, CN	11453	12030.4465	6015.22326	18045.7
Blades	China	Tiajin, CN	11453	34086.2651	17043.1326	51129.4
Towers	China	Tiajin, CN	11453	56795.427	28397.7135	85193.1
					TOTAL	172,223

Fuel Consumption Estimate (includes hotelling [CONS 6])

Component	Origin	Probable Port	One-way trip		# Trips (return)	Total Transport (hrs)	Vessel	Main Engine			ρ_{MGO} (kg/L)	Fuel Burn Rate		Fuel Consumption (L)
			Days	Hours				Type	#	Power (kW)		g/kWh	(L/hr)	
Nacelles	China	Tiajin, CN	30	720	12	8,640	Rotra Vente	Wärtsilä 8L38	1	1,320	0.855	179	276	2,385,004
Hubs	China	Tiajin, CN	30	720	12	8,640	Vestvind	MAN-B&W 6L21/31	2	2,640	0.855	192	593	5,122,156
Blades	China	Tiajin, CN	30	720	34	24,480	Vestvind	MAN-B&W 6L21/31	2	2,640	0.855	192	593	14,512,775
Towers	China	Tiajin, CN	30	720	58	41,760	Boldwind*	MAN-B&W 6L21/31	4	5,280	0.855	192	1186	49,514,173
													TRANSPORT	71,534,107
													HOTELLING	145,152
													MARINE TOTAL	71,679,259

CONSTRUCTION - MARINE TRANSPORT OF SUPPLIES

Emissions include loading/unloading at port (hotelling)

These calculations were performed under the assumption that all wind turbine components will be delivered in the same calendar year.

This assumption aligns with the fact that Argentia Renewables' schedule: WTG delivery start (May 2026) and WTG delivery complete (July 2026).

Fuel Consumption Details

Vessel	Vessel Type	Components	AUX Engine Details			ρ_{MGO} (kg/L)	Fuel Burn Rate		Hotelling Time (hr/yr)	Annual Fuel Consumption (L/yr)
			Type	Number	Power (kW)		g/kWh	L/hr [4]		
Rotra Vente [1]	RoRo	Nacelles	Scandia D160 75M aux engine	2	511	0.855	201	240	180	43,247
Vestvind [2]	Cargo	Hubs/Blades	Volvo Penta D13 diesel genset	3	368	0.855	212	274	180	49,273
Boldwind [3]	Cargo	Towers	MAN 6L16/24 diesel generator	2	625	0.855	200	292	180	52,632

[1] Rotra Vente engine details here: https://shippingtandy.com/features/rotra-vente/

[2] Vestvind engine details here: https://www.scheepvaartwest.be/CMS/index.php/general-cargo/9787-vestvind-imo-9750579

[3] Boldwind detailed here: https://www.unitedwindlogistics.de/boldwind/#:~:text=The%20newbuilding%20(built%202020)%20combines,driven%20by%20high%20quality%20MDO; https://www.projectcargojournal.com/shipping/2020/05/12/united-wind-logistics-takes-delivery-of-first-new-deck-carrier/; https://www.scheepvaartwest.be/CMS/index.php/general-cargo/11740-boldwind-imo-9870018 AND https://www.ship-technology.com/news/united-wind-logistics-delivery-mv-boldwind/?cf-view

[4] Fuel burn rate in L/h includes # units

Emissions

Year	Consumption (L)	Emission Factors (g/L)			Actual GHG Emissions (tonnes)			GHG Emissions (tonnes CO2e)			Total GHG Emissions (tm/yr)
		CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	
Rotra Vente [1]	43,247	2680.5	0.25193	0.07198	115.92	0.01	0.00	115.92	0.31	0.82	117
Vestvind [2]	49,273	2680.5	0.25193	0.07198	132.08	0.01	0.00	132.08	0.35	0.94	133
Boldwind [3]	52,632	2680.5	0.25193	0.07198	141.08	0.01	0.00	141.08	0.37	1.00	142
										TOTAL	393

EF Source: NIR Part 3, Annex 6 https://publications.gc.ca/collections/collection_2023/eccc/En81-4-2021-2-eng.pdf

OPERATION - MOBILE EQUIPMENT

Mobile equipment during operation phase anticipated to be limited to light duty pickup trucks

Assume that approximately half of the hwy truck/light vehcile (LV) requirement estimated for the construction phase (provided by Dexter via CPL) will be used for the operation phase

LV Details

Annual LV use (hr)	2900
Daily LV used (hr)	8
Vehicle speed (km/hr)	40
Fuel rating (L/km) [1]	0.15
Annual fuel consumption (L)	17400

[1] Fuel rating retrieved from: https://fcr-ccc.nrcan-rncan.gc.ca/en?_gl=1*14vg18q*_ga*MzIzMzA2MjkxLjE3MDkwNTg1MTg.*_ga_C2N57Y7DX5*MTcwOTkwODUwNC40LjAuMTcwOTkwODUwNC4wLjAuMA..

Details	Consumption (L)	Emission Factors (g/L) [1]			Actual GHG Emissions (tonnes)			GHG Emissions (CO2e)			Total GHG Emissions (tm/yr)
		CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	
Operation - Mobile Equipment	17,400	2680.5	0.068	0.22	46.64	0.00	0.00	46.64	0.03	1.01	48

[1] EFs for mobile equipment retrieved from Canada NIR (2021) part 2, Table A6.1-14 (Road Transport, Light-duty Diesel Trucks, Advanced Control)

OPERATION - FLARE STACKS

INPUTS

NH_3 Process Flare Unit Details

Flare Volumetric Flow Rate (m3/hr) [1]	72.7
Pilot Volumetric Flow Rate (m3/hr) [2]	2.181
Pilot Mass Flow Rate (kg/hr)	3.7077
Density of propane (kg/m^3) [3]	1.7
Pilot operation (hr/yr)	8760
Annual fuel consumption (m^3/yr)	19,106
Annual fuel consumption (L/yr)	19,105,560

[1] As per SNC FEL-1 Heat & Materials Balance for Flare Gas
[2] Assumed to be 3% of volumetric flow rate of flare (USEPA 2012)
[3] Engineering toolbox

NH_3 Tank Flare Unit Details

Flare Volumetric Flow Rate (m3/hr) [1]	72.7
Pilot Volumetric Flow Rate (m3/hr) [2]	2.181
Mass Flow Rate (kg/hr)	3.7077
Density of propane (kg/m^3)	1.7
Pilot operation (hr/yr)	8760
Annual fuel consumption (m^3/yr)	19,106
Annual fuel consumption (L/yr)	19,105,560

Total annual fuel consumption (m^3)	38,211
Total annual fuel consumption (L)	38,211,120

EMISSIONS

CO_2

MW propane (kg/kg·mol)	44.097
MWC (m^3/kg·mol)	23.64575692
CC flare gas (kg C/kg propane) [1]	0.82
Combustion Efficiency [2]	0.98
CO_2 EMISSIONS (t/yr)	209.8171504

[1] https://www.engineeringtoolbox.com/co2-emission-fuels-d_1085.html
[2] Assumed 98% per TCEQ

CH_4

EF CH4 (kg/GJ)	0.00083
EF (kg CO2/GJ)	62.4
Combustion Efficiency [2]	0.98
f_{CH4}	0.4
CH_4 EMISSIONS (t/yr)	0.625624679

N2O

EF N2O (kg/GJ)	5.00E-04
EF (kg CO2/GJ)	62.4
N2O EMISSIONS (t/yr)	1.68E-03

Details	Consumption (L)	Actual GHG Emissions (tonnes)			GHG Emissions (CO2e)			Total GHG Emissions (tm/yr)
		CO2	CH4	N2O	CO2	CH4	N2O	
Operation - Flaring	38,211,120	209.82	0.63	0.00	209.82	17.52	0.45	228

OPERATION - EMERGENCY GENERATOR

One diesel generator will be required to generate approx. 8 MW of standby (i.e., emergency) power in the event of power loss, maintenance, start up/shut down, etc.

It was assumed that the emergency generator will be used for a maximum of 100 hours per year (i.e., approx 1 day per quarter)

The general rule of thumb that a diesel generator will use 0.4 L of fuel per kWh was applied here in the absence of equipment-specific fuel burn rate.

Default heating value and sulfur content used in calculations.

INPUTS: Generator & Fuel Details

Power Output (MW)	Operating Hours	Diesel Consumption (m^3/yr)	Heating Value (GJ/m^3)	S content (%)
8	96	307.2	38.184	0.1

Details	Consumption (L)	Emission Factors (g/L) [1]			Actual GHG Emissions (tonnes)			GHG Emissions (CO2e)			Total GHG Emissions (tm/yr)
		CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	
Operation - Emergency Generator	307,200	2681	0.078	0.022	823.60	0.02	0.01	823.60	0.67	1.79	826

[1] EFs for emergency generator retrieved from Canada NIR (2021) part 2, Table A6.1-5 (Emission Factors for Refined Pretroleum Products, Diesel)

OPERATION - MARINE TRANSPORT OF PRODUCT

Assumptions

Ammonia will be transported by standard liquified petroleum/natural gas (LPG/LNG) capabe vessels

One vessel per month will be required

Clipper Eirene gas carrier will transport product to global market

Ammonia will be shipped to a major european port (assume Hamburg, Germany)

EMISSIONS - TRANSPORT

Parameter	Value
Daily production (tonnes)	400
29-day production (tonnes)	11,600
Max production capacity (37.5 days; tonnes)	15,000
ρ_{NH3} (@ -32°C, kg·m^{-3})	696
29-day production (m^3)	16,667
Max production (m^3) [1]	21,552
Vessel [link below]	Clipper Eirene
Vessel capacity (m^3)	21220
Component	NH3 Product
# trips/year	12
Tonnage Deadweight (tonnes)	18056
Tonnage Empty (tonne)	9028
Emission Factor Category	Liquified gas tanker (0-49999 cbm)
Emission Factor (gCO2/dwt.nm)	23.4
One-way trip (nm)	2550

[1] Tanker should support close to max production

Vessel Status (Route)	Vessel Tonnage	# Trips/yr	Shipping Distance (nm)	Emissions (tonnes CO_2e/yr)
Empty (EUR-CAN)	9028	12	2,550	6,464
Full (CAN-EUR)	18056	12	2,550	12,929
			TOTAL	19,393

EMISSIONS - VESSEL HOTELLING

Vessel hotelling during operation is required for product loading at Port -- there will be two loading arms (i.e., cannot fill all three at once)

Species	Emission Factor (g/L)	GWP
CO_2	2680.5	1
CH_4	0.25193	28
N_2O	0.07198	265

EF Source: NIR Part 3, Annex 6 https://publications.gc.ca/collections/collection_2023/eccc/En81-4-2021-2-eng.pdf

Cargo Tank Capacities	Quantity (tonne)	Quantity (m^3)	Loading Time (hr)
1	3934	5652.3	4.0
2	5097	7323.3	5.2
3	5098	7324.7	5.2
Total	14129	20300.3	14.5

Average fuel consumption, AUX, loading (ton/day)	9
Hourly fuel consumption (L/hr) [1]	398
Hotelling time (hours) [2]	15
Loading Rate (m3/hr)	1400

[1] Marine gas oil density retrieved from https://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html

[1] Round up to 15 hrs hotelling time

Vessel Status	Annual Hotelling (hr/yr) [2]	Fuel Consumption (L/yr)	Emissions (tonnes CO_2e/yr)			Total Emissions (tonnes CO_2e/yr)
			CO_2	CH_4	N_2O	
Hotelling (Loading)	180	71620	191.98	0.51	1.37	194

[2] 12x24 hr periods over a calendar year

FUEL BURN ESTIMATE - TRANSIT (MAIN ENGINE ONLY)

Annual MGO Estimate					
Component	Fuel Cons (tonne/day)	Days in transit*	# trips/year	Fuel Burn (tonnes/year	Fuel Burn (L/year)
Main Engine	20.0	22	12	5268.9	61,624,918

OPERATION - ELECTRICITY CONSUMPTION

The wind farm will require 10 MW of firm power from NLH on an annual basis

EMISSIONS

Power requirement (MW)	10
Power requirement (kW)	10000
Hours required (h) [1]	8760
Megawatt-hours (MWh/year)	87600
kilowatt-hours (kWh/year)	87600000
EF (g CO_2/kWh)	17
Emissions (tonnes CO_2/year)	1,489

[1] Assumes that firm power will be required 24/7/365

Appendix H.3
Air Release Inventory Results

Table H.3-1 Air Release Inventory Results: Construction.

Substance Details			Annual Construction Emissions (tonnes per year)									
Substance Name	CAS Number	NPRI Part	BLASTING	STOCKPILE EROSION	AGGREGATE HANDLING & TRANSFERS	CRUSHING & SCREENING	LAYDOWN AREAS	UNPAVED ROADS	MOBILE EQUIPMENT	STATIONARY COMBUSTION	TOTAL	CONSTRUCTION PERIOD (2 YRS)
CO	630-08-0	4	4.250						114.204	2.852	121.306	242.612
SO_2	7446-09-5	4	0.125						39.749	0.871	40.745	81.489
NOx, expressed as NO_2	11104-93-1	4	1.000						13.842	13.238	28.080	56.161
Total VOCs	*	4								1.081	1.081	2.161
TSP	*	4	0.123	1.579	2.511	2.140	5.754	2.254	0.426	0.931	15.717	31.434
PM_{10}	*	4	0.064	0.790	1.188	0.800	2.877	0.645		0.931	7.294	14.587
$PM_{2.5}$	*	4	0.004	0.118	0.180	0.132	0.432	0.065		0.931	1.861	3.722
Acetaldehyde	75-07-0	1A								0.002	0.002	0.005
Acrolein	107-08-8	1A								0.000	0.000	0.000
Benzene	71-43-2	1A/5								0.003	0.003	0.006
1,3-Butadiene	106-99-0	1A/5								0.000	0.000	0.000
Formaldehyde	50-00-0	1A/5								0.004	0.004	0.007
Naphthalene	91-20-3	1A								0.000	0.000	0.001
Propylene	115-07-1	1A/5								0.008	0.008	0.015
Toluene	108-88-3	1A/5								0.001	0.001	0.002
Xylene (all isomers)	1330-20-7	1A/5								0.001	0.001	0.002
Mercury (and its compounds)	*	1B								0.000	0.000	0.000
Acenaphthene	83-32-9	2								0.000	0.000	0.000
Acenaphthylene	208-96-8	2								0.000	0.000	0.000
Anthracene	120-12-7	2								0.000	0.000	0.000
Benz[a]anthracene	56-55-3	2								0.000	0.000	0.000
Chrysene	218-01-9	2								0.000	0.000	0.000
Benzo[a]pyrene	50-32-8	2								0.000	0.000	0.000
Benzo[b] fluoranthene	205-99-2	2								0.000	0.000	0.000
Benzo[ghi]perylene	191-24-2	2								0.000	0.000	0.000
Benzo[k]fluoranthene	207-08-9	2								0.000	0.000	0.000
Dibenz[a,h]anthracene	53-70-3	2								0.000	0.000	0.000
Fluoranthene	206-44-0	2								0.000	0.000	0.000
Fluorene	86-73-7	2								0.000	0.000	0.000
Inden[1,2,3-cd]pyrene	193-39-5	2								0.000	0.000	0.000
Phenanthrene	85-01-8	2								0.000	0.000	0.000
Pyrene	129-00-0	2								0.000	0.000	0.000

Table H.3-2 Air Release Inventory Results: Operation.

Substance Details			Annual Operation Emissions (tonnes per year)					OPERATION PERIOD (30 YRS)
Substance Name	CAS Number	NPRI Part	EMERGENCY GENERATOR	FLARE STACKS	MARINE TRANSPORT	MOBILE EQUIPMENT	TOTAL	
CO	630-08-0	4	4.287	0.767	0.248	1.885	7.187	215.599
SO_2	7446-09-5	4	0.509		0.106	0.676	1.291	38.729
NOx, expressed as NO_2	11104-93-1	4	16.138	0.283	2.171	0.218	18.809	564.276
Total VOCs	*	4	0.413				0.413	12.391
TSP	*	4	0.313	0.031		0.007	0.351	10.541
PM_{10}	*	4	0.250		0.040		0.291	8.718
$PM_{2.5}$	*	4	0.242		0.037		0.279	8.366
NH_3	NA-16	1A		0.667			0.667	20.000
Acetaldehyde	75-07-0	1A	0.000				0.000	0.004
Acrolein	107-08-8	1A	0.000				0.000	0.001
Benzene	71-43-2	1A/5	0.00391		0.000		0.004	0.127
1,3-Butadiene	106-99-0	1A/5					0.000	0.000
Formaldehyde	50-00-0	1A/5	0.000		0.000		0.000	0.013
Naphthalene	91-20-3	1A	0.001		0.000		0.001	0.021
Propylene	115-07-1	1A/5	0.014		0.001		0.015	0.458
Toluene	108-88-3	1A/5	0.001		0.000		0.002	0.046
Xylene (all isomers)	1330-20-7	1A/5	0.001		0.000		0.001	0.032
Mercury (and its compounds)	*	1B					0.000	0.000
Acenaphthene	83-32-9	2	0.000		0.000		0.000	0.001
Acenaphthylene	208-96-8	2	0.000		0.000		0.000	0.002
Anthracene	120-12-7	2	0.000		0.000		0.000	0.000
Benz[a]anthracene	56-55-3	2	0.000		0.000		0.000	0.000
Chrysene	218-01-9	2	0.000		0.000		0.000	0.000
Benzo[a]pyrene	50-32-8	2	0.000		0.000		0.000	0.000
Benzo[b] fluoranthene	205-99-2	2	0.000		0.000		0.000	0.000
Benzo[ghi]perylene	191-24-2	2	0.000		0.000		0.000	0.000
Benzo[k]fluoranthene	207-08-9	2	0.000		0.000		0.000	0.000
Dibenz[a,h]anthracene	53-70-3	2	0.000		0.000		0.000	0.000
Fluoranthene	206-44-0	2	0.000		0.000		0.000	0.001
Fluorene	86-73-7	2	0.000		0.000		0.000	0.002
Inden[1,2,3-cd]pyrene	193-39-5	2	0.000		0.000		0.000	0.000
Phenanthrene	85-01-8	2	0.000		0.000		0.000	0.007
Pyrene	129-00-0	2	0.000		0.000		0.000	0.001
Propane	74-98-6	5		1.299			1.299	38.975

Appendix H.4
Air Release Inventory Calculation Details

CONSTRUCTION - BLASTING

ASSUMPTIONS

Approximately 200,000 m3 of rock will be required to be blasted. Assume that 1.2-1.4 kg explosives per m3 of rock will be required therefore assume 250,000 kg of explosives will be required

Per FEL-1, no explosives shall be required during Argentia Green Fuels Facility construction

Assume that explosive consumption for wind farm construction is split evenly across the two years (i.e., 2025 and 2026)

Assume that minimum blast hole diameter is 65 mm

Blasting Details

Explosive type	Pumped emulsion
Quantity to blast (m^3)	200,000
Explosives per m^3 of rock (kg)	1.2-1.4
Total explosive requirement (kg)	250,000
Bench height (m)	4
Total blast area (m^2)	50,000
Per blast area (m^2)	500
# blasts per year	50

EMISSIONS

Substance	Quantity (tonnes/yr)	EF	Units	Emissions (tonnes/yr)
NOx	125	8	kg/Mg	1.00
CO	125	34	kg/Mg	4.25
SO_2	125	1	kg/Mg	0.125
TSP		2.46	kg/blast	0.123
PM_{10}		1.28	kg/blast	0.064
$PM_{2.5}$		0.07	kg/blast	0.004

https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/pits-quarries-guide.html

CONSTRUCTION - STOCKPILE EROSION

Emission Factor Calculations

$$EF = 1.12 \times 10^{-4} \times J \times 1.7 \times \left(\frac{s}{1.5}\right) \times 365 \times \left(\frac{365 - P}{235}\right) \times \left(\frac{I}{15}\right)$$

Where:
- J = Particulate Aerodynamic Diameter
- s = average silt loading of storage pile (%)
- P = average number of days with at least 0.254 mm of precipitation and/or snow cover
- I = time in year with unobstructed wind speed > 19.3 km/hr (%)

NPRI SOURCE
https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/tools-calculating-emissions/stockpiles-exposed-area-wind-erosion-calculator.html#toc5

Emission Factor Inputs

Constant	Value	Units	Source
J_{TSP}	1.0		NPRI Toolbox
J_{PM10}	0.5		NPRI Toolbox
$J_{PM2.5}$	0.075		NPRI Toolbox
s	0.5	%	Mojave Desert 2013
P	243	days/year	NPRI stockpile and exposed area wind erosion emission calculator and Argentia (AUT) daily and hourly data, 2023
I	61	%	

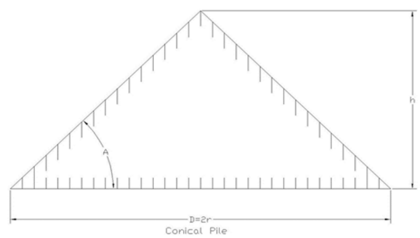
Emission Factors

Size Fraction	EF (kg/m^2)
TSP	4.93E-02
PM_{10}	2.46E-02
$PM_{2.5}$	3.70E-03

Stockpile Parameters

Details & Assumptions

Assume that height (h) of stockpiles will not exceed 10 m, and that stockpiles are conical and composed of gravel (bulk aggregate)
If the angle of repose (A) of gravel is 45°, then the diameter (D) will be 20 m (radius, r=10 m)



Calculations

$$V = \frac{1}{3}\pi r^2 h$$

Where:
- V = volume of stockpile
- r = radius of stockpile
- h = height of stockpile

$$f_s = \frac{1}{4}\pi D^2$$

- f_s = footprint of stockpile
- D = diameter

$$A = \pi r\sqrt{r^2 + h^2}$$

- A = exposed surface area of stockpile
- r = radius of stockpile
- h = height of stockpile

$V_{stockpile}$ (m^3)	1,047
f_s (m^2)	315
A (m^2)	445

ρ_{gravel} (kg/m^3)	1,475

tonnes to m^3 conversion: $Quantity\ (m^3) = \frac{Quantity\ (tonnes)}{\rho\left(\frac{kg}{m^3}\right)} \times \frac{1000\ kg}{tonne}$

STOCKPILES

Inputs

Material	Quantity	Units	# of Stockpiles		
			Total	Year 2	Year 3
Argentia Wind Facility					
Road Base	98,320	m^3	94	47	47
Select Screened Cable Backfill	3,080	m^3	3	2	2
Substation Imported Fill	4,440	m^3	4	2	2
Surfacing Gravel	35,190	m^3	34	17	17
Washed Gravel	1,710	m^3	2	1	1
Argentia Green Fuels Facility					
Class A	6,000	tonnes	4	2	2
Class B	2,600	tonnes	2	1	1

* 0 to reflect that construction will occur across two calendar years rather than three

EMISSIONS

Emissions (tonnes)	Argentia Wind Facility					Argentia Green Fuels Facility		TOTAL (tonnes)
	Road Base	Select Screened Cable Backfill	Substation Imported Fill	Surfacing Gravel	Washed Gravel	Class A	Class B	
Year 2								
TSP	1.03	0.03	0.04	0.37	0.02	0.04	0.02	1.57
PM_{10}	0.52	0.02	0.02	0.19	0.01	0.02	0.01	0.78
$PM_{2.5}$	0.08	0.00	0.00	0.03	0.00	0.00	0.00	0.12
Year 3								
TSP	1.03	0.03	0.04	0.37	0.02	0.04	0.02	1.57
PM_{10}	0.52	0.02	0.02	0.19	0.01	0.02	0.01	0.78
$PM_{2.5}$	0.08	0.00	0.00	0.03	0.00	0.00	0.00	0.12

EMISSIONS - COMPONENT SUMMARY BY YEAR

Emissions (tonnes)	Argentia Wind Facility			Argentia Green Fuels Facility		
	Year 2	Year 3	Total	Year 2	Year 3	Total
TSP	1.50	1.50	3.00	0.07	0.07	0.13
PM_{10}	0.75	0.75	1.50	0.03	0.03	0.07
$PM_{2.5}$	0.11	0.11	0.23	0.00	0.00	0.01

EMISSIONS - PROJECT SUMMARY BY YEAR

Emissions (tonnes)	Year 2	Year 3
TSP	1.57	1.57
PM_{10}	0.78	0.78
$PM_{2.5}$	0.12	0.12

CONSTRUCTION - AGGREGATE HANDLING & TRANSFERS

STOCKPILES

Inputs from CONS 2 (Stockpile Erosion)

$V_{stockpile}$ (m^3)	1,047
f_s (m^2)	315
A (m^2)	445
ρ_{gravel} (kg/m^3)	1,475

Supplemental inputs required for aggregate handling calculations

Total qty stored in pile (tonnes)	1,545

Inputs from Stockpile Erosion

Material	Quantity	Units	# of Stockpiles		
			Total	Year 2 (2025)*	Year 3 (2026)*
Argentia Wind Facility					
Road Base	98,320	m3	94	47	47
Select Screened Cable Backfill	3,080	m3	3	2	2
Substation Imported Fill	4,440	m3	4	2	2
Surfacing Gravel	35,190	m3	34	17	17
Washed Gravel	1,710	m3	2	1	1
Argentia Green Fuels Facility					
Class A	6,000	tonnes	4	2	2
Class B	2,600	tonnes	2	1	1

Table 13.2.4-1. TYPICAL SILT AND MOISTURE CONTENTS OF MATERIALS AT VARIOUS INDUSTRIES[a]

Industry	No. Of Facilities	Material	Silt Content (%)			Moisture Content (%)		
			No. Of Samples	Range	Mean	No. Of Samples	Range	Mean
Iron and steel production	9	Pellet ore	13	1.3 - 13	4.3	11	0.64 - 4.0	2.2
		Lump ore	9	2.8 - 19	9.5	6	1.6 - 8.0	5.4
		Coal	12	2.0 - 7.7	4.6	11	2.8 - 11	4.8
		Slag	3	3.0 - 7.3	5.3	3	0.25 - 2.0	0.92
		Flue dust	3	2.7 - 23	13	1	—	7
		Coke breeze	2	4.4 - 5.4	4.9	2	6.4 - 9.2	7.8
		Blended ore	1	—	15	1	—	6.6
		Sinter	1	—	0.7	0	—	—
		Limestone	3	0.4 - 2.3	1.0	2	ND	0.2
Stone quarrying and processing	2	Crushed limestone	2	1.3 - 1.9	1.6	2	0.3 - 1.1	0.7
		Various limestone products	8	0.8 - 14	3.9	8	0.46 - 5.0	2.1
Taconite mining and processing	1	Pellets	9	2.2 - 5.4	3.4	7	0.05 - 2.0	0.9
		Tailings	2	ND	11	1	—	0.4
Western surface coal mining	4	Coal	15	3.4 - 16	6.2	7	2.8 - 20	6.9
		Overburden	15	3.8 - 15	7.5	0	—	—
		Exposed ground	3	5.1 - 21	15	3	0.8 - 6.4	3.4
Coal-fired power plant	1	Coal (as received)	60	0.6 - 4.8	2.2	59	2.7 - 7.4	4.5
Municipal solid waste landfills	4	Sand	1	—	2.6	1	—	7.4
		Slag	2	3.0 - 4.7	3.8	2	2.3 - 4.9	3.6
		Cover	5	5.0 - 16	9.0	5	8.9 - 16	12
		Clay/dirt mix	1	—	9.2	1	—	14
		Clay	2	4.5 - 7.4	6.0	2	8.9 - 11	10
		Fly ash	4	78 - 81	80	4	26 - 29	27
		Misc. fill materials	1	—	12	1	—	11

[a] References 1-10. ND = no data.

EMISSIONS

Emission Factors

Variable	Input	Units	Multiplier*	Substance	EF**	EF Units
Mean Wind Speed	6.860	m/s	0.74	TSP	0.02258	kg/tonne
Material Moisture content	0.700	%	0.35	PM_{10}	0.01068	kg/tonne
Total Quantity Stored in Pile	1544.616	tonnes	0.053	$PM_{2.5}$	0.00162	kg/tonne

* Particle Size Multiplier is constant for each specific particle size range (AP-42, chapter 13.2.4-1, Final report, November 2006).

** EF= Emission Factor for Aggregate Handling activities calculated using equation (1) in AP-42, chapter 13.2.4-1, Final report, November 2006.

Releases per Stockpile

Emissions (tonnes)	Per Stockpile
TSP	0.035
PM_{10}	0.016
$PM_{2.5}$	0.002

Phase	Argentia Wind Facility					Argentia Green Fuels Facility	
Material	Road Base	Select Screened Cable Backfill	Substation Imported Fill	Surfacing Gravel	Washed Gravel	Class A	Class B
# Stockpiles							
Year 2	47	2	2	17	1	2	1
Year 3	47	2	2	17	1	2	1

Emissions (tonnes)	Argentia Wind Facility					Argentia Green Fuels Facility		TOTAL (tonnes)
	Road Base	Select Screened Cable Backfill	Substation Imported Fill	Surfacing Gravel	Washed Gravel	Class A	Class B	
Year 2								
TSP	1.64	0.05	0.07	0.59	0.03	0.07	0.03	2.49
PM_{10}	0.78	0.02	0.03	0.28	0.02	0.03	0.02	1.18
$PM_{2.5}$	0.12	0.00	0.00	0.04	0.00	0.00	0.00	0.18
Year 3								
TSP	1.64	0.05	0.07	0.59	0.03	0.07	0.03	2.49
PM_{10}	0.78	0.02	0.03	0.28	0.02	0.03	0.02	1.18
$PM_{2.5}$	0.12	0.00	0.00	0.04	0.00	0.00	0.00	0.18

*assume that emissions in this table are both in tonnes and tonnes per year

TOTAL	TSP	4.99
	PM_{10}	2.36
	$PM_{2.5}$	0.36

CONSTRUCTION - CRUSHING & SCREENING

ASSUMPTIONS
All required materials will be crushed and screened on site as a conservative estimate
Moisture content of crushed/screened material will be <1.5% (i.e., 0.3-1.1%) therefore emissions assumed to be uncontrolled
https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/pits-quarries-guide.html#crushing

ρ_{gravel} (kg/m^3)	1475

Material	Quanity (tonnes)
Argentia Wind Facility	
Road Base	145,022
Select Screened Cable Backfill	4,543
Substation Imported Fill	6,549
Surfacing Gravel	51,905
Washed Gravel	2,522
Argentia Green Fuels Facility	
Class A	6,000
Class B	2,600
TOTAL	219,142
Annual Aggregate Requirement	109,571

Process	Substance	EF (kg/tonne)	Emissions (tonnes/yr)
Primary Crushing	TSP - Uncontrolled	0.0027	0.296
Primary Crushing	PM_{10} - Uncontrolled	0.0012	0.131
Primary Crushing	$PM_{2.5}$ - Uncontrolled	0.0006	0.066
Secondary Crushing	TSP - Uncontrolled	0.0027	0.296
Secondary Crushing	PM_{10} - Uncontrolled	0.0012	0.131
Secondary Crushing	$PM_{2.5}$ - Uncontrolled	0.0006	0.066
Screening	TSP - Uncontrolled	0.0125	1.370
Screening	PM_{10} - Uncontrolled	0.0043	0.471
Screening	$PM_{2.5}$ - Uncontrolled	0	0.000
Conveyor Transfer Point	TSP - Uncontrolled	0.0015	0.164
Conveyor Transfer Point	PM_{10} - Uncontrolled	0.00055	0.060
Conveyor Transfer Point	$PM_{2.5}$ - Uncontrolled	0	0.000

Total Release

Substance	Emissions (tonnes/yr)	Total (tonnes)
TSP - Uncontrolled	2.126	4.251
PM_{10} - Uncontrolled	0.794	1.589
$PM_{2.5}$ - Uncontrolled	0.131	0.263

CONSTRUCTION - LAYDOWN AREAS

ASSUMPTIONS

Turbine laydown areas and crane pads assume just in time blade delivery, allowance for single blade offload only

Size Fraction	TSP	PM_{10}	$PM_{2.5}$
Emission Factors (kg/m^2)	4.93E-02	2.46E-02	3.70E-03

Laydown Area	Area		Annual Emissions (t/yr)		
	ha	m^2	TSP	PM_{10}	$PM_{2.5}$
Argentia Wind Facility					
Port Laydown & Storage Area	6	60000	2.96	1.48	0.22
Backlands Laydown	5	50000	2.46	1.23	0.18
Argentia Green Fuels Facility					
Laydown 1	0.24	2400	0.12	0.06	0.01
Laydown 2	0.05	500	0.02	0.01	0.00
Laydown 3	0.084	840	0.04	0.02	0.00
Laydown 4	0.3	3000	0.15	0.07	0.01
		TOTAL	5.754	2.877	0.432

CHECK	TOTAL	116740	5.75	2.88	0.43

CONSTRUCTION - UNPAVED ROADS

EMISSION FACTOR

Species	TSP	PM_{10}	$PM_{2.5}$
k (kg/VKT)	1.381	0.423	0.042
a	0.700	0.900	0.900
b	0.450	0.450	0.450

Where
k - constant in kg/VKT from AP-42 Table 13.2.2-2
a & b - constants from AP-42 Table 13.2.2-2 (unitless)
s - surface material silt content (%)
W - mean vehicle weight (metric tons)

Vehicle	Empty (tonnes)	Full (tonnes)	Average	Average
Blade Transport	15	38	26.5	
Other Component Transport*	15	90	52.5	39.5

*Assumes heaviest component

EF	TSP	PM_{10}	$PM_{2.5}$
kg/VKT	3.642	1.043	0.104

EMISSIONS

Project Work Area*	Area Location	Wind Turbine Site Numbers	# Turbines	# components	# blades	# other components
1**	Within the PoA	1-7	6	60	18	42
2	PoA Privately owned land, known as the Backlands	8 - 43	36	360	108	252
3	South from PoA, Moll Point area	44 - 46	3	30	9	21
4	Hilltop, west of the community of Freshwater	47	1	10	3	7
		Total	46	460	138	322

*As defined in Appendix "E" - Transportation Impact Study and Traffic Mgmt Plan
**Turbine 3 does not exist

Area	Segment	Length (km)	# Turbines	# Blade Trips Total	# Blade Trips Annual	Annual Blade VKT	# Other Trips Total	# Other Trips Annual	Annual Other VKT	Total Annual VKT	Dust Control Method (H2O 2x)	Natural Adjustment	TSP Emissions (t/y)	PM10 Emissions (t/y)	PM2.5 Emissions (t/y)
Area 1	1	5.891	6	120	60	353.434	36	18	106.030	459.464	55%	33%	0.308	0.088	0.009
Area 2	1	8.628	8	48	24	207.072	112	56	483.168	690.240	55%	33%	0.462	0.132	0.013
	2	8.767	10	60	30	263.021	200	100	876.735	1139.756	55%	33%	0.763	0.218	0.022
	3	3.559	4	24	12	42.707	56	28	99.651	142.358	55%	33%	0.095	0.027	0.003
	4	3.677	4	24	12	44.130	56	28	102.970	147.099	55%	33%	0.098	0.028	0.003
	5	1.840	3	18	9	16.556	42	21	38.632	55.188	55%	33%	0.037	0.011	0.001
	6	9.261	7	42	21	194.491	98	49	453.812	648.302	55%	33%	0.434	0.124	0.012
Area 3	1	2.340	3	18	9	21.063	42	21	49.148	70.211	55%	33%	0.047	0.013	0.001
Area 4	1	1.385	1	6	3	4.155	14	7	9.696	13.851	55%	33%	0.009	0.003	0.000
												Annual (t/y)	2.254	0.645	0.065

CONSTRUCTION - MOBILE EQUIPMENT

ASSUMPTIONS
Assume 10 hour work days
Assume that usage is across entire construction period, estimated to be 140 weeks/35 months per FEL-1 Section 9.0 (Schedule)
Models selected to estimate rated engine power, conservative assumptions made
Where unit numbers were not specified, assume that usage includes sum of all units required to complete the work

EQUIPMENT DETAILS - Argentia Wind Facility

Type	Net Power (output; hp)	Units	Usage (hrs)
Excavator	108	1	4,500
Support	111	1	1500
Backfill Equip	157	1	7800
Support	160	1	5500
Backfill Equip	162	1	2100
Trucks	173	1	15000
Excavator	188	1	4,200
Excavator	188	1	1,000
Backfill Equip	215	1	8600
Drills	225	1	3600
Trucks	250	1	5,800
Excavator	300	1	6,000
Support	360	1	2000
Trucks	370	1	1,500
Crushing	393	1	2300
Excavator	424	1	12,500
Concrete	425	1	7500
Drills	431	1	3800
Trucks	473	1	10,000
Concrete	485	1	7500
Crushing	541	1	2300
Cranes	544	2	2800
Support	544	1	1200
Cranes	687	2	2450
Trucks	700	1	1,500

Argentia Green Fuels Facility

Equipment	Net Power (output; hp)	Units	Operating Hours	Usage Factor
Backhoe	104	4	3,920	40%
Compactor	157	4	1,960	20%
Bulldozers	215	2	3,920	40%
Pickup Truck	250	4	3,920	40%
Impact Pile Driver	335	2	1,960	20%
Hyd. Rock Breakers	359	2	3,920	40%
Vibratory Hammer	359	2	1,960	20%
Flat Bed Truck	360	4	3,920	40%
Concrete Truck	425	10	3,920	40%
Concrete Pump Truck	485	2	1,960	20%
Crane	544	4	1,568	16%

EMISSION DETAILS - Argentia Wind Facility

Emission Factors

Engine Power [1]	g/hp-hr			lb/hp-hr
	NOx	CO	TSP	SO_2 [2,3]
≥75 to <100	0.3	0	0.01	2.05E-03
≥100 to <175	0.3	3.7	0.01	2.05E-03
≥175 to <300	0.3	2.6	0.01	2.05E-03
≥300 to <600	0.3	2.6	0.01	2.05E-03
≥600 to <750	0.3	2.6	0.01	0.004045
≥750	2.6	2.6	0.03	0.004045

[1] Assume all engines are Tier 4
[2] Diesel fuel EF for SOx for engines < 600 hp retrieved from AP-42 Gasoline and Diesel Industrial Engines, Table 3.3-1
[3] Diesel fuel EF for SOx for engines >600 hp retrieved from AP-42 Large Stationary Diesel and All Stationary Dual-fuel Engines, Table 3.4-1; %S assumed to be 0.5%
** assumes all SOx converted to SO2

Type	Net Power (output; hp)	Units	Usage (hrs)	Emissions (tonnes) NOx	CO	TSP	SO_2
Excavator	108	1	4500	0.1	1.8	0.00	0.45
Support	111	1	1500	0.0	0.6	0.00	0.16
Backfill Equip	157	1	7800	0.4	4.5	0.01	1.14
Support	160	1	5500	0.3	3.3	0.01	0.82
Backfill Equip	162	1	2100	0.1	1.3	0.00	0.32
Trucks	173	1	15000	0.8	9.6	0.03	2.42
Excavator	188	1	4200	0.2	2.1	0.01	0.74
Excavator	188	1	1000	0.1	0.5	0.00	0.18
Backfill Equip	215	1	8600	0.6	4.8	0.02	1.72
Drills	225	1	3600	0.2	2.1	0.01	0.75
Trucks	250	1	5800	0.4	3.8	0.01	1.35
Excavator	300	1	6000	0.5	4.7	0.02	1.68
Support	360	1	2000	0.2	1.9	0.01	0.67
Trucks	370	1	1500	0.2	1.4	0.01	0.52
Crushing	393	1	2300	0.3	2.4	0.01	0.84
Excavator	424	1	12500	1.6	13.8	0.05	4.94
Concrete	425	1	7500	1.0	8.3	0.03	2.97
Drills	431	1	3800	0.5	4.3	0.02	1.53
Trucks	473	1	10000	1.4	12.3	0.05	4.41
Concrete	485	1	7500	1.1	9.5	0.04	3.39
Crushing	541	1	2300	0.4	3.2	0.01	1.16
Cranes	544	2	2800	0.9	7.9	0.03	2.84
Support	544	1	1200	0.2	1.7	0.01	0.61
Cranes	687	2	2450	1.0	8.8	0.03	6.19
Trucks	700	1	1500	2.7	2.7	0.03	1.93
			TOTAL	15.2	117.0	0.4	43.7
			Annual	7.6	58.5	0.2	21.9

EMISSION DETAILS - Argentia Green Fuels Facility

Engine Power [1]	g/hp-hr			lb/hp-hr
	NOx	CO	TSP	SO_2 [2,3]
≥75 to <100	0.3	0	0.01	2.05E-03
≥100 to <175	0.3	3.7	0.01	2.05E-03
≥175 to <300	0.3	2.6	0.01	2.05E-03
≥300 to <600	0.3	2.6	0.01	2.05E-03
≥600 to <750	0.3	2.6	0.01	0.004045
≥750	2.6	2.6	0.03	0.004045

[1] Assume all engines are Tier 4
[2] Diesel fuel EF for SOx for engines < 600 hp retrieved from AP-42 Gasoline and Diesel Industrial Engines, Table 3.3-1
[3] Diesel fuel EF for SOx for engines >600 hp retrieved from AP-42 Large Stationary Diesel and All Stationary Dual-fuel Engines, Table 3.4-1; %S assumed to be 0.5%
** assumes all SOx converted to SO2

Equipment	Net Power (output; hp)	Units	Operating Hours	Emissions (tonnes) NOx	CO	TSP	SO_2
Backhoe	104	4	3920	0.489	6.034	0.016	1.520
Compactor	157	4	1960	0.369	4.554	0.000	1.147
Bulldozers	215	2	3920	0.506	4.383	0.017	1.571
Pickup Truck	250	4	3920	1.176	10.192	0.039	0.659
Impact Pile Driver	335	2	1960	0.394	3.414	0.013	1.224
Hyd. Rock Breakers	359	2	3920	0.844	7.318	0.028	2.623
Vibratory Hammer	359	2	1960	0.422	3.659	0.014	1.311
Flat Bed Truck	360	4	3920	1.693	14.676	0.056	5.260
Concrete Truck	425	10	3920	4.998	43.316	0.167	15.524
Concrete Pump Truck	485	2	1960	0.570	4.943	0.019	1.772
Crane	544	4	1568	1.024	8.871	0.034	3.179
			TOTAL	12.5	111.4	0.4	35.8
			Annual	6.2	55.7	0.2	17.9

ANNUAL EMISSIONS - Construction Period

Project Component	Annual Emissions (tonnes) NOx	CO	TSP	SO_2
Argentia Wind Facility	7.6	58.5	0.2	21.9
Argentia Green Fuels Facility	6.2	55.7	0.2	17.9
Total	13.8	114.2	0.4	39.7

CONSTRUCTION - STATIONARY COMBUSTION

Argentia Wind Facility

Approximately 4.5 million liters will be required for the construction period; approx. 7.5% (5-10% estimated) will be used in stationary equipment. The remaining 92.5% will be burned in mobile equipment

Assume that fuel burn is split evenly across the two years of construction for the Argentia Wind Facility

Fuel Details

Fuel Type	Diesel
Total fuel burn (L)	4,500,000
Stationary fuel burn (L)	337,500

Argentia Green Fuels Facility

Assume that only stationary equipment to be used on site shall be generators and vibratory hammers.

Assumptions will likely result in an overestimate of diesel consumption, which shall account for any diesel used for other small stationary equipment

Generator Details

Equipment [1]	Power Output (kW) [1]	Quantity	Usage Factor	Operating Hours	Diesel Consumption (L)	Annual Diesel Consumption (L)
6 kW light tower generator	6	8	50%	11,760	28,224.00	14,112

[1] Assume comparable to light tower generator (https://www.unitedrentals.com/marketplace/equipment/lighting-equipment/towable-light-towers/towable-light-tower-6kw-generator-4200w-30-ft-vertical-mast-diesel-powered)

EMISSIONS - Argentia Green Fuels Facility & Argentia Wind Facility

Emissions calculation method(s) derived from the Diesel Fuel Generator - Fuel Usage (Up to 600 hp) calculation spreadsheet developped by the NPRI (https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/tools-calculating-emissions/diesel-fuel-generator-fuel-usage.html)

Total fuel burn (L)	365,724
Annual fuel burn (L; 2 yrs)	182,862
HHV_{Diesel} ($GJ \cdot m^{-3}$)	38.184

Substance Name	CAS Number	Emission Factor	EF** Units	EF Rating	Activity Rate (m^3)	Total Release to 3 decimals	Units
Carbon Monoxide (CO)	630-08-0	1.560E+01	kg/m^3	D	182.862	2.852	tonnes
Sulphur Dioxide (SO_2)	7446-09-5	4.761E+00	kg/m^3	D	182.862	0.871	tonnes
NOx, expressed as NO_2	11104-93-1	7.240E+01	kg/m^3	D	182.862	13.238	tonnes
Total VOCs	*	5.910E+00	kg/m^3	D	182.862	1.081	tonnes
Total Suspended Particulate (TSP)	*	5.089E+00	kg/m^3	D	182.862	0.931	tonnes
PM10	*	5.089E+00	kg/m^3	D	182.862	0.931	tonnes
PM2.5	*	5.089E+00	kg/m^3	D	182.862	0.931	tonnes
Acetaldehyde	75-07-0	1.259E-02	kg/m^3	E	182.862	0.002	tonnes
Acrolein	107-08-8	7.592E-04	kg/m^3	E	182.862	0.000	tonnes
Benzene	71-43-2	1.532E-02	kg/m^3	E	182.862	0.003	tonnes
1,3-Butadiene	106-99-0	3.209E-04	kg/m^3	E	182.862	0.000	tonnes
Formaldehyde	50-00-0	1.937E-02	kg/m^3	E	182.862	0.004	tonnes
Naphthalene	91-20-3	1.392E-03	kg/m^3	E	182.862	0.000	tonnes
Propylene	115-07-1	4.235E-02	kg/m^3	E	182.862	0.008	tonnes
Toluene	108-88-3	6.714E-03	kg/m^3	E	182.862	0.001	tonnes
Xylene (all isomers)	1330-20-7	4.679E-03	kg/m^3	E	182.862	0.001	tonnes
Mercury (and its compounds)	*	4.948E-06	kg/m^3	U	182.862	0.000	tonnes
Acenaphthene	83-32-9	1.166E-05	kg/m^3	E	182.862	0.000	tonnes
Acenaphthylene	208-96-8	4.153E-05	kg/m^3	E	182.862	0.000	tonnes
Anthracene	120-12-7	3.070E-05	kg/m^3	E	182.862	0.000	tonnes
Benz[a]anthracene	56-55-3	2.758E-05	kg/m^3	E	182.862	0.000	tonnes
Chrysene	218-01-9	5.795E-06	kg/m^3	E	182.862	0.000	tonnes
Benzo[a]pyrene	50-32-8	1.543E-06	kg/m^3	E	182.862	0.000	tonnes
Benzo[b] fluoranthene	205-99-2	8.134E-07	kg/m^3	E	182.862	0.000	tonnes
Benzo[ghi]perylene	191-24-2	4.014E-06	kg/m^3	E	182.862	0.000	tonnes
Benzo[k]fluoranthene	207-08-9	1.272E-06	kg/m^3	E	182.862	0.000	tonnes
Dibenz[a,h]anthracene	53-70-3	4.785E-06	kg/m^3	E	182.862	0.000	tonnes
Fluoranthene	206-44-0	1.249E-04	kg/m^3	E	182.862	0.000	tonnes
Fluorene	86-73-7	4.794E-04	kg/m^3	E	182.862	0.000	tonnes
Inden[1,2,3-cd]pyrene	193-39-5	3.078E-06	kg/m^3	E	182.862	0.000	tonnes
Phenanthrene	85-01-8	4.826E-04	kg/m^3	E	182.862	0.000	tonnes
Pyrene	129-00-0	7.847E-05	kg/m^3	E	182.862	0.000	tonnes

OPERATION - EMERGENCY GENERATOR

One diesel generator will be required to generate approx. 8 MW of standby (i.e., emergency) power in the event of power loss, maintenance, start up/shut down, etc.
It was assumed that the emergency generator will be used for a maximum of 100 hours per year (i.e., approx 1 day per quarter)
The general rule of thumb that a diesel generator will use 0.4 L of fuel per kWh was applied here in the absence of equipment-specific fuel burn rate.
Default heating value and sulfur content used in calculations.
The default value for sulfur (S) corresponds with Maximum Limits for large stationary engines under the Sulphur in Duesel Fuel Regs (noted in 2022 calculator from NPRI).

INPUTS: Generator & Fuel Details

Power Output (MW)	Operating Hours	Diesel Consumption (m^3)	Heating Value (GJ/m^3)	S content (%)	Heat Input rate (MMBtu/hr)
8	96	307.2	38.184	0.1	115.8

Large Stationary Diesel Engines (>600 hp) [Source: NPRI] NPRI AP-42 Ch 3.4

Emissions

Substance	Emission Factor (kg/m^3)	Annual Emissions (tonnes/year)
Acetaldehyde	4.137E-04	0.000
Acrolein	1.294E-04	0.000
Benzene	1.274E-02	0.004
Formaldehyde	1.295E-03	0.000
Naphtalene	2.134E-03	0.001
Propylene	4.580E-02	0.014
Toluene	4.613E-03	0.001
Xylene (all isomers)	3.168E-03	0.001
Acenaphthene	7.683E-05	0.000
Acenaphthylene	1.515E-04	0.000
Anthracene	2.019E-05	0.000
Benz[a]anthracene	1.021E-05	0.000
Benzo[b]fluoranthene	1.822E-05	0.000
Benzo[k]fluoranthene	1.789E-06	0.000
Benzo[a]pyrene	2.109E-06	0.000
Chrysene	2.512E-05	0.000
Benzo[ghi]perylene	4.564E-06	0.000
Dibenz[a,h]anthracene	2.840E-06	0.000
Fluoranthene	6.616E-05	0.000
Fluorene	2.101E-04	0.000
Indeno[1,2,3-cd]pyrene	3.398E-06	0.000
Phenanthrene	6.698E-04	0.000
Pyrene	6.090E-05	0.000
CO	13.954	4.287
SO_2	1.658	0.509
NOx (expressed as NO_2)	52.532	16.138
Total VOCs	1.344	0.413
TSP	1.018	0.313
PM_{10}	0.814	0.250
$PM_{2.5}$	0.786	0.242

Emission Rates

Substance	Emission Factor (lb/mmBtu)	Emission Rate (g/s)		
		Hourly	Daily	Annual
Acetaldehyde	2.520E-05	3.677E-04	3.677E-04	4.030E-06
Acrolein	7.880E-06	1.150E-04	1.150E-04	1.260E-06
Benzene	7.760E-04	1.132E-02	1.132E-02	1.241E-04
Formaldehyde	7.890E-05	1.151E-03	1.151E-03	1.262E-05
Naphtalene	1.300E-04	1.897E-03	1.897E-03	2.079E-05
Propylene	2.790E-03	4.071E-02	4.071E-02	4.462E-04
Toluene	2.810E-04	4.100E-03	4.100E-03	4.494E-05
Xylene (all isomers)	1.930E-04	2.816E-03	2.816E-03	3.086E-05
Acenaphthene	4.680E-06	6.829E-05	6.829E-05	7.484E-07
Acenaphthylene	9.230E-06	1.347E-04	1.347E-04	1.476E-06
Anthracene	1.230E-06	1.795E-05	1.795E-05	1.967E-07
Benz[a]anthracene	6.220E-07	9.076E-06	9.076E-06	9.947E-08
Benzo[b]fluoranthene	1.110E-06	1.620E-05	1.620E-05	1.775E-07
Benzo[k]fluoranthene	1.090E-07	1.591E-06	1.591E-06	1.743E-08
Benzo[a]pyrene	1.285E-07	1.875E-06	1.875E-06	2.055E-08
Chrysene	1.530E-06	2.233E-05	2.233E-05	2.447E-07
Benzo[ghi]perylene	2.780E-07	4.057E-06	4.057E-06	4.446E-08
Dibenz[a,h]anthracene	1.730E-07	2.524E-06	2.524E-06	2.767E-08
Fluoranthene	4.030E-06	5.881E-05	5.881E-05	6.445E-07
Fluorene	1.280E-05	1.868E-04	1.868E-04	2.047E-06
Indeno[1,2,3-cd]pyrene	2.070E-07	3.021E-06	3.021E-06	3.310E-08
Phenanthrene	4.080E-05	5.954E-04	5.954E-04	6.524E-06
Pyrene	3.710E-06	5.414E-05	5.414E-05	5.933E-07
CO	0.8500	12.403	12.403	0.136
SO_2 (expressed as SOx)	0.1010	1.474	1.474	0.016
NOx (expressed as NO_2)	3.2000	46.695	46.695	0.512
Total VOCs	0.0900	1.313	1.313	0.014
TSP	0.0620	0.905	0.905	0.010
PM_{10}	0.0496	0.724	0.724	0.008
$PM_{2.5}$	0.0479	0.699	0.699	0.008

OPERATION - FLARE STACKS

INPUTS

Flare Details

	Process Flare	Tank Flare
Destruction Efficiency (%)	0.98	0.98
Flare Volumetric Flow Rate (m^3/hr) [1]	72.7	72.7
Pilot Volumetric Flow Rate (m^3/hr) [2]	2.18	2.18
Pilot Mass Flow Rate (kg/hr)	3.71	3.71
Density of propane (kg/m^3) [3]	1.7	1.7
Pilot operation (hr/yr)	8760	8760
Annual fuel consumption (m^3/yr)	19,106	19,106
Annual fuel consumption (L/yr)	19,105,560	19,105,560

[1] As per FEL-1 Heat & Materials Balance for Flare Gas
[2] Assumed to be 3% of volumetric flow rate of flare (USEPA 2012)
[3] Engineering toolbox

Emission Factors - Thermal NOx

Species	EF	Units	EF Source
NOx	0.068	lb/10^6 Btu	TCEQ 2022
CO	0.5496	lb/10^6 Btu	TCEQ 2022
TSP	0.82312	kg/10^3 m^3 fuel	M&J 2012

Emission Factors - Fuel NOx

Species	EF	Units	EF Source
NOx	0.005	kg NOx/kg NH_3	TCEQ 2021

[1] EF retrieved from TCEQ 2021 sample calculations

Supplementary Data

Destruction Efficiency	0.98
Uncombusted	0.02
BTU/MJ (conversion)	947.82

Fuel Details

Species	HHV (MJ/kg)
C_3H_8	50.4
NH_3	22.5

EMISSIONS

Flare	Species Combusted	Flow Rate (kg/hr)[1]	Annual Operating Hours	Annual Emissions (tonnes/year)				
				NOx	CO	TSP	C_3H_8	NH_3
Continuous Pilots								
NH_3 Flare Unit (Process Flare)	C_3H_8	3.71	8,760	4.75E-02	3.84E-01	1.57E-02	0.650	
NH_3 Tank Flare Unit (Tank Flare)	C_3H_8	3.71	8,760	4.75E-02	3.84E-01	1.57E-02	0.650	
Intermittent Releases [3]								
NH_3 Flare Unit (Process Flare)	NH_3	16,667	1	9.42E-02				0.333
NH_3 Tank Flare Unit (Tank Flare)	NH_3	16,667	1	9.42E-02				0.333

[1] Continous pilot flow rates and intermittent releases from FEL-1
[2] Assume that both flows are comprised of 100% species combusted
[3] Assume that 1-hour worth of production could be released over a 1-hour period

EMISSION RATES

Flare	Species Combusted	Flow Rate (kg/hr)[1]	Annual Operating Hours	Emission Rate (g/s)														
				Hourly					Daily					Annual				
				NOx	CO	TSP	C_3H_8	NH_3	NOx	CO	TSP	C_3H_8	NH_3	NOx	CO	TSP	C_3H_8	NH_3
Continuous Pilots																		
NH3 Flare Unit (Process Flare)	C_3H_8	3.71	8,760	1.51E-03	1.22E-02	4.99E-01	2.06E-02		1.51E-03	1.22E-02	4.99E-01	2.06E-02		1.51E-03	1.22E-02	4.99E-01	2.06E-02	
NH3 Tank Flare Unit (Tank Flare)	C_3H_8	3.71	8,760	1.51E-03	1.22E-02	4.99E-01	2.06E-02		1.51E-03	1.22E-02	4.99E-01	2.06E-02		1.51E-03	1.22E-02	4.99E-01	2.06E-02	
Intermittent Releases [3]																		
NH3 Flare Unit (Process Flare)	NH_3	16,667	1	26.2				92.6	1.09				3.86	2.99E-03				1.06E-02
NH3 Tank Flare Unit (Tank Flare)	NH_3	16,667	1	26.2				92.6	1.09				3.86	2.99E-03				1.06E-02

[1] Continous pilot flow rates and intermittent releases from FEL-1
[2] Assume that both flows are comprised of 100% species combusted
[3] Assume that 1-hour worth of production could be released over a 1-hour period

OPERATION - MARINE TRANSPORT

SNC FEL assumes that ship loading for NH3 off takers occurs once a month using a small-medium ammonia ship carrier

AQ releases are estimated for within-project area impacts rather than entire marine shipping route (Guidance Doc does not stipulate the requirement of AQ release accounting outside of the project boundary)

Calculations conducted for emissions on a tonnes per year basis; emission rates were not used.

INPUTS, PARAMETERS & EMISSION FACTORS

Fuel Details

Type	Marine Gas Oil (MGO)
Density (kg/L)	0.855
Sulfur content (%)	0.10
HHV (kWh/kg) [1]	12.75

[1] Source: https://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html

Vessel Details

Type	LPG Tanker Clipper Eirene
Main Engine RPM	112.7
Engine Speed Designation	Slow (<130 RPM)
NH3 Capacity (tonnes)	14129
Main Engine Power (kW)	7100
AUX Engine Power (kW)	4200
Boiler Engine Power (kW)	482
Maneuvering Time (hr) [1]	1
Hotelling Time (hr) [2]	15

[1] Maneuvering time assumed to be 1 hour based on the short distance the vessel is required to travel from the Marine Entrance/Port Authority (MEPA) to the offtake jetty

[2] Hotelling time (rounded to nearest integer) based on tank capacities and loading rate of LPG Tanker

Vessel Time Details

Vessels per trip	1
Trips per year	12
Maneuvering Time per year	12
Hotelling Time per year	180
Total Vessel Time per year	192

Fuel Consumption - Clipper Eirene

Component	Fuel Consumption			
	ton/day	tonne/hr	L/hr	m^3/hr
Main Engine	22	0.8316	972.6	0.9726
AUX, Loading	9	0.3402	397.9	0.3979
SO_2	6	0.2268	265.3	0.2653
NOx (expressed as NO_2)	4	0.1512	176.8	0.1768
Boiler	1	0.0378	44.2	0.0442

[1] Equivalent to average consumption for loaded condition; assume that idle consumption=maneuvering consumption

Emission Factors (g/kWh)	Maeuvering		Hotelling	Boiler
	Main Engine	AUX Engine		(kg/m^3)
Time per mode (hr/yr)	12	12	180	192
Tanker Load Factor	0.07	0.33	0.26	0.6
NOx	14.4	9.7	9.7	2.4
CO	1.40	1.1	1.1	0.6
SO2	0.36	0.42	0.42	1.7
PM10	0.19	0.18	0.18	0.12
PM2.5	0.14	0.17	0.17	0.03
HC	0.60	0.40	0.40	-
TSP	0.19	0.18	0.18	0.12

[1] Tier II NOx limit used as a conservative estimate

[2] Hotelling auxiliary engine EFs retrieved from Table 2-16 (MGO, 0.10% S) of Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories: Ocean Going Vessels (https://www.epa.gov/sites/default/files/2016-06/documents/2009-port-inventory-guidance.pdf)

[3] EF for SOx, assume 100% SO2

[4] No EF for TSP, assume equal to PM10

[5] Main engine EFs retreived from Table 2-9 (EFs for Ocean Going Vessel Main Engines, slow-speed diesel (SSD))

[6] AUX Engine Load Factors retreived from Table 2-7 (Auxiliary Engine Load Factor Assumptions, Tanker)

[7] Boiler EFS retrieved from AP-42 Chapter 1.3 Fuel Oil Combustion (External Combustion Sources) Tables 1.3-1 & 1.3-6. Boilers < 100 MBtu/hr, distillate oil fired

[8] No Load Factor for main engine during hotelling as main engine is not in use

Emission Factors - Speciated Organics & PAHs - Clipper Eirene (w/ 0.1% S MGO)

Contaminant	EF (lb/MMBtu)	EF (kg/kWh)
Benzene	7.76E-04	1.20E-06
Toluene	2.81E-04	4.36E-07
Xylenes	1.93E-04	2.99E-07
Propylene	2.79E-03	4.33E-06
Formaldehyde	7.89E-05	1.22E-07
Acetaldehyde	2.52E-05	3.91E-08
Acrolein	7.88E-06	1.22E-08
Naphthalene	1.30E-04	2.02E-07
Acenaphthylene	9.23E-06	1.43E-08
Acenaphthene	4.68E-06	7.26E-09
Fluorene	1.28E-05	1.99E-08
Phenanthrene	4.08E-05	6.33E-08
Anthracene	1.23E-06	1.91E-09
Fluoranthene	4.03E-06	6.25E-09
Pyrene	3.71E-06	5.75E-09
Benz(a)anthracene	6.22E-07	9.65E-10
Chrysene	1.53E-06	2.37E-09
Benzo(b)fluoranthene	1.11E-06	1.72E-09
Benzo(k)fluoranthene	2.18E-07	3.38E-10
Benzo(a)pyrene	2.57E-07	3.99E-10
Indeno(1,2,3-cd)pyrene	4.14E-07	6.42E-10
Dibenz(a,h)anthracene	3.46E-07	5.37E-10
Benzo(g,h,l)perylene	5.56E-07	8.62E-10
Total PAH	2.12E-04	3.29E-07

SOURCE: USEPA AP-42 Table 3.4-3 & 4 Efs for Large Uncontrolled Stationary Diesel Engines (https://www.epa.gov/sites/default/files/2020-10/documents/c03s04.pdf)

ANNUAL & DAILY EMISSIONS

Emission calculations followed methodology set out in the DRAFT TECHNICAL GUIDE RELATED TO THE STRATEGIC ASSESSMENT OF CLIMATE CHANGE (Equation 3)

ANNUAL EMISSIONS - CACs

Contaminant	Emissions (tonnes/yr)				Total Annual Emissions (t/yr)	Total Annual Emissions (kg/yr)
	Maeuvering		Hotelling	Boiler		
	Main Engine	AUX Engine	AUX Engine			
NOx	0.082	0.161	1.907	0.020	2.171	2170.6
CO	0.008	0.018	0.216	0.005	0.248	247.6
SO2	0.002	0.007	0.083	0.014	0.106	106.1
PM10	0.001	0.003	0.035	0.001	0.040	40.5
PM2.5	0.001	0.003	0.033	0.000	0.037	37.3
HC (hydrocarbons)	0.003	0.007	0.079	-	0.089	88.7

DAILY EMISSIONS - CACs

Contaminant	Emissions (tonnes/day)				Total Daily Emissions (t/yr)	Total Daily Emissions (kg/yr)	CHECK
	Maeuvering		Hotelling	Boiler			
	Main Engine	AUX Engine	AUX Engine				
NOx	0.007	0.013	0.159	0.002	0.181	180.9	2170.6
CO	0.001	0.002	0.018	0.000	0.021	20.6	247.6
SO2	0.000	0.001	0.007	0.001	0.009	8.8	106.1
PM10	0.000	0.000	0.003	0.000	0.003	3.4	40.5
PM2.5	0.000	0.000	0.003	0.000	0.003	3.1	37.3
HC	0.000	0.001	0.007	-	0.007	7.4	88.7

ANNUAL EMISSIONS - Speciated Organics & PAHs

Contaminant	Emissions (tonnes/yr)				Total Annual Emissions (t/yr)	Total Annual Emissions (kg/yr)
	Maeuvering		Hotelling	Boiler		
	Main Engine	AUX Engine	AUX Engine			
Benzene	6.875E-06	2.002E-05	2.366E-04	6.682E-05	3.303E-04	3.303E-01
Toluene	2.490E-06	7.248E-06	8.566E-05	2.420E-05	1.196E-04	1.196E-01
Xylenes	1.710E-06	4.978E-06	5.884E-05	1.662E-05	8.214E-05	8.214E-02
Propylene	2.472E-05	7.197E-05	8.505E-04	2.402E-04	1.187E-03	1.187E+00
Formaldehyde	6.990E-07	2.035E-06	2.405E-05	6.794E-06	3.358E-05	3.358E-02
Acetaldehyde	2.233E-07	6.500E-07	7.682E-06	2.170E-06	1.073E-05	1.073E-02
Acrolein	6.981E-08	2.033E-07	2.402E-06	6.785E-07	3.354E-06	3.354E-03
Naphthalene	1.152E-06	3.353E-06	3.963E-05	1.119E-05	5.533E-05	5.533E-02
Acenaphthylene	8.177E-08	2.381E-07	2.814E-06	7.948E-07	3.928E-06	3.928E-03
Acenaphthene	4.146E-08	1.207E-07	1.427E-06	4.030E-07	1.992E-06	1.992E-03
Fluorene	1.134E-07	3.302E-07	3.902E-06	1.102E-06	5.448E-06	5.448E-03
Phenanthrene	3.615E-07	1.052E-06	1.244E-05	3.513E-06	1.737E-05	1.737E-02
Anthracene	1.090E-08	3.173E-08	3.750E-07	1.059E-07	5.235E-07	5.235E-04
Fluoranthene	3.570E-08	1.040E-07	1.229E-06	3.470E-07	1.715E-06	1.715E-03
Pyrene	3.287E-08	9.570E-08	1.131E-06	3.195E-07	1.579E-06	1.579E-03
Benz(a)anthracene	5.511E-09	1.604E-08	1.896E-07	5.356E-08	2.647E-07	2.647E-04
Chrysene	1.356E-08	3.947E-08	4.664E-07	1.317E-07	6.512E-07	6.512E-04
Benzo(b)fluoranthene	9.834E-09	2.863E-08	3.384E-07	9.558E-08	4.724E-07	4.724E-04
Benzo(k)fluoranthene	1.931E-09	5.623E-09	6.646E-08	1.877E-08	9.278E-08	9.278E-05
Benzo(a)pyrene	2.277E-09	6.629E-09	7.835E-08	2.213E-08	1.094E-07	1.094E-04
Indeno(1,2,3-cd)pyrene	3.668E-09	1.068E-08	1.262E-07	3.565E-08	1.762E-07	1.762E-04
Dibenz(a,h)anthracene	3.065E-09	8.925E-09	1.055E-07	2.979E-08	1.473E-07	1.473E-04
Benzo(g,h,i)perylene	4.926E-09	1.434E-08	1.695E-07	4.788E-08	2.366E-07	2.366E-04
Total PAH	1.878E-06	5.469E-06	6.463E-05	1.825E-05	9.023E-05	9.023E-02

DAILY EMISSIONS - Speciated Organics & PAHs

Contaminant	Emissions (tonnes/yr)				Total Annual Emissions (t/yr)	Total Annual Emissions (kg/yr)	CHECK
	Maeuvering		Hotelling	Boiler			
	Main Engine	AUX Engine	AUX Engine				
Benzene	5.729E-07	1.668E-06	1.971E-05	5.568E-06	2.752E-05	2.752E-02	3.303E-01
Toluene	2.075E-07	6.040E-07	7.139E-06	2.016E-06	9.966E-06	9.966E-03	1.196E-01
Xylenes	1.425E-07	4.149E-07	4.903E-06	1.385E-06	6.845E-06	6.845E-03	8.214E-02
Propylene	2.060E-06	5.997E-06	7.088E-05	2.002E-05	9.896E-05	9.896E-02	1.187E+00
Formaldehyde	5.825E-08	1.696E-07	2.004E-06	5.662E-07	2.798E-06	2.798E-03	3.358E-02
Acetaldehyde	1.861E-08	5.417E-08	6.402E-07	1.808E-07	8.938E-07	8.938E-04	1.073E-02
Acrolein	5.818E-09	1.694E-08	2.002E-07	5.654E-08	2.795E-07	2.795E-04	3.354E-03
Naphthalene	9.598E-08	2.794E-07	3.303E-06	9.328E-07	4.611E-06	4.611E-03	5.533E-02
Acenaphthylene	6.814E-09	1.984E-08	2.345E-07	6.623E-08	3.274E-07	3.274E-04	3.928E-03
Acenaphthene	3.455E-09	1.006E-08	1.189E-07	3.358E-08	1.660E-07	1.660E-04	1.992E-03
Fluorene	9.450E-09	2.751E-08	3.252E-07	9.185E-08	4.540E-07	4.540E-04	5.448E-03
Phenanthrene	3.012E-08	8.770E-08	1.036E-06	2.928E-07	1.447E-06	1.447E-03	1.737E-02
Anthracene	9.081E-10	2.644E-09	3.125E-08	8.826E-09	4.363E-08	4.363E-05	5.235E-04
Fluoranthene	2.975E-09	8.663E-09	1.024E-07	2.892E-08	1.429E-07	1.429E-04	1.715E-03
Pyrene	2.739E-09	7.975E-09	9.425E-08	2.662E-08	1.316E-07	1.316E-04	1.579E-03
Benz(a)anthracene	4.592E-10	1.337E-09	1.580E-08	4.463E-09	2.206E-08	2.206E-05	2.647E-04
Chrysene	1.130E-09	3.289E-09	3.887E-08	1.098E-08	5.427E-08	5.427E-05	6.512E-04
Benzo(b)fluoranthene	8.195E-10	2.386E-09	2.820E-08	7.965E-09	3.937E-08	3.937E-05	4.724E-04
Benzo(k)fluoranthene	1.609E-10	4.686E-10	5.538E-09	1.564E-09	7.732E-09	7.732E-06	9.278E-05
Benzo(a)pyrene	1.897E-10	5.524E-10	6.529E-09	1.844E-09	9.115E-09	9.115E-06	1.094E-04
Indeno(1,2,3-cd)pyrene	3.057E-10	8.899E-10	1.052E-08	2.971E-09	1.468E-08	1.468E-05	1.762E-04
Dibenz(a,h)anthracene	2.555E-10	7.438E-10	8.790E-09	2.483E-09	1.227E-08	1.227E-05	1.473E-04
Benzo(g,h,l)perylene	4.105E-10	1.195E-09	1.412E-08	3.990E-09	1.972E-08	1.972E-05	2.366E-04
Total PAH	1.565E-07	4.557E-07	5.386E-06	1.521E-06	7.519E-06	7.519E-03	9.023E-02

EMISSION RATES

Emission Rates - CACs

Contaminant	Hourly Emission Rates (g/s)				Total Hourly Maximum Emissions (g/s)
	Maeuvering		Hotelling	Boiler	
	Main Engine	AUX Engine	AUX Engine		
NOx	1.904	3.735	2.942	0.018	8.599
CO	0.185	0.424	0.334	0.004	0.947
SO2	0.048	0.162	0.127	0.013	0.349
PM10	0.025	0.069	0.055	0.001	0.150
PM2.5	0.019	0.065	0.052	0.000	0.136
HC	0.079	0.154	0.121	-	0.355

Emission Rates - Speciated Organics & PAHs

Contaminant	Hourly Emission Rates (g/s)				Total Hourly Maximum Emissions (g/s)
	Maeuvering		Hotelling	Boiler	
	Main Engine	AUX Engine	AUX Engine		
Benzene	2.180E-08	1.951E-08	3.458E-08	8.868E-09	8.476E-08
Toluene	7.894E-09	7.065E-09	1.252E-08	3.211E-09	3.069E-08
Xylenes	5.422E-09	4.852E-09	8.602E-09	2.206E-09	2.108E-08
Propylene	7.838E-08	7.014E-08	1.243E-07	3.188E-08	3.048E-07
Formaldehyde	2.217E-09	1.984E-09	3.516E-09	9.016E-10	8.618E-09
Acetaldehyde	7.080E-10	6.336E-10	1.123E-09	2.880E-10	2.753E-09
Acrolein	2.214E-10	1.981E-10	3.512E-10	9.005E-11	8.607E-10
Naphthalene	3.652E-09	3.268E-09	5.794E-09	1.486E-09	1.420E-08
Acenaphthylene	2.593E-10	2.321E-10	4.114E-10	1.055E-10	1.008E-09
Acenaphthene	1.315E-10	1.177E-10	2.086E-10	5.348E-11	5.112E-10
Fluorene	3.596E-10	3.218E-10	5.705E-10	1.463E-10	1.398E-09
Phenanthrene	1.146E-09	1.026E-09	1.818E-09	4.663E-10	4.457E-09
Anthracene	3.456E-11	3.092E-11	5.482E-11	1.406E-11	1.344E-10
Fluoranthene	1.132E-10	1.013E-10	1.796E-10	4.605E-11	4.402E-10
Pyrene	1.042E-10	9.327E-11	1.653E-10	4.240E-11	4.052E-10
Benz(a)anthracene	1.747E-11	1.564E-11	2.772E-11	7.108E-12	6.794E-11
Chrysene	4.298E-11	3.847E-11	6.819E-11	1.748E-11	1.671E-10
Benzo(b)fluoranthene	3.118E-11	2.791E-11	4.947E-11	1.268E-11	1.212E-10
Benzo(k)fluoranthene	6.124E-12	5.481E-12	9.716E-12	2.491E-12	2.381E-11
Benzo(a)pyrene	7.220E-12	6.461E-12	1.145E-11	2.937E-12	2.807E-11
Indeno(1,2,3-cd)pyrene	1.163E-11	1.041E-11	1.845E-11	4.731E-12	4.522E-11
Dibenz(a,h)anthracene	9.720E-12	8.699E-12	1.542E-11	3.954E-12	3.779E-11
Benzo(g,h,l)perylene	1.562E-11	1.398E-11	2.478E-11	6.354E-12	6.073E-11
Total PAH	5.956E-09	5.330E-09	9.448E-09	2.423E-09	2.316E-08

OPERATION - MOBILE EQUIPMENT

Mobile equipment during operation phase anticipated to be limited to light duty pickup trucks
Assume that approximately half of the hwy truck/light vehcile (LV) requirement estimated for the Argentia Wind Facility construction phase will be used for the operation phase

LV Details

Annual LV use (hr)	2900
Daily LV used (hr)	8
Vehicle speed (km/hr)	40
Fuel rating (L/km) [1]	0.15
Annual fuel consumption (L)	17400
Engine power (hp) [2]	250

[1] Fuel rating retrieved from: https://fcr-ccc.nrcan-rncan.gc.ca/en?_gl=1*14vg18q*_ga*MzIzMzA2MjkxLjE3MDkwNTg1MTg.*_ga_C2N57Y7DX5*MTcwOTkwODUwNC40LjAuMTcwOTkwODUwNC4wLjAuMA.

[2] Assume all engines are Tier 4; Diesel fuel for SOx for engines < 600 hp retrieved from AP-42 Gasoline and Diesel Industrial Engines, Table 3.3-1

EMISSIONS

			Emission Factors				Annual Emissions			
Vehicle Type	Engine Power (hp)	Annual LV Use (hr)	g/hp-hr			lb/hp-hr	tonnes			
			NOx	CO	TSP	SO_2	NOx	CO	TSP	SO_2
Highway Truck	250	2900	0.3	2.6	0.01	2.05E-03	0.218	1.885	0.007	0.676

** assumes all SOx converted to SO2

Appendix H.5
Air Dispersion Modelling Emission Rates

Table H.5-1 Air Dispersion Modelling Emission Rates: Operation

Air Contaminant	Hourly (g/s)					Daily (g/s)					Annual (g/s)				
	Tank Flare - Pilot	NH_3 Flare - Pilot	Emergency Generator	Tank Flare - NH_3 Release	NH_3 Flare - NH_3 Release	Tank Flare - Pilot	NH_3 Flare - Pilot	Emergency Generator	Tank Flare - NH_3 Release	NH_3 Flare - NH_3 Release	Tank Flare - Pilot	NH_3 Flare - Pilot	Emergency Generator	Tank Flare - NH_3 Release	NH3 Flare - NH_3 Release
Modelled [subject to APCR]															
CO	1.217E-02	1.22E-02	12.403			1.217E-02	1.217E-02	12.403			1.217E-02	1.217E-02	1.359E-01		
SO_2			1.474					1.474					1.615E-02		
NOx	1.505E-03	1.51E-03	46.695	26.200	26.200	1.505E-03	1.505E-03	46.695	1.090	1.090	1.505E-03	1.505E-03	5.117E-01	2.990E-03	2.990E-03
TSP	4.987E-01	4.99E-01	9.047E-01			4.987E-01	4.987E-01	0.905			4.987E-01	4.987E-01	9.915E-03		
PM_{10}			7.238E-01					0.724					7.932E-03		
$PM_{2.5}$			6.990E-01					0.699					7.660E-03		
NH_3				92.600	92.600				3.860	3.860				1.060E-02	1.060E-02
Not Modelled [not subject to APCR; provided for illustrative purposes]															
Benzene			1.132E-02					1.132E-02					1.241E-04		
Acetaldehyde			3.677E-04					3.677E-04					4.030E-06		
Acrolein			1.150E-04					1.150E-04					1.260E-06		
Formaldehyde			1.151E-03					1.151E-03					1.262E-05		
Naphthalene			1.897E-03					1.897E-03					2.079E-05		
Propylene			4.071E-02					4.071E-02					4.462E-04		
Benzo[a]pyrene			1.875E-06					1.875E-06					2.055E-08		
Acenaphthene			6.829E-05					6.829E-05					7.484E-07		
Acenaphthylene			1.347E-04					1.347E-04					1.476E-06		
Anthracene			1.795E-05					1.795E-05					1.967E-07		
Benz[a]anthracene			9.076E-06					9.076E-06					9.947E-08		
Chrysene			2.233E-05					2.233E-05					2.447E-07		
Benzo[b]fluoranthene			1.620E-05					1.620E-05					1.775E-07		
Benzo[ghi]perylene			4.057E-06					4.057E-06					4.446E-08		
Benzo[k]fluoranthene			1.591E-06					1.591E-06					1.743E-08		
Dibenz[a,h]anthracene			2.524E-06					2.524E-06					2.767E-08		
Fluoranthene			5.881E-05					5.881E-05					6.445E-07		
Fluorene			1.868E-04					1.868E-04					2.047E-06		
Inden[1,2,3-cd]pyrene			3.021E-06					3.021E-06					3.310E-08		
Phenanthrene			5.954E-04					5.954E-04					6.524E-06		
Pyrene			5.414E-05					5.414E-05					5.933E-07		
Propane	2.060E-02	2.060E-02				2.060E-02	2.060E-02				2.060E-02	2.060E-02			