# Actual Deployment Potential of Atlantic Canada Offshore Wind

January 2026 Report

Stantec

Energy+Environmental Economics

## Phase Two Results

net-zero atlantic

Atlantic Canada Offshore Wind Grid Integration and Transmission Study

# ACKNOWLEDGEMENTS

The Atlantic Canada Offshore Wind Grid Integration and Transmission Study is a research project developed and led by Net Zero Atlantic. The research is conducted by Stantec in partnership with Energy and Environmental Economics (E3). The project is supported by funding from Natural Resource Canada's Office of Energy Research and Development through the Energy Innovation Program.

Canada

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Letter from Net Zero Atlantic

Net Zero Atlantic is pleased to share the findings from Phase 2 of the Atlantic Canada Offshore Wind Grid Integration and Transmission Study.

Following the Market Opportunities report released in June 2025, this report highlights the technical, locational, economic, and deployment potential of offshore wind in Atlantic Canada. It will be accompanied by a publicly accessible base and visual interface tools, to be released in early Spring 2026. This will provide access to data used and developed during this phase of the project.

Support for this work was provided by Natural Resources Canada's Office of Energy Research and Development through the Energy Innovation Program.

We also thank consultants Stantec and Energy and Environmental Economics (E3) for their expertise and collaboration in undertaking this work and in delivering this comprehensive report. Net Zero Atlantic further acknowledges the valuable input and guidance provided by provincial governments and electric utility representatives who participated on the project management and technical committees.

Work is currently underway on the project's final phase – the Grid Integration Study – which will develop a transmission expansion plan for integrating offshore wind and builds on the insights from phases 1 and 2. We look forward to sharing these results over the coming months.

For more information on the study, including updates on remaining work, we invite readers to visit Net Zero Atlantic's website.

Thank you for your continued interest in this important study.

Kiera Walsh, Project Manager
Sven Scholtysik, Research Director
Net Zero Atlantic

# Revision Schedule

| Revision | Description | Author | Date | Quality Check | Date | Independent Review | Date |
|---|---|---|---|---|---|---|---|
| D1 | Draft | D. Pantoja | September 26, 2025 | J. Moran | September 29, 2025 | J. Crowther<br>I. Shaw | October 1, 2025 |
| F1 | Final | D. Pantoja | December 19, 2025 | N. Grady<br>J. Moran | Nov 12, 2025 | E. Wicks<br>K. Walsh<br>Project & Technical Management Committees | December 4, 2025 |

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Prepared by:

Signature

Daniela Pantoja, M. Eng.

Reviewed by:

Signature

Joaquin Moran, PhD, P. Eng.

Approved by

Signature

Ivor Shaw, P. Eng.

# Executive Summary

Atlantic Canada is uniquely positioned to become a North American leader in offshore wind energy, with world-class wind resources, favourable bathymetry, and proximity to major domestic and export markets. This report provides a comprehensive assessment of the region's actual offshore wind deployment potential, synthesizing technical, locational, economic, and policy factors across Nova Scotia, Newfoundland and Labrador, New Brunswick, and Prince Edward Island. This report is a key deliverable of Phase 2: Offshore Wind Resource Potential of the *Atlantic Canada Offshore Wind Grid Integration and Transmission Study*, facilitated and managed by Net Zero Atlantic and funded by Natural Resources Canada.

This report focuses on the Actual Deployment potential of offshore wind in Atlantic Canada and describes the analytical pathway used to progress from resource availability to realistic build-out outcomes. The assessment distinguishes between four levels of offshore wind potential. Technical Potential represents the full theoretical offshore wind resource and associated energy yield based on wind conditions and turbine performance. Locational Potential narrows this resource to areas that are physically and regulatorily feasible after applying bathymetric, environmental, and spatial constraints. Economic Potential further refines these areas to those that are cost-competitive under assumed capital and infrastructure conditions. Actual Deployment reflects the portion of the resource that could potentially be developed, accounting for economic factors, demand growth, grid integration capability, policy frameworks, and social and environmental considerations.

The methodology used for this *Actual Deployment Potential of Atlantic Canada Offshore Wind* report integrated advanced wind resource modelling, geospatial constraint mapping, economic benchmarking, and scenario-based market assessments. High-resolution atmospheric simulations were conducted using Weather Research and Forecasting (WRF) modelling and Computational Fluid Dynamics (CFD) modelling to characterize wind speeds and energy yields across the study area. These were combined with detailed bathymetric and environmental datasets to identify technically and locationally feasible areas for offshore wind development. Geographic Information Systems (GIS) were used to apply regulatory, ecological, and social constraints, while economic screening incorporated capital and operating cost benchmarks from leading industry sources. Finally, deployment scenarios were modelled based on varying demand conditions identified in the project's Phase 1 Report, *Market Opportunities for Offshore Wind in Atlantic Canada*[1] – including domestic consumption, export opportunities, and hydrogen production – to estimate realistic build-out levels across Atlantic Canada.

The Actual Deployment Potential of Atlantic Canada Offshore Wind analysis generated the following key findings:

- Resource Abundance: The region's technical offshore wind potential is immense, with hundreds of gigawatts identified across nearshore and offshore waters. High-resolution modelling confirms average wind speeds at 120 m hub height consistently exceed 9-11 m/s, supporting net capacity factors of 50-60% – among the highest globally.

[1] Market Opportunities for Offshore Wind in the Atlantic Provinces

- Buildable Area and Technology: After applying environmental, regulatory, and technical constraints, tens of gigawatts of feasible capacity remain, distributed between fixed-bottom and floating foundation technologies. Nova Scotia and Prince Edward Island are well-positioned for early fixed-bottom projects, while Newfoundland and Labrador offer vast floating wind opportunities.
- Economic and Market Drivers: Actual deployment will be governed by economics, infrastructure readiness, and demand growth. Cost-competitiveness, grid interconnection, and the scale of domestic and export markets (including hydrogen production or other high electricity demand industries) are critical determinants.

**Provincial Highlights**: Each of the four Atlantic Provinces presents unique offshore wind opportunities based on raw technical and locational potential, which reflects the **theoretical capacities** before accounting for economic viability, market demand, permitting constraints, or infrastructure readiness.

- Newfoundland and Labrador has the largest overall technical potential, estimated at ~473 GW, primarily driven by deepwater floating wind opportunities. While much of this potential is located farther offshore, it presents significant long-term export opportunities. However, realizing this scale will depend heavily on future infrastructure and market conditions.
- Nova Scotia offers a strong and balanced offshore wind profile with a strong mix of fixed-bottom and floating wind resources. The province has an estimated technical potential of approximately 434 GW. Notably, around 40 GW of this capacity is located within the Wind Energy Areas (NS Draft WEAs) currently designated by the Canada-Nova Scotia Offshore Energy Regulator (CNSOER), positioning Nova Scotia as a key player in early-stage development.
- New Brunswick has a more moderate technical potential of ~37 GW, with most of its resource located in deeper waters suitable for floating wind. While not as expansive as NS or NL, New Brunswick's offshore wind potential could support targeted projects that complement regional energy strategies.
- Prince Edward Island presents a smaller but high-quality offshore wind resource, with an estimated technical potential of ~9.5 GW. Its relatively shallow waters and strong wind conditions make it well-suited for niche applications, demonstration-scale projects, or integration into broader regional efforts.
- While this technical and locational potential far exceeds foreseeable demand, the evolution of the study has shown that demand is the primary determinant of actual deployment levels. Even under scenarios with expanded interprovincial transmission, new interconnection to New England or other export markets, and large-scale hydrogen production, the modelled offshore wind ranges remain only a fraction of the total technical potential. This reinforces a central theme of this report: the resource is abundant, but its utilization might be constrained by economics, infrastructure, and demand growth.

The factors above form the basis for evaluating the Actual Deployment potential of offshore wind: a synthesis that reflects not only the physical wind resource, but also policy frameworks, environmental constraints, cost competitiveness, and market demand. The amounts of offshore wind identified for development in this initial study for the region are what were analyzed to be attainable. Certain areas in the region could have additional capacity, which can be studied for specific sites in future phases of offshore wind build-out.

**Deployment Scenarios**: Phase 1 of this study, conducted with Energy and Environmental Economics (E3), explored market opportunities under a spectrum of future demand conditions. Modelled scenarios for 2035 and 2050 show a wide range of plausible buildouts. While the Domestic-Only market scenario[2] caps development at 2.5 GW by 2050 to serve provincial loads, the All Markets with High Hydrogen Sensitivity scenario demonstrates the transformative potential of offshore wind when export and hydrogen production are included, reaching up to 16.5 GW by 2050.

- By 2050, Nova Scotia and its designated Wind Energy Areas (clusters C11, C13, C14, C27[3]) emerges as the largest contributor to offshore wind development, leveraging its current CNSOER-designated Wind Energy Areas to reach approximately 9 GW of capacity. Early builds at C11 and C27 focus on fixed-bottom foundations, while later phases expand into floating projects at C13 and C14. Nova Scotia plays a leading role in both domestic electricity supply and hydrogen-linked export markets, and the provision of renewable energy resources in the development of hydrogen for export, positioning itself as a first mover in regional offshore wind deployment.
- Newfoundland and Labrador contributes significantly to offshore wind development through both fixed-bottom and floating projects across clusters C4, C5, and C25. With capacity factors consistently above 54–57% and access to vast deepwater areas, NL could scale to approximately 4–5 GW by 2050. Its development is anchored in floating wind opportunities and green hydrogen and ammonia production for export, complementing Nova Scotia's leadership in the sector.
- Despite a smaller technical potential, New Brunswick clusters C21 and C24 are included in the high-hydrogen scenario, primarily as floating projects. Their combined contribution is modest but meaningful, reaching ~2 GW by 2050, ensuring NB plays a role in the balanced regional deployment strategy.
- Prince Edward Island's C22 cluster, though limited in scale, provides high-quality fixed-bottom potential with one of the region's highest capacity factors of ~58%. By 2050, PEI will contribute ~1 GW, positioning the province as a niche but reliable player in regional offshore wind deployment.

[2] See Section 3.4, Figure 23 for explanation market scenarios identified during Phase 1 of the Atlantic Canada Offshore Wind Grid Integration and Transmission Study.
[3] Clusters reviewed in Section 3.1.

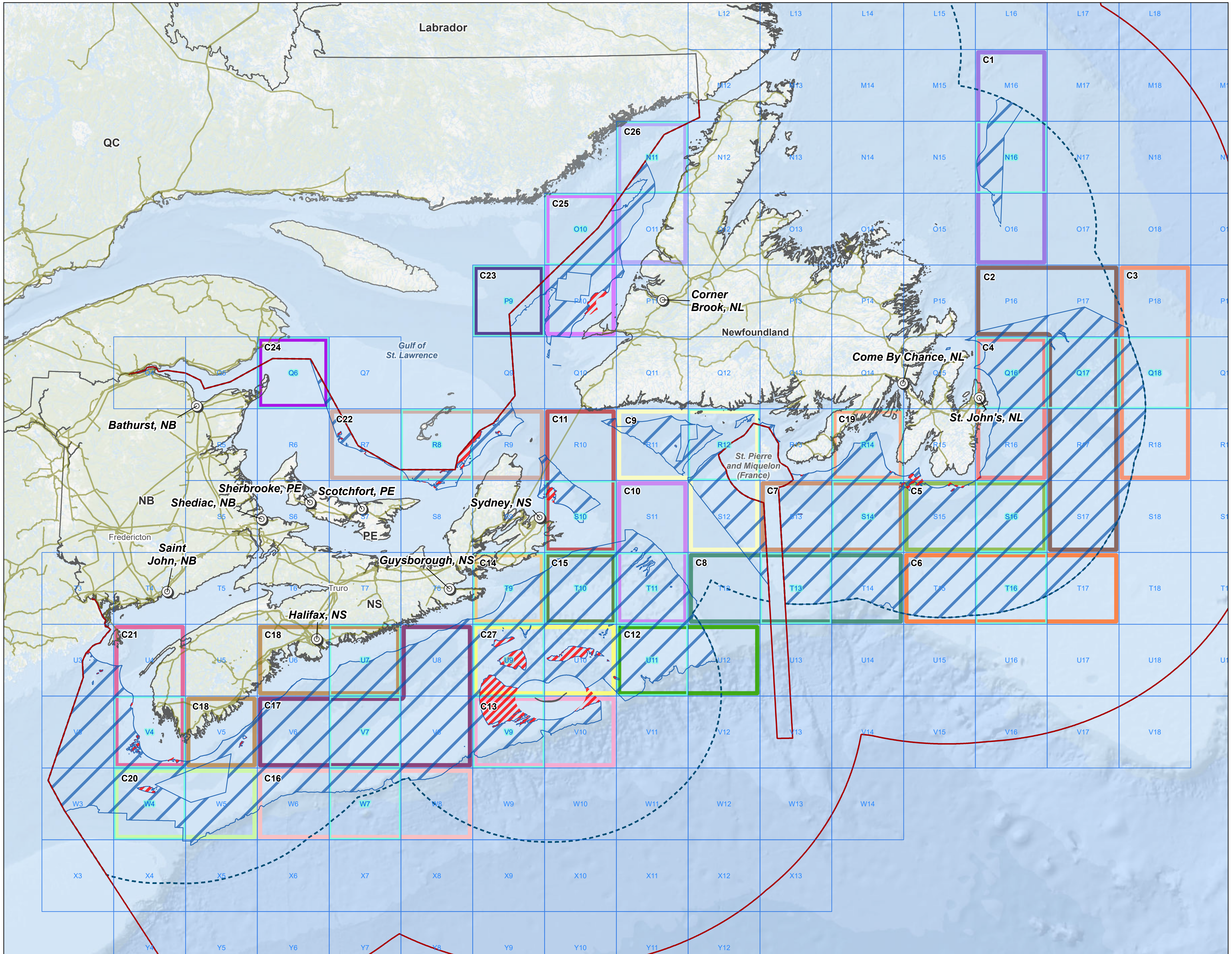


Figure No.

**ES1**

Title

**Offshore Wind Analysis Clusters Used for Resource and Grid Integration Modelling**

Client/Project 126560144_035

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location

Atlantic Canada

Prepared by NW on 2025-07-17
Revised by SC on 2025-09-24
TR by DP on 2025-09-29

N

0 100 200 Kilometres

(At original document size of 11x17)
1:5,500,000

**Legend**

- Point of Interconnection
- Transmission Line
- NZA Study Area
- Floating Platform Technical Development Limit (195 km)
- Buildable Area - Floating Platform
- Buildable Area - Fixed Platform
- Processing Grid (100 km x 100 km)
- Time Series Data Reference Cell

Optimization Cluster

| | | |
|---|---|---|
| C1 | C10 | C19 |
| C2 | C11 | C20 |
| C3 | C12 | C21 |
| C4 | C13 | C22 |
| C5 | C14 | C23 |
| C6 | C15 | C24 |
| C7 | C16 | C25 |
| C8 | C17 | C26 |
| C9 | C18 | C27 |

***Notes***
**1.** Coordinate System: WGS84 Azimuthal Equidistant Projection, Central Meridian -62
**2.** Data Sources: Stantec
**3.** Background: NRCan CanVec; Statistics Canada; Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, CHS, Esri, GEBCO, Garmin, NaturalVue

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The clusters shown in Figure ES-1 represent standardized offshore wind analysis zones developed to support resource characterization, time-series generation, and subsequent grid-integration modelling. Each cluster aggregates a group of grid cells with similar offshore wind characteristics, bathymetry, distance to shore, and proximity to potential Points of Interconnection (POIs). This clustering approach enables consistent comparison of offshore wind resource quality and deployment potential across Atlantic Canada while maintaining computational efficiency for time-series and system modelling.

Realizing this potential will require significant investments in transmission, infrastructure, ports, the progression of large load offtakers, such as hydrogen, as well as careful management of environmental and visual impacts and Indigenous involvement. Early engagement and alignment with regulatory frameworks are essential.

# Strategic Recommendations

- The modelling outcomes demonstrate support for Nova Scotia's current Canada/NS-designated Wind Energy Areas (WEAs) off Nova Scotia, particularly those in the Sydney Bight and Middle Bank regions, corresponding to clusters C11 and C27, showing alignment between deployment priorities and the province's established regulatory pathway.
- In parallel, targeted deployment in New Brunswick (clusters C21 and C24) could be considered to support incremental capacity and provide strategic grid routing opportunities toward New England markets.
- Pursue development of Prince Edward Island's C22 cluster as a demonstration project, building early momentum and proving competitiveness.
- Develop pilot floating capacity in Newfoundland and Labrador's C4 cluster to de-risk floating technology before large-scale rollout.
- Coordinate transmission planning to align Tier 1 and Tier 2[4] sites with interregional and international export demand growth, ensuring offshore wind build-out scales with system needs.
- Plan hydrogen production plants in proximity to Tier 3 OSW projects to enable growth in hydrogen production and development.
- Evaluate and implement incentive frameworks such as Offshore Wind Renewable Energy Certificates, tax incentives, and power purchase agreement structures to encourage development by offshore wind developers.
- Work collaboratively with federal regulators to establish clear offshore wind setback guidance and sector-specific environmental assessment frameworks. Consistent federal–provincial direction could reduce permitting uncertainty and provide early clarity for project proponents across Atlantic Canada.

[4] Explanation of Tiers provided in section 4

The findings of the *Actual Deployment Potential of Atlantic Canada Offshore Wind* report provide the essential foundation for Phase 3 of the Atlantic Canada Offshore Wind Grid Integration and Transmission Study, which will focus on grid integration. The deployment scenarios, suggested locations, and technology mixes (fixed vs. floating) identified here will be used to define and refine the grid integration scenarios for 2035-2050, ensuring that transmission planning and system modelling are grounded in realistic, demand-driven outcomes. Phase 3 will evaluate the transmission investments, operational strategies, and reliability requirements needed to support offshore wind at the modelled build-out levels, with a focus on cost-effective solutions, system resilience, and alignment with provincial and federal policy objectives.

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# List of Abbreviations and Terminology

| | |
|---|---|
| AACE | Association for the Advancement of Cost Engineering |
| Actual Deployment | What is *likely to be built*, given demand and system constraints |
| ADSAS | Active Disposal at Sea Sites |
| AEP | Annual Energy Production |
| ATB | Annual Technology Baseline |
| AEP | Annual Energy Production |
| CapEX | Capital Expenditures |
| CF | Capacity Factor |
| CFD | Computational Fluid Dynamics |
| CHS | Canadian Hydrographic Service |
| CNLOER | Canada–Newfoundland and Labrador Offshore Energy Regulator |
| CNSOER | Canada-Nova Scotia Offshore Energy Regulator |
| DFO | Fisheries and Oceans Canada |
| DND | Department of National Defence |
| EBSA | Ecologically and Biologically Significant Area |
| ECCC | Environment and Climate Change Canada |
| Economic Potential | Where wind energy *makes financial sense* |
| ENC | Maritime Chart Service |
| GIS | Geographic Information System |
| GW | Gigawatt |
| IBA Canada | Important Bird Areas Canada |
| Locational Potential | Narrows the offshore wind resource to areas that are physically and regulatorily feasible after applying bathymetric, environmental, and spatial constraints. Where wind energy *can* be built. |
| MMC | Meso-micro Coupling |
| MPA | Marine Protected Area |
| MW | Megawatt |
| MWh | Megawatt Hour |
| NHS | National Historic Site |
| NMCA | National Marine Conservation Areas |

| | |
|---|---|
| NLDFA | Newfoundland and Labrador Department of Fisheries and Aquaculture |
| NRCan | Natural Resources Canada |
| NREL | National Renewable Energy Laboratory |
| NSFA | Nova Scotia Fisheries and Aquaculture |
| NSIDC | National Snow and Ice Data Center |
| OSW | Offshore Wind |
| PEXA | Firing Practice and Exercise Areas |
| PCA | Parks Canada Agency |
| Project Management Committee | Provincial government representatives from the Atlantic provinces that provide strategic oversight for the study |
| PDA | Potential Development Areas |
| POI | Point of Interconnection |
| TB | Terabytes |
| Technical Committee | Utility representatives from each province and a system operator with expertise relevant to the project and transmission planning |
| Technical Potential | The full theoretical offshore wind resource and associated energy yield based on wind conditions and turbine performance |
| VIA | Viewshed Impact Assessments |
| WEA | Nova Scotia Government-identified offshore zones designated to guide and prioritize offshore wind development |
| Draft WEAs | Areas shared by NS province and frozen on February 2025. First areas suggested as a draft to be developed. |
| Canada/NS-Designated WEAs | Government of Canada and Province of Nova Scotia jointly Designated Offshore Wind Energy Areas, published on July 2025. |
| WRA | Wind Resource Assessment |
| WRF | Weather Research and Forecasting |

# 1. Introduction

Atlantic Canada is host to a high-quality offshore wind resource, offering the potential to deliver stable, high-capacity factor renewable electricity generation throughout the coastal waters of Nova Scotia, Newfoundland and Labrador, New Brunswick, and Prince Edward Island. This region is well-positioned to become a leader in offshore wind development in North America.

In collaboration with WindSim, Stantec has characterized the offshore wind resource with refined detail, producing high-resolution wind datasets, capacity factors, and assessments of buildable areas. Collectively, these analyses demonstrate that hundreds of gigawatts of technical potential exist within nearshore waters.

While this technical and locational potential far exceeds foreseeable demand, the evolution of the study has shown that demand is the primary determinant of actual deployment levels. Even under scenarios with expanded interprovincial transmission, new interconnection to New England, and large-scale hydrogen production, the modelled offshore wind generation ranges remain only a fraction of the total technical potential. This reinforces a central finding of this report: the resource is highly abundant, but its utilization might be constrained by economics, infrastructure, and demand growth.

Phase 1 of this study, conducted with Energy and Environmental Economics (E3), explored market opportunities under a spectrum of future demand conditions. Market scenarios (see Figure below) ranged from a conservative Domestic-Only Case, where offshore wind serves only the electricity needs of the Atlantic Provinces, to an expansive All Markets with High Hydrogen scenario that includes electricity exports to New England, as well as several gigawatts of electrolyzer demand to support hydrogen production and potential hydrogen and derivative exports. In these scenarios, by 2050, cumulative offshore wind buildouts varied from 2.5 GW in the domestic-only case to upwards of 16.5 GW under the high-hydrogen export case.


**Figure 1. Offshore Market Scenarios Deployment for Future Demand Conditions in Atlantic Canada**

This Actual Deployment report integrates results from technical and locational assessments; the identification of feasible areas and capacity factors through advanced resource modeling and Geographic Information System (GIS) constraints; economic assessments by way of applying cost benchmarks to determine which portions of the resource are competitive; and policy and market scenarios (Phase 1), defining the demand conditions under which offshore wind could realistically be deployed. Additional factors form the basis for evaluating Actual Deployment potential ─ a synthesis that reflects not only the physical wind resource, but also policy frameworks, environmental constraints, cost competitiveness, and market demand.

# 2. Methodology Overview

## 2.1 Scope of Analysis

The geographic area of the analysis undertaken for this report extends across the Atlantic Canadian provinces of Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador, encompassing their adjacent nearshore and offshore waters. The study area boundary for the Atlantic Canada Offshore Wind Grid Integration and Transmission Study also includes provincial waters within the Gulf of St. Lawrence and along the Atlantic coastline (Figure 2).

Within this study area, resource potential was characterized across a bathymetry range from shallow nearshore to deep-water offshore areas. This enables consideration of both fixed-bottom foundations (monopile, jacket, or suction bucket) in shallower waters, and floating platform technologies (semi-submersible, spar, or tension-leg) in deeper regions. Fixed-bottom potential is mainly concentrated along the continental shelf margins, while floating potential expands into available areas further offshore into the deeper Atlantic. For the purposes of this study, fixed-bottom offshore wind foundations are considered technically feasible in water depths up to approximately 60 m. Areas exceeding this depth threshold are assumed to require floating foundation technologies.

The study was subdivided into standardized grid cells of 100 km by 100 km, within which wind resource, bathymetry, and constraint datasets were evaluated. To facilitate scenario analysis and provincial breakdowns, these cells were aggregated into larger zones or clusters that share similar characteristics as distance to Points of Interconnection (POIs) and wind speed. Each cluster was standardized to represent an equivalent installed capacity for comparative purposes, reflecting a consistent number of turbines and spatial extent. This structure enables a scalable comparison of resource quality and buildable areas across provinces, where variations in annual energy yield can be attributed directly to differences in wind regime and site-specific characteristics rather than scale or configuration.

In summary, the scope of analysis provides full Atlantic Canada coverage consistent with the study boundary, provincial and regional granularity, bathymetry assessment capturing both fixed-bottom and floating technologies and grid-based evaluation. This analysis features spatial consistency in integrating offshore wind resources, where wind resources, constraints, and economic assumptions are evaluated over the same standardized grid cell structure.

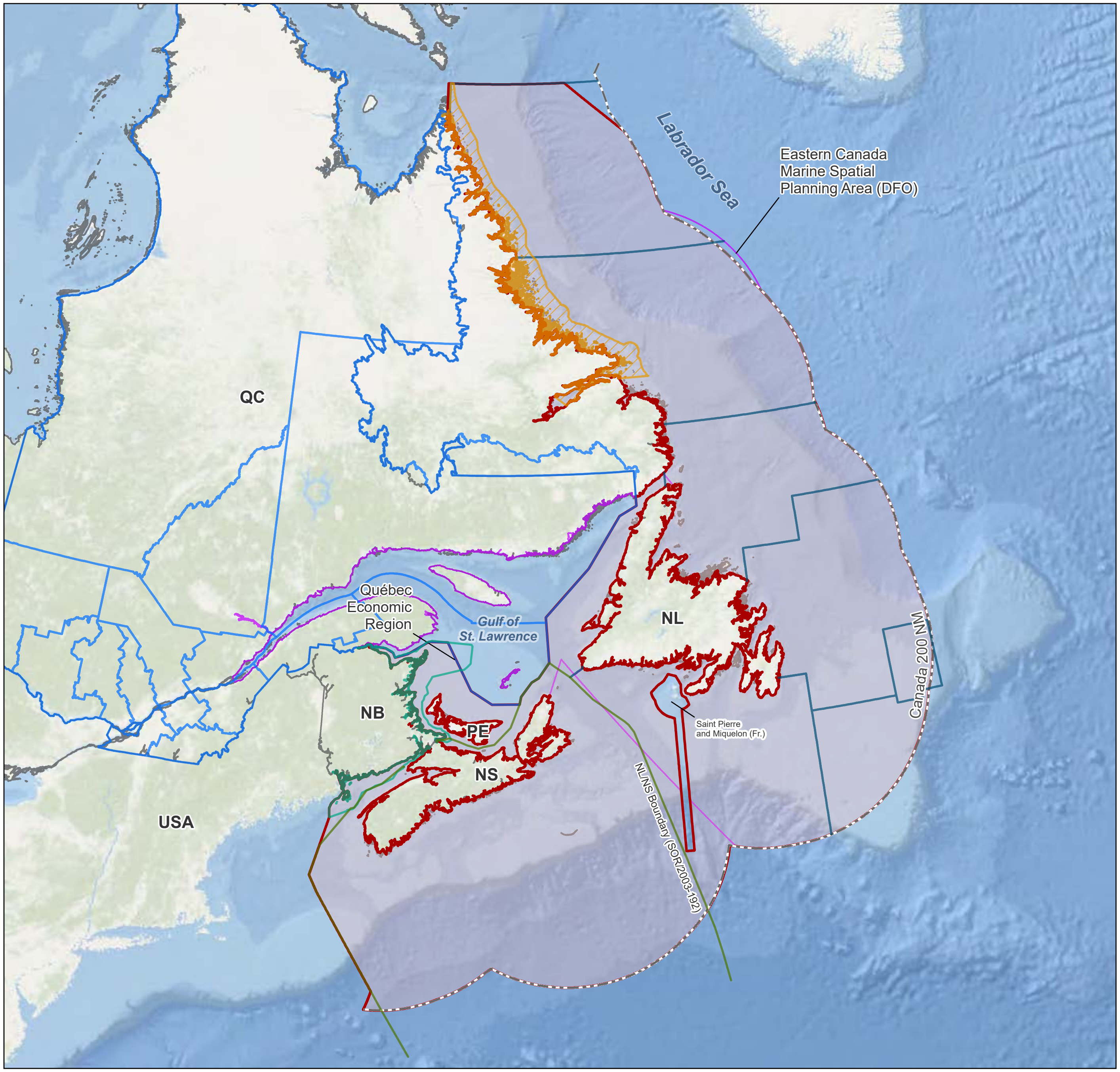


*Figure No.*
**2**

*Title*
## Atlantic Canada Study Area Boundary

*Client/Project* 126560144_001

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location*
Atlantic Canada

Prepared by NW on 2024-09-03
TR by IM on 2024-09-03

N

0 100 200 300 km
(At original document size of 8.5x11)
1:15,000,000

Legend

- NZA Study Area
- Newfoundland and Labrador Land Tenure Region (CNLOPB)
- Nova Scotia Offshore Jurisdiction (CNSOEB)
- Exclusive Economic Zone
- Québec Economic Region
- Eastern Canada Marine Spatial Planning Area
- Labrador Inuit Land Claims Agreement Zone
- Provincial Boundary

**Project Location:**

***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada; CNSOEB; CNLOPB; Service New Brunswick; Institut de la statistique du Québec
**3.** Background: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

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## 2.2 Data Sources

The Actual Deployment analysis integrates multiple datasets and references to provide a comprehensive view of offshore wind potential in Atlantic Canada. These sources span meteorological modeling, geospatial constraints, economic benchmarking, and policy/stakeholder inputs.

- Wind Resource Modelling using Weather Research and Forecasting (WRF) Model: Simulated mesoscale atmospheric conditions (wind speed and wind direction) at 9 x 9 km resolution for the 2018-2020 period, providing baseline wind speed and direction fields across the full Atlantic study area.
- Computational Fluid Dynamics (CFD) – WindSim: High-resolution microscale simulations (100 m horizontal resolution) applied in nearshore areas to capture coastal and terrain-induced effects, including local acceleration due to coastline geometry, wind channelling along headlands, increased shear gradients near complex terrain, and wake interactions influenced by shoreline morphology.

Meso-Micro Coupling (MMC): Scaling methodology combining WRF mesoscale outputs with WindSim CFD results, producing merged datasets at 1 km spatial resolution and 5-minute temporal resolution.

Validation Data: Observed wind speed and direction measurements from nearshore meteorological masts and offshore buoy platforms were used to evaluate model performance. Measurements collected at instrument heights (typically 10 m) were extrapolated to turbine hub heights (80 m and 120 m) using CFD-based vertical extrapolation methods. These extrapolated values were then compared against modelled outputs to validate wind speed distributions, vertical shear behaviour, and representativeness of mesoscale-microscale combining results.

Geospatial Constraints: Constraints were derived from a master database of geospatial inputs and setbacks consolidated in Table 1. Key categories include bathymetry, environmental and ecological areas (marine protected areas, species-at-risk habitats, bird migration corridors), marine use and navigation (shipping lanes, ferry routes, anchorage zones), Indigenous and community considerations (traditional use areas, cultural and archaeological resources), fishing and aquaculture areas (active fishing grounds, aquaculture leases), National Defence and security zones (public knowledge-restricted military zones).

The following table summarizes the background data review undertaken within the Study Area:

**Table 1: Background Data Reviewed within the Study Area**

| Category | Constraint Type | Typical Setback/Buffer | Primary Data Sources |
|---|---|---|---|
| Indigenous Communities and Reserves | Aboriginal Lands of Canada Legislative Boundaries – Reserves | Site-specific – buffers applied where mapped | NRCan; Crown-Indigenous Relations and Northern Affairs Canada |
| Bathymetry | Water Depth | <60 m depth for fixed, <300 m depth for floating | Stantec[5]; GEBCO data download |
| Coastal | Transmission Distance 70/195 km | Exclusion area | Stantec; 2021 Census Boundary files |
| Coastal | Bay of Fundy Tidal Area (approximate) | Exclusion area | Stantec; 2021 Census Boundary files |
| Coastal | General Coastal Buffer – New Brunswick, Prince Edward Island, Nova Scotia | 25 km | Stantec; 2021 Census Boundary files |
| Coastal | General Coastal Buffer – Newfoundland and Labrador | 15 km | Stantec; 2021 Census Boundary files |
| Sea Ice | Sea Ice Extent (Max. extent 2023 only) | Exclusion area | NSIDC; Arctic Sea Ice Extent - 1979 to Present - Overview |
| Critical Habitat Aquatic Species | Critical Habitat for Aquatic Species at Risk (offshore) | Exclusion area | DFO - Critical Habitat for Aquatic Species at Risk |
| Critical Habitat Coastal Species at Risk | Critical Habitat for Species at Risk (onshore) | Coastal buffer, 25 km | ECCC CWS Critical Habitat for Species at Risk |
| Special Areas | Areas of Interest | Exclusion area | ECCC Canadian Protected and Conserved Areas Database (CPCAD) |
| Seabirds | Breeding Bird Colonies | Coastal buffer, 25 km | IBA Canada - Important Bird Areas |
| Seabirds | Marine Bird Sanctuaries | Coastal buffer, 25 km | ECCC CWS Canadian Protected and Conserved |

[5] 'Stantec' indicates that data were modified or processed in some way - isolated bathymetry, coastal buffers, etc.

| Category | Constraint Type | Typical Setback/Buffer | Primary Data Sources |
|---|---|---|---|
| | | | Areas Database (CPCAD) |
| Special Areas | Marine Protected Areas | Exclusion area | ECCC CWS Canadian Protected and Conserved Areas Database (CPCAD) |
| Special Areas | Marine Refuges/Fisheries Closure Areas | Exclusion area | ECCC CWS Canadian Protected and Conserved Areas Database (CPCAD) |
| Special Areas | National Marine Conservation Areas | Exclusion area | ECCC CWS Canadian Protected and Conserved Areas Database (CPCAD) |
| Special Areas | National Park | Coastal buffer/Exclusion Area | ECCC CWS Canadian Protected and Conserved Areas Database (CPCAD) |
| Special Areas | National Wildlife Area | Coastal buffer, 25 km | ECCC CWS Canadian Protected and Conserved Areas Database (CPCAD) |
| Special Areas | Other Effective Area-Based Conservation Measures (OEABCM) – Coastal Only | Exclusion area | ECCC CWS |
| Special Areas | Georges Bank Exclusion Zone | Exclusion area | Stantec; NRCan Moratorium on Offshore Wind Development in Georges Bank |
| Other Offshore Uses | Aquaculture Licenses – Newfoundland and Labrador | Coastal buffer, 25 km | NLDFA Licensed Fish Processors and Aquaculture Sites |
| Other Offshore Uses | Aquaculture Licenses – Nova Scotia | Coastal buffer, 25 km | NS FA Land-based Aquaculture Licenses |
| Other Offshore Uses | Aquaculture Licenses – New Brunswick | Coastal buffer, 25 km | NB AAF MASMP |
| Other Offshore Uses | Aquaculture Licenses – Prince Edward Island | Coastal buffer, 25 km | Prince Edward Island Aquaculture |

| Category | Constraint Type | Typical Setback/Buffer | Primary Data Sources |
|---|---|---|---|
| Other Offshore Uses | Offshore Petroleum Infrastructure | Site-specific buffers | CNSOER/CNLOER |
| Other Offshore Uses | Pipelines | Site-specific buffers | CNSOER/CNLOER |
| Other Offshore Uses | Active and Inactive Disposal at Sea Sites in Canadian Waters | Coastal buffer 25 km, transmission distance constraint | ECCC Active Disposal at Sea Sites |
| Other Offshore Uses | Active Subsea/Submarine Cables | Site-specific buffers | Canadian Hydrographic Service - ENC MaritimeChartService |
| Other Offshore Uses | Department of National Defence Firing Practice and Exercise Areas, Atlantic Canada | | Department of National Defence Firing Practice and Exercise Areas, Atlantic Canada |
| Marine Traffic | Ports of the World | Coastal buffer, 25 km | |
| Marine Traffic | Airports and Aerodromes | Coastal buffer, 25 km | |
| Marine Traffic | Traffic Separation Zones | Coastal buffer 25 km, Site-specific buffers | Transport Canada |
| Marine Traffic | Vessel Density from AIS data | Coastal buffer, 25 km | DFO |

Economic and Cost Data: Capital and operating cost benchmarks were developed using a combination of reputable sources, including the National Renewable Energy Laboratory (NREL) Annual Technology Baseline (ATB, 2024), the Global Offshore Wind Report 2025 (GOWR25), and regional studies from the Gulf of Maine. These sources provided insights into global cost trajectories, technology-specific benchmarks, and regionally relevant data.

Policy and Market Inputs: 1) Phase 1 Policy & Markets Report (E3, 2025)[6]: Defined demand growth scenarios, including domestic-only load, expanded export markets, and high hydrogen demand sensitivity. 2) Nova Scotia Designated Offshore Wind Energy Areas (NS Draft WEAs)[7]: were incorporated as spatial constraints for Nova Scotia based on the delineations developed by the Province and currently managed through the Canada-Nova Scotia Offshore Energy Regulator (CNSOER). These NS Draft WEAs boundaries were frozen to the February 2025 input provided to the project team to ensure consistency throughout scenario development and buildable-area screening. This alignment ensures that modelling outcomes reflect active provincial planning guidance and regulatory direction.

[6] 250603 OSWG Phase 1 Report Market Opportunities WEB.pdf
[7] designated-offshore-wind-energy-areas.pdf

Stakeholder and Committee Guidance: Regular feedback from Net Zero Atlantic's Technical and Project Management Committees, ensuring alignment with regional policy objectives and integration studies.

## 2.3 Framework

The framework for this Actual Deployment study follows a sequential process that progressively refines the offshore wind resource from broad theoretical estimates to demand-driven deployment outcomes. Each stage – Technical Potential, Locational Potential, Economic Potential, and Actual Deployment – applies increasingly detailed filters and assumptions, ensuring that results reflect both the physical abundance of the wind resource and the practical realities of development in Atlantic Canada.

The assessment of Technical Potential, the full theoretical offshore wind resource and associated energy yield based on wind conditions and turbine performance, establishes the foundation of this work. Leveraging advanced modeling techniques, Stantec, with support from WindSim, combined mesoscale (WRF) and microscale (CFD) simulations to characterize wind speeds and energy yields across the Atlantic Canadian study area. To overcome the limited availability of offshore meteorological mast data, nearshore met masts were used. Wind speeds were simulated at hub heights of 80 m and 120 m, producing a 5-minute resolution dataset over three years (2018-2020). The CFD approach provided 100 m resolution for areas near the coast, while the mesoscale model provided 1 km resolution offshore, together providing robust coverage of the full bathymetry range – from shallow waters suitable for monopile or jacket foundations to deepwater areas requiring floating platforms. The outcome was a high-resolution wind atlas, capacity factor distributions, and energy yield estimates for hundreds of gigawatts of gross resource potential.

From this result, Locational Potential analysis identified the subset of Technical Potential that is realistically buildable when physical and regulatory constraints are applied. Using geographic information systems (GIS), Stantec screened the study area for exclusions and setbacks, including environmentally sensitive areas (Marine Protected Areas, refuges, sanctuaries, colonies, and critical habitats), offshore infrastructure and use (oil and gas, fishing, submarine cables, and disposal-at-sea sites), coastal use (ports, aquaculture, vessel traffic), and Indigenous use areas. Where possible, categories were combined and screened through general cautionary buffers. For example, the maritime provinces used a 25 km coastal buffer as an exclusion area to avoid a variety of traffic and coastal activity. Infrastructure such as submarine cables and pipelines are mapped and acknowledged but would require site-specific buffers during detailed design phases. These constraints were compiled from federal and provincial datasets and applied iteratively alongside technical filtering by water depth, offshore distance, and ice coverage. These outcomes also reflect inputs from the project's Project Management and Technical Committees. This step helps confirm that only sites compatible with locational and technical feasibility remain in the buildable area dataset (Figure 3 and Figure 4). The result is a set of provincial and regional maps (Figure 5) and databases showing net feasible areas, buildable megawatts, and associated capacity factors.

It is important to note that the analysis utilized a power density assumption aligned with existing and operating offshore projects to characterize deployment potential across the region. Power density is defined as the installed offshore wind capacity per unit area (MW/km²) to characterize deployment potential across the region. The assumed power density is directly linked to the reference turbine size and array spacing adopted in the study (15 MW turbines with 10D × 10D spacing), resulting in an effective density of approximately 3.5 MW/km². This value was selected to provide a consistent basis for comparison among provinces and study zones. However, given the strong wind regimes observed in Atlantic Canada, actual projects may achieve significantly higher effective power densities than modelled here. Final power density will be determined during preliminary project design and optimization, where micro-siting, wake losses, additional environmental constraints, and turbine-specific capabilities are accounted for. Accordingly, the results presented in this report should be understood as bounding estimates, with the recognition that build-out efficiencies may improve during detailed project development.

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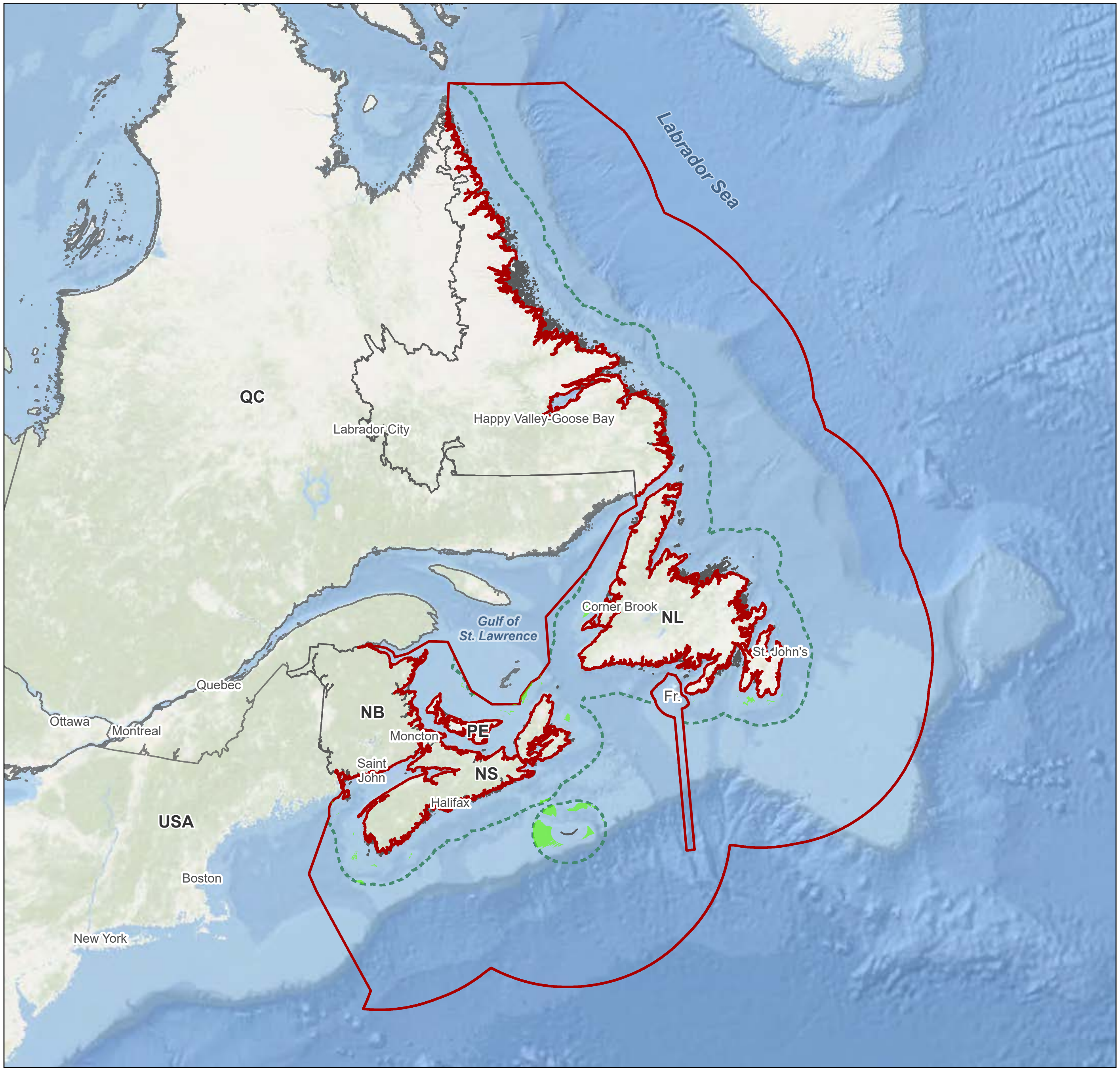



*Figure No.*
**3**

*Title*
**Buildable Area - Fixed Platform**

*Client/Project* 126560144_016

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location* Prepared by NW on 2025-03-31
TR by DP on 2025-03-31

Atlantic Canada

N

0 100 200 300 km
(At original document size of 8.5x11)
1:15,000,000

Legend

- Buildable Area - Fixed Platform
- NZA Study Area
- Fixed Platform Technical Development Limit (70 km)

**Project Location:**

***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada
**3.** Background: ESRI; NRCan CanVec

Stantec

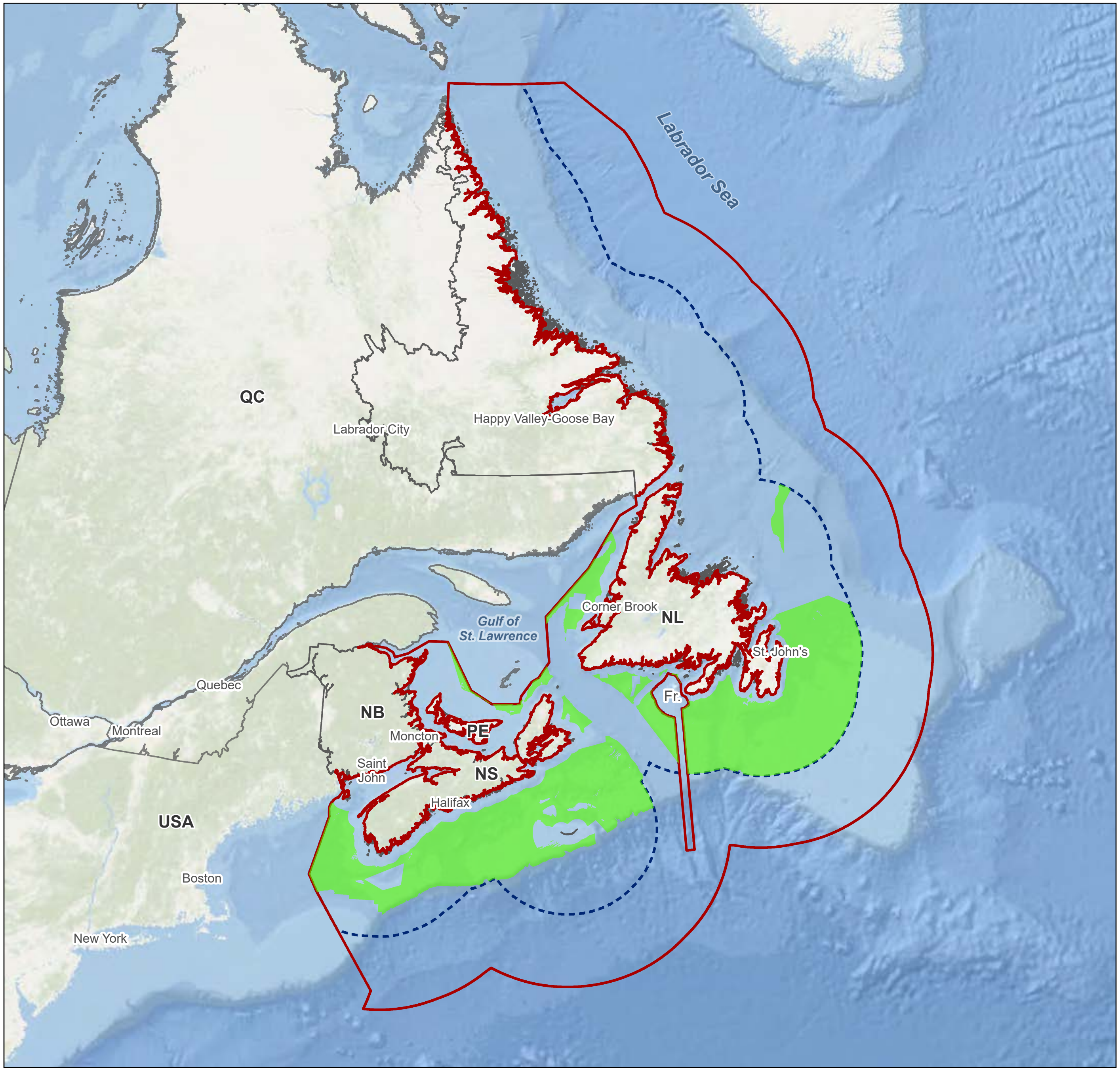



*Figure No.*
**4**

*Title*
**Buildable Area - Floating Platform**

*Client/Project* 126560144_017

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location*
Atlantic Canada

Prepared by NW on 2025-03-31
TR by DPantoja on 2025-04-22

N

0 100 200 300 km
(At original document size of 8.5x11)
1:15,000,000

Legend

- Buildable Area - Floating Platform
- NZA Study Area
- Floating Platform Technical Development Limit (195 km)

**Project Location:**

***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada
**3.** Background: ESRI; NRCan CanVec

Stantec

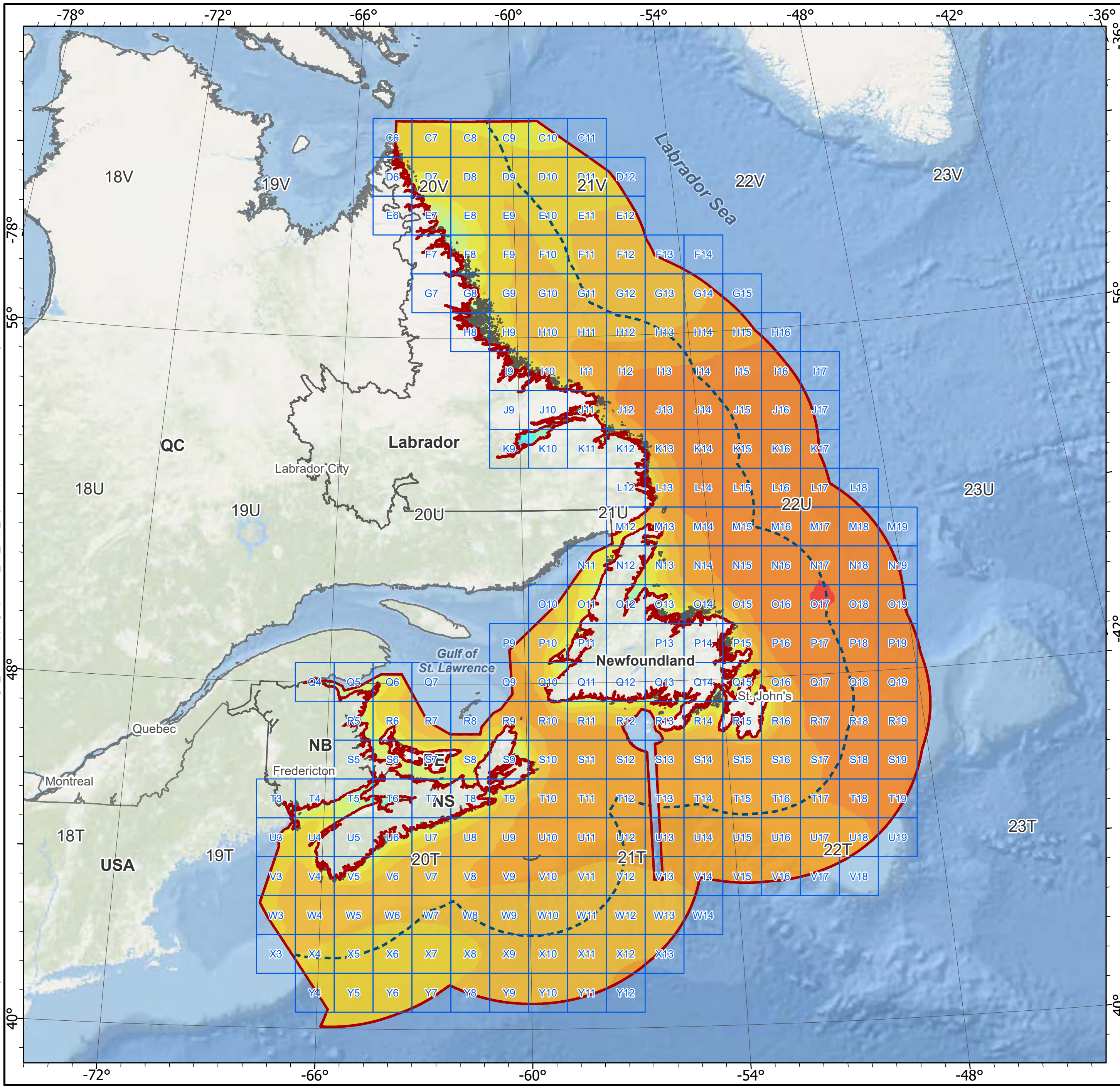



*Figure No.*
**5**

*Title*
## Wind Potential with Buildable Areas

*Client/Project* 126560144_028

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location* Prepared by NW on 2025-04-22
TR by DP on 2025-04-22

Atlantic Canada

N

0 250 500 km

(At original document size of 8.5x11)
1:15,000,000

Legend

- NZA Study Area
- Study Grid (8 deg. Lat., 6 deg. Long.)
- Processing Grid (100 km x 100 km)
- Floating Platform Technical Development Limit (195 km)

Average Wind Speed (m/s) at 120 m ASL

- <= 6
- 6 - 6.5
- 6.5 - 7
- 7 - 7.5
- 7.5 - 8
- 8 - 8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- 10 - 10.5
- 10.5 - 11
- 11 - 11.5
- 11.5 - 12
- >12

**Project Location:**

***Notes***

**1.** Coordinate System: WGS 84 Azimuthal Equidistant Projection, Central Meridian -62
**2.** Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset
**3.** Background: ESRI; NRCan CanVec; Statistics Canada

Stantec

\\CA0151-PPFSS01\stjohns$\DATA\DB\CADDATA\JOBS\NetZeroAtlantic\126560144\gis_data\mapping\aprx\nza_act_depl_report.aprx Revised: 2025-12-19 By: nlwhite

The Economic Potential assessment narrows the locationally feasible areas to those that are cost-competitive under current or projected market conditions. Stantec applied early-stage cost estimates at an Association for the Advancement of Cost Engineering (AACE) Class 5 level, with -50%/+100% accuracy based on NREL Annual Technology Baseline 2024 benchmarks[8], Gulf of Maine regional studies, conversations with original equipment manufacturers and offshore wind developers, and site-specific cost adjustments. The analysis included turbine supply and installation, foundation type (fixed-bottom or floating), electrical interconnection, permitting, engineering, soft costs, and contingency. By integrating energy generation with cost, areas were screened to identify those most likely to achieve favourable outcomes. This step provided the link between resource quality and financial viability, highlighting competitive clusters across Atlantic Canada.

Finally, the scope of Actual Deployment reflects the portion of Economic Potential that could realistically be built under plausible demand and policy scenarios. Building on Phase 1 modeling led by E3[9], deployment levels were bounded by demand conditions ranging from domestic-only load absorption to expansive cases that include interties with New England, strengthened interprovincial transmission, and significant hydrogen production demand. Beyond market drivers, actual deployment scope also considers logistical, ecological, and social realities, such as shipping and fishing interactions, Indigenous engagement, cultural heritage, defence operations, and visual impact minimization. The result is a demand-driven synthesis resulting in a range of deployment scenarios that demonstrate that while Atlantic Canada's technical and locational potential far exceeds foreseeable needs, the amount that will be developed is ultimately governed by economics and demand growth.

[8] Data | Electricity | 2024 | ATB | NREL

[9] 250603 OSWG Phase 1 Report Market Opportunities WEB.pdf

# 3. Regional Overview and Comparative Summary

Atlantic Canada possesses one of the strongest and most extensive offshore wind resources in North America. High mean wind speeds, favorable bathymetry, and potential access to major load centers and export markets together make the region uniquely positioned for future offshore wind development. Across the combined waters of Nova Scotia, Newfoundland and Labrador, New Brunswick, and Prince Edward Island, the study has identified hundreds of gigawatts of technical potential. After applying locational constraints and depth thresholds, tens of gigawatts of feasible capacity remain, distributed across both fixed-bottom and floating foundation technologies.

Average wind speeds at 120 m hub height consistently exceed 9-11 m/s in many offshore areas, with modeled net capacity factors ranging from 50% to over 59% depending on location and technology type. This translates into an abundant, high-quality generation resource, reflected by consistently strong energy yields and high annual utilization of installed capacity – well above typical offshore wind benchmarks globally. Bathymetric conditions vary considerably across the region, with shallow continental shelf areas suitable for fixed-bottom development concentrated in the Gulf of St. Lawrence and along the Nova Scotia shelf, while deeper waters to the east and northeast require floating technologies.

The region also benefits from existing grid infrastructure, including interconnections between provinces and transmission links to New England. These create opportunities for both domestic decarbonization and export-oriented development, particularly in scenarios with significant hydrogen demand growth. However, the extent to which the technical and locational potential can be deployed remains governed by economic competitiveness, infrastructure readiness, social license, and demand growth.

This section provides a comparative summary of provincial-level results, including buildable area, capacity factors, and proximity to key points of interconnection (POIs).

## 3.1 Provincial Breakdown

To provide a fair and consistent basis for comparing offshore wind potential across the Atlantic provinces, the analysis was built around a standardized conceptual layout and turbine assumption set. Each reference site was modeled as a wind farm with an approximate installed capacity of 1 GW (Figure 6) represented by 72-15 MW offshore wind turbines with a rotor diameter of 236 m, operating with typical cut-in, rated, and cut-out wind speeds of 3, 13, and 30 m/s, respectively. Turbines were arranged using a spacing of 10 rotor diameters (10D × 10D, or ~2.36 km)[10], resulting in an effective power density of ~3.5 MW/km$^2$. This approach balances the need to capture wake effects and mechanical loading while preparing for future turbine designs that will continue to increase in size and rotor swept area. By applying the same layout across the study region, the results enable a direct comparison of provincial buildable areas, capacity factors, and energy yields (Table 2 and Table 3). It should be noted that while this methodology provides a consistent benchmark, actual project designs will optimize layouts based on site-specific conditions, environmental constraints, and technology availability at the time of deployment.

The use of 10D x 10D turbine spacing balances wake losses, structural loading, and futureproofing for larger turbine technologies and surrounding projects. Wider spacing reduces wake-induced energy losses and mechanical fatigue on turbines, ensuring longer design lifetimes and lower maintenance costs. While this assumption results in a lower modeled power density compared to tighter layouts used in some other assessments of the area, it provides a robust, albeit conservative, baseline.

It is important to note that turbine technology continues to evolve toward larger rotor diameters (>290 m) and higher nameplate capacities (>20 MW). Actual power density in commercial projects could be higher than modeled here. Final decisions on spacing and power density will be determined during project-specific micro-siting and optimization reflecting site conditions, environmental considerations, and technology readiness.

[10] The use of a 10D × 10D turbine spacing reflects current international design practice for large offshore wind turbines (>15 MW) and provides a reasonable balance between achievable energy yield and long-term mechanical performance. Modern turbines with rotor diameters near ~236 m generate substantially larger wake effects than legacy 5 MW-class machines for which tighter spacing (~6D to 7D) was originally used. Increasing spacing reduces wake-induced turbulence, improves turbine fatigue life, and enhances operational availability at utility scale. Although an exact spacing varies by site, turbine vendor, and wake modeling outcomes, a practical design range for large offshore turbines generally falls within ~8D–12D. The 10D assumption therefore represents a defensible midpoint within that range and aligns with early-stage planning guidance used in U.S. federal lease assessments, as well as emerging OEM separation recommendations. This approach ensures that capacity estimates are realistic, scalable, and refle

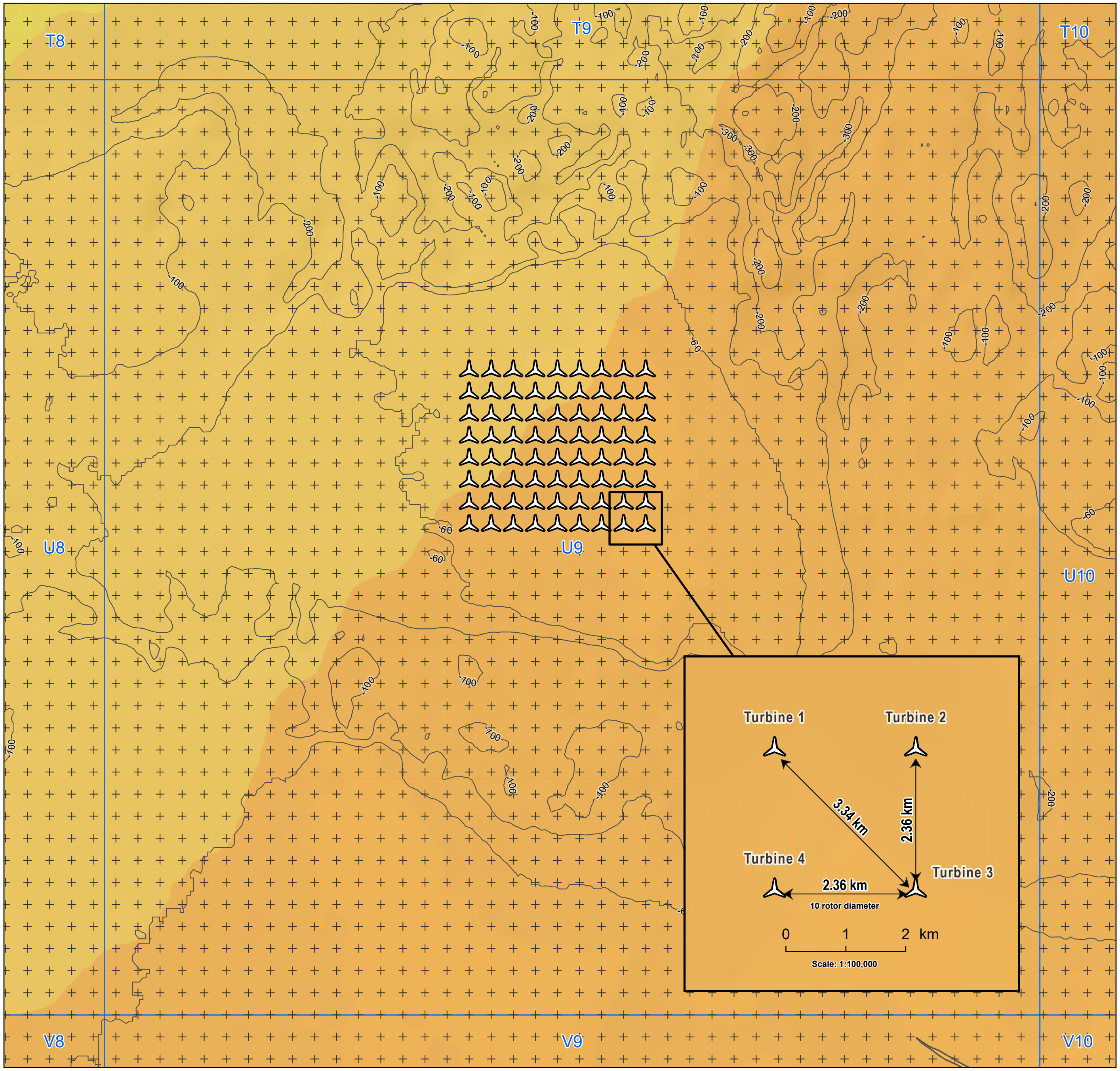



*Figure No.*
**6**
*Title*
## Reference Wind Farm Separation

*Client/Project* 126560144_024

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location*
Atlantic Canada

Prepared by NW on 2025-03-27
Revised by SC on 2025-09-24
TR by DP on 2025-09-24

N

0 10 20 km
(At original document size of 8.5x11)
1:640,000

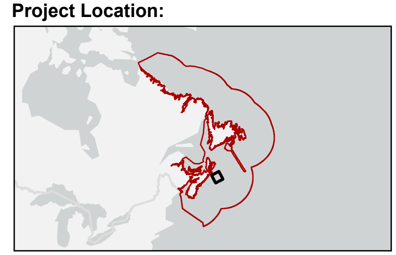
Legend

- Proposed NZA Study Area (V2.2)
- Turbine Maximum Placement (2.36 km spacing)
- Central 8 x 9 Turbine Array (n=72)
- Bathymetry Contours
- Distance Measurement (Center of Turbine)
- Processing Grid (100 km x 100 km)

Average Wind Speed (m/s) at 120 m ASL

- 10 - 10.5
- 10.5 - 11
- 11 - 11.5

**Project Location:**



*Notes*
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset; IAAC Committee for the Regional Assessment of Offshore Wind Development in Nova Scotia
**3.** Background: ESRI; NRCan CanVec; GEBCO 2024

Stantec

**Table 2: Developable Area per Province, Fixed and Floating Foundation**

| | Area Name | Approx. Area (sq km.) | % |
|---|---|---|---|
| **Fixed** | New Brunswick | 32.79 | 0.5% |
| | Prince Edward Island | 159.21 | 2.3% |
| | Nova Scotia | 6,088.12 | 86.0% |
| | Newfoundland and Labrador | 795.52 | 11.2% |
| | Total: | 7,075.64 | |
| | | | |
| **Floating** | New Brunswick | 2,874.71 | 0.9% |
| | Prince Edward Island | 2,388.18 | 0.8% |
| | Nova Scotia | 143,185.89 | 46.8% |
| | Newfoundland and Labrador | 157,640.02 | 51.5% |
| | Total: | 306,088.80 | |

**Table 3: Matrix Comparison**

| Province | Avg. Wind Speed (m/s @ 120 m) | Buildable Capacity (GW) | Fixed-Bottom (GW) | Floating (GW) | Avg. Distance to POI (km) |
|---|---|---|---|---|---|
| **Nova Scotia** | 10.8 | 433.9 | 17.4 | 416.5 | 176 |
| **Newfoundland and Labrador** | 11.2 | 472.7 | 2.1 | 470.6 | 210 |
| **New Brunswick** | 10.3 | 36.8 | 1.0 | 35.8 | 183 |
| **Prince Edward Island** | 11 | 9.5 | 1.4 | 8.1 | 112 |

### 3.1.1 Newfoundland and Labrador

Newfoundland and Labrador have the single largest provincial potential, with an estimated ~473 GW of buildable capacity and the highest mean wind speeds of the region at 11.2 m/s. This resource is overwhelmingly suited to floating foundations (~471 GW), while ~2 GW of fixed-bottom potential exists in select shallower zones along the continental shelf. Average proximity to POIs is ~210 km, slightly greater than in Nova Scotia, but still within distances considered viable for offshore wind power transmission to shore and potential export markets. These ranges are consistent with transmission distances observed in other offshore wind projects globally and remain technically and economically feasible for export-oriented development. The scale and quality of Newfoundland and Labrador's resource positions it as a long-term candidate for large-scale export-oriented development, particularly under hydrogen or intertie expansion scenarios.

### 3.1.2 New Brunswick

New Brunswick's offshore wind potential is more moderate in scale compared to Nova Scotia and Newfoundland and Labrador, but still significant at ~37 GW of buildable capacity. Mean wind speeds average 10.3 m/s, and the resource is predominantly floating (~36 GW), with ~1 GW of fixed-bottom opportunities. Average distance to POIs is ~183 km. While smaller in scale, New Brunswick's potential could support targeted projects aligned with domestic decarbonization goals or cross-border transmission opportunities.

### 3.1.3 Prince Edward Island

Prince Edward Island (PEI) offers a smaller but high-quality offshore wind resource, with ~9.5 GW of buildable capacity. Mean wind speeds are strong at ~11 m/s, the second highest in the region, supporting attractive capacity factors. The potential includes ~1.4 GW of fixed-bottom and ~8.1 GW of floating capacity. Average distance to POIs is ~112 km, the shortest among the provinces. While limited in scale, PEI's resource could enable niche developments that complement the province's onshore wind portfolio and strengthen local energy independence.

### 3.1.4 Nova Scotia

Nova Scotia shows one of the strongest offshore wind profiles in Atlantic Canada, with an average modeled wind speed of 10.8 m/s and a total buildable capacity of ~434 GW. Most of this potential lies in floating foundation zones (~416 GW), although a meaningful fixed-bottom resource of ~17 GW is also identified, concentrated on the shallower banks and shelf areas. Average distance to POIs is ~176 km, providing relatively favourable grid access compared to other provinces.

As discussed further below, Nova Scotia's NS Draft WEAs define priority zones that reduce the broader technical and locational offshore wind potential identified in this study to approximately 40 GW of buildable capacity. The NS Draft WEAs in Figure 7 represent the first phase (draft) of Provincially identified offshore wind development areas, intended to focus early planning and development efforts, but do not necessarily define the full extent to which offshore wind development may be authorized in the future. **The analysis presented in this report applies the *draft* WEA boundaries provided by the Province and frozen as of February 2025**, ensuring consistency across capacity estimation and scenario modelling. While subsequent refinements to WEAs have occurred, the results reflect the planning context and regulatory inputs available at the time of analysis.

To support consistency with Nova Scotia's Wind Energy Areas (NS Draft WEAs), adjustments were made to the buildable area totals (Figure 7). Using GIS mapping provided by the Province of Nova Scotia, which distinguishes between fixed-bottom and floating foundation zones, the buildable capacity in Nova Scotia was adjusted to reflect these boundaries. These GIS-defined zones distinguish between fixed-bottom and floating opportunities and significantly reduce the broader technical estimate (Table 4 and Table 5). Within the NS Draft WEAs, the buildable capacity is estimated at ~40 GW, comprising ~23 GW of fixed-bottom (Sydney Bight, Middle Bank, Sable Island Bank[11]) and ~17 GW of floating (Sydney Bight, Canso Bank, Emerald Bank, French Bank). This helps align subsequent deployment scenarios to reflect the province's identified priority areas, rather than theoretical buildouts across the entire offshore domain.

Building on the provincial offshore wind planning process, Nova Scotia's current near-term focus is on advancing development within the Canada/NS-Designated WEAs of Sydney Bight, Middle Bank, and French Bank. Figure 8 illustrates the Government-designated offshore Wind Energy Areas as published by the CNSOER in July 2025.

[11] As of the publishing of this report, the Province of Nova Scotia is now focused on Sydney Bight, Middle Bank and French Bank.

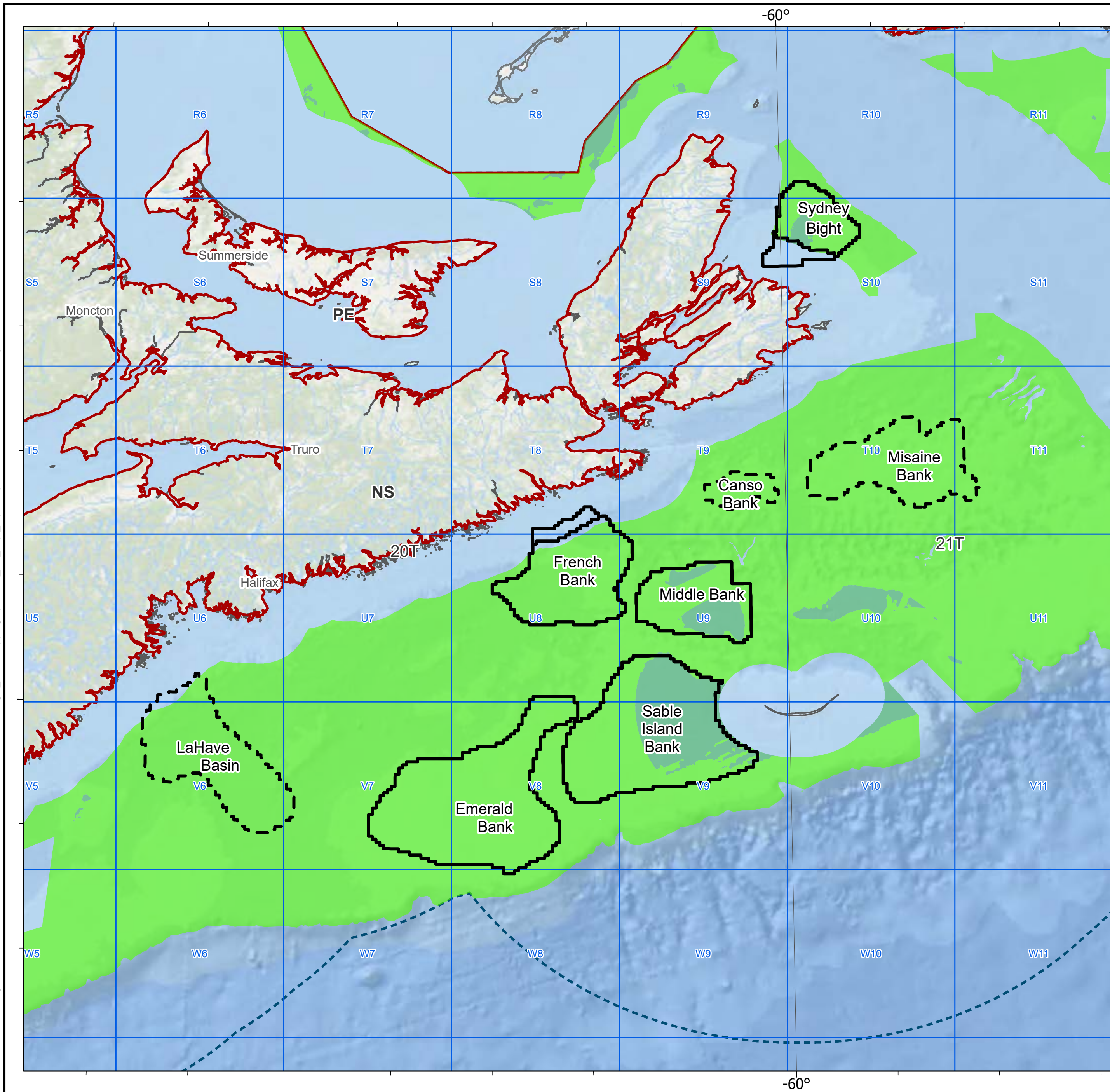



*Figure No.*
**7**

*Title*
## Nova Scotia Draft Wind Energy Areas (February 2025)

*Client/Project* 126560144_034

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location* Prepared by NW on 2025-11-18
TR by DP on 2025-11-18

Atlantic Canada

N
0 50 100 km
(At original document size of 8.5x11)
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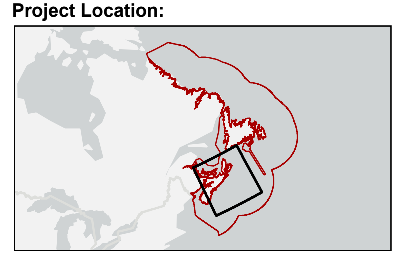
Legend

- NZA Study Area
- Nova Scotia Wind Energy Areas (WEAs)
- Processing Grid (100 km x 100 km)
- Floating Platform Technical Development Limit (195 km)
- Buildable Area - Fixed Platform
- Buildable Area - Floating Platform

**Project Location:**



***Notes***
**1.** Coordinate System: WGS 84 Azimuthal Equidistant Projection, Central Meridian -62
**2.** Data Sources: Stantec; Nova Scotia Department of Energy; Windsim / NASA MERRA reanalysis dataset
**3.** Background: ESRI; NRCan CanVec; Statistics Canada

Stantec

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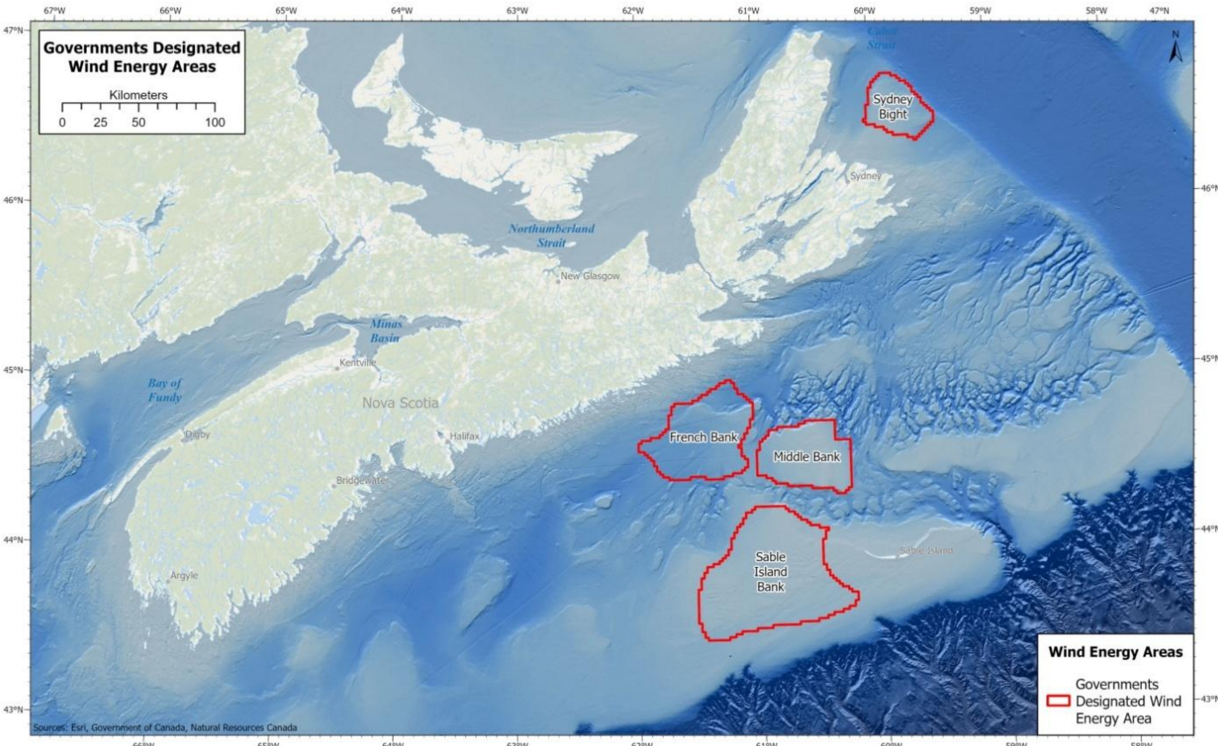


**Figure 8: Canada/NS-Designated Offshore Wind Energy Areas in Nova Scotia (July 2025)**

**Table 4: NS Draft Offshore Wind Energy Areas (sq km)**

| Wind Energy Areas (PDA) | Wind Area (km²) |
|---|---|
| Sydney Bight | 1,007 |
| Middle Bank | 922 |
| Sable Island Bank | 5,141 |
| Western/Emerald Bank | 3,848 |
| French Bank | 539 |
| Canso Bank | 475 |

**Table 5: NS Offshore Wind Energy Areas, Potential Installed Capacity for Fixed and Floating**

| | GW Capacity |
|---|---|
| Sydney Bight **–** Fixed Foundation | 1.8 |
| Sable Island **–** Fixed Foundation | 18.3 |
| Middle Bank **–** Fixed Foundation | 3.3 |
| Sydney Bight **–** Floating Foundation | 1.4 |
| Canso Bank **–** Floating Foundation | 1.5 |
| Emerald Bank **–** Floating Foundation | 12.4 |
| French Bank **–** Floating Foundation | 1.7 |
| **Total Fixed Foundation:** | 23.3 |
| **Total Floating Foundation:** | 17.1 |
| **Total Offshore Wind MW Capacity:** | 40.4 |

### 3.1.5 Capacity Factor and Energy Production

The Annual Energy Production (AEP) was calculated based on the referenced offshore wind farm configuration standardized across all provinces, and it already includes wake effects. The following typical losses were also considered across the entire area: Unavailability 4.98%, Electrical 2.87%, Turbine performance 1.68%, and Environmental 1.49%.

Based on this configuration, net AEP values per 1 GW reference offshore wind farm ranged from ~4.7 TWh/year to ~5.7 TWh/year, reinforcing the world-class quality of Atlantic Canada's offshore wind regime.

The offshore wind resource in Atlantic Canada is not only vast in scale but also of exceptionally high quality, as demonstrated by modelled capacity factors (CFs). Across the study area, gross capacity factors for a standardized 1 GW reference project ranged from 59% to over 71%, with net CFs (after accounting for technical losses) between 50 and 60% (Table 6). These values place Atlantic Canada among the strongest offshore wind regimes globally, where typical net CFs are generally lower, for example the North Sea (UK, Germany, Denmark): ~45-50%, U.S. East Coast (Massachusetts, New York Bight): ~40-45%, Global offshore fleet average: ~42% net CF (IEA 2023)[12].

Against this backdrop, the 50-60% net CFs in Atlantic Canada represent a globally competitive and offshore wind resource with consistency of performance across different jurisdictions.

**Table 6: Provincial Capacity Factors**

| Province | Gross CF (%) | Net CF (%) | Notes |
|---|---|---|---|
| Nova Scotia | 61-66 | 51-56 | Strong, steady regime; aligns with provincial NS Draft WEAs |
| New Brunswick | 60-62 | 51-53 | Slightly lower consistency; optimization important |
| Newfoundland and Labrador | 59-71 | 50-60 | Highest CFs; robust resource for export potential |
| Prince Edward Island | ~61 | ~58 | Smaller scale, but competitive performance |

## 3.2 Regional Comparison and Site Attractiveness

### 3.2.1 Bathymetry and Technology Implications

Bathymetry is the study and measurement of water depths and is a defining factor in offshore wind development, as it governs which foundation technologies are technically and economically feasible. Figure 9 (below) illustrates depth ranges across the Atlantic Canada study area:

- Shallow Waters (<60 m, shown in light blue): Concentrated along the Nova Scotia shelf, Gulf of St. Lawrence, and nearshore PEI and NB, these areas are most suitable for fixed-bottom foundations (monopile, jacket, suction bucket). The Shallow Water zone is limited in extent, as it has a comparatively small spatial footprint of waters shallower than ~60 m, in relation to to the much larger offshore areas exceeding this depth threshold across Atlantic Canada, making it a valuable development space.

[12] Offshore Wind Outlook 2019: World Energy Outlook Special Report

- Transitional Depths (60-300 m, shown in purple): Found widely around the Grand Banks, south of NS, and parts of NL, this zone represents a transition where floating technology becomes necessary. These areas expand the feasible footprint of offshore wind considerably beyond fixed-bottom limits.
- Deep Waters (>300 m, shown in magenta): Dominant in the Labrador Sea and northern offshore regions of NL, these areas are not considered for development of offshore wind at this point.

In practical terms, Nova Scotia and PEI benefit most from nearshore shallow waters, offering opportunities for early-stage fixed-bottom projects. Newfoundland and Labrador, by contrast, is characterized by large expanses of deep water, making it the natural candidate for long-term floating wind build-out at scale. New Brunswick straddles a middle ground, with modest shallow areas but larger floating-suited zones offshore.

This distribution highlights why provincial development strategies may differ. Nova Scotia can move first with fixed-bottom Canada/NS-Designated WEAs, while Newfoundland and Labrador positions for massive floating deployment, and Prince Edward Island and New Brunswick may support smaller-scale or niche projects where bathymetry is favorable.

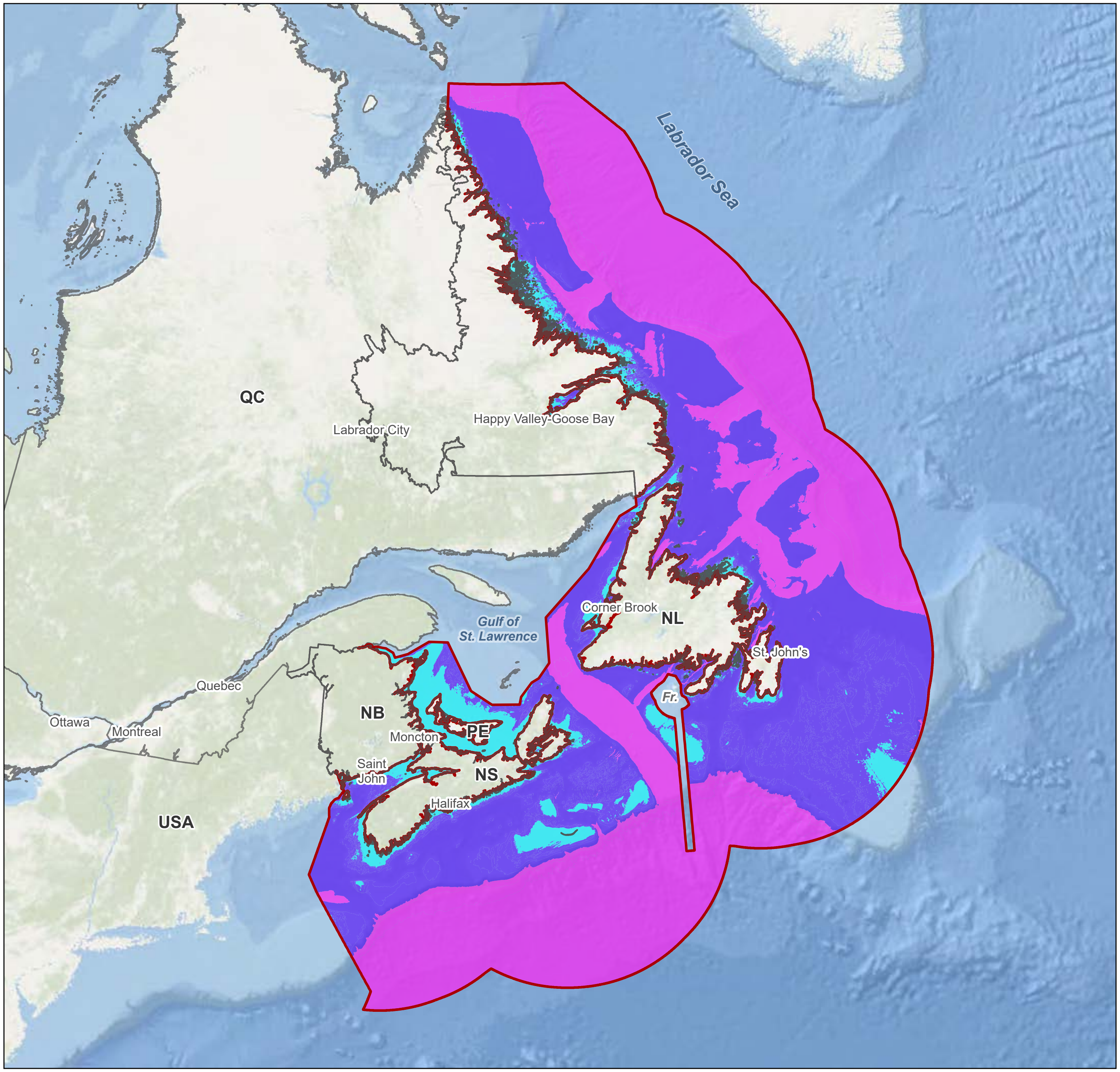


*Figure No.*
**9**

*Title*
**Bathymetry within the Atlantic Canada Study Area**

*Client/Project* 126560144_007

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location* Prepared by NW on 2025-01-21

Atlantic Canada

N

0 100 200 300 km
(At original document size of 8.5x11)
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Legend

NZA Study Area

Depth (m) and Zone

Shallow Water (<60)

Transitional Depths (60 - 300)

Deep Waters (300)

**Project Location:**

***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; GEBCO 2024; Fisheries and Oceans Canada
**3.** Background: ESRI; NRCan CanVec

Stantec

### 3.2.2 Provincial Close-Up Maps

This section provides a cross-provincial comparison of offshore wind development potential, highlighting the relative strengths and constraints of each jurisdiction. Attractiveness is defined not by a single score, but by a combination of three factors: resource quality (capacity factors), scale of buildable area (GW potential), and proximity to points of interconnection (POIs).

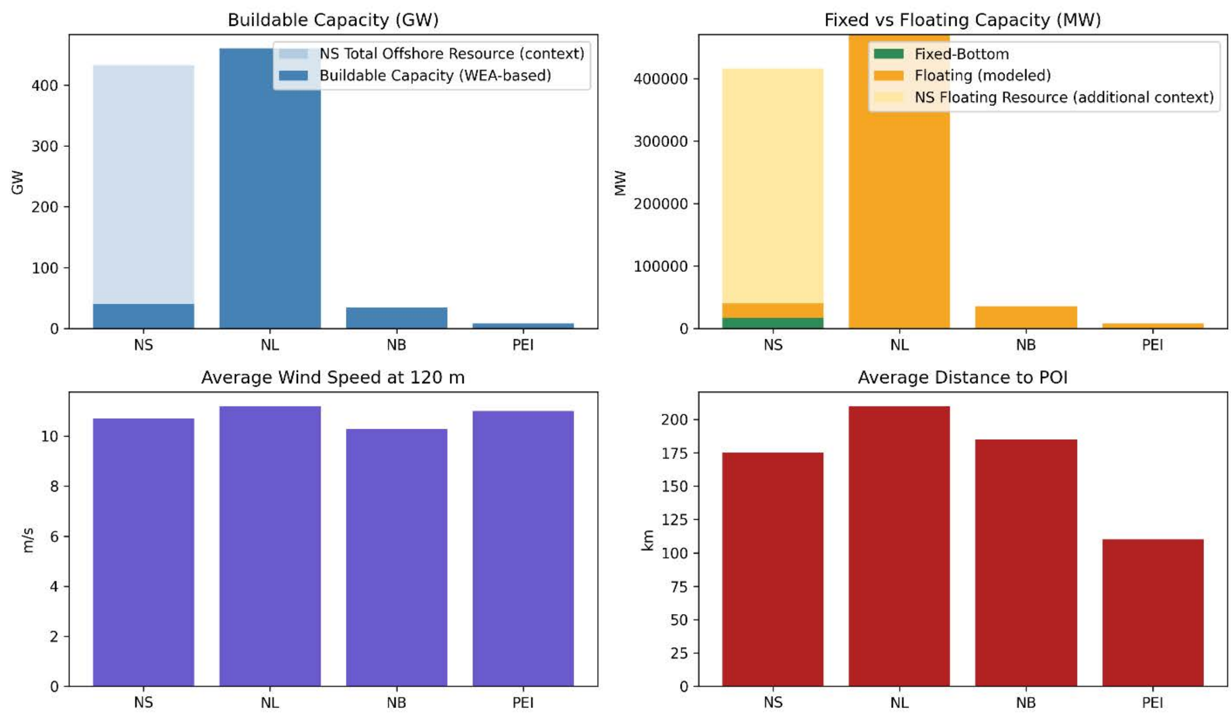



**Figure 10: Provincial multidimensional comparison**

Figure 10 provides a multidimensional comparison of the offshore wind resource across the four Atlantic provinces based on the constraints assumed in this report. The upper left panel highlights the scale of buildable capacity, with Newfoundland and Labrador dominating in potential, while Nova Scotia's NS Draft WEAs-aligned capacity reflects ~40 GW. The upper right panel compares fixed-bottom and floating capacity, illustrating NL's overwhelming floating resource and Nova Scotia's mix of fixed-bottom and floating opportunities. The lower left panel shows consistently high average wind speeds (10-11+ m/s) across all provinces, while the lower right panel presents average distance to POIs, with PEI offering the closest access to shore and NL requiring longer export corridors. Nova Scotia's values should be interpreted as a focused subset of its broader offshore resource, aligned with current provincial planning priorities.

Together, these results demonstrate both the scale of the opportunity and the strategic differences between provinces, which will be further illustrated in Figure 11 to Figure 22 below.

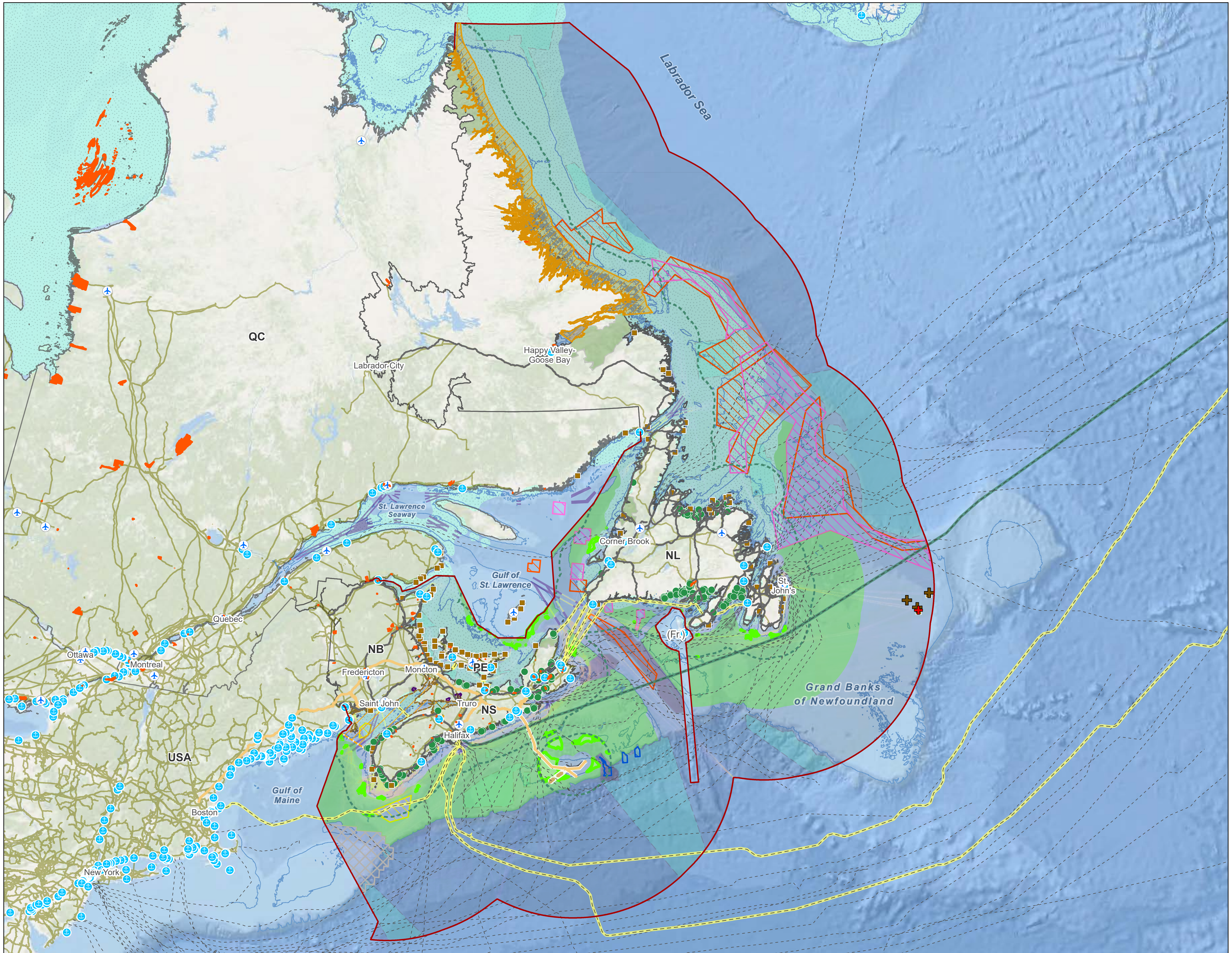



*Figure No.*

**11**

*Title*

## Constraints Analysis Overview of the Study Area

*Client/Project* 126560144_200a

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location*

Atlantic Canada

Prepared by NW on 2025-08-25
TR by DP on 2025-08-25

N

0 100 200 300 Kilometres

(At original document size of 11x17)
1:10,000,000

**Legend**

- Buildable Area - Fixed Platform (Stantec)
- Buildable Area - Floating Platform (Stantec)
- NZA Study Area
- Fixed Platform Technical Development Limit (70 km)

Indigenous Lands

- First Nations Reserves (NRCan)
- Labrador Inuit Land Claims Agreement Zone

Onshore Infrastructure

- Airport
- Seaport
- Highway
- Onshore Pipeline
- Transmission Line

Offshore Wells (CNLOPB)

- Production Installation
- Production - Off Station

Offshore Infrastructure

- Disposal at Sea Sites (ECCC)
- Aquaculture Sites
- Abandoned Subsea Pipelines (SOEP, Deep Panuke)
- EXA Express (formerly Hibernia Express) Subsea Cable
- Subsea Cables (Active)
- Traffic Separation Scheme Lane (CHS 2019)

Vessel Density, Generalized (DFO, 2024)

- Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km$^2$)
- High Density Vessel Traffic (>0.6 vessels per day/km$^2$

Critical Habitat for Aquatic Species at Risk

- Atlantic Mud-piddock
- Atlantic Salmon
- North Atlantic Right Whale
- Northern Bottlenose Whale
- Northern Wolffish
- Spotted Wolffish

Protected and Conserved Areas

- Ecological Reserve
- Marine Protected Area
- Migratory Bird Sanctuary
- National Park
- Other Effective Area-Based Conservation Measure

Other Features

- Bathymetry Contour
- Sea Ice Extent 2023 (NSIDC)
- Georges Bank Exclusion Zone (CNSOER)
- Bay of Fundy Tidal Area

***Notes***

**1.** Coordinate System: North American 1983 CSRS Lambert Conformal Conic Central Meridian: -62.0000

**2.** Data Sources: Stantec; NRCan Aboriginal Lands of Canada (2024); Transport Canada; National Geospatial Intelligence Agency; Environment and Climate Change Canada , Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; Canada - Newfoundland and Labrador Offshore Energy Regulator; Government of Nova Scotia; Government of Newfoundland and Labrador Dept. of Fisheries, Forestry and Agriculture; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); IAAC Committee for the Regional Assessment of Offshore Wind Development in Nova Scotia / Newfoundland and Labrador; TeleGeography; Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada

**3.** Background: NRCan CanVec; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

Stantec

*Figure No.*
**12**

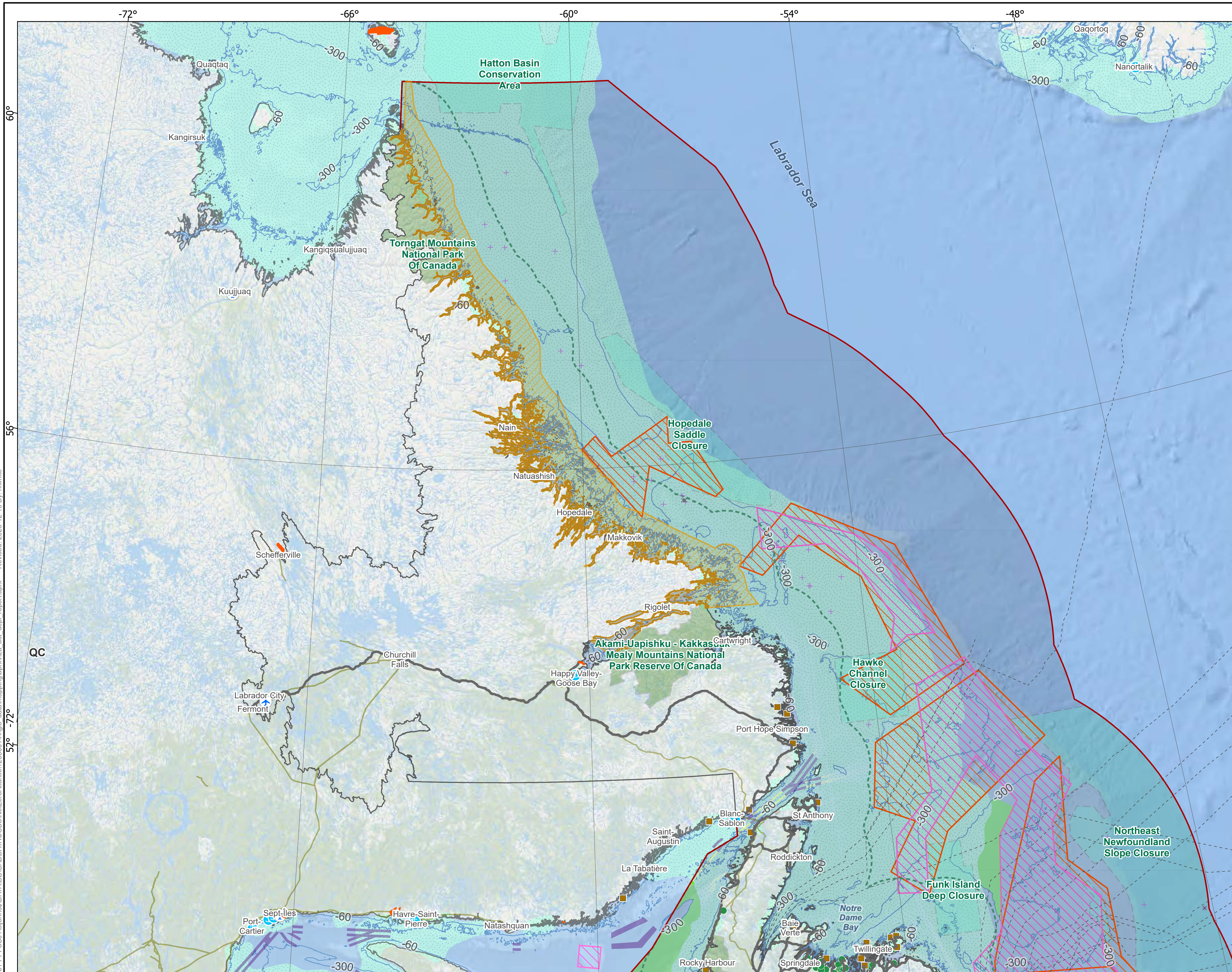
*Title*
## Constraints Analysis Overview, Labrador

*Client/Project* 126560144_200

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location*
Atlantic Canada

Prepared by NW on 2025-08-25
TR by DP on 2025-08-25




N

0 50 100 150 Kilometres
(At original document size of 11x17)
1:5,500,000

**Legend**

- Buildable Area - Fixed Platform (Stantec)
- Buildable Area - Floating Platform (Stantec)
- NZA Study Area
- Fixed Platform Technical Development Limit (70 km)

Indigenous Lands
- First Nations Reserves (NRCan)
- Labrador Inuit Land Claims Agreement Zone

Onshore Infrastructure
- Airport
- Seaport
- Highway
- Transmission Line

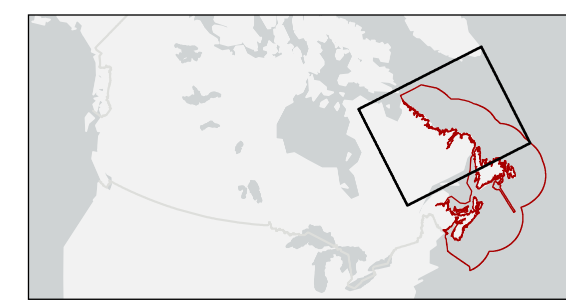
Offshore Infrastructure
- Disposal at Sea Sites (ECCC)
- Aquaculture Sites
- Traffic Separation Scheme Lane (CHS, 2019)

Vessel Density, Generalized (DFO, 2024)
- Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/$km^2$)
- High Density Vessel Traffic (>0.6 vessels per day/$km^2$

Critical Habitat for Aquatic Species at Risk
- Northern Wolffish
- Spotted Wolffish

Protected and Conserved Areas
- Ecological Reserve
- Marine Protected Area
- Migratory Bird Sanctuary
- National Park
- Other Effective Area-Based Conservation Measure

Other Features
- Bathymetry Contour
- Sea Ice Extent 2023 (NSIDC)



***Notes***
**1.** Coordinate System: North American 1983 CSRS Lambert Conformal Conic Central Meridian: -62.0000
**2.** Data Sources: Stantec; NRCan Aboriginal Lands of Canada (2024); Transport Canada; National Geospatial Intelligence Agency; Environment and Climate Change Canada , Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; Canada - Newfoundland and Labrador Offshore Energy Regulator; Government of Nova Scotia; Government of Newfoundland and Labrador Dept. of Fisheries and Agriculture; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); IAAC Committee for the Regional Assessment of Offshore Wind Development in Nova Scotia / Newfoundland and Labrador; TeleGeography; Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada
**3.** Background: NRCan CanVec; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

Stantec

Figure No.

**13**

Title

## Constraints Analysis Overview, Maritimes and Southern Newfoundland

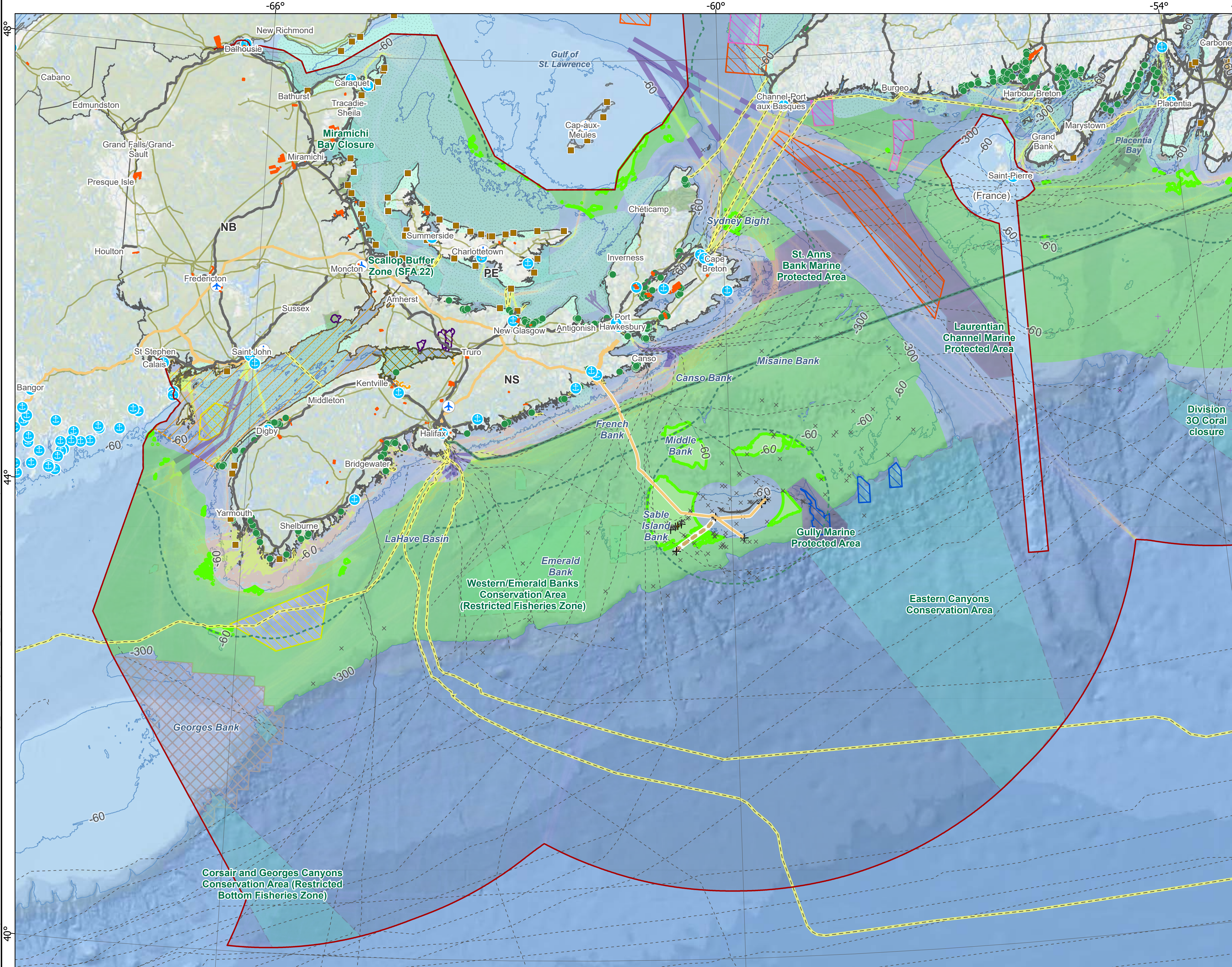
Client/Project 126560144_200

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location

Prepared by NW on 2025-08-25
TR by DP on 2025-08-25

Atlantic Canada




N

0 50 100 150 Kilometres

(At original document size of 11x17)
1:4,000,000

**Legend**

- Buildable Area - Fixed Platform (Stantec)
- Buildable Area - Floating Platform (Stantec)
- NZA Study Area
- Fixed Platform Technical Development Limit (70 km)

Indigenous Lands

- First Nations Reserves (NRCan)
- Labrador Inuit Land Claims Agreement Zone

Onshore Infrastructure

- Airport
- Seaport
- Highway
- Onshore Pipeline
- Transmission Line

Offshore Wells (CNSOER)

- Gas well
- Injection well
- Abandoned/Suspended Wellhead

Offshore Infrastructure

- Disposal at Sea Sites (ECCC)
- Aquaculture Sites
- Abandoned Subsea Pipelines (SOEP, Deep Panuke)
- EXA Express (formerly Hibernia Express) Subsea Cable
- Subsea Cables (Active)
- Traffic Separation Scheme Lane (CHS, 2019)

Vessel Density, Generalized (DFO, 2024)

- Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/$km^2$)
- High Density Vessel Traffic (>0.6 vessels per day/$km^2$

Critical Habitat for Aquatic Species at Risk

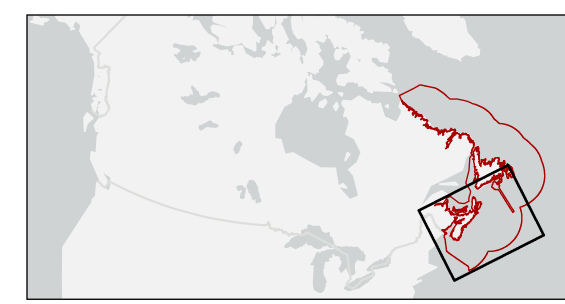
- Atlantic Mud-piddock
- Atlantic Salmon
- North Atlantic Right Whale
- Northern Bottlenose Whale
- Northern Wolffish
- Spotted Wolffish

Protected and Conserved Areas

- Ecological Reserve
- Marine Protected Area
- Migratory Bird Sanctuary
- National Park
- Other Effective Area-Based Conservation Measure

Other Features

- Bathymetry Contour
- Sea Ice Extent 2023 (NSIDC)
- Georges Bank Exclusion Zone (CNSOER)
- Bay of Fundy Tidal Area (Approximate)



***Notes***

**1.** Coordinate System: North American 1983 CSRS Lambert Conformal Conic Central Meridian: -62.0000

**2.** Data Sources: Stantec; NRCan Aboriginal Lands of Canada (2024); Transport Canada; National Geospatial Intelligence Agency; Environment and Climate Change Canada , Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; Canada - Newfoundland and Labrador Offshore Energy Regulator; Government of Nova Scotia; Government of Newfoundland and Labrador Dept. of Fisheries and Agriculture; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); IAAC Committee for the Regional Assessment of Offshore Wind Development in Nova Scotia / Newfoundland and Labrador; TeleGeography; Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada

**3.** Background: NRCan CanVec; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, CHS, Esri, GEBCO, Garmin, NaturalVue

Stantec

Revised: 2025-12-19 By: niwhite

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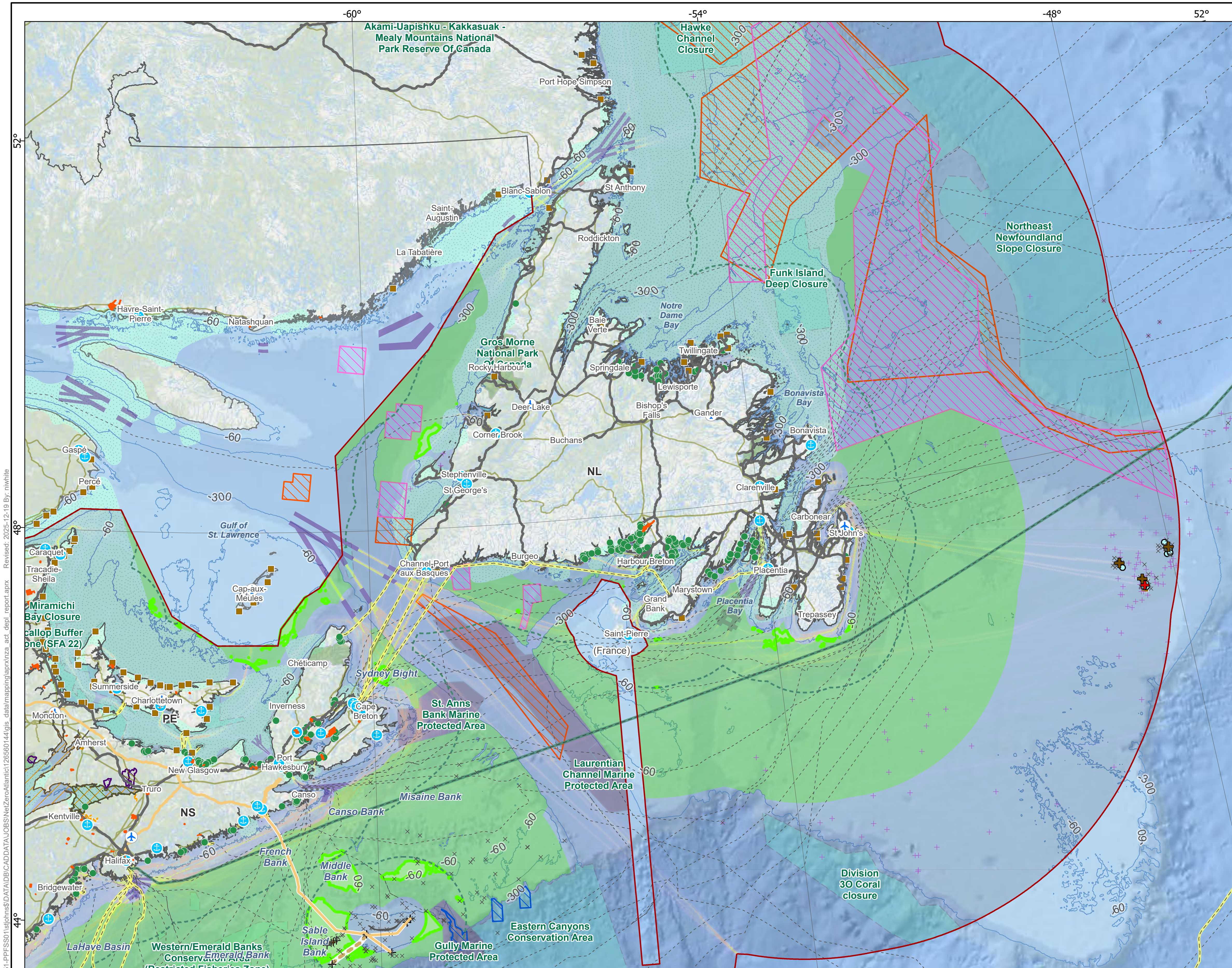



Figure No.
**14**

Title
## Constraints Analysis Overview, Newfoundland and Labrador

Client/Project 126560144_200

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Atlantic Canada

Prepared by NW on 2025-08-25
TR by DP on 2025-08-25

N

0 50 100 150 Kilometres
(At original document size of 11x17)
1:4,500,000

**Legend**

Buildable Area - Fixed Platform (Stantec)
Buildable Area - Floating Platform (Stantec)
NZA Study Area
Fixed Platform Technical Development Limit (70 km)

Indigenous Lands
First Nations Reserves (NRCan)
Labrador Inuit Land Claims Agreement Zone

Onshore Infrastructure
Airport
Seaport
Highway
Onshore Pipeline
Transmission Line

Offshore Wells (CNLOPB)
Production Installation
Production - Off Station
Abandoned/Suspended Wellheads
Delineation Well
Oil Producer

Offshore Wells (CNSOER)
Gas well
Injection well
Abandoned/Suspended Wellhead

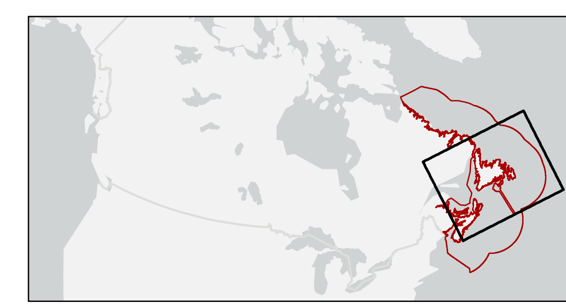
Offshore Infrastructure
Disposal at Sea Sites (ECCC)
Aquaculture Sites

Vessel Density, Generalized (DFO, 2024)
Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km$^2$)
High Density Vessel Traffic (>0.6 vessels per day/km$^2$

Critical Habitat for Aquatic Species at Risk
Atlantic Mud-piddock
Atlantic Salmon
Northern Bottlenose Whale
Northern Wolffish
Spotted Wolffish

Protected and Conserved Areas
Ecological Reserve
Marine Protected Area
Migratory Bird Sanctuary
National Park
Other Effective Area-Based Conservation Measure

Other Features
Bathymetry Contour
Sea Ice Extent 2023 (NSIDC)
Bay of Fundy Tidal Area (Approximate)

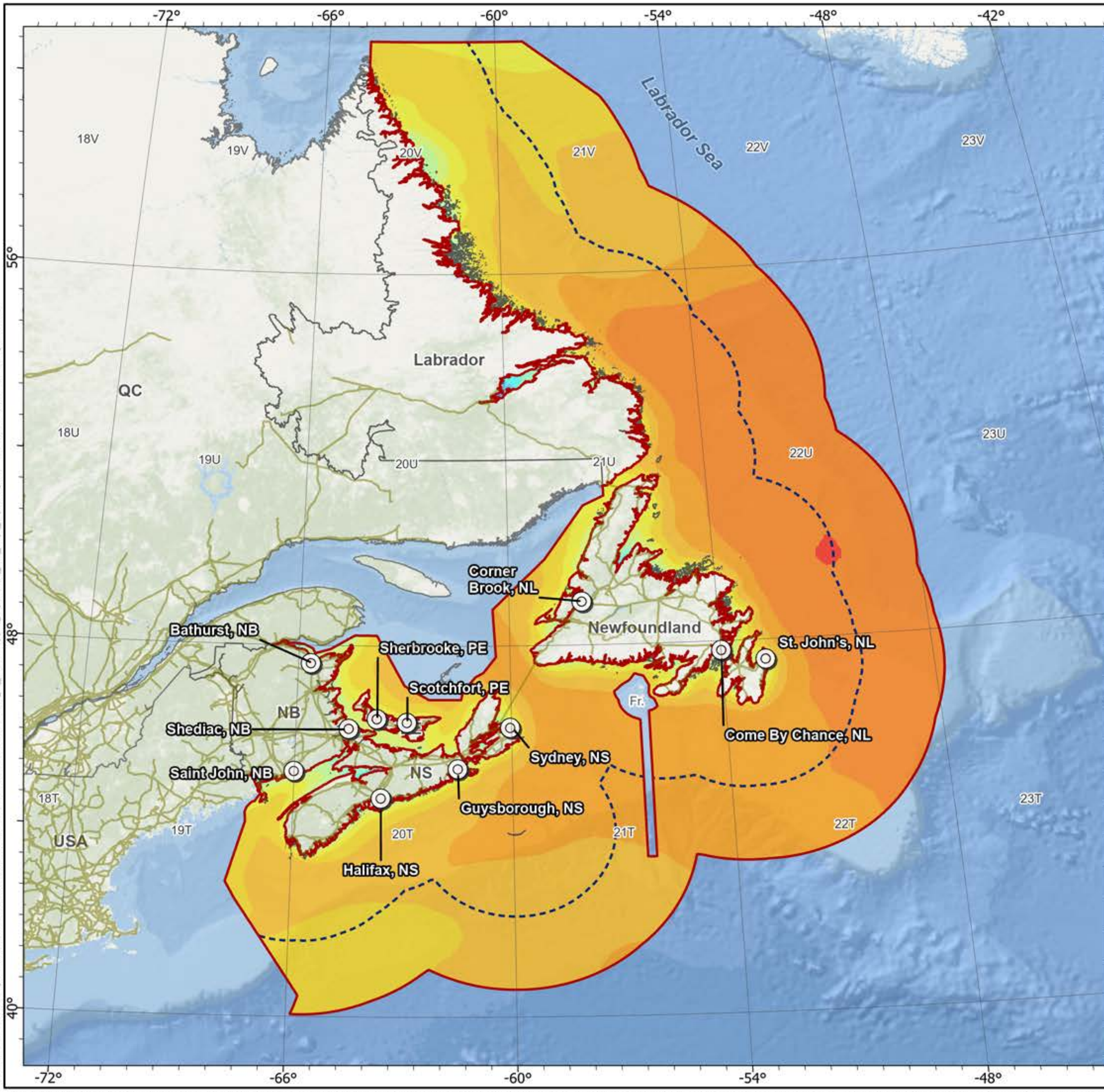


***Notes***

**1.** Coordinate System: North American 1983 CSRS Lambert Conformal Conic Central Meridian: -62.0000
**2.** Data Sources: Stantec; NRCan Aboriginal Lands of Canada (2024); Transport Canada; National Geospatial Intelligence Agency; Environment and Climate Change Canada , Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; Canada - Newfoundland and Labrador Offshore Energy Regulator; Government of Nova Scotia; Government of Newfoundland and Labrador Dept. of Fisheries and Agriculture; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); IAAC Committee for the Regional Assessment of Offshore Wind Development in Nova Scotia / Newfoundland and Labrador; TeleGeography; Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada
**3.** Background: NRCan CanVec; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, CHS, Esri, GEBCO, Garmin, NaturalVue

Stantec

Revised: 2025-12-19 By: nwhite




Revised: 2025-12-19 By: nwhite

\\CA0151-PPFSS01\stjohns$\DATA\DB\CADD\DATA\JOBS\NetZeroAtlantic\126560144\gis_data\mapping\aprx\nza_act_depl_report.aprx

*Figure No.*
**15**

*Title*
**Average Wind Speeds at 120 m hub height and POIs**

*Client/Project* 126560144_026

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location*
Atlantic Canada

Prepared by NW on 2025-07-17
TR by DP on 2025-07-17

N

0 230 460 km

(At original document size of 8.5x11)
1:14,000,000

Legend

- Point of Interconnection
- Floating Platform Technical Development Limit (195km)
- Transmission Line
- NZA Study Area

Average Wind Speed (m/s) at 120 m ASL

- <= 6
- 6 - 6.5
- 6.5 - 7
- 7 - 7.5
- 7.5 - 8
- 8 - 8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- 10 - 10.5
- 10.5 - 11
- 11 - 11.5
- 11.5 - 12
- >12

**Project Location:**

***Notes***
**1.** Coordinate System: WGS 84 Azimuthal Equidistant Projection, Central Meridian -62
**2.** Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset; Statistics Canada; OpenStreetMap
**3.** Background: ESRI; NRCan CanVec; Statistics Canada

Stantec

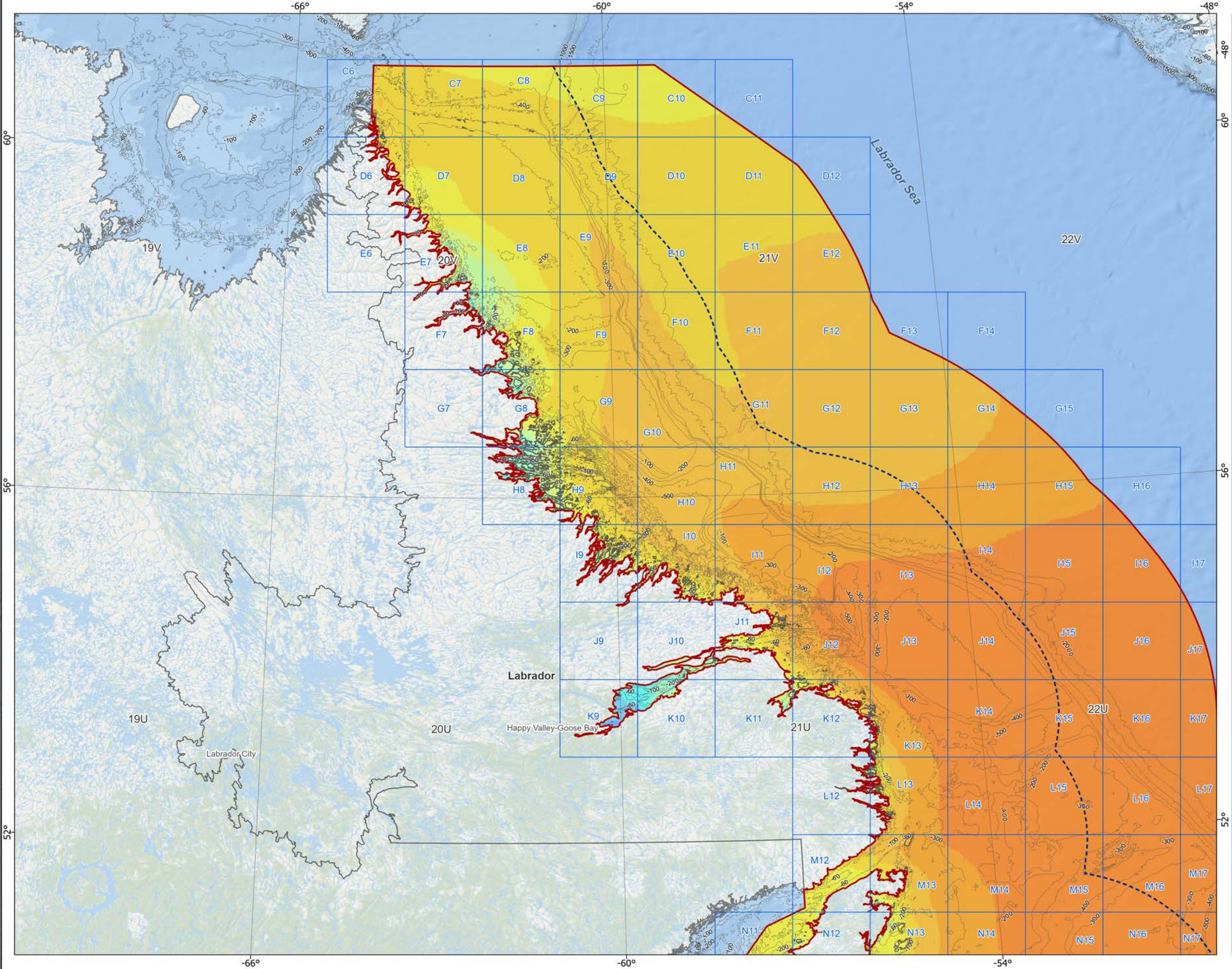



Figure No.
**16**

Title
## Average Wind Speed, Labrador

Client/Project
126560144_200

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Atlantic Canada

Prepared by NW on 2025-08-25
Revised by NW on 2025-10-08
TR by DP on 2025-10-08

N

0 50 100 Kilometres
(At original document size of 11x17)
1:5,000,000

**Legend**

- Floating Platform Technical Development Limit (195km)
- Bathymetry Contours
- NZA Study Area
- Processing Grid (100 km x 100 km)

Average Wind Speed (m/s) at 120 m ASL

- <= 6
- 6 - 6.5
- 6.5 - 7
- 7 - 7.5
- 7.5 - 8
- 8 - 8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- 10 - 10.5
- 10.5 - 11
- 11 - 11.5
- 11.5 - 12
- >12

***Notes***
**1.** Coordinate System: WGS 84 Azimuthal Equidistant Projection, Central Meridian -62
**2.** Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset; Statistics Canada; OpenStreetMap
**3.** Background: ESRI; NRCan CanVec; GEBCO 2024; Statistics Canada

Stantec

Figure No.
**17**

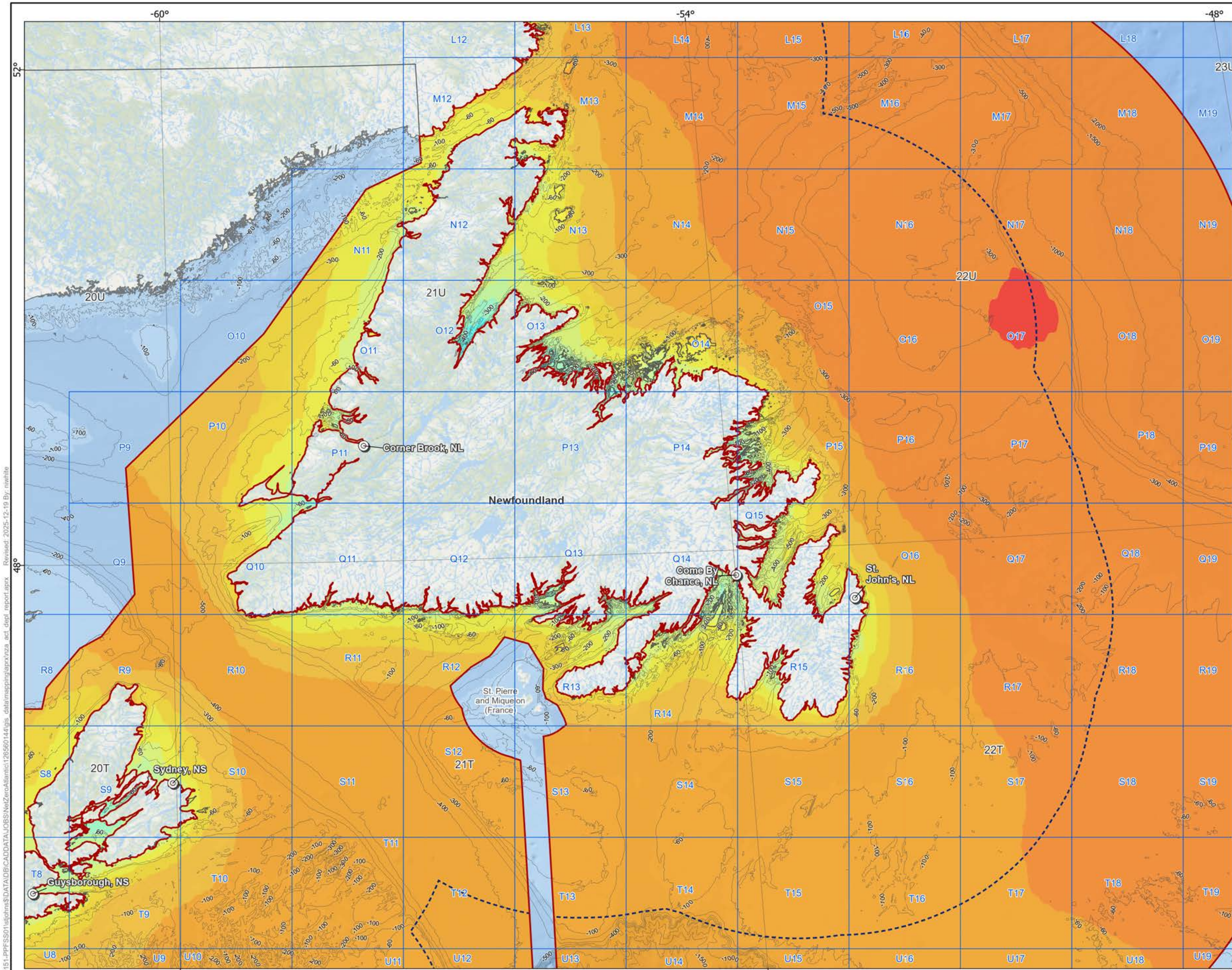
Title
## Average Wind Speed, Newfoundland and Labrador

Client/Project 126560144_200

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Atlantic Canada

Prepared by NW on 2025-08-25
Revised by NW on 2025-10-08
TR by DP on 2025-10-08




N

0 50 100 Kilometres
(At original document size of 11x17)
1:3,500,000

**Legend**

- Point of Interconnection
- Floating Platform Technical Development Limit (195km)
- Bathymetry Contours
- NZA Study Area
- Processing Grid (100 km x 100 km)

Average Wind Speed (m/s) at 120 m ASL

- <= 6
- 6 - 6.5
- 6.5 - 7
- 7 - 7.5
- 7.5 - 8
- 8 - 8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- 10 - 10.5
- 10.5 - 11
- 11 - 11.5
- 11.5 - 12
- >12

**Notes**
1. Coordinate System: WGS 84 Azimuthal Equidistant Projection, Central Meridian -62
2. Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset; Statistics Canada; OpenStreetMap
3. Background: ESRI; NRCan CanVec; GEBCO 2024; Statistics Canada

Stantec

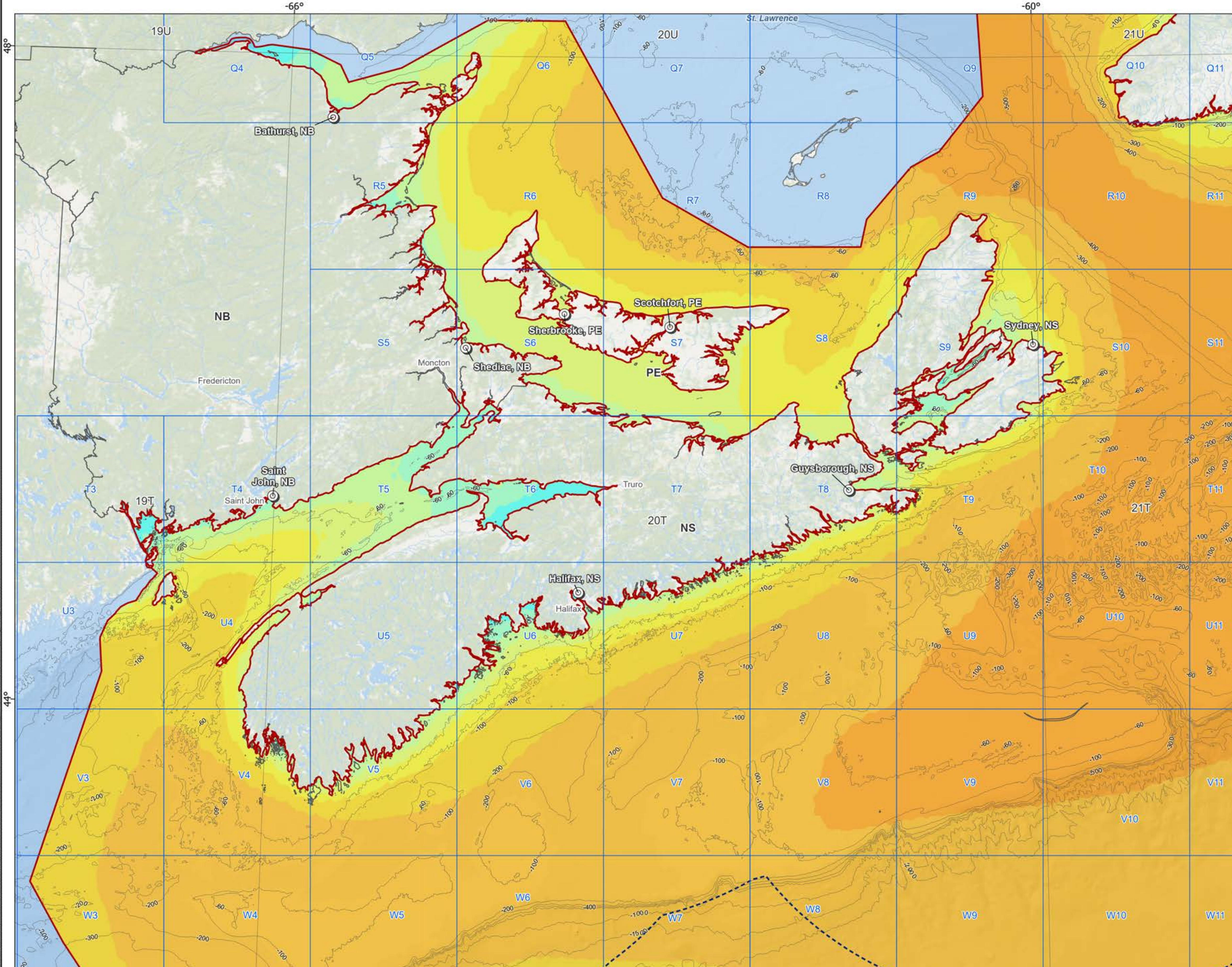



Figure No.
18

Title
**Average Wind Speed, Maritimes and Southern Newfoundland**

Client/Project
126560144_200

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Atlantic Canada

Prepared by NW on 2025-08-25
Revised by NW on 2025-10-08
TR by DP on 2025-10-08

N

0 50 100 Kilometres
(At original document size of 11x17)
1:2,700,000

**Legend**

- Point of Interconnection
- Floating Platform Technical Development Limit (195km)
- Bathymetry Contours
- NZA Study Area
- Processing Grid (100 km x 100 km)

Average Wind Speed (m/s) at 120 m ASL

- <= 6
- 6 - 6.5
- 6.5 - 7
- 7 - 7.5
- 7.5 - 8
- 8 - 8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- 10 - 10.5
- 10.5 - 11
- 11 - 11.5
- 11.5 - 12
- >12

**Notes**
1. Coordinate System: WGS 84 Azimuthal Equidistant Projection, Central Meridian -62
2. Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset; Statistics Canada; OpenStreetMap
3. Background: ESRI; NRCan CanVec; GEBCO 2024; Statistics Canada

Stantec

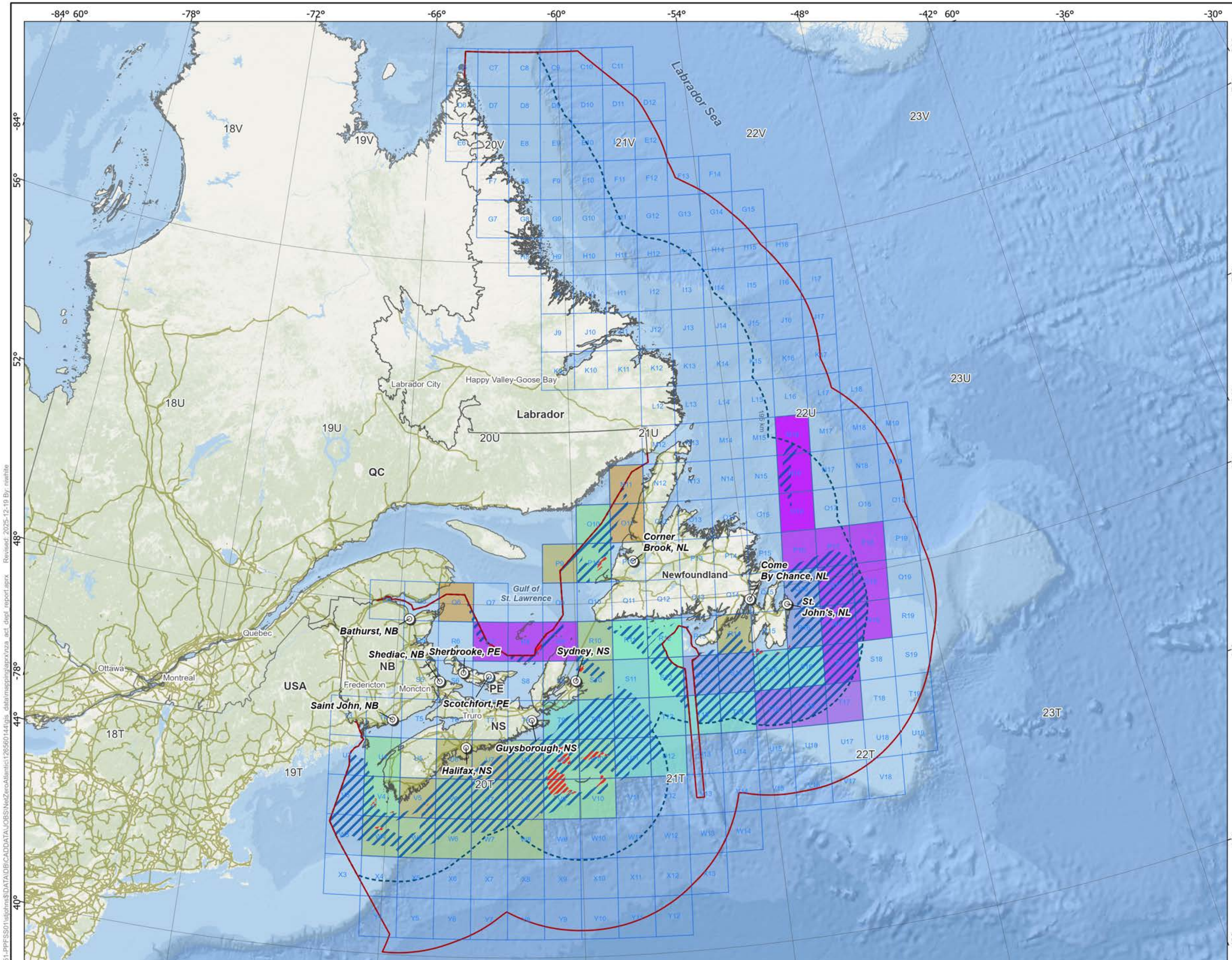



Figure No.
**19**

Title
## Net Capacity Factors for the Study Area

Client/Project 126560144_201

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Atlantic Canada

Prepared by NW on 2025-08-25
TR by DP on 2025-08-25

N

0 100 200 300 Kilometres
(At original document size of 11x17)
1:10,000,000

**Legend**

- Point of Interconnection
- Transmission Line
- Buildable Area - Fixed Platform
- Buildable Area - Floating Platform
- NZA Study Area
- Floating Platform Technical Development Limit (195 km)

Net Capacity Factor

- 59.1 - 60.0
- 58.1 - 59.0
- 57.1 - 58.0
- 56.1 - 57.0
- 55.1 - 56.0
- 54.1 - 55.0
- 53.1 - 54.0
- 52.1 - 53.0
- 51.1 - 52.0
- 50.1 - 51.0

***Notes***
1. Coordinate System: WGS84 Azimuthal Equidistant Projection, Central Meridian -62
2. Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset
3. Background: NRCan CanVec; OpenStreetMap; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

Stantec

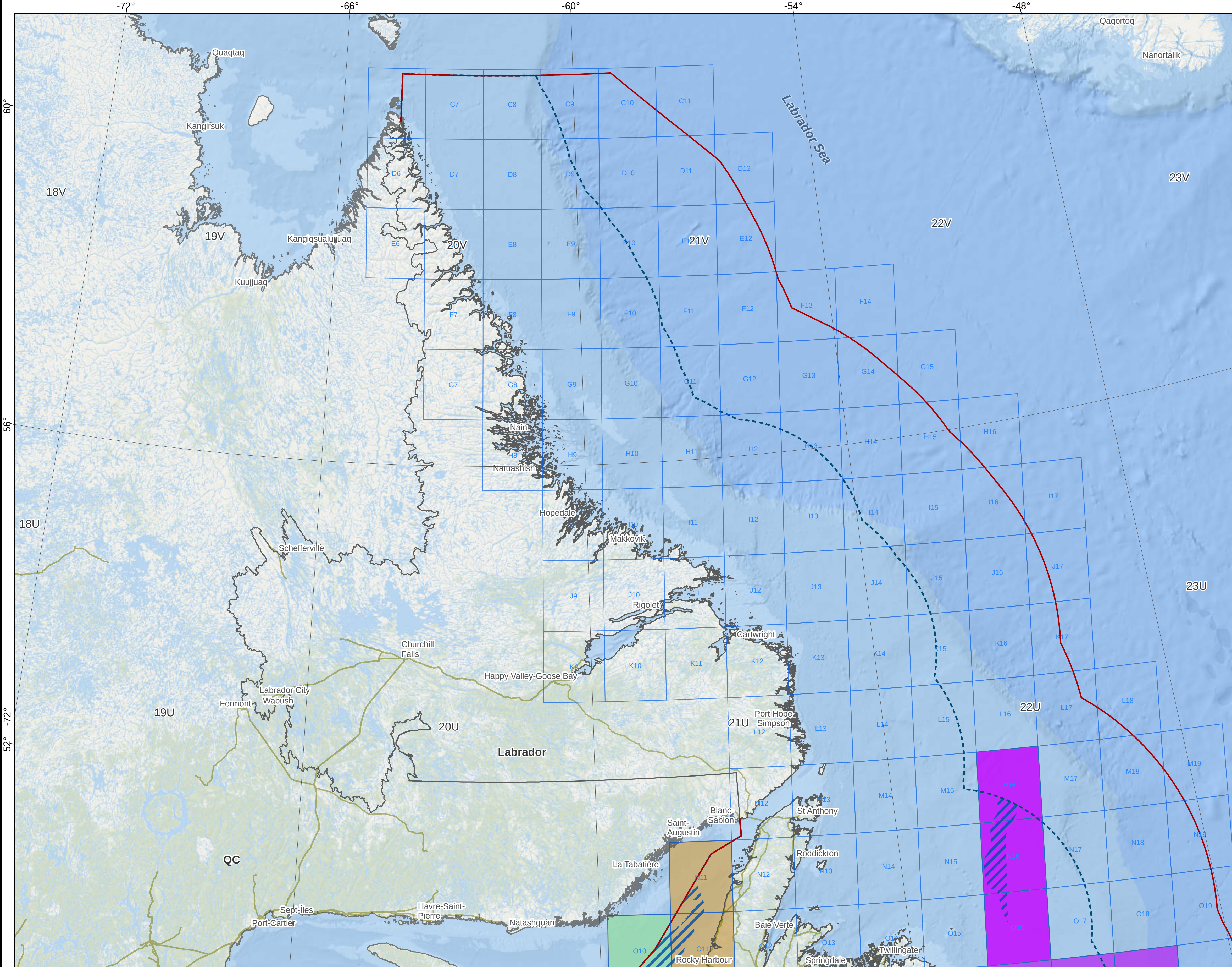



Figure No.
20

Title
**Net Capacity Factors, Labrador**

Client/Project
126560144_201

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Atlantic Canada

Prepared by NW on 2025-08-25
TR by DP on 2025-08-25

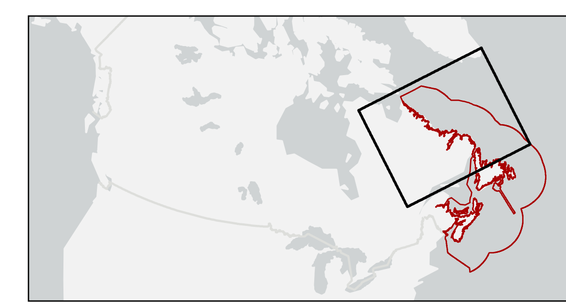
0 50 100 150 Kilometres
(At original document size of 11x17)
1:5,500,000

Legend

- Point of Interconnection
- Transmission Line
- Buildable Area - Fixed Platform
- Buildable Area - Floating Platform
- NZA Study Area
- Floating Platform Technical Development Limit (195 km)

Net Capacity Factor

- 59.1 - 60.0
- 58.1 - 59.0
- 57.1 - 58.0
- 56.1 - 57.0
- 55.1 - 56.0
- 54.1 - 55.0
- 53.1 - 54.0
- 52.1 - 53.0
- 51.1 - 52.0
- 50.1 - 51.0



**Notes**
1. Coordinate System: WGS84 Azimuthal Equidistant Projection, Central Meridian -62
2. Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset
3. Background: NRCan CanVec; OpenStreetMap; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

Stantec

Revised: 2025-12-19 By: nwhite

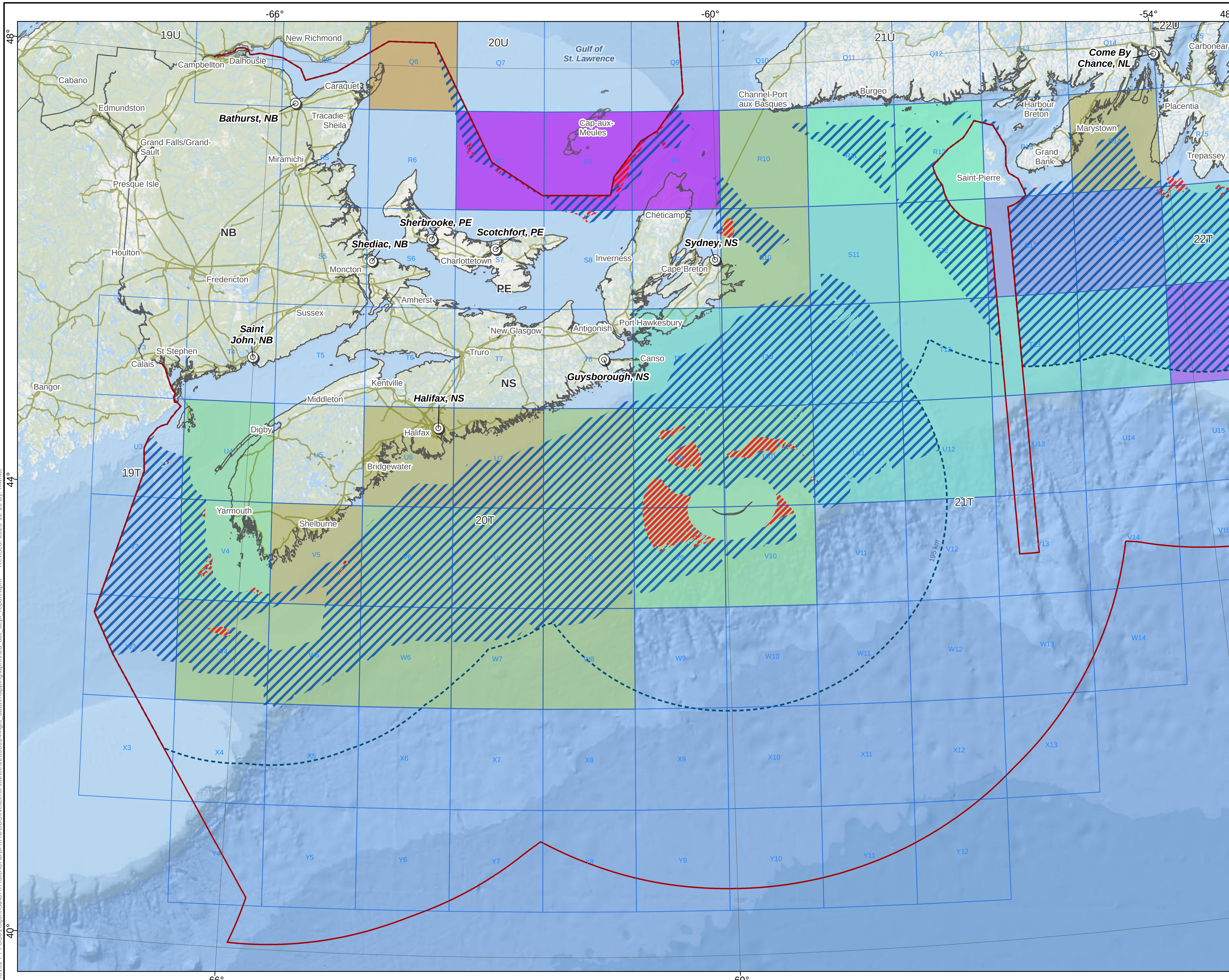



*Figure No.*

**21**

*Title*

## Net Capacity Factors, Maritimes and Southern Newfoundland

*Client/Project* 126560144_201

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location*

Atlantic Canada

Prepared by NW on 2025-08-25
TR by DP on 2025-08-25

0 50 100 150 Kilometres
(At original document size of 11x17)
1:4,000,000

Legend

- Point of Interconnection
- Transmission Line
- Buildable Area - Fixed Platform
- Buildable Area - Floating Platform
- NZA Study Area
- Floating Platform Technical Development Limit (195 km)

Net Capacity Factor

- 59.1 - 60.0
- 58.1 - 59.0
- 57.1 - 58.0
- 56.1 - 57.0
- 55.1 - 56.0
- 54.1 - 55.0
- 53.1 - 54.0
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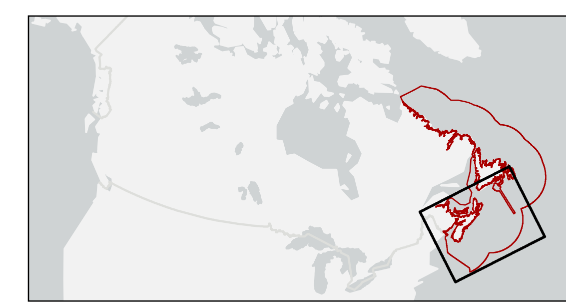
- 51.1 - 52.0
- 50.1 - 51.0



***Notes***

**1.** Coordinate System: WGS84 Azimuthal Equidistant Projection, Central Meridian -62
**2.** Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset
**3.** Background: NRCan CanVec; OpenStreetMap; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, CHS, Esri, GEBCO, Garmin, NaturalVue

Stantec

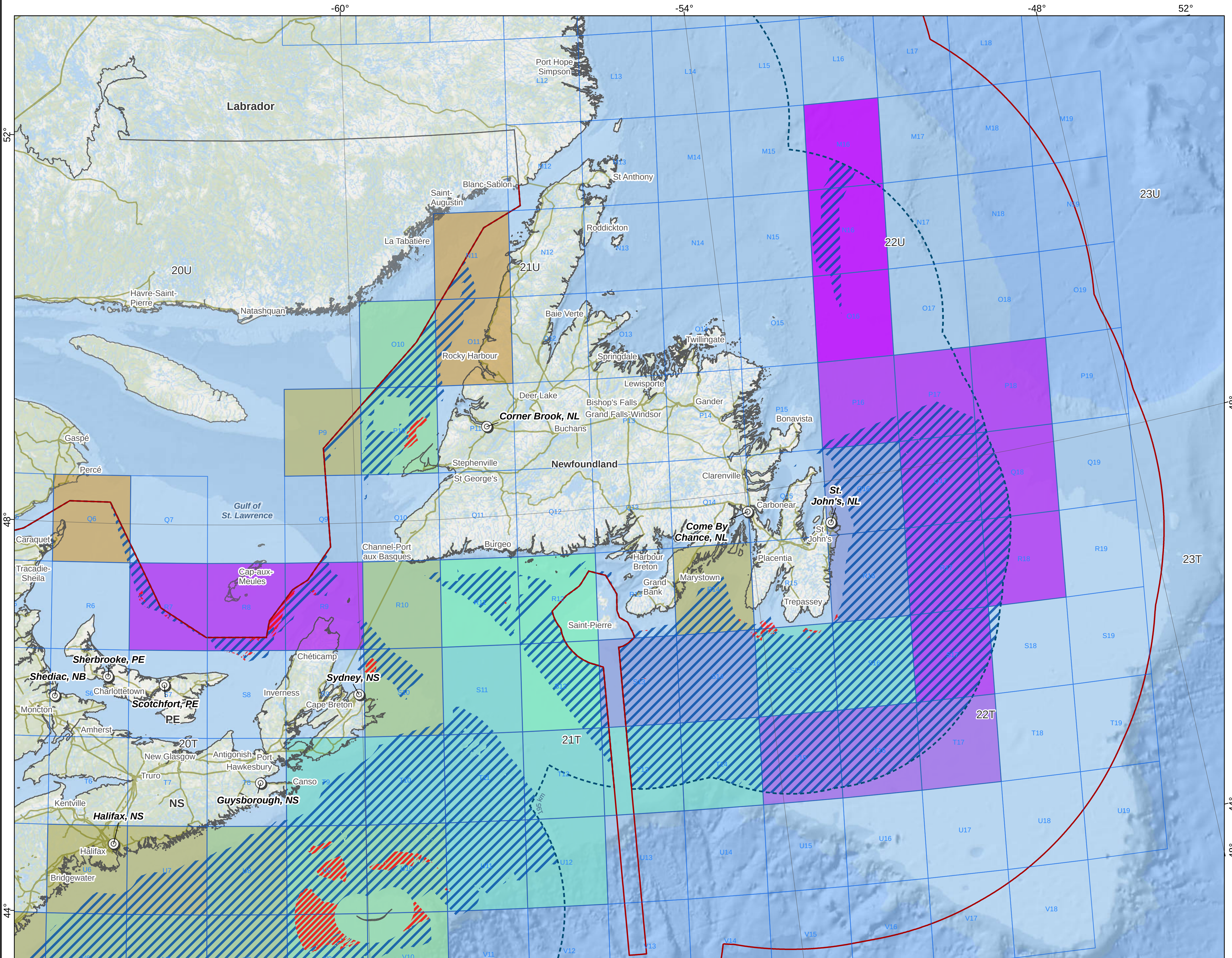



Figure No.

22

Title

# Net Capacity Factors, Newfoundland and Labrador

Client/Project

126560144_201

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location

Atlantic Canada

Prepared by NW on 2025-08-25
TR by DP on 2025-08-25

$ ( $

0 50 100 150 Kilometres

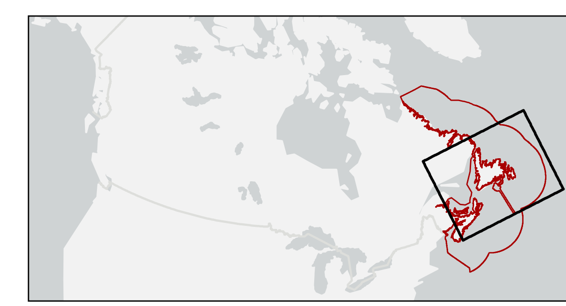
(At original document size of 11x17)
1:4,500,000

Legend

- Point of Interconnection
- Transmission Line
- Buildable Area - Fixed Platform
- Buildable Area - Floating Platform
- NZA Study Area
- Floating Platform Technical Development Limit (195 km)

Net Capacity Factor

- 59.1 - 60.0
- 58.1 - 59.0
- 57.1 - 58.0
- 56.1 - 57.0
- 55.1 - 56.0
- 54.1 - 55.0
- 53.1 - 54.0
- 52.1 - 53.0
- 51.1 - 52.0
- 50.1 - 51.0



***Notes***

1. Coordinate System: WGS84 Azimuthal Equidistant Projection, Central Meridian -62
2. Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset
3. Background: NRCan CanVec; OpenStreetMap; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

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## 3.3 Visual Impact

In addition to technical and locational factors, offshore wind development must also account for its potential visual impact on coastal communities, cultural landmarks, and protected landscapes. Visibility of turbines depends on distance, atmospheric conditions, and the sensitivity of the surrounding viewsheds. A summary of the main considerations and recommendations is outlined below.

- Viewer Distance: Distance will affect the apparent size and degree of contrast between a wind turbine and its surroundings, which will be more significant closer to shore. At an increased distance from the observer, wind turbines will become more difficult to distinguish against the environmental background.
- Curvature of the Earth: At long distances, when not including the atmospheric phenomenon of refraction, the curvature of the Earth will begin to conceal objects at the horizon (as seen in Figure 23). For instance, a 213 m tall turbine at about 50 km would result in only 66 m of the turbine being theoretically visible. Meteorological and atmospheric conditions will also affect visibility, and the visible portion of the turbine will appear to be much smaller when it is viewed in a wider ocean setting.


**Figure 23: Effect of Earth's curvature on line-of-sight visibility**

- Meteorological and Atmospheric Conditions: The atmosphere contains water vapour (humidity) and particulates such as dust and various pollutants. These factors, compounded with increased distance between the observer and the project, can impact the visibility of an offshore wind turbine. With increased distance from an object in this setting, there will be a reduction in the contrast between light and dark colours, and colour intensity will be reduced, with objects appearing to be "washed out".
- Backdrop and Sun Position: The backdrop and position of the sun may affect the visibility of wind turbines. The degree to which visibility is affected will depend on the colours and position of the sun in the sky. For instance, when a light-coloured turbine is viewed against a dark sky, there will be a high contrast between the two, while a light-coloured turbine viewed against a light sky (e.g., blue or light gray), may be difficult to visualize.

- Aircraft Detection Lighting Systems (ADLS): At night, visual impacts may be heightened due to the presence of ADLS, which are required for aviation safety. These systems activate turbine-mounted lights when aircraft are detected nearby, resulting in intermittent but highly visible lighting events. While ADLS reduce continuous nighttime lighting, they can still be a source of concern for coastal communities due to their sudden activation and brightness, particularly in otherwise dark seascapes.

### 3.3.1 Areas of Importance with Protected Views and Identification of Buffer Zones

Several locations have been identified by Parks Canada Agency (PCA), where the ocean viewshed should be protected. Zones for development and their suggested viewshed buffers should be further evaluated to determine their importance and any limited factors that would impede the construction and operation of an offshore wind project.

Nova Scotia, per Parks Canada Agency (October 31, 2023):

- Cape Breton Highlands National Park:
  - A buffer of 45 km around the entirety of Cape Breton Highlands National Park coast has been recommended.
  - A buffer that extends further, from around the Skyline Trail is also recommended, although a distance is not provided.
- Sable Island National Park Preserve:
  - It is recommended that offshore wind development begin at a distance from the national park reserve to minimize potential environmental and visual impacts. While a specific setback distance has not been defined, the recommendation reflects a precautionary approach to protect the park's sensitive ecosystem.
- Fortress of Louisbourg National Historic Site (NHS):
  - It is recommended that any turbines seen from this site be at a distance where the turbines could be interpreted as ship sails. Parks Canada also recommends a buffer of 25 km around the Fortress of Louisbourg NHS, which includes Wolf's Landing MHS and Royal Battery NHS.
- Wolfe's Landing NHS;
- Royal Battery NHS;
- Fort Gaspareaux NHS:
  - It is recommended that turbines appear no taller than the trees on the island.
- Marconi NHS:
  - A 5 km buffer around the Marconi NHS has been recommended.
- Canso Islands and Grassy Island Fort NHS:

  - A 5 km buffer around the Canso Islands and Grassy Island Fort NHS has been recommended.
- Pemsik NMCA and Cape Breton Highlands National Marine Conservation Areas (NMCA):
  - It has been recommended that both the Pemsik NMCA and the Cape Breton Highlands NMCA be excluded from areas where wind farms are permitted, due to their ecological, cultural, and recreational significance.
- Kejimkujik National Park Seaside:
  - No buffer guidance is identified.

Newfoundland and Labrador, per Parks Canada Agency (October 31, 2023):

- Gros Morne National Park and UNESCO World Heritage Site:
  - It is recommended that development of wind farms result in no impacts on the viewscape from the park.
- South Coast Fjords NMCA (Proposed Protected Area):
  - It is recommended that the South Coast Fjords NMCA be excluded from where wind farms are permitted.

New Brunswick and Prince Edward Island do not appear to have been evaluated by Parks Canada to identify protected viewsheds. However, several areas should be recognized that may receive some sort of buffer in the future. Those waterfront resources of interest are identified below.

New Brunswick:

- Kouchibougual National Park;
- Fundy National Park;
- Little Salmon Gorge Natural Reserve;
- Bay Du Vin Island Natural Area;
- Tabusintal Blacklands Natural Reserve;
- New River Beach Provincial Park;
- Little Salmon Provincial Park;
- Hay Island Provincial Park.

Prince Edward Island:

- Prince Edward Island National Park.

As seen in the list above, the distance buffer required is highly dependent on the project location, which means that analyses need to be conducted on a case-by-case basis. Additional guidance might be required to determine if future marine (NMCAs) identified by Parks Canada should be included in any assessments.

There are several studies completed in the United States and Europe that offer opinions as to where an offshore wind project should be sited in order to minimize potential visual impacts. For example, White (2020) identified that the visual impact from a 300 m tall (to blade tip) turbine is considered low at an average distance of 38.6 km. Sullivan et al. (2013) found that 350-m tall turbines were partially visible at a distance of 42 km. It is important to recognize that visibility by itself does not equate impact and as identified above, several additional factors can impact visibility. Viewshed Impact Assessments (VIAs) are typically performed for offshore wind development

While there are limited options to minimize potential visual impacts of offshore wind turbines, there are design considerations that can minimize the visual impact of these structures, including:

- Locating the turbines as far offshore as economically feasible.
- Location of offshore windfarms adjacent to remote shorelines (e.g., away from high-use areas).
- Use of Aircraft Detection Lighting Systems to reduce nighttime impacts. Based on radar, the lights will only turn on when an aircraft is within a certain radius of the wind farm.

## 3.4 Capital Expenditure Cost Assumptions Summary

The economic assessment of offshore wind in Atlantic Canada is grounded in NREL's 2024 Annual Technology Baseline cost framework, complemented by adjustments specific to the region. The modelled capital expenditure (CapEx) values (Table 7) ranges shown represent early-stage resource-side capital costs, based primarily on turbine supply, offshore installation, foundations, offshore electrical infrastructure, and contingency. These values do not include interconnection to the inland grid, major transmission system upgrades, port/yard modifications, insurance, finance costs, taxes, or development-phase expenditures. Therefore, the figures should be interpreted as cost ranges related to offshore infrastructure only, rather than full delivered-power cost estimates. These values establish a baseline for estimating economic potential across provinces, while recognizing that site-specific conditions may drive adjustments.

**Table 7: Cost Estimate Offshore Wind Projects 2025 USD**

| Configuration | Min ($/kW) | Mid ($/kW) | Max ($/kW) |
|---|---|---|---|
| Fixed-Bottom | $4,315 | $5,735 | $7,650 |
| Floating | $6,360 | $8,770 | $11,295 |

- Nova Scotia: CapEx assumptions must account for relatively shallow waters in Canada/NS-Designated WEAs aligned banks (Sydney Bight, Middle Bank, Sable Island Bank), making fixed-bottom deployments competitive. However, grid interconnection upgrades are expected to be a major cost driver, particularly for export-oriented scenarios.
- Newfoundland and Labrador: The province's vast buildable capacity is primarily in deeper waters, making floating wind the dominant technology. CapEx adjustments will be needed to reflect the higher cost of floating substructures and installation, offset by the superior wind resource and higher capacity factors.
- New Brunswick: Offshore wind opportunities are smaller in scale and closer to shore, resulting in lower site preparation costs. However, NB's limited buildable area may require integration with regional transmission expansion to achieve economies of scale.
- Prince Edward Island: While PEI benefits from strong wind speeds and close proximity to POIs, its smaller buildable area constrains economies of scale. CapEx assumptions here reflect limited but potentially high-value niche developments.

The economic outputs developed serve as inputs for the Atlantic Canada Offshore Wind Grid Integration and Transmission Study's Phase 3 system modeling, to be run by E3. This integration will allow for system-wide analysis and optimization, considering not only offshore wind costs but also the role of alternative resources and demand growth.

Three core economic drivers will shape how offshore wind is ultimately deployed in Atlantic Canada:

- Cost of development and grid interconnection – including site-specific CapEx and the ability to access transmission.
- Availability and competitiveness of alternative resources – Offshore wind must compete against onshore wind, hydro, imports, and emerging technologies such as small modular nuclear reactors.
- Scale of demand – deployment levels depend on whether offshore wind (OSW) serves only local needs or expands to include exports to New England and hydrogen electrolysis demand.

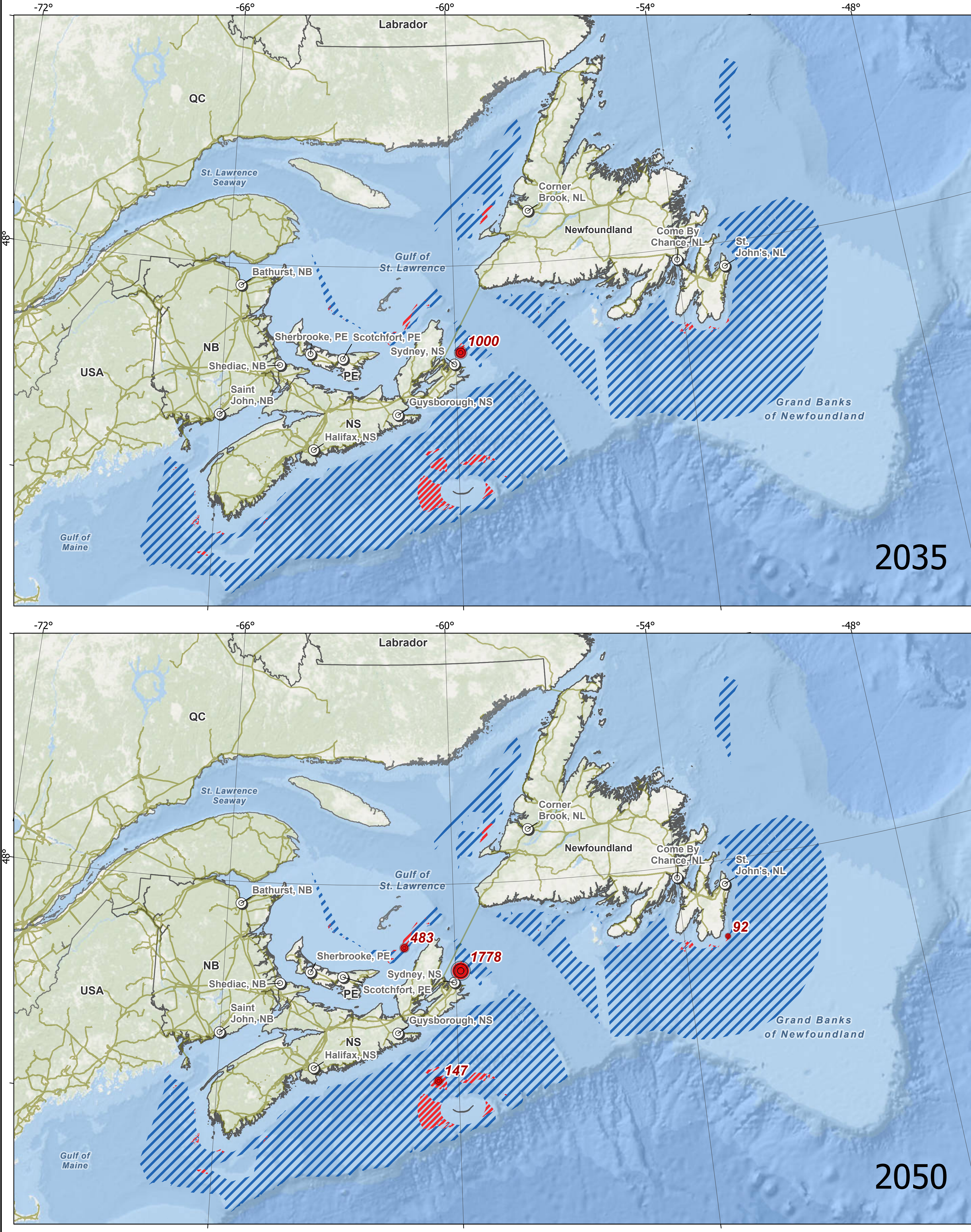

**Figure 24: Market Scenarios Established During Phase 1 of the Atlantic Canada Offshore**

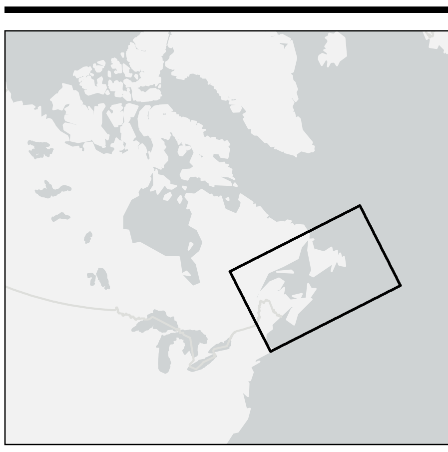
To capture these uncertainties, demand-driven market scenarios were introduced in the modeling framework. These range from domestic-only low-offshore wind scenarios to all-markets high-offshore wind scenarios, reflecting the balance between resource availability, costs, and long-term demand for clean energy as illustrated in Figure 24.

### 3.4.1 Site Level Analysis

Following the application of economic screening and scenario modeling, several clusters emerged as representative opportunities for offshore wind development in Atlantic Canada. The deployment outcomes for 2035 and 2050 under the four market demand scenarios (C1: Domestic Only, C2: Domestic + Export, C3: Domestic + Hydrogen, and C4: All Markets with High Hydrogen Sensitivity) highlight the progression from modest early-stage capacity in provincial waters to significant build-out in futures where export corridors are developed and hydrogen markets expand.

The following figures (from Figure 25 to Figure 28) present the modeled scenario-based deployment results across provinces and timelines.



Legend

Point of Interconnection

Transmission Line

Approximate Turbine Deployment Locations [3]

Fixed Platform

Floating Platform

Buildable Area - Fixed Platform

Buildable Area - Floating Platform

Installed Capacity (MW)

- 0 - 100
- 101 - 500
- 501 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 2500
- 2501 - 3000
- 3001 - 3500

0 100 200 300 km

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Stantec

Project Location
Atlantic Canada

Prepared by NW on 2025-08-28
TR by DP on 2025-08-28

Client/Project
126560144_206
Net Zero Atlantic
Offshore Wind Resource Potential Study

Figure No.
25

Title
**Actual Deployment, C1: Domestic-only Market**

***Notes***
1. Coordinate System: WGS84 Azimuthal Equidistant Projection, Central Meridian -62
2. Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset
3. Turbine locations do not indicate specific deployment sites
4. Background: NRCan CanVec; OpenStreetMap; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

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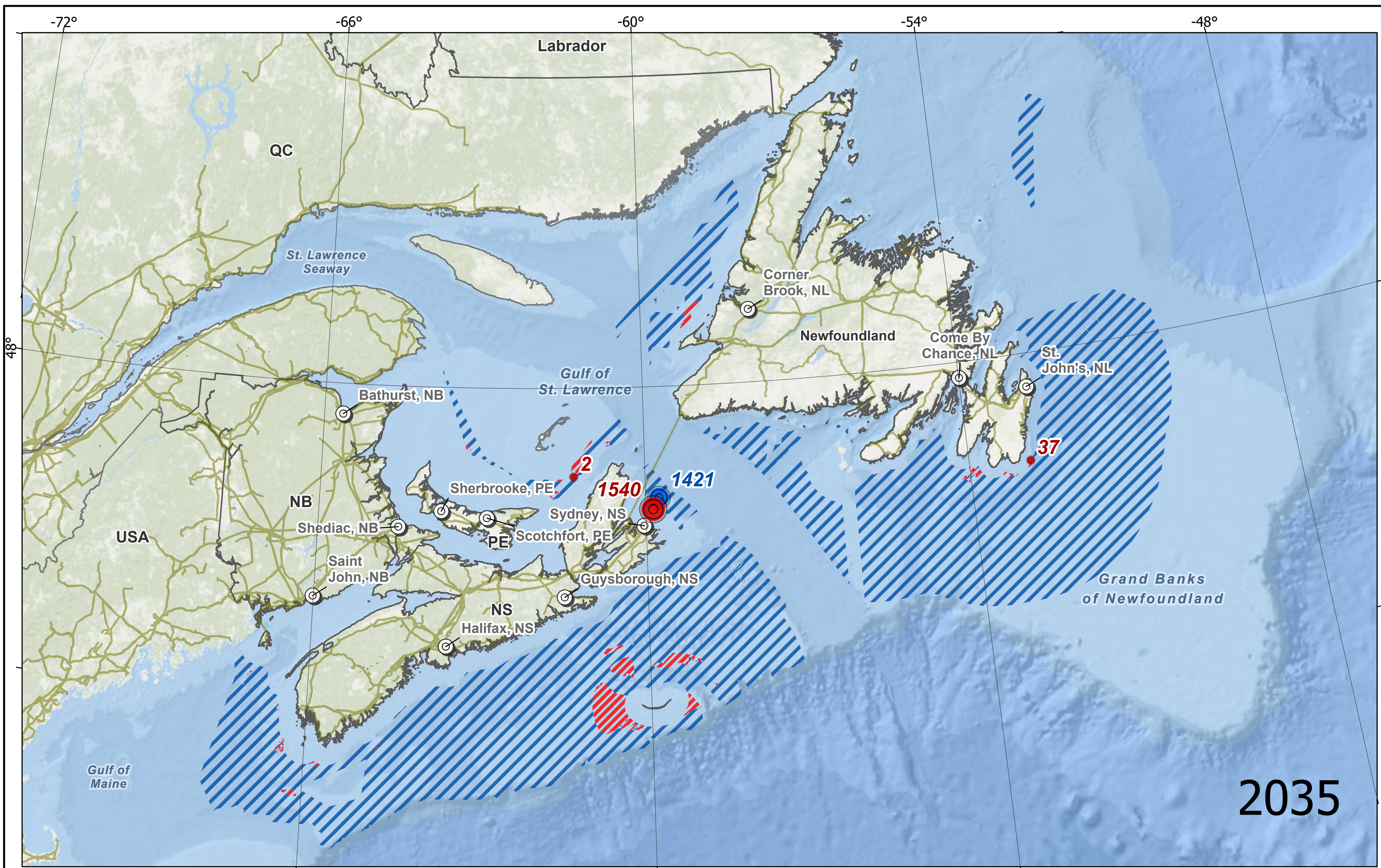


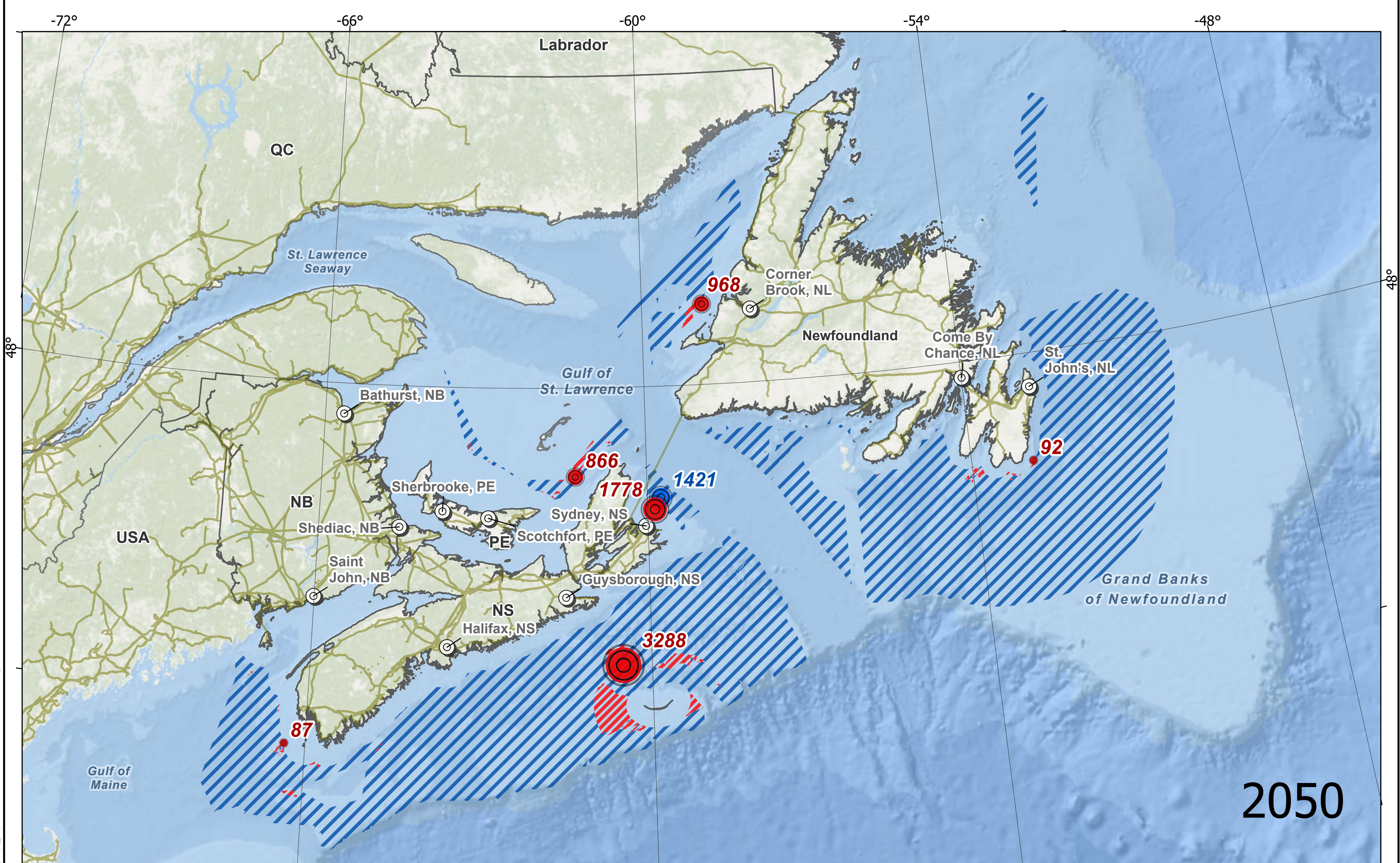




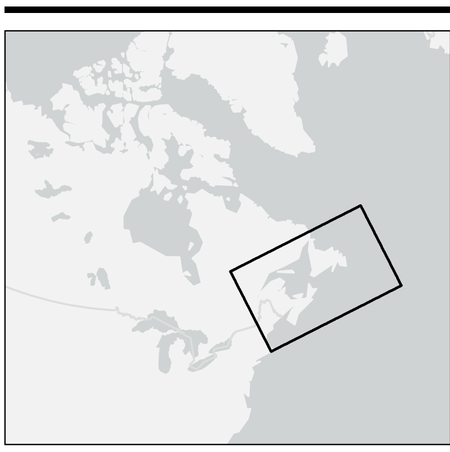

Legend

- Point of Interconnection
- Transmission Line

Approximate Turbine Deployment Locations [3]

- Fixed Platform
- Floating Platform
- Buildable Area - Fixed Platform
- Buildable Area - Floating Platform

Installed Capacity (MW)

- 0 - 100
- 101 - 500
- 501 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 2500
- 2501 - 3000
- 3001 - 3500

0 100 200 300 km

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Project Location
Atlantic Canada

Prepared by NW on 2025-08-28
TR by DP on 2025-08-28

Client/Project
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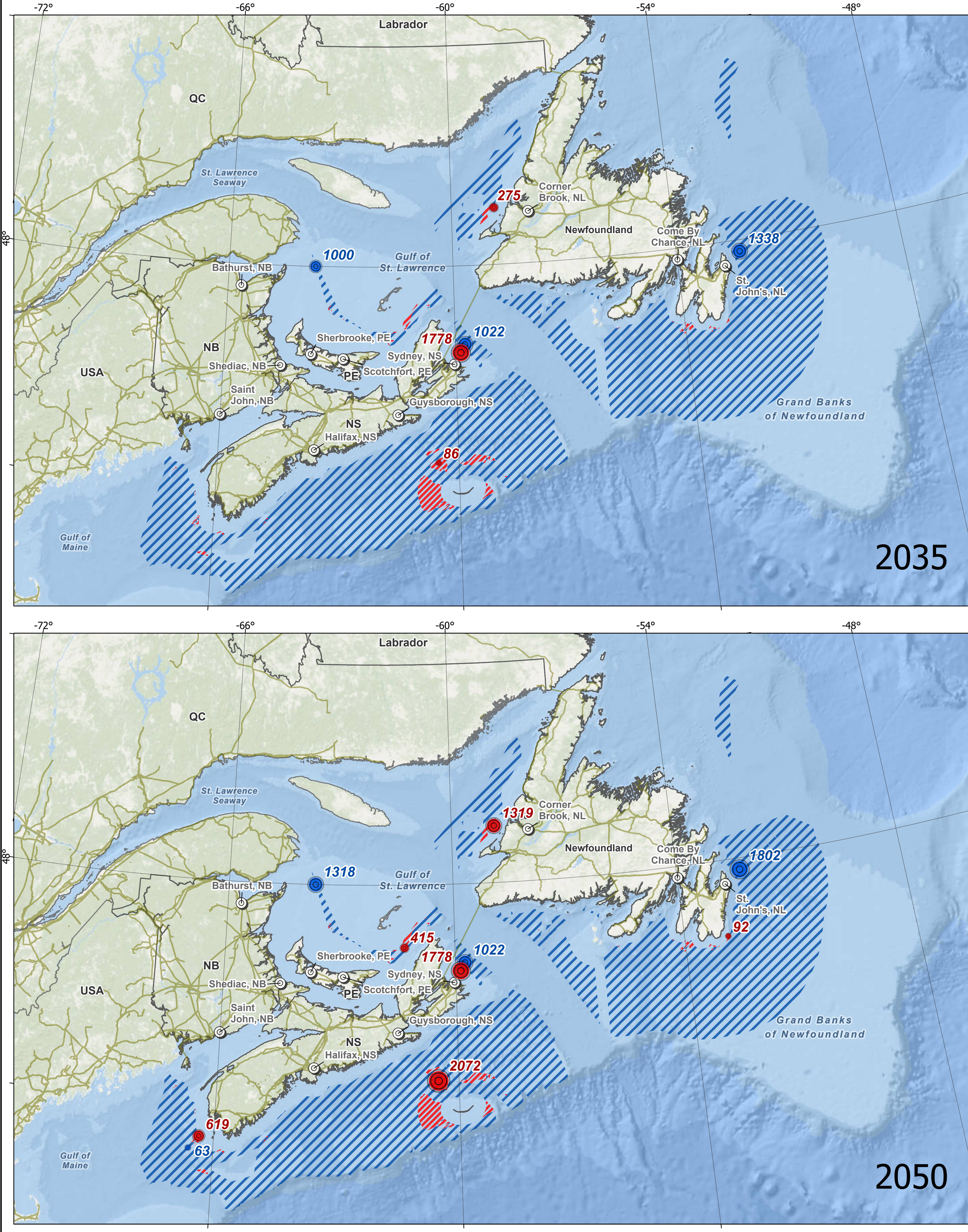
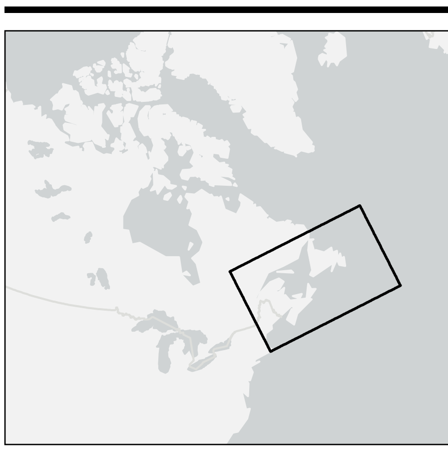
Net Zero Atlantic
Offshore Wind Resource Potential Study

Figure No.
26

Title
**Actual Deployment, C2: Domestic + Exports Market**

**Notes**
1. Coordinate System: WGS84 Azimuthal Equidistiant Projection, Central Meridian -62
2. Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset
3. Turbine locations do not indicate specific deployment sites
4. Background: NRCan CanVec; OpenStreetMap; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue



**Notes**
1. Coordinate System: WGS84 Azimuthal Equidistant Projection, Central Meridian -62
2. Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset
3. Turbine locations do not indicate specific deployment sites
4. Background: NRCan CanVec; OpenStreetMap; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

Legend
- Point of Interconnection
- Transmission Line

Approximate Turbine Deployment Locations [3]
- Fixed Platform
- Floating Platform
- Buildable Area - Fixed Platform
- Buildable Area - Floating Platform

Installed Capacity (MW)
- 0 - 100
- 101 - 500
- 501 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 2500
- 2501 - 3000
- 3001 - 3500

0 100 200 300 km

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Project Location
Atlantic Canada

Prepared by NW on 2025-08-28
TR by DP on 2025-08-28

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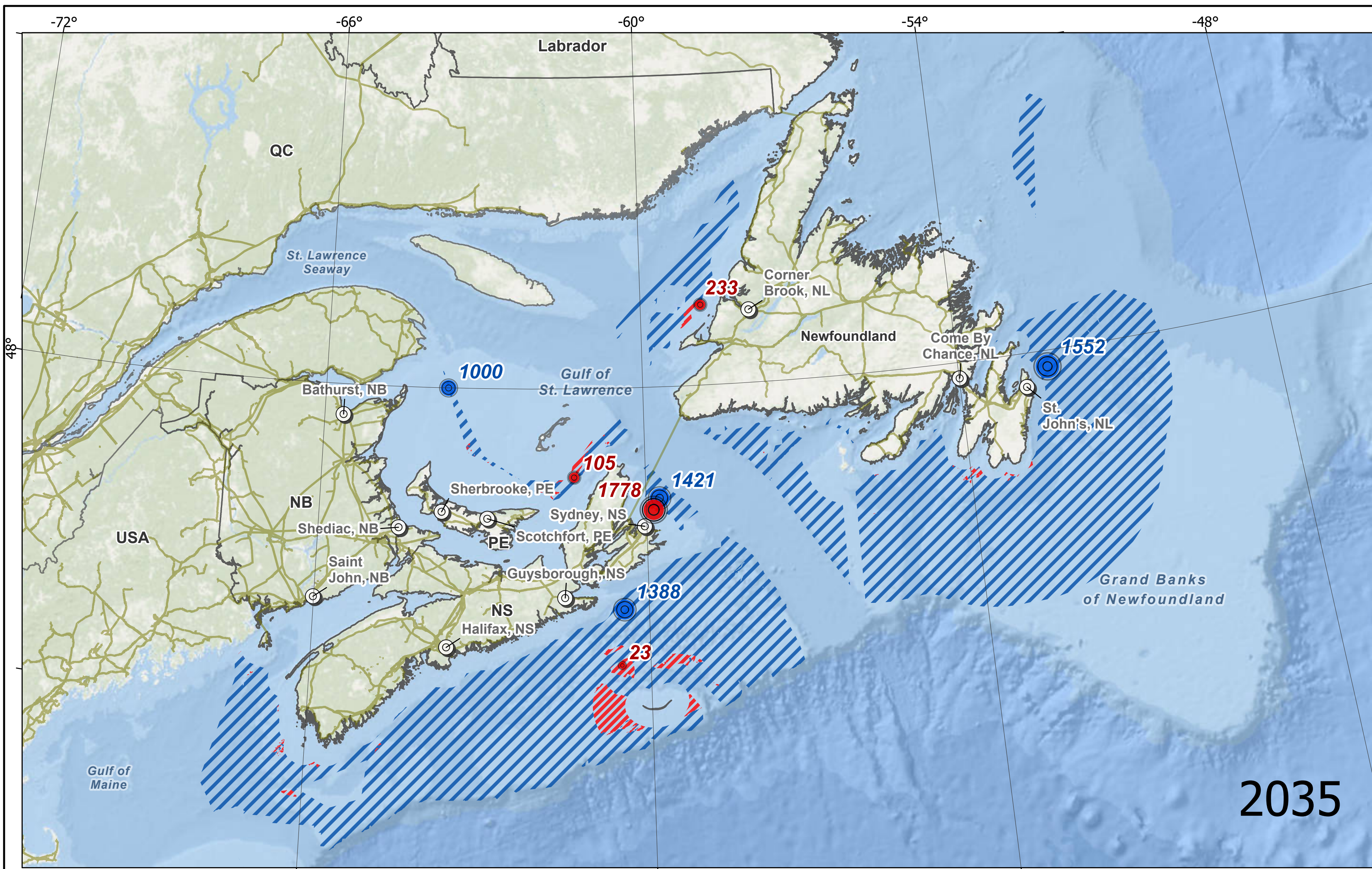
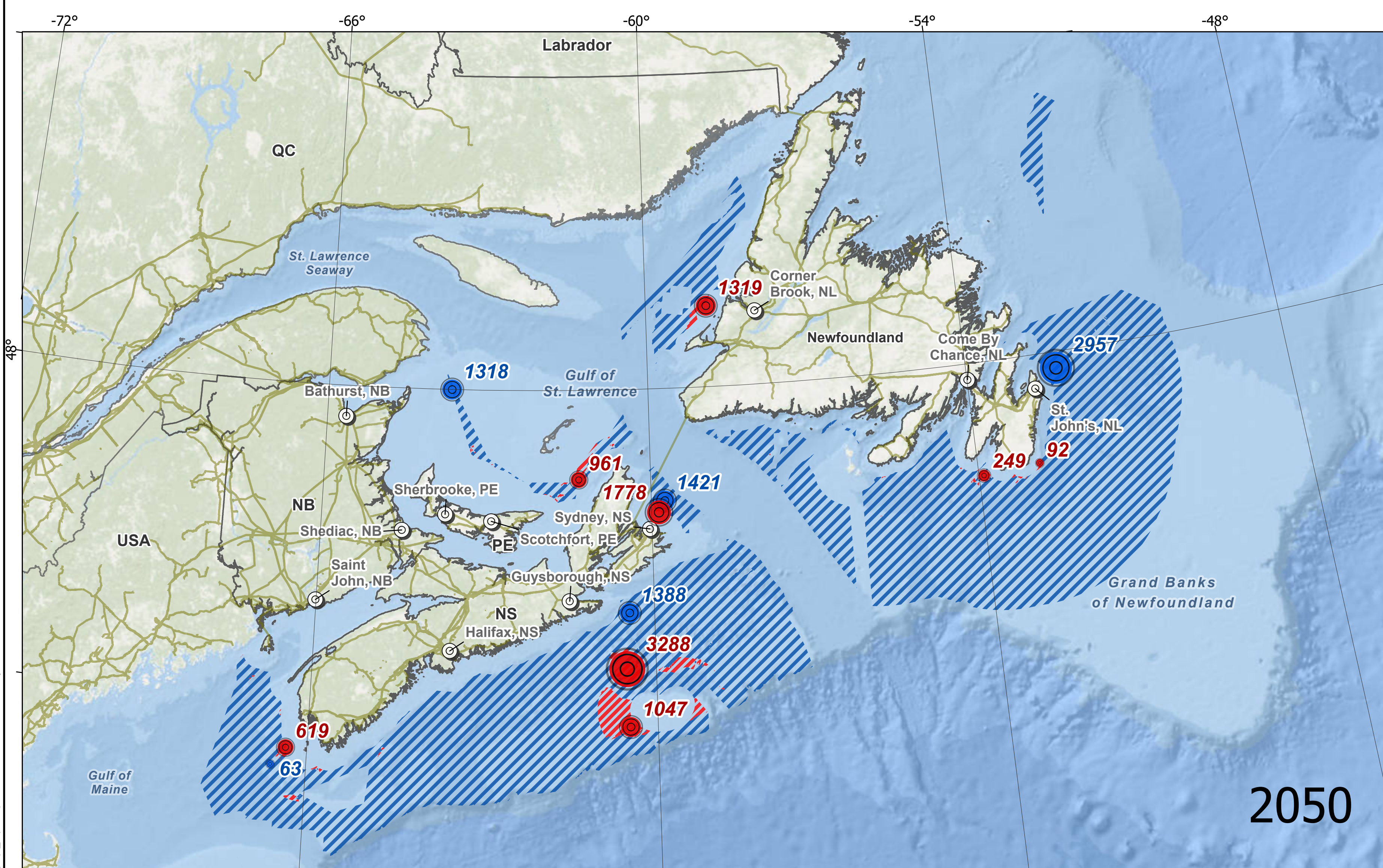
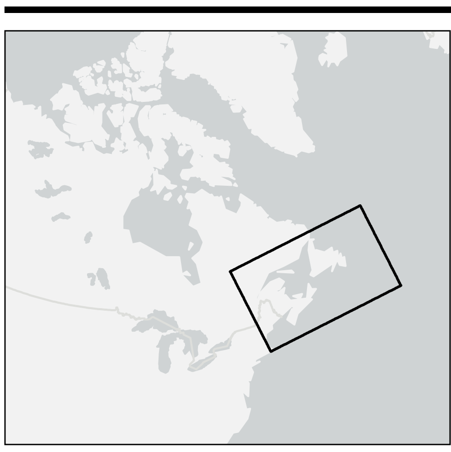
Figure No.
27

Title
**Actual Deployment, C3: Domestic + Hydrogen Market (High Sensitivity)**



Legend

- Point of Interconnection
- Transmission Line

Approximate Turbine Deployment Locations [3]

- Fixed Platform
- Floating Platform
- Buildable Area - Fixed Platform
- Buildable Area - Floating Platform

Installed Capacity (MW)

- 0 - 100
- 101 - 500
- 501 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 2500
- 2501 - 3000
- 3001 - 3500

0 100 200 300 km

(At original document size of 11x17)
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**Notes**
1. Coordinate System: WGS84 Azimuthal Equidistant Projection, Central Meridian -62
2. Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset
3. Turbine locations do not indicate specific deployment sites
4. Background: NRCan CanVec; OpenStreetMap; Statistics Canada; Basemap Service Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

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Project Location
Atlantic Canada

Prepared by NW on 2025-08-28
TR by DP on 2025-08-28

Client/Project
126560144_206
Net Zero Atlantic
Offshore Wind Resource Potential Study

Figure No.
28

Title
**Actual Deployment, C4: All Markets with High Hydrogen Sensitivity**

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The deployment scenarios summarized above highlight how offshore wind build-out in Atlantic Canada can vary depending on economic drivers and demand conditions. Across all cases, the region's technical potential far exceeds near-term build levels, underscoring that deployment will ultimately be determined by the ability to connect to markets.

The modelled scenarios therefore provide a range of plausible outcomes between 2035 and 2050: conservative growth when limited to domestic markets, moderate expansion with New England exports, and high build-out when hydrogen demand is layered on top of electrification. Development beyond these levels is technically possible but would require large-scale additional transmission to external markets.

A distinct set of clusters emerged as the most viable development areas across Atlantic Canada. These sites combine strong wind resource quality, large buildable areas, and acceptable proximity to interconnection points, making them the natural constructability candidates for expansion when the region pursues high levels of offshore wind integration and prioritization of work.

The clusters (Figure 29) selected in this case include:

- Newfoundland and Labrador: C4, C5, C25
- Nova Scotia: C11, C13, C27, C14
- New Brunswick: C21, C24
- Prince Edward Island: C22

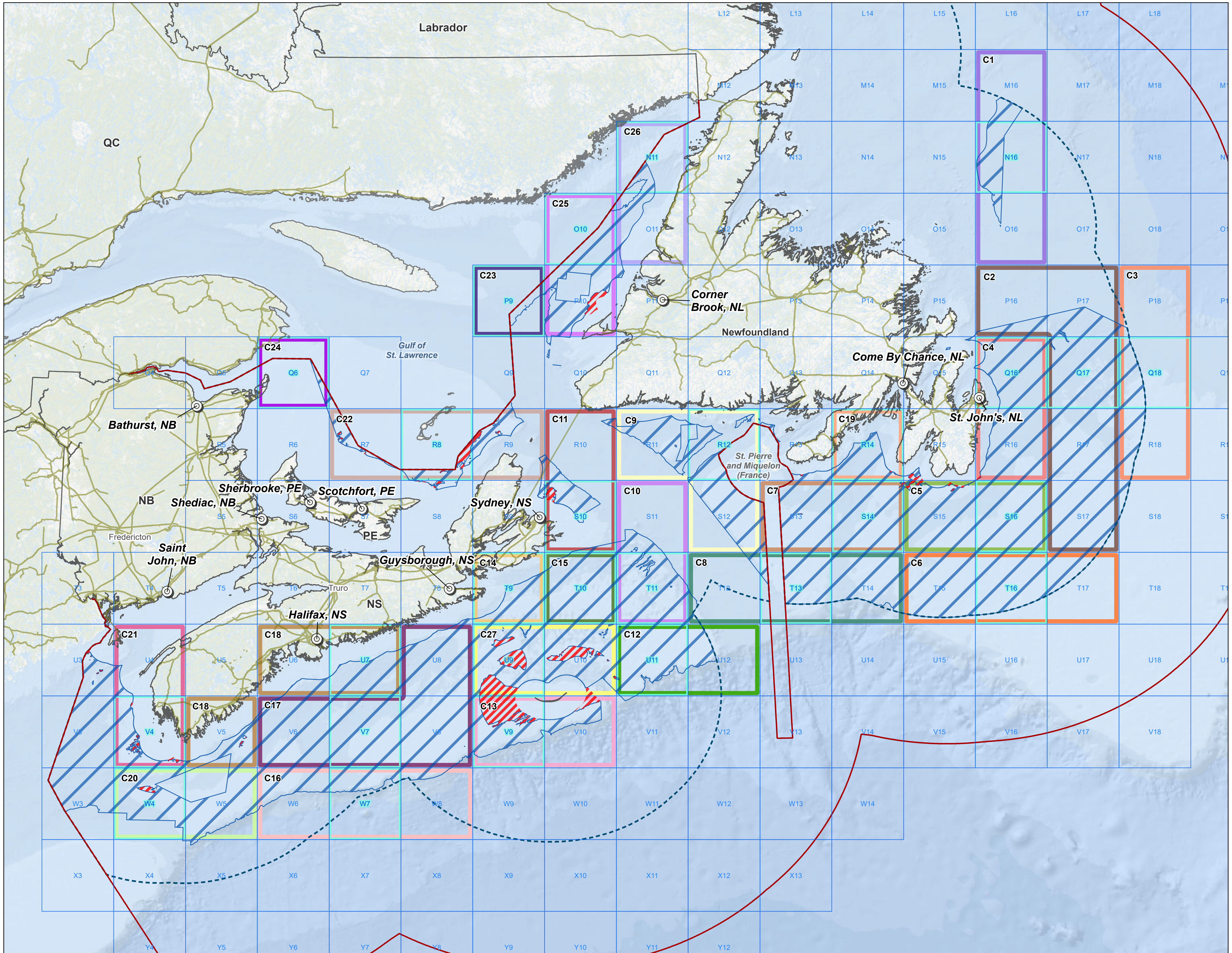


Figure No.
**29**

Title
## Grid Optimization Clusters

Client/Project 126560144_035

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Atlantic Canada

Prepared by NW on 2025-07-17
Revised by SC on 2025-09-24
TR by DP on 2025-09-29

N

0 100 200 Kilometres
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**Legend**

- Point of Interconnection
- Transmission Line
- NZA Study Area
- Floating Platform Technical Development Limit (195 km)
- Buildable Area - Floating Platform
- Buildable Area - Fixed Platform
- Processing Grid (100 km x 100 km)
- Time Series Data Reference Cell

Optimization Cluster

| | | |
|---|---|---|
| C1 | C10 | C19 |
| C2 | C11 | C20 |
| C3 | C12 | C21 |
| C4 | C13 | C22 |
| C5 | C14 | C23 |
| C6 | C15 | C24 |
| C7 | C16 | C25 |
| C8 | C17 | C26 |
| C9 | C18 | C27 |

**Notes**
1. Coordinate System: WGS84 Azimuthal Equidistant Projection, Central Meridian -62
2. Data Sources: Stantec
3. Background: NRCan CanVec; Statistics Canada; Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue

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Together, these areas represent a balance between scale and diverse locations. Newfoundland and Labrador contribute vast floating wind resources in the deeper waters of the Labrador Sea and Grand Banks. Nova Scotia provides both fixed-bottom and floating opportunities within its Wind Energy Areas, particularly along the Sable Island and Emerald Bank regions. New Brunswick offers smaller scale but strategically valuable capacity near the Gulf of St. Lawrence, while Prince Edward Island demonstrates competitive performance despite its limited total area.

The following site-level narratives and Table 8 synthesize technical characteristics, resource quality, infrastructure context, and modeled deployment levels for the key clusters identified.

**Table 8: Development Clusters Characteristics Overview**

| Cluster | Min Depth (m) | Max Depth (m) | Net CF (%) | Technology | |
|---|---|---|---|---|---|
| **C4** | 26 | 266 | 56.91 | fixed | floating |
| **C5** | 45 | 204 | 57.03 | fixed | floating* |
| **C25** | 34 | 299 | 54.12 | fixed | floating* |
| **C11** | 51 | 299 | 52.53 | fixed | floating |
| **C13** | 15 | 299 | 53.52 | fixed | floating* |
| **C27** | 15 | 299 | 54.47 | fixed | floating* |
| **C14** | 76 | 283 | 55.90 | | floating |
| **C21** | 8 | 192 | 53.02 | fixed | floating |
| **C24** | 62 | 122 | 50.62 | | floating |
| **C22** | 47 | 299 | 58.10 | fixed | floating* |

- Clusters marked with an asterisk (*) include areas where water depths exceed 60 meters, making them technically suitable for floating wind development based on current technology. In the model outputs, only the fixed-bottom portions were selected for development, reflecting economic analyses that currently favour fixed technology in these locations. Floating options remain technically viable and may be reconsidered as market conditions and cost structures evolve.

The list below provides more detail on the key clusters in Table 8.

- C4 (NL) – Located offshore Newfoundland and Labrador, C4 benefits from world-class wind speeds exceeding 11 m/s and expansive deepwater areas. Bathymetry ranges from ~26 m to 266 m, creating opportunities for a hybrid development approach – fixed-bottom nearshore and floating offshore. With net CFs around ~57%, C4 is a cornerstone of NL's long-term export-oriented potential.

- C5 (NL) – Positioned adjacent to C4, this cluster shares similar high-wind conditions and bathymetry ranging from 45–204 m. Its consistently strong resource supports floating deployment, with net CFs of ~57%. C5 complements C4 by providing additional large-scale capacity, reinforcing Newfoundland's role as a global floating wind hub.
- C25 (NL) – Located off western Newfoundland near Stephenville, C25 bathymetry ranges from 34-299 m, making it largely a floating-oriented cluster. Some localized shallower zones could support fixed-bottom deployment, adding flexibility. With net CFs of ~54%, C25 is well-suited for phased build-out linked to transmission expansion and long-term export.
- C11 (NS) – Located within the Sydney Bight area, off the northeast coast of Nova Scotia, within one of Nova Scotia's Canada/NS-Designated WEAs, C11 combines shallow waters suitable for fixed-bottom with consistently strong winds (~10.5-11 m/s). Its bathymetry ranges from 15-299 m, extending into floating territory. With net CFs of ~52-53%, it is one of the strongest near-term candidates for development, benefiting from regulatory alignment.
- C13 (NS) – Extending Nova Scotia's footprint toward deeper waters, C13 overlaps with the Sable Island Bank area. Bathymetry again spans 15-299 m, with resource strengths in the ~52–53% net CF range. While leaning toward floating in deeper zones, C13 provides scalability beyond C11, making it essential for Nova Scotia's medium-term growth.
- C27 (NS) – Located on the eastern edge of Nova Scotia's shelf, close to the Canada/NS-Designated WEAs Sable, French and Middle Banks, C27 bathymetry ranges from 15 m at its shallow edges to nearly 300 m offshore. With net CFs of ~54%, it offers flexibility and scalability for phased expansion, diversifying Nova Scotia's buildable portfolio. C27 combines favourable wind speeds with moderate distances to interconnection points. It strengthens the province's long-term portfolio by diversifying potential build zones
- C14 (NS) –Lies entirely in floating territory, bathymetry ranges from 76-283 m. Its net CF of ~56% and large buildable area makes it highly attractive for post-2040 deployment, particularly under hydrogen-linked scenarios where scale and long-term competitiveness are critical.
- C21 (NB) – Located in the Bay of Fundy, C21 bathymetry ranges from 8–192 m, supporting both fixed-bottom and floating. Although wind speeds are slightly lower (~10.3 m/s) and net CFs sit just above 50%, its proximity to shore reduces interconnection costs. C21 plays a strategic role in balancing NB's strategic contribution to regional balance.
- C24 (NB) – Positioned further offshore, C24 is a floating-only site with bathymetry ranging from 62–122 m. Its net CF is again just above 50%, somewhat lower than NL and NS clusters, but it provides incremental diversity and capacity under higher-demand scenarios.
- C22 (PEI) – This cluster is PEI's primary offshore opportunity, with bathymetry ranging from 47–299 m. It sits at the threshold between fixed-bottom and floating, but its net CF of ~58% is among the highest in the region. Despite its smaller scale, C22 demonstrates that even niche projects near PEI could deliver outsized energy performance, making it a valuable contributor to regional deployment.

# 4. Strategic Insights and Recommendations

## 4.1 Cluster Tiering and Scenario Evolution

It is important to note that while floating offshore wind represents a substantial share of the long-term technical and locational potential identified in this study, it is unlikely to feature in initial development in Atlantic Canada. Early deployment is expected to focus primarily on fixed-bottom projects located in relatively shallow waters, where technology maturity, lower capital costs, simpler installation logistics, and clearer regulatory pathways support near-term feasibility. Floating wind is therefore treated predominantly as a medium to long-term opportunity, emerging only under higher demand scenarios and later planning horizons.

The clusters can be grouped into tiers that reflect both their technical and economic strength and their likelihood of near- vs. long-term deployment, based on selection across the four scenarios (Domestic Only, Domestic + Export, Domestic + Hydrogen, and All Markets with Hydrogen Sensitivity):

The tiering presented below reflects relative outcomes from the *Atlantic Canada Offshore Wind Grid Integration and Transmission Study's* Phase 2 scenario modelling rather than a definitive development sequence. Cluster selection and ordering are influenced by assumed capital costs, distance to and capability of points of interconnection, ability to serve modelled load growth, and relative wind resource quality. As such, the prioritization should be interpreted as indicative and conditional on the input assumptions applied.

It should be noted that offshore wind cost assumptions were not re-optimized as part of Phase 2 and were carried forward from earlier economic screening. Consequently, the relative ordering of clusters is sensitive to the assumed cost and transmission inputs, and may evolve as updated resource costs, injection capabilities, and transmission configurations are incorporated in Phase 3 of the project where grid integration modelling will be conducted. While the current scenario results highlight recurring priority development areas, further analysis is required to validate both updated cost assumptions and point-of-interconnection capability before confirming development sequencing.

For clarity, clusters are grouped into Tier 1 (near-term, led opportunities), Tier 2 (medium-term expansions and export sites) and Tier 3 (longer-term and hydrogen-driven opportunities)

- Tier 1: Early Deployment / Core Sites:
  - NS_C11
  - PE_C22
  - NS_C27
  - NL_C4

These clusters appear as early selections in the Domestic Only Market scenario (Scenario 1), reflecting a combination of shallow-to-moderate bathymetry, strong net CFs (>52%), and proximity to points of interconnection.

They are especially well-positioned for 2025–2035 development, with Nova Scotia's Canada/ NS-Designated WEAs (C11, C27) being most advanced due to regulatory support, and PEI's C22 standing out for its high net CF (~58%). NL C4 enters early at a modest scale, signalling Newfoundland and Labrador's potential role even in domestic-limited demand.

- Tier 2: Expansion / Export-Linked Sites:
  - NB_C24
  - NB_C21
  - NL_C25

These clusters appear consistently in Domestic + Export scenarios (Scenario 2) as demand grows beyond provincial loads. With net CFs in the 52–54% range and mixed bathymetry (fixed-bottom edges with floating potential), they provide scalability and redundancy.

Deployment would likely follow transmission expansion into New England, Ontario or Québec, supporting 2035-2045 build-out.

- Tier 3: Long-Term / Hydrogen Development and Floating-Dominant
  - NS_C14
  - NB_C24
  - NL_C5
  - NS_C13

These sites emerge primarily in Domestic + Hydrogen and All Markets scenarios (Scenarios 3-4), requiring deeper water floating solutions and higher demand levels (notably hydrogen electrolysis). With net CFs in the 55-57% range (C14, C5) and adequate area, they are excellent long-term growth assets.

They are expected to become viable toward 2040-2050, as floating technology costs decline and hydrogen infrastructure matures.

## 4.2 Opportunities for Early Deployment

- Nova Scotia (C11, C27): Immediate candidates due to shallow bathymetry, strong wind speeds, and alignment with provincial Canada/NS-Designated WEAs. They could underpin the first commercial offshore wind (OSW) projects in Atlantic Canada.
- Prince Edward Island (C22): Smaller in scale but highly productive; ideal for niche or demonstration-scale projects that deliver outsized performance.

- Newfoundland and Labrador (C4): Although primarily floating, portions of C4 fall within transitional depths and appear even under domestic-only demand, signalling potential for early pilot-scale floating deployment.

### 4.2.1 Infrastructure Needs

- Transmission Expansion: Early deployment in Nova Scotia requires reinforcement of the provincial grid and expanded interties to New Brunswick, Quebec, Ontario and New England. Long-term deployment in Newfoundland and Labrador hinges on high-capacity subsea export corridors to external markets.
- Port and Operations and Maintenance Facilities: Large-scale floating deployment (C14, C5, C25) will demand deepwater ports with heavy-lift capacity. Early planning for port upgrades is suggested.[13]
- Hydrogen Production Infrastructure: By 2040-2050, Tier 3 sites (C14, C24, C5) will benefit from co-located or near-shore hydrogen hubs to monetize excess output and avoid transmission bottlenecks.

## 4.3 Strategic Recommendations

The pathway to unlocking Atlantic Canada's offshore wind potential requires a staged strategy: securing quicker wins, scaling capacity in line with system needs, electricity demand, and positioning the region for hydrogen export leadership. The following recommendations are presented in three phases, aligned with deployment horizons and infrastructure readiness.

- Phase 1: Early Deployment and Market Signalling

Nova Scotia's Canada/NS-Designated WEAs, particularly clusters C11 and C27, could be advanced due to their proximity to existing grid infrastructure and strong wind regimes, and the CNSOER calls for information[14] and prequalification[15]. These clusters are well-suited for initial permitting, stakeholder engagement, and grid-readiness studies, helping to establish momentum and attract developer interest. While C11 and C27 are prioritized for early action, permitting efforts could be extended to all identified Canada/NS-Designated WEAs to support a steady and scalable pipeline of offshore wind projects across the province. This comprehensive approach will support long-term deployment and maximize Nova Scotia's offshore wind potential.

[13] See Net Zero Atlantic's Assessing Ports in Atlantic Canada study for more detail: Offshore Wind Potential: Assessing Ports in Atlantic Canada | Net Zero Atlantic.

[14] Offshore Wind Call for Information | CNSOER

[15] Offshore Wind Prequalification | CNSOER

Prince Edward Island's C22 cluster represents an ideal opportunity for a demonstration-scale project. With high capacity factors (~58%) and favourable bathymetry, C22 can serve as a visible early success story, proving competitiveness while also providing valuable experience in integrating offshore wind into PEI's smaller grid. Building momentum here will strengthen local stakeholder confidence and signal market viability to investors.

- Phase 2: Scaling Capacity and Enabling Exports

By the mid-late 2030s, Newfoundland and Labrador's world-class clusters (C4, C5, C24) could be positioned as the region's floating wind testbed. Launching pilot-scale floating projects, particularly in C4, will de-risk the technology while leveraging NL's unique strengths in port infrastructure, shipbuilding, and marine industries. Partnering with global floating developers, shipping partners and upgrading local ports will enable NL to build industrial readiness and establish itself as North America's hub for floating wind. This step is critical to prepare for gigawatt-scale deployment in the 2040s and beyond.

New Brunswick could be positioned as a strategic enabler for regional offshore wind integration and export pathways. While the levels are modest in comparison with other provinces, clusters like C21 offer potential to support interprovincial grid connectivity, flexibility and export routing.

- Phase 3: Hydrogen Leadership and Global Positioning

Looking toward 2050, Atlantic Canada could focus on establishing hydrogen hubs linked to large-scale floating clusters such as NS's C14 and NL's C4 and C5. These sites, characterized by deepwater conditions, vast buildable areas, and high capacity factors, are well-suited for powering multi-gigawatt electrolysis facilities. Locating hydrogen hubs in proximity to these offshore wind resources will provide a direct outlet for surplus renewable energy, reduce reliance on domestic grid absorption, and enable exports of green fuels to Europe and North America. This approach could contribute to securing Atlantic Canada's long-term competitiveness as a global supplier of clean hydrogen and green fuels.

Conducting pre-feasibility studies for hydrogen terminal infrastructure in NL and NS, linked explicitly to these floating clusters, will be a crucial step in this phase. By strategically pairing offshore wind and hydrogen development, Atlantic Canada can de-risk its floating projects, provide reliable offtake opportunities, and position itself as a leader in the emerging hydrogen economy.

### 4.3.1 Next Steps and Implications for Phase 3

The results of the Actual Deployment Potential analysis and market scenarios defined in the Phase 1: Path to Market study set the stage for Phase 3: Grid Integration of the *Atlantic Canada Offshore Wind Grid Integration and Transmission Study*, which will focus on the integration of offshore wind into the Atlantic Canada electricity system. Building on the technical, locational, and economic assessments presented in this report, Phase 3 will assess the impact of offshore wind deployment scenarios on the onshore grid. The scenarios to be studied will include the deployment volumes and technology mixes identified here. These scenarios will be refined in consultation with the project's Project Management and Technical Committees.

A central focus of Phase 3 will be the evaluation of transmission system investments required to support offshore wind integration at the scale and locations modelled in Phase 2. This will involve identifying optimal Points of Interconnection, assessing transmission constraints, developing onshore transmission build-out scenarios for both provincial and interprovincial networks, and assessing transmission options to bring the power to shore. The study will compare transmission technologies and topologies for the offshore transmission system, considering costs for the onshore and offshore transmission infrastructure, including any system upgrades identified in the studies. In parallel, detailed resource adequacy and production cost modelling will be conducted to evaluate the ability of offshore wind to meet system needs, support reliability standards, and balance supply and demand. Production cost modelling using PLEXOS will simulate operational impacts, curtailment risks, and the economic interplay between offshore wind, other renewables, and conventional generation.

Drawing on these technical assessments, Phase 3 will deliver a flexible, multi-year roadmap and action plan for the Atlantic region with specific recommendations for each province. This roadmap will identify key barriers, regulatory requirements, utility actions, and province-specific opportunities and challenges for offshore wind integration, along with recommendations for tracking, monitoring, and adapting the plan over time. A visual graphic interface will be developed to present grid integration results, scenario comparisons, and system alerts, supporting transparent decision-making and stakeholder engagement.

The transition to Phase 3 marks a shift from resource characterization and deployment modelling to system integration and planning. The implications for this phase are significant: the actual deployment scenarios and cluster locations identified in Phase 2 will serve as the basis for the injection of offshore wind power into the onshore system. By quantifying transmission infrastructure costs, Phase 3 will identify pathways for offshore wind integration, balancing economic efficiency, reliability, and resilience. The final deliverables – a multi-year roadmap and action plan, and interactive data visualization tools – will provide policymakers, utilities, developers and other stakeholders with guidance on the possible steps for realizing Atlantic Canada’s offshore wind potential.

# Appendix A Turbine Specifications and Energy Model Assumptions (Technical and Locational Potential Report)

# Technical and Locational Potential of Atlantic Canada Offshore Wind

Prepared for:
Net Zero Atlantic

July 25, 2025

Prepared by:
Daniela Pantoja
Joaquin Moran

Project/File:
126560144

Stantec Consulting Ltd.

# Revision Schedule

| Revision | Description | Author | Date | Quality Check | Date | Independent Review | Date |
|---|---|---|---|---|---|---|---|
| D1 | Draft | D. Pantoja | July 4, 2025 | J. Moran | July 7,2025 | | |
| D2 | Initial report | D. Pantoja<br>J. Moran | July 14, 2025 | I. Shaw | July 15, 16 2025 | E. Wicks. J Crowther | July 15, 16 2025 |
| 1.0 | Reviewed report | D. Pantoja<br>J. Moran | July 24, 2025 | I. Shaw | July 24, 16 2025 | E. Wicks. J Crowther | July 25, 2025 |

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Prepared by: ______________________
Signature

______________________
Daniela Pantoja

Reviewed by: ______________________
Signature

______________________
Joaquin Moran

Approved by: ______________________
Signature

______________________
Ivor Shaw

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# List of Abbreviations

| | |
|---|---|
| AEP | Annual Energy Production |
| CF | Capacity Factor |
| CFD | Computational Fluid Dynamics |
| EBSA | Ecologically and Biologically Significant Area |
| GIS | Geographic Information System |
| GW | Gigawatt |
| MMC | Meso-micro Coupling |
| MPA | Marine Protected Area |
| MWh | Megawatt Hour |
| OSW | Offshore Wind |
| POI | Point of Interconnection |
| TB | Terabytes |
| WRA | Wind Resource Assessment |
| WRF | Weather Research and Forecasting |

# Executive Summary

This report presents a summary of Wind Resource Assessment and energy estimation results to identify the technical and locational potential of offshore wind in Atlantic Canada. This report constitutes a broader effort under the Atlantic Canada Offshore Wind Integration and Transmission Study to evaluate the technical and economic viability of wind power, support future planning of energy development in the region and understand the impact of offshore projects on Atlantic Canada's electricity grid.

Stantec engaged wind energy software manufacturer WindSim AS to generate a detailed computational fluid dynamics model of the entire project area, comprising more than 1.5 million square kilometres. For this purpose, the Weather Research and Forecasting model was coupled with a meso-micro technique to produce data with the required temporal and spatial resolutions. Measurements from existing weather stations and buoys were used to validate the model predictions and calibrate the algorithm.

The strongest wind resources were found offshore Newfoundland and Labrador, where average wind speeds exceeded 11–12 m/s at 120 m hub height. Nova Scotia's nearshore areas also showed high potential, with wind speeds typically between 9–11 m/s, supporting both fixed and floating wind development. These findings confirm that multiple subregions within Atlantic Canada offer promising wind regimes for utility-scale offshore projects

GIS-based constraints and desktop environmental data were used to define buildable areas and assess potential siting limitations. Stantec estimated the energy production potential for the buildable areas by dividing the total project area into discrete cells, each with an installed capacity of approximately 1 gigawatt (GW). The software Furow was then used to determine the power output for a predetermined layout within a representative cell for each cluster. It was found that the maximum Annual Energy Production value was approximately 6,709,402 MWh/year per GW installed, corresponding to a net capacity factor of about 59.8%.  Energy estimates will allow identification of strategic areas for development and prioritization of specific sites based on a combination of wind resource quality, spatial feasibility, and proximity to interconnection points. These insights provide a technical foundation for evaluating economic viability in subsequent project phases.

# 1 Introduction

This report presents the results of Phase 2, Task 1: Develop Assumptions of the Atlantic Canada Offshore Wind Integration and Transmission Study, led by Stantec as part of the Net Zero Atlantic initiative. The purpose of this part of the study is to assess the technical and locational potential for offshore wind (OSW) development across Atlantic Canada, including the provinces of Nova Scotia, Newfoundland and Labrador, New Brunswick, and Prince Edward Island.

The study area exceeds 1.5 million square kilometres, representing the first effort of this scale in Canada to characterize wind resource potential in support of future OSW policy, planning, and investment. The analysis integrates meteorological modelling, geospatial constraints, and energy yield estimates to identify suitable areas for development. Estimates of total offshore wind potential across the full buildable area will be addressed in a subsequent report of the study.

This document includes:

- An overview of the wind resource modelling methodology
- Technical wind resource maps validated using data from met towers and buoys across Atlantic Canada
- An assessment of buildable areas using geographic information system (GIS) and constraint screening
- Energy production estimates
- A classification of fixed vs. floating technology zones

The results of this study will be used as the technical foundation for subsequent economic modelling and transmission system planning in future project phases.

# 2 Technical Potential – Offshore Wind Resource

This section outlines the methods and results used to evaluate the offshore wind resource along the Atlantic Canadian coast. The objective was to assess the technical potential of the wind resource (or theoretical energy production available) using a validated high-resolution numerical model of the project area.

Stantec retained WindSim, an international consultant with extensive experience in mesoscale and microscale wind modelling, to lead the offshore wind resource assessment. WindSim has been carrying out computational fluid dynamics (CFD) modelling for over 30 years and has provided services for 88 companies in 37 countries for 307 projects. WindSim has widespread experience in OSW developments and analysis of wind resources in complex terrain.

## 2.1 Weather Research and Forecasting and Computational Fluid Dynamics Modelling

A Weather Research and Forecasting (WRF) model was used to provide mesoscale wind data as the foundation for the wind resource map. WRF was used to simulate wind conditions for the 3 years from 2018 to 2020, at a 9 km x 9 km resolution across the entire Atlantic Canadian offshore area. The output included time-series data with 5-minute resolution and wind field data interpolated at hub heights of 80m and 120m.

To refine the accuracy of results closer to the shoreline, where there can be a significant change in the wind flow behaviour, WindSim performed over 100 high-resolution Computational Fluid Dynamics (CFD) simulations. These were executed at a 100 m resolution and focused on capturing the effects of coastal terrain, surface roughness, and other microscale features that influence wind behaviour in nearshore regions.

Stantec provided observational datasets from several meteorological towers across the region to support numerical model calibration and improve reliability. WindSim selected five meteorological towers and buoys across Atlantic Canada. These were used to validate the modelling framework, calibrate results, and enhance confidence in the simulations. The CFD results were scaled using a Meso-Micro Coupling (MMC) technique, applying wind speed enhancement factors derived from WRF to improve reliability and integration. Details of the process, methodology and constraints used for WRF and the MMC procedure can be found in Appendix C, which contains the original report provided by WindSim.

## 2.2 Wind Resource Map and Validation

By combining WRF outputs and CFD modelling, WindSim generated a high-resolution offshore wind resource map with a final spatial resolution of 1 km x 1 km (see Figure 1). The modelling includes wind speed distributions at hub heights of 80 m and 120 m and covers both offshore and nearshore regions within the designated study area.

The maps highlight zones of higher wind resource potential across the four Atlantic provinces. The strongest resources were observed in offshore areas near Newfoundland and Labrador, where mean wind speeds exceeded 11–12 m/s at a 120 m hub height. Nearshore areas along Nova Scotia also demonstrated strong potential, with wind speeds typically ranging from 9–11 m/s at 120 m hub height, confirming the suitability of this region for both fixed and floating offshore wind development.

Model calibration was conducted using five met towers located throughout the study area. These observational data were vertically extrapolated from 10 m to both 80 m and 120 m using site-specific CFD models. The comparison between the simulated wind speeds and measured data showed strong agreement, with a correlation coefficient reaching 0.81, highlighting the effectiveness of the modelling approach for the selected sites. The modelling process produced an extensive results dataset (initially over 56 TB, later compressed to approximately 20 TB), forming the basis for subsequent energy yield and capacity factor estimates. These results will support downstream modelling, permitting analysis and stakeholder engagement in future phases of the project.

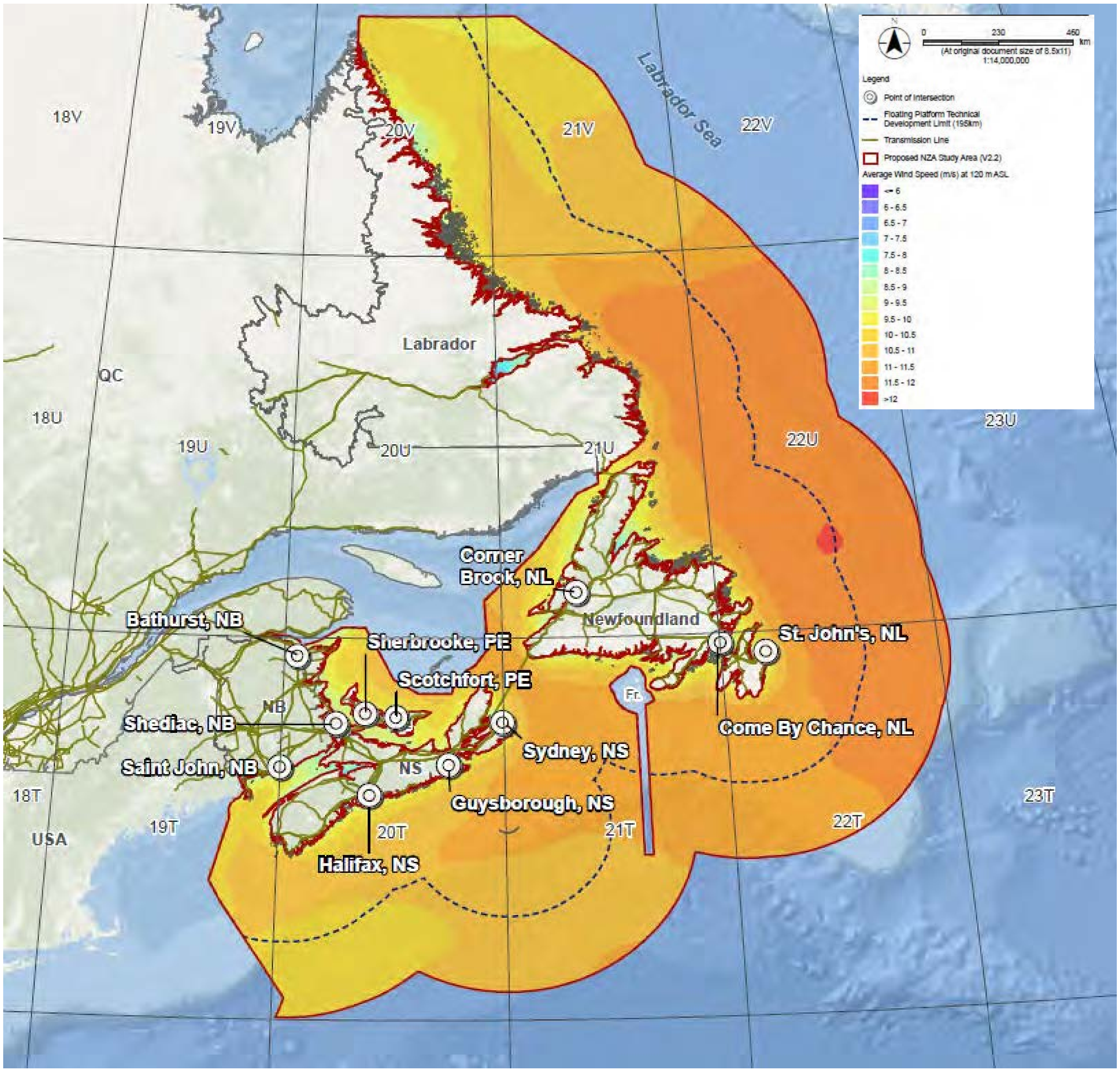



*Figure 1. Wind Resource Map for Study Area at 120 m with Points of Interconnection*

# 3 Locational Potential - Energy Production Estimates

Building on the wind resource data, the Locational Potential was evaluated using the computational package Furow, created by the Spanish company Solute. Furow is a software specialized in wind simulations for calculating wind farm energy output using high-resolution inputs to estimate potential energy production. GIS analysis was also used to identify feasible project areas by layering environmental, logistical, and permitting constraints as outlined in the project scope. The locational and technical assessments were conducted iteratively to ensure spatial accuracy and development viability.

## 3.1 Constraints Analysis

A comprehensive geospatial analysis was conducted to identify constraints affecting offshore wind siting. This information was gathered from publicly accessible datasets, regulatory guidance, and stakeholder input, and was divided into environmental, technical, and permitting categories. The following constraints were considered:

- Marine Protected Areas (MPAs) and Ecologically and Biologically Significant Areas (EBSAs)
- Species-at-risk critical habitats (e.g., migratory bird zones, marine mammals)
- Fisheries activity zones
- Existing infrastructure and development zones
- Commercial shipping routes and navigation corridors
- Aviation flight paths and airport buffer zones
- Water depth and bathymetric contours
- Grid interconnection points and cable landing sites

These constraints were mapped and analyzed within a GIS framework to create a combined set that was applied to the technical wind resource map. The result was a refined set of candidate areas for offshore wind development that balances energy potential with spatial feasibility and regulatory compliance.

## 3.2 Definition of Project Buildable Areas

Buildable areas were defined by intersecting technical potential zones with filtered constraints. Areas were categorized based on bathymetry to distinguish between locations suitable for fixed and floating wind foundations. For this project, we set a technical development limit of 195 kilometers from shore. This distance reflects the current limits seen in operational offshore wind farms, considering installation logistics and transmission constraints.

### 3.2.1 Fixed and Floating Foundations

Fixed foundation zones were defined as areas with water depths up to 60 meters, typically located closer to shore and suitable for monopile or jacket substructures. These zones align with current technology limits and construction economics, and they leverage proximity to shore-based logistics infrastructure.

Floating foundation zones were identified in deeper waters, exceeding 60 meters, where fixed foundations become technically infeasible or prohibitively expensive. These zones allow for broader spatial deployment and access to higher wind resources further offshore.

Both types of zones were delineated using bathymetric data layered with the technical wind resource and constraint mapping, so that foundation classification aligns with real-world constructability and site access conditions.

### 3.2.2 Points of Interconnection - Clustering

Points of Interconnection (POIs) were identified to represent high-confidence sites where offshore wind power could feasibly connect to the onshore electricity grid. For each province, two to three POIs were proposed based on their proximity to major load centers, access to existing high-voltage transmission infrastructure, physical separation from other POIs, and relative distance from the nearest viable offshore wind zones.

This identification process was conducted jointly by the Stantec and E3 teams with confirmation from the project's Technical Committee Members (utility representatives from each region) and/or Project Management Committee Members (government representatives from each province). The proposed POIs were reviewed and validated through electricity system case assessments for each province.

Proposed POIs include:

- Newfoundland: Cornerbrook, Come By Chance, St. John's
- Nova Scotia: Halifax, Sydney, Guysborough
- PEI: Sherbrooke, Scotchfort
- New Brunswick: Saint John, Bathurst, Shediac

These POIs were then used to outline offshore wind zone clusters, which are defined as groups of potential project areas that share similar characteristics in terms of distance to shore, wind resource quality (wind speed), and grid accessibility. This clustering methodology allows for integrated energy and transmission modelling.

As the Atlantic Canada Offshore Wind Integration and Transmission Study project progresses into Phase 3, these POIs may be refined further based on updated grid studies, curtailment risk evaluations, or stakeholder and developer feedback. Figure 2 shows the current cluster layout and POI distribution (see higher resolution version in Appendix A).

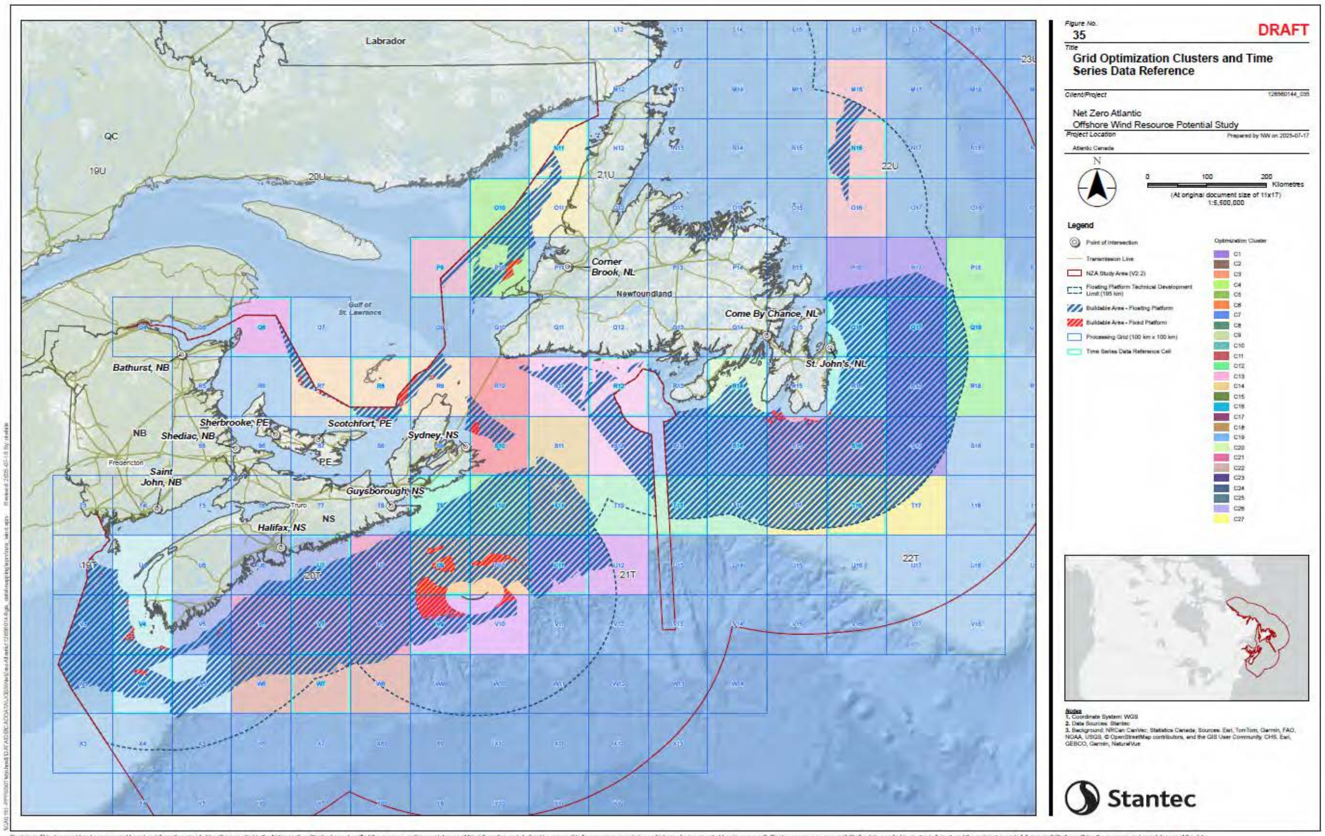



*Figure 2. Distribution of clusters and location of POIs for the project area*

## 3.3 Energy Model

This subsection outlines the modelling approach used to estimate energy production across the defined buildable areas. Simulations were conducted on a per-cell basis using a representative turbine with current market characteristics, with offshore wind generation corrections applied to emulate realistic outputs. The energy modelling was performed using the Furow software, integrating wind data and turbine specifications to estimate gross and net energy yields.

The project area was divided into discrete cells of 100 x 100 km. Each modelled cell represents a potential offshore wind zone with approximately 1 GW of capacity (72 turbines x 15 MW = 1,080 MW), as shown in Figure 3. Simulations incorporated wind speed inputs derived from the validated WindSim data, along with loss factors accounting for wake effects, electrical losses, availability, and inefficiencies. This approach allowed for a standardized, yet location-sensitive, comparison of energy potential across the entire Atlantic Canada study region.

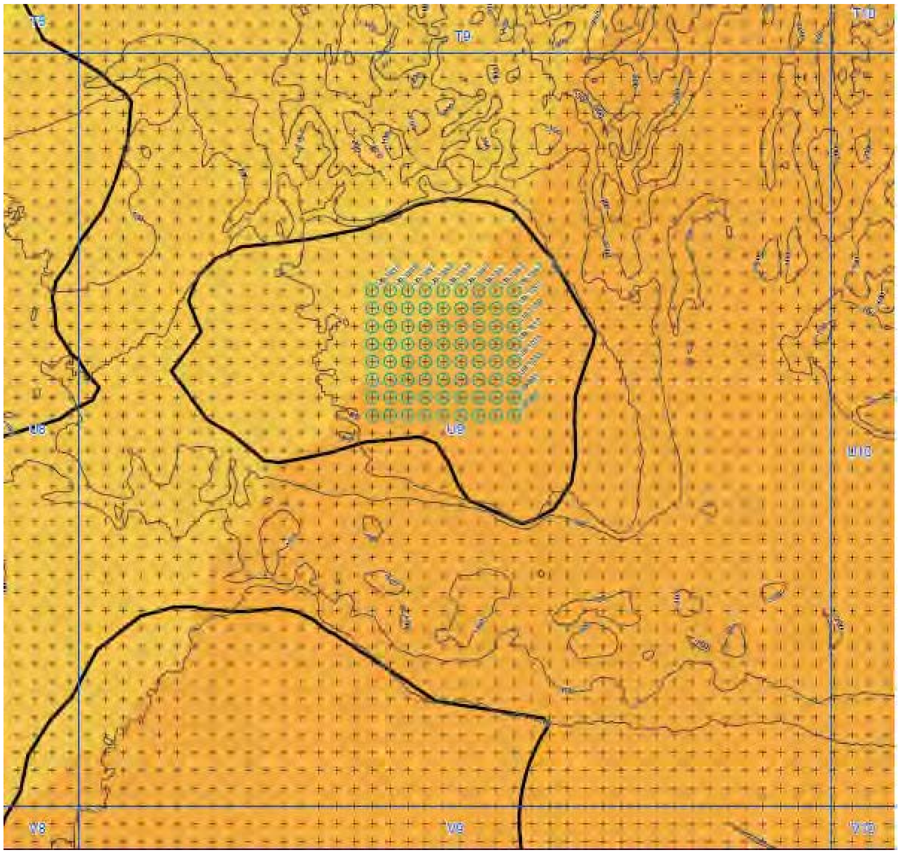


*Figure 3. Example of a 1 GW cluster located inside a buildable area within a cell. Each circle represents a wind turbine*

### 3.3.1 Model Setup and Wind Turbine Characteristics

As mentioned in the previous section, the offshore study area was divided into 100 km × 100 km grid cell to perform simulations at a regional scale. Each cell was assumed to hold an installed capacity of nearly 1 GW, and multiple cells were grouped into clusters for simulation purposes.

Clusters were defined using two primary criteria:

- Proximity to the nearest POI
- Wind resource quality, based on mean wind speed

This method allowed for a scalable, conservative grid-integrated view of offshore wind potential. Since each cluster aggregates several cells with similar resource and logistical conditions, this methodology provides a practical and scalable framework for regional planning and interconnection cost modelling.

A standardized turbine model was used across all simulated cells to ensure comparability in the model calibration. While specific turbine details are confidential, the energy model was based on the characteristics of a modern commercial offshore wind turbine currently installed and operated on fixed foundations. For consistency with the wind resource data outputs—particularly from simulation model—the turbine hub height was set at 120 m. Specifications for the wind turbine used in the report are shown in Table 1.

*Table 1. Technical Specifications of Wind Turbine*

| | |
|---|---|
| Rated Power | 15 MW |
| Hub Height | 120 m |
| Rotor Diameter | 236 m |
| Cut-in Speed | 3 m/s |
| Rated Speed | 14 m/s |
| Cut-out Speed | 28 m/s |

As an offshore turbine designed for high energy output and efficient space utilization, the machine is well-suited to the wind regimes found in Atlantic Canada. The power curve corresponding to the turbine is shown in Figure 4.

Each cell was modelled assuming a rectangular array spaced at 10 rotor diameters to mitigate wake effects. The Furow model incorporates several wake models, but the Jensen Model was deemed appropriate given the scope of this study. Gross energy production estimates were calculated and used to determine net values of energy and capacity factors by using a standardized set of energy loss assumptions (see Table 2). Additional environmental and site-specific factors, such as turbulence, wind shear, and inflow direction, were captured through the high-resolution wind resource model.

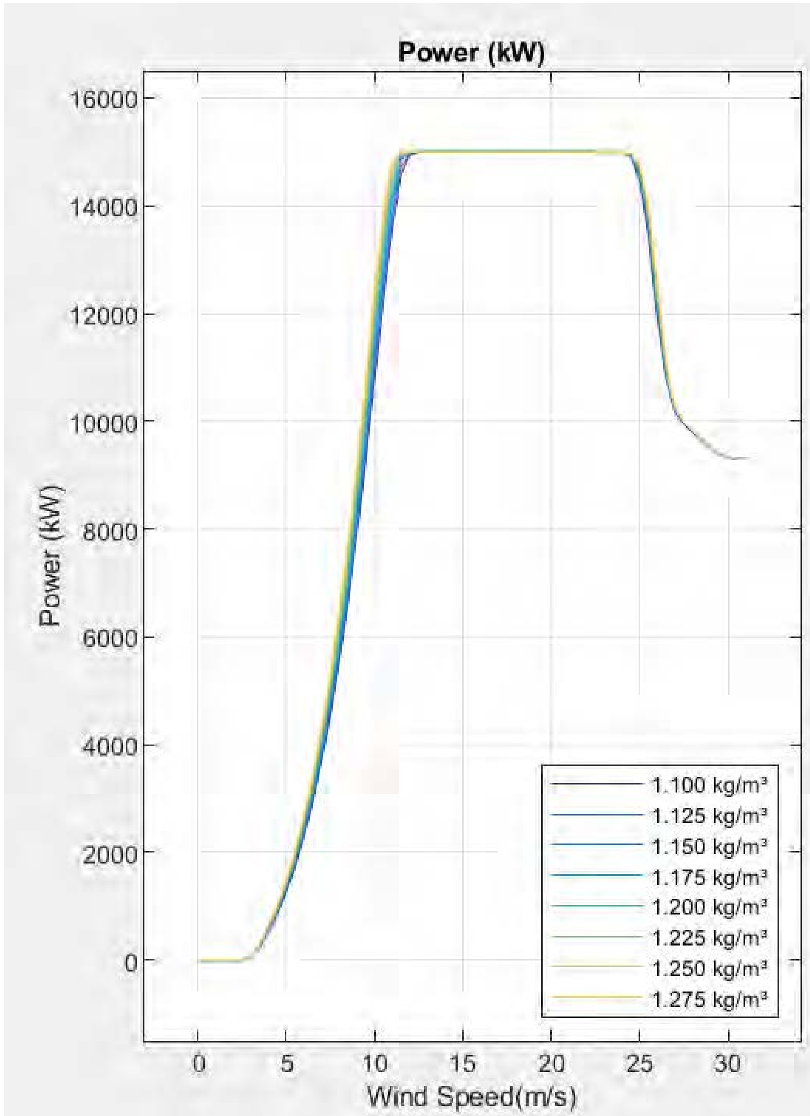



*Figure 4. Power curve for the offshore wind turbine used for energy production estimates*

*Table 2. Energy losses used to determine net values of Annual Energy Production and capacity factor*

| LOSS ELEMENT | VALUE |
|---|---|
| **Unavailability losses** | |
| Wind Turbine | 3.00% |
| Collection system | 0.50% |
| Substation | 0.30% |
| Utility grid | 0.75% |
| Other | 0.00% |
| **Total** | **4.98%** |
| **Turbine Performance** | |
| Power curve adjustment | 0.50% |
| High Wind Control Hysteresis | 0.50% |
| Wind Shear | 0.10% |
| Inflow Angle | 0.10% |
| Yaw Misalignment | 0.50% |
| **Total** | **1.68%** |

| LOSS ELEMENT | VALUE |
|---|---|
| **Electrical losses** | |
| Wind Turbine Transformer | 0.80% |
| Collection system | 0.50% |
| Substation | 0.30% |
| Transmission line | 1.20% |
| Power consumption in idling | 0.10% |
| **Total** | **2.87%** |
| **Environmental losses** | |
| Blade Degradation | 1.00% |
| Blade Icing | 0.30% |
| Low Temperature Shutdown | 0.20% |
| High Temperature Shutdown | 0.00% |
| **Total** | **1.49%** |

### 3.3.2 Annual Energy Production and Capacity Factors

The Annual Energy Production (AEP) and Capacity Factors (CF) were calculated for each cluster to evaluate the generation potential of both fixed and floating offshore wind zones. The calculations were based on a representative 1 GW layout within a selected cell from each cluster. Gross AEP was derived from the simulated wind resource and turbine performance, while net AEP incorporated energy loss assumptions including wake effects, availability, electrical transmission, and site-specific considerations.

Table 3 shows the values of gross and net AEP, as well as the capacity factors across the study area. The variability observed is caused by the specific wind conditions found at each cell of the domain. Gross values ranged from approximately 5,614,365 to 6,709,402 MWh/year per GW installed, depending on wind conditions and site location. Net AEP figures, obtained by applying energy loss factors, ranged from 4,739,458 to 5,657,016 kWh/year per GW installed. The estimated energy production for each cluster is scalable and can be extrapolated to the total available buildable area by comparing it to the area of the 1 GW reference layout.

*Table 3. Ranges of AEP and capacity factors for project area*

| | Maximum | Minimum |
|---|---|---|
| Gross AEP (MWh/year) | 6,709,402 | 5,614,365 |
| Net AEP (MWh/year) | 5,657,016 | 4,739,458 |
| Gross CF (%) | 70.92 | 59.34 |
| Net CF (%) | 59.79 | 50.09 |

Net CFs across modelled clusters ranged from 50.09% to 59.79%, with an average of 54.64%. The highest values are typically observed in areas with stronger and more consistent wind resources, particularly southeast of Newfoundland and Labrador, within the offshore areas of the Atlantic Ocean.

These estimates reflect a robust offshore wind resource potential in Atlantic Canada and form the basis for assessing system integration scenarios, economic feasibility, and phased development planning in future phases of the study.

To assess the offshore wind energy potential across Atlantic Canada, we conducted a detailed analysis of AEP and CF for each jurisdiction. The following tables present a province-by-province summary of these metrics, highlighting regional variability driven by localized wind conditions and resource quality.

*Table 4. Ranges of AEP and CF for Nova Scotia, aligned with WEA areas*

| | Maximum | Minimum |
|---|---|---|
| Gross AEP (MWh/year) | 6,248,097 | 5,795,312 |
| Net AEP (MWh/year) | 5,288,419 | 4,868,879 |
| Gross CF (%) | 66.04 | 61.26 |
| Net CF (%) | 55.90 | 51.46 |

*Table 5. Ranges of AEP and CF for New Brunswick*

| | Maximum | Minimum |
|---|---|---|
| Gross AEP (MWh/year) | 5,896,577 | 5,703,218 |
| Net AEP (MWh/year) | 4,992,987 | 4,789,188 |
| Gross CF (%) | 62.33 | 60.28 |
| Net CF (%) | 52.78 | 50.62 |

*Table 6. Ranges of AEP and CF for Newfoundland and Labrador*

| | Maximum | Minimum |
|---|---|---|
| Gross AEP (MWh/year) | 6,709,402 | 5,614,365 |
| Net AEP (MWh/year) | 5,657,016 | 4,739,458 |
| Gross CF (%) | 70.92 | 59.34 |
| Net CF (%) | 59.79 | 50.09 |

*Table 7. AEP and CF for Prince Edward Island*

| | Reference Value |
|---|---|
| Gross AEP (MWh/year) | 5,805,763 |
| Net AEP (MWh/year) | 5,497,178 |
| Gross CF (%) | 61.37 |
| Net CF (%) | 58.10 |

### 3.3.3 Time-series Energy Production Profiles

Time-series profiles were generated to support production simulation, integration modelling, and transmission analysis. For each cluster, hourly energy production estimates were derived using the ‘direct method’, which combines a time series of wind speed for each cluster with the park or wind farm curve for each cell (see Figure 5). The resulting profiles reflect the dynamic variability of offshore wind generation over time and were observed to be consistent across all buildable areas. These profiles allow system planners and analysts to evaluate hourly dispatch patterns, seasonal production trends, and potential coincidence with load or curtailment risk.

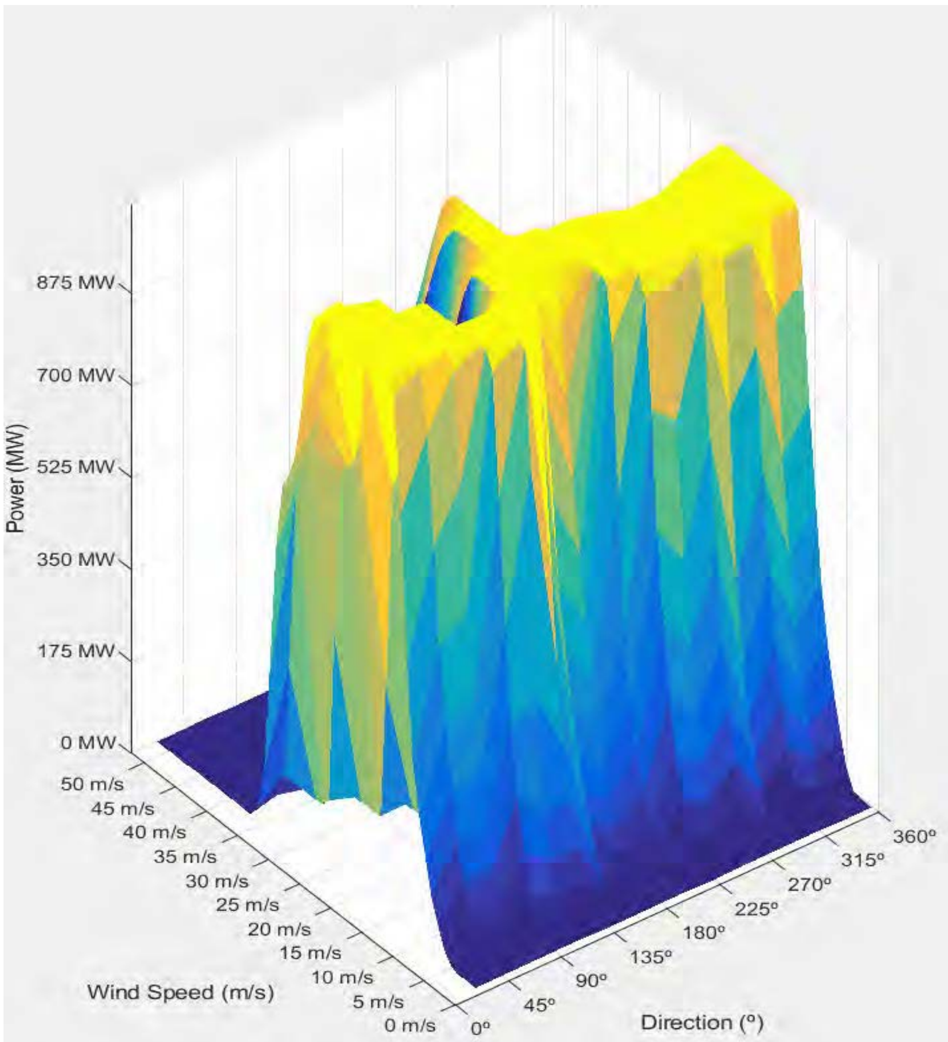



*Figure 5. Example of typical wind farm power curve for single cell in the model*

The final time-series outputs were delivered in a standardized format for integration into broader modelling platforms, including PLEXOS. These profiles are key to understanding the temporal behaviour of offshore wind and its interaction with the evolving grid system in Atlantic Canada. Examples of clusters of fixed and floating generation profiles are shown for each province in the tables below.

Table 8. Example of a fixed and floating cluster generation profile for a sample day, Nova Scotia

| Cluster | C27 | | C11 | |
|---|---|---|---|---|
| Grid cell | U9 - Middle Bank fixed | | S10 - Sydney Bight floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 0:00 | 1,080,000 | 14.01 | 1,031,665 | 13.58 |
| 1/1/2018 1:00 | 1,080,000 | 13.78 | 1,026,388 | 13.29 |
| 1/1/2018 2:00 | 1,080,000 | 13.69 | 1,030,440 | 13.45 |
| 1/1/2018 3:00 | 1,080,000 | 13.55 | 1,043,843 | 15.36 |
| 1/1/2018 4:00 | 1,080,000 | 13.43 | 1,043,843 | 17.13 |
| 1/1/2018 5:00 | 1,079,993 | 13.14 | 1,043,843 | 15.98 |
| 1/1/2018 6:00 | 1,079,958 | 12.71 | 1,043,840 | 14.84 |
| 1/1/2018 7:00 | 1,077,379 | 12.15 | 1,043,843 | 15.18 |
| 1/1/2018 8:00 | 1,062,927 | 11.62 | 1,043,843 | 14.93 |
| 1/1/2018 9:00 | 1,011,709 | 11.05 | 1,043,843 | 14.56 |
| 1/1/2018 10:00 | 912,477 | 10.48 | 1,043,843 | 13.99 |
| 1/1/2018 11:00 | 740,339 | 9.63 | 1,043,843 | 13.36 |
| 1/1/2018 12:00 | 566,899 | 8.79 | 1,043,801 | 12.58 |
| 1/1/2018 13:00 | 434,031 | 8.08 | 1,033,859 | 11.61 |
| 1/1/2018 14:00 | 397,253 | 7.93 | 1,005,534 | 11.12 |

| Cluster | C27 | | C11 | |
|---|---|---|---|---|
| Grid cell | U9 - Middle Bank fixed | | S10 - Sydney Bight floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 15:00 | 404,938 | 8.08 | 1,032,028 | 11.51 |
| 1/1/2018 16:00 | 410,606 | 8.20 | 1,040,606 | 12.06 |
| 1/1/2018 17:00 | 400,451 | 8.16 | 1,040,123 | 12.50 |
| 1/1/2018 18:00 | 371,780 | 7.95 | 1,032,442 | 12.44 |
| 1/1/2018 19:00 | 343,675 | 7.74 | 1,025,279 | 12.01 |
| 1/1/2018 20:00 | 317,875 | 7.54 | 997,246 | 11.37 |
| 1/1/2018 21:00 | 278,982 | 7.24 | 905,912 | 10.84 |
| 1/1/2018 22:00 | 253,101 | 6.90 | 838,800 | 10.51 |
| 1/1/2018 23:00 | 212,208 | 6.40 | 735,974 | 10.09 |

*Table 9. Example of a fixed and floating cluster generation profile for a sample day, New Brunswick*

| Cluster | C20 | | C24 | |
|---|---|---|---|---|
| Grid cell | W4 - Fixed | | Q6 - Floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 0:00 | 1,044,085 | 13.45 | 1,013,991 | 11.77 |
| 1/1/2018 1:00 | 1,044,085 | 13.30 | 1,031,174 | 12.03 |

| Cluster | C20 | | C24 | |
|---|---|---|---|---|
| Grid cell | W4 - Fixed | | Q6 - Floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 2:00 | 1,044,074 | 13.04 | 1,035,824 | 12.16 |
| 1/1/2018 3:00 | 1,044,065 | 12.88 | 1,042,434 | 12.60 |
| 1/1/2018 4:00 | 1,044,048 | 12.60 | 1,043,041 | 12.89 |
| 1/1/2018 5:00 | 1,039,532 | 12.00 | 1,041,888 | 12.27 |
| 1/1/2018 6:00 | 1,031,050 | 11.51 | 983,997 | 11.65 |
| 1/1/2018 7:00 | 1,027,614 | 11.32 | 900,322 | 11.03 |
| 1/1/2018 8:00 | 1,029,038 | 11.40 | 812,778 | 10.57 |
| 1/1/2018 9:00 | 1,031,121 | 11.51 | 749,395 | 10.19 |
| 1/1/2018 10:00 | 1,025,572 | 11.25 | 707,706 | 9.96 |
| 1/1/2018 11:00 | 940,823 | 10.73 | 612,759 | 9.52 |
| 1/1/2018 12:00 | 937,432 | 10.71 | 482,762 | 8.82 |
| 1/1/2018 13:00 | 957,851 | 10.83 | 369,596 | 8.08 |
| 1/1/2018 14:00 | 933,326 | 10.68 | 267,375 | 7.30 |
| 1/1/2018 15:00 | 954,077 | 10.81 | 197,541 | 6.57 |
| 1/1/2018 16:00 | 1,027,388 | 11.30 | 166,573 | 6.15 |
| 1/1/2018 17:00 | 1,034,483 | 11.71 | 158,301 | 6.00 |

| Cluster | C20 | | C24 | |
|---|---|---|---|---|
| Grid cell | W4 - Fixed | | Q6 - Floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 18:00 | 1,032,511 | 11.79 | 138,168 | 5.76 |
| 1/1/2018 19:00 | 1,017,661 | 11.50 | 115,213 | 5.48 |
| 1/1/2018 20:00 | 1,014,898 | 11.53 | 94,805 | 5.10 |
| 1/1/2018 21:00 | 1,006,580 | 11.30 | 58,348 | 4.48 |
| 1/1/2018 22:00 | 1,010,978 | 11.36 | 22,648 | 3.74 |
| 1/1/2018 23:00 | 1,034,567 | 11.90 | 5,550 | 3.33 |

*Table 10. Example of a fixed and floating cluster generation profile for a sample day, Newfoundland and Labrador*

| Cluster | C5 | | C25 | |
|---|---|---|---|---|
| Grid cell | S15 - Fixed | | O10 - Floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 0:00 | 1,044,786 | 20.60 | 111,960 | 5.62 |
| 1/1/2018 1:00 | 1,044,786 | 20.52 | 178,237 | 6.56 |
| 1/1/2018 2:00 | 1,044,786 | 19.92 | 235,298 | 7.19 |
| 1/1/2018 3:00 | 1,044,786 | 19.02 | 258,636 | 7.40 |
| 1/1/2018 4:00 | 1,044,786 | 18.99 | 301,211 | 7.73 |
| 1/1/2018 5:00 | 1,044,786 | 18.94 | 472,370 | 8.99 |
| 1/1/2018 6:00 | 1,044,786 | 18.70 | 706,675 | 10.33 |
| 1/1/2018 7:00 | 1,044,786 | 17.72 | 959,241 | 11.73 |
| 1/1/2018 8:00 | 1,044,786 | 16.65 | 1,036,149 | 12.50 |
| 1/1/2018 9:00 | 1,044,786 | 15.73 | 1,005,973 | 12.04 |
| 1/1/2018 10:00 | 1,044,786 | 15.31 | 962,432 | 11.61 |
| 1/1/2018 11:00 | 1,044,786 | 15.62 | 837,611 | 10.85 |
| 1/1/2018 12:00 | 1,044,786 | 16.24 | 489,879 | 9.06 |
| 1/1/2018 13:00 | 1,044,786 | 16.91 | 268,104 | 7.54 |
| 1/1/2018 14:00 | 1,044,786 | 17.13 | 338,523 | 7.80 |

| Cluster | C5 | | C25 | |
|---|---|---|---|---|
| Grid cell | S15 - Fixed | | O10 - Floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 15:00 | 1,044,786 | 17.01 | 515,616 | 9.02 |
| 1/1/2018 16:00 | 1,044,786 | 16.03 | 466,630 | 9.03 |
| 1/1/2018 17:00 | 1,044,786 | 15.47 | 464,442 | 8.99 |
| 1/1/2018 18:00 | 1,044,786 | 15.27 | 453,588 | 8.91 |
| 1/1/2018 19:00 | 1,044,786 | 15.13 | 457,157 | 8.91 |
| 1/1/2018 20:00 | 1,044,786 | 14.96 | 492,462 | 9.13 |
| 1/1/2018 21:00 | 1,044,786 | 14.83 | 393,855 | 8.47 |
| 1/1/2018 22:00 | 1,044,786 | 14.75 | 178,752 | 6.58 |
| 1/1/2018 23:00 | 1,044,786 | 14.59 | 94,824 | 5.21 |

*Table 11. Example of a fixed and floating cluster generation profile for a sample day, Prince Edward Island*

| Cluster | C22 | |
|---|---|---|
| Grid cell | R8 - Fixed and Floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 0:00 | 1,079,937 | 12.65 |
| 1/1/2018 1:00 | 1,080,000 | 15.99 |

| Cluster | C22 | |
|---|---|---|
| Grid cell | R8 - Fixed and Floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 2:00 | 1,080,000 | 15.62 |
| 1/1/2018 3:00 | 1,080,000 | 14.25 |
| 1/1/2018 4:00 | 1,080,000 | 14.87 |
| 1/1/2018 5:00 | 1,080,000 | 15.24 |
| 1/1/2018 6:00 | 1,080,000 | 14.30 |
| 1/1/2018 7:00 | 1,079,968 | 13.21 |
| 1/1/2018 8:00 | 1,079,421 | 12.70 |
| 1/1/2018 9:00 | 1,079,181 | 12.41 |
| 1/1/2018 10:00 | 1,067,603 | 12.02 |
| 1/1/2018 11:00 | 1,063,584 | 11.94 |
| 1/1/2018 12:00 | 1,079,296 | 12.43 |
| 1/1/2018 13:00 | 1,079,876 | 12.96 |
| 1/1/2018 14:00 | 1,080,000 | 13.28 |
| 1/1/2018 15:00 | 1,080,000 | 13.31 |
| 1/1/2018 16:00 | 1,079,984 | 13.00 |
| 1/1/2018 17:00 | 1,079,930 | 12.29 |

| Cluster | C22 | |
|---|---|---|
| Grid cell | R8 - Fixed and Floating | |
| Date/Time | Net Power Production (kWh) | Wind speed (m/s) |
| 1/1/2018 18:00 | 1,061,451 | 11.49 |
| 1/1/2018 19:00 | 990,175 | 10.90 |
| 1/1/2018 20:00 | 904,394 | 10.43 |
| 1/1/2018 21:00 | 828,931 | 10.11 |
| 1/1/2018 22:00 | 785,110 | 9.97 |
| 1/1/2018 23:00 | 816,266 | 10.17 |

# 4 Closing

The findings in this report demonstrate that Atlantic Canada possesses exceptional offshore wind potential, with net capacity factors ranging from 50.09% to 59.79% across identified buildable areas. The analysis integrates high-resolution wind resource modelling, constraint mapping, and energy yield simulations to identify technically and spatially viable zones for development. The delineation of fixed and floating foundation areas, along with strategically selected Points of Interconnection, provides a robust framework for future planning and integration.

Time-series production profiles offer valuable insights into the temporal behaviour of offshore wind generation, supporting system-level modelling and infrastructure design. The methodology employed—combining meso-micro coupling, computational fluid dynamics, wind farm development and simulation software and GIS-based screening—ensures that the findings are both technically rigorous and spatially grounded.

Taken together, the results underscore the transformative potential of offshore wind in Atlantic Canada. With its vast wind resources, favourable bathymetry, and proximity to major markets, the region is uniquely positioned to play a leading role in Canada's energy transition and to emerge as a globally significant hub for offshore wind energy development.

# Appendix A – GIS Figures and Supporting Maps

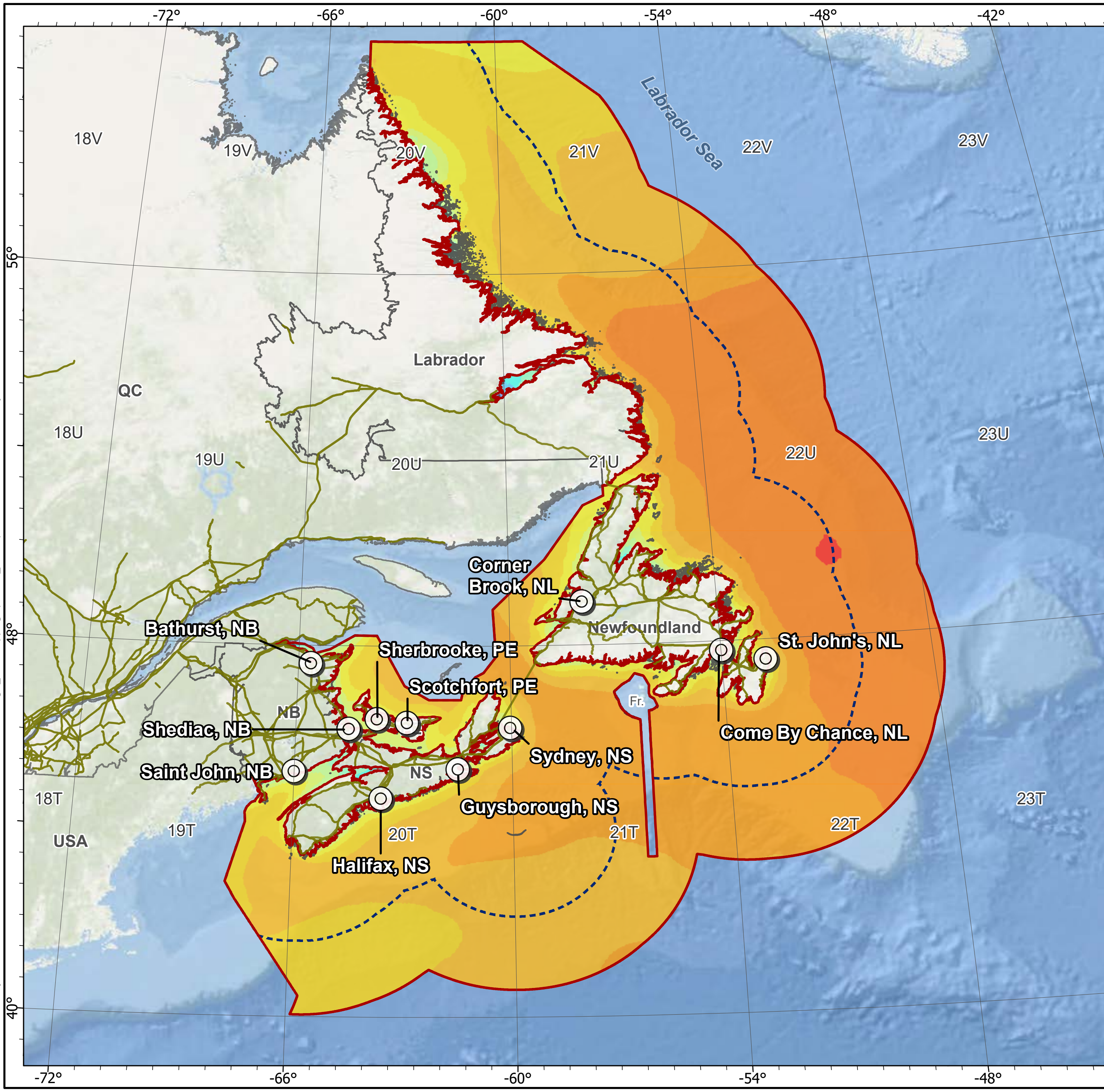



Figure No.
26

**DRAFT**

Title
## Points of Intersection

Client/Project 126560144_026

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Atlantic Canada

Prepared by NW on 2025-04-10
Revised by NW on 2025-07-17

N

0 230 460 km

(At original document size of 8.5x11)
1:14,000,000

Legend

- Point of Intersection
- Floating Platform Technical Development Limit (195km)
- Transmission Line
- Proposed NZA Study Area (V2.2)

Average Wind Speed (m/s) at 120 m ASL

- <= 6
- 6 - 6.5
- 6.5 - 7
- 7 - 7.5
- 7.5 - 8
- 8 - 8.5
- 8.5 - 9
- 9 - 9.5
- 9.5 - 10
- 10 - 10.5
- 10.5 - 11
- 11 - 11.5
- 11.5 - 12
- >12

**Project Location:**

***Notes***

**1.** Coordinate System: WGS 84 Azimuthal Equidistant Projection, Central Meridian -62
**2.** Data Sources: Stantec; Windsim / NASA MERRA reanalysis dataset; Statistics Canada; OpenStreetMap
**3.** Background: ESRI; NRCan CanVec; Statistics Canada

Stantec

\\CA0151-PPFSS01\stjohns$\DATA\DB\CADDATA\JOBS\NetZeroAtlantic\126560144\gis_data\mapping\aprx\nza_wind.aprx Revised: 2025-07-18 By: niwhite

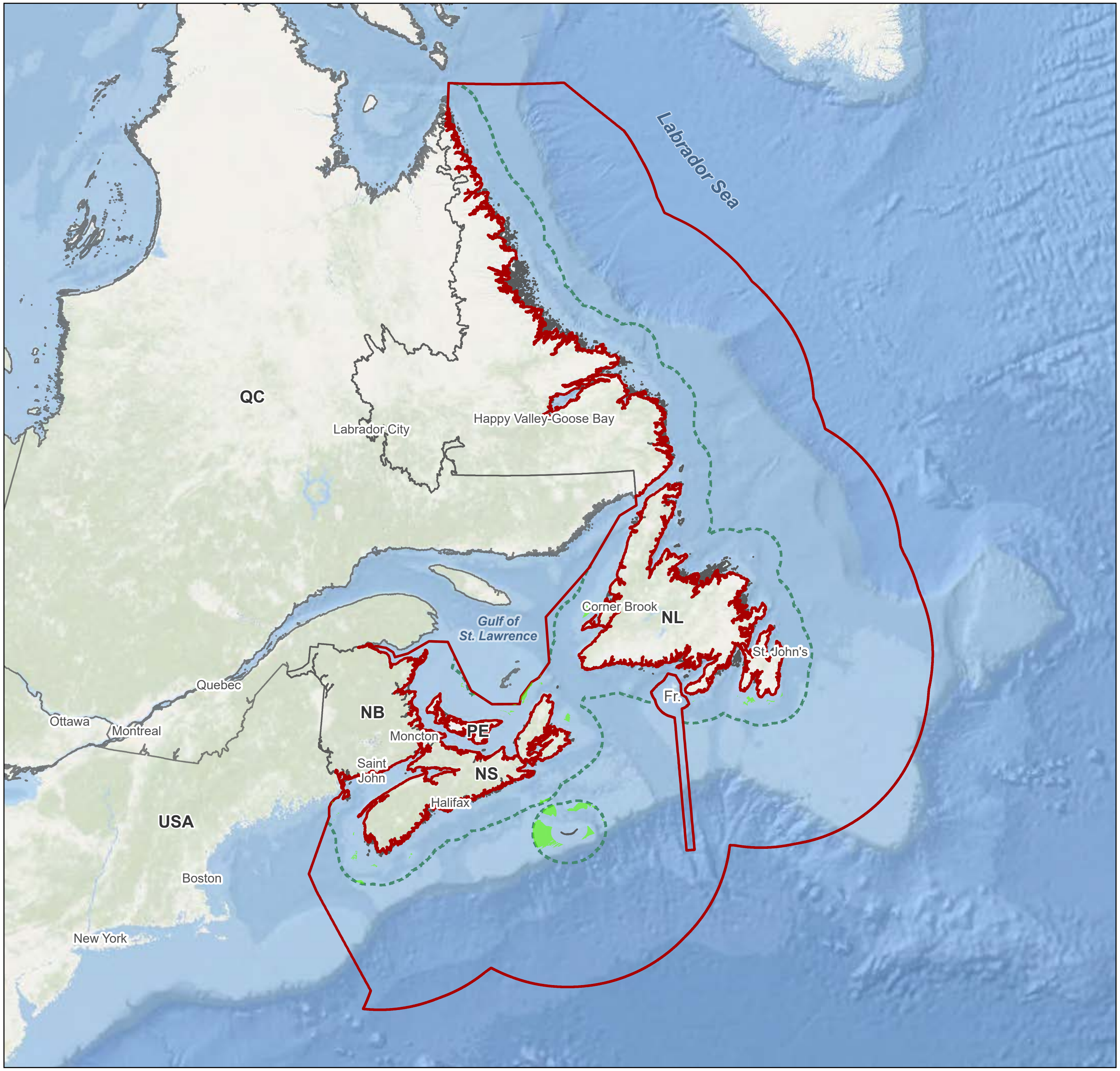



*Figure No.*
**16**

**DRAFT**

*Title*
**Buildable Area - Fixed Platform**

*Client/Project* 126560144_016

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location* Prepared by NW on 2025-03-31

Atlantic Canada

N

0 100 200 300 km
(At original document size of 8.5x11)
1:15,000,000

Legend

- Buildable Area - Fixed Platform (V4)
- Proposed NZA Study Area (V2.2)
- Fixed Platform Technical Development Limit (70 km)

**Project Location:**

***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada
**3.** Background: ESRI; NRCan CanVec

Stantec

\\CA0151-PPFSS01\stjohns$\DATA\DB\CADD\DATA\JOBS\NetZeroAtlantic\126560144\gis_data\mapping\aprx\nza_base_data_v2.aprx Revised: 2025-04-04 By: nlwhite

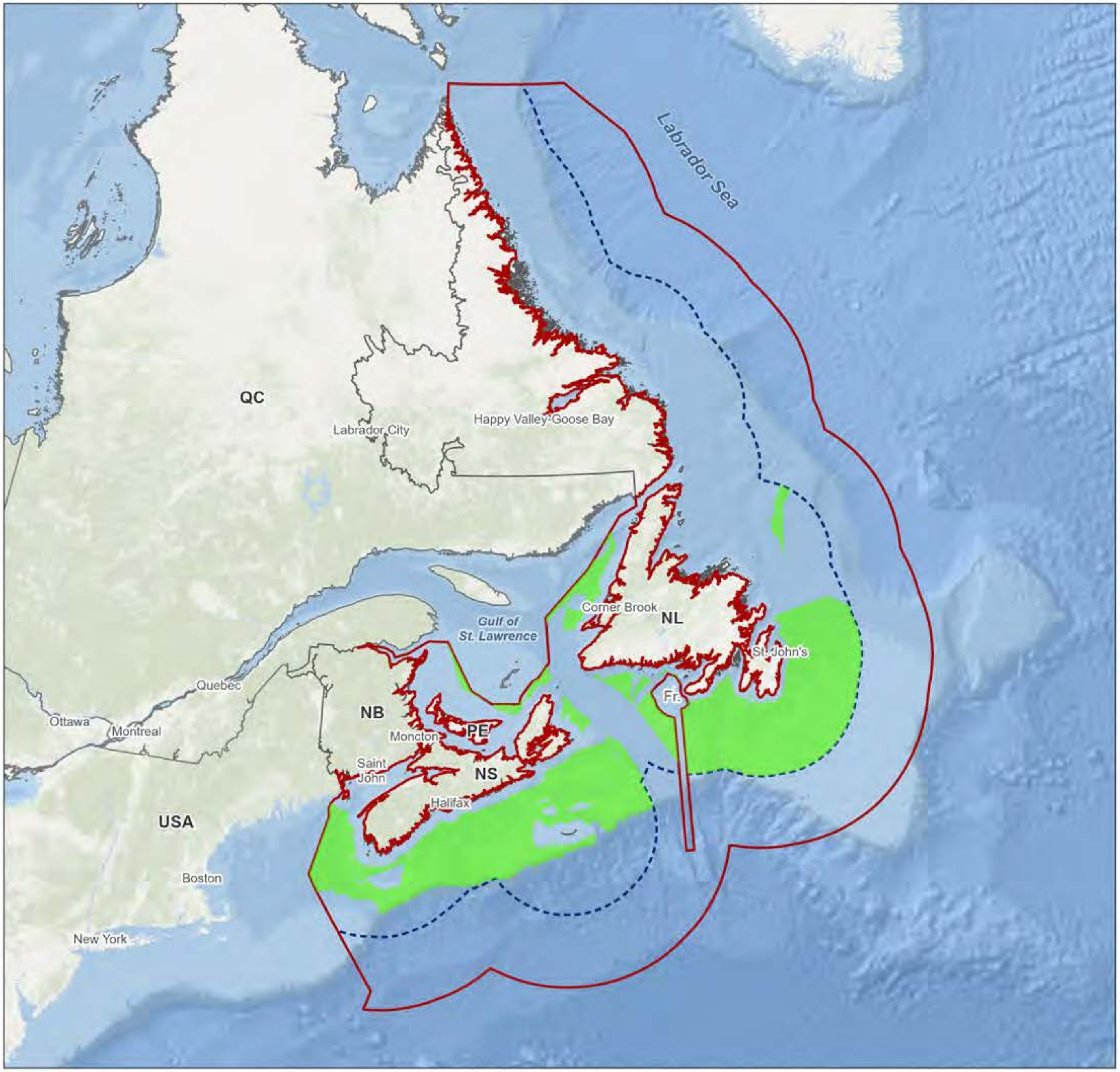



*Figure No.*
**17**
**DRAFT**

*Title*
**Buildable Area - Floating Platform**

*Client/Project* 126560144_017

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location*
Prepared by NW on 2025-03-31
TR by DPantoja on 2025-04-22

Atlantic Canada

N
0 100 200 300 km
(At original document size of 8.5x11)
1:15,000,000

Legend

- Buildable Area - Floating Platform (V4)
- Proposed NZA Study Area (V2.2)
- Floating Platform Technical Development Limit (195 km)

**Project Location:**

***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada
**3.** Background: ESRI; NRCan CanVec

Stantec

\\CA0151-PPFSS01\stjohns$\DATA\DB\CADDATA\JOBS\NetZeroAtlantic\126560144\gis_data\mapping\aprx\nza_base_data_v2.aprx Revised: 2025-04-22 By: nwhite

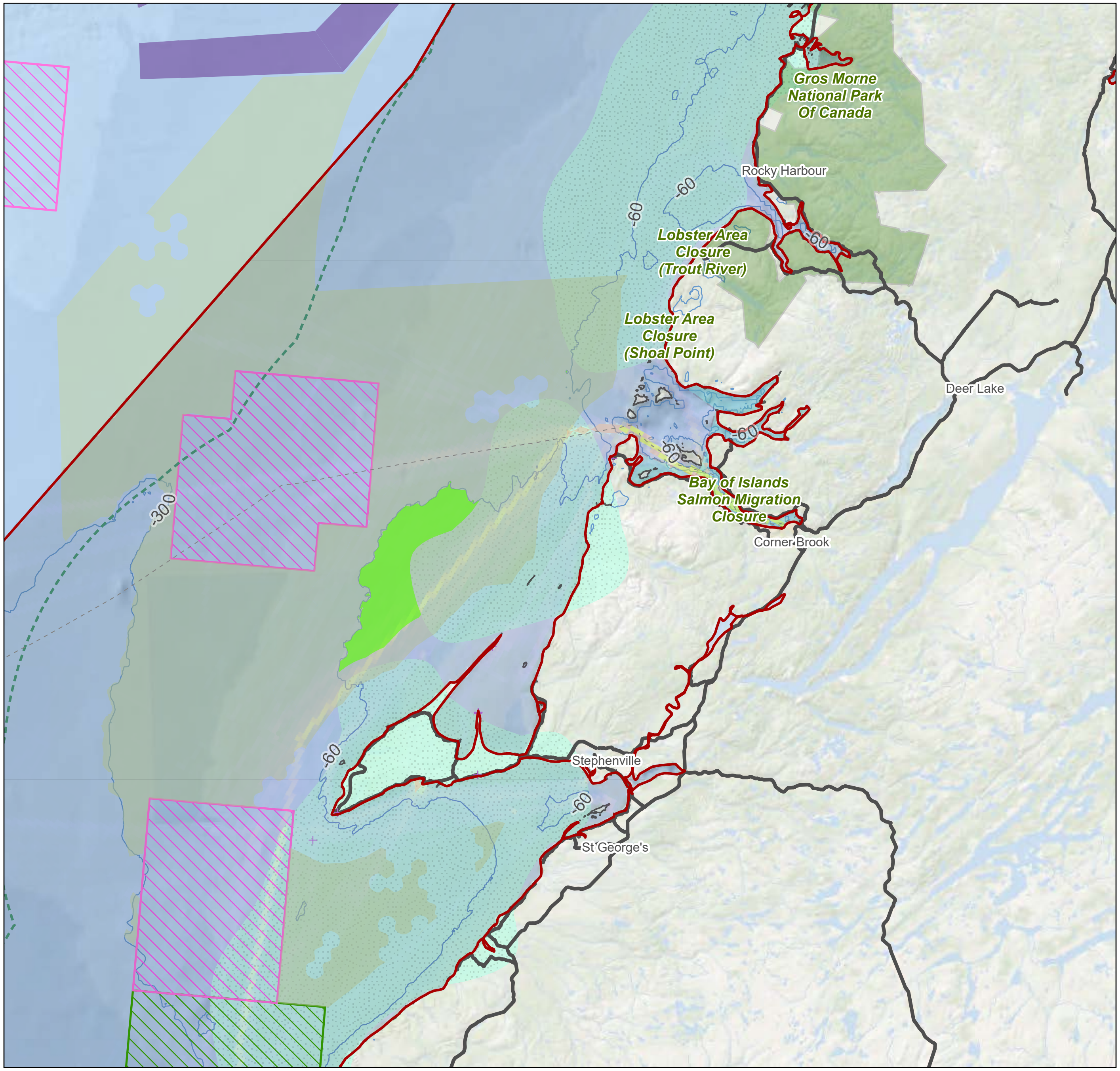



Figure No.
**16.1**

**DRAFT**

Title
**Buildable Area - Fixed Platform Constraints Analysis (Eastern Gulf)**

Client/Project 126560144_016a

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location Prepared by NW on 2025-03-31

Atlantic Canada

0 10 20 30 km
(At original document size of 8.5x11)
1:1,250,000

Legend

- Buildable Area - Fixed Platform (Stantec)
- Preliminary Offshore Wind Licensing (NL OSW RA)
- Proposed NZA Study Area (V2.2)
- Fixed Platform Technical Development Limit (70 km)

Critical Habitat for Aquatic Species at Risk
- Northern Wolffish
- Spotted Wolffish

Protected and Conserved Areas
- National Park
- Other Effective Area-Based Conservation Measure

Offshore Wells
- Exploration Wells

- Subsea Cables (Inactive)

Onshore Infrastructure
- Onshore Pipeline

Vessel Traffic
- Traffic Separation Scheme Lane (CHS, 2019)
- Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km$^2$)
- High Density Vessel Traffic (>0.6 vessels per day/km$^2$)

Other Features
- Bathymetry Contour
- Sea Ice Extent 2023 (NSIDC)

**Project Location:**


***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); Environment and Climate Change Canada, Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; TeleGeography Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada
**3.** Background: ESRI; NRCan CanVec; GEBCO 2024

Stantec

\\CA0151-PPFSS01\stjohns$\DATA\DB\CADDATA\JOBS\NetZeroAtlantic\126560144\gis_data\mapping\aprx\nza_base_data_v2.aprx Revised: 2025-04-11 By: niwhite

Figure No.
**16.2**

**DRAFT**

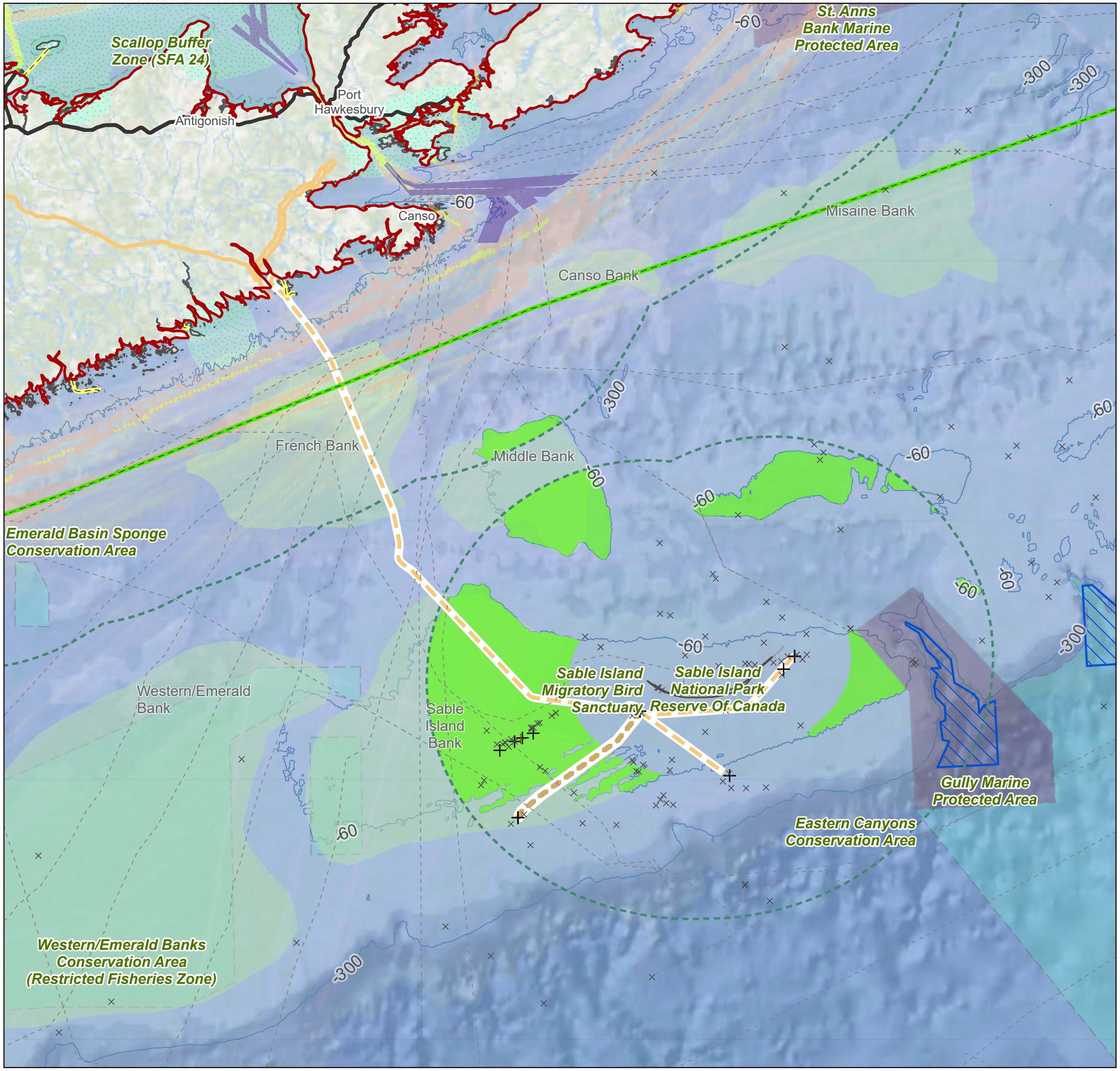
Title
## Buildable Area - Fixed Platform Constraints Analysis (Sable Island and Middle Bank)

Client/Project 126560144_016a

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location Prepared by NW on 2025-03-31

Atlantic Canada




N

0 10 20 30 km
(At original document size of 8.5x11)
1:1,940,000

Legend

- Buildable Area - Fixed Platform (Stantec)
- Potential Development Areas (Nova Scotia OSW RA)
- Proposed NZA Study Area (V2.2)
- Fixed Platform Technical Development Limit (70 km)

Critical Habitat for Aquatic Species at Risk
- Northern Bottlenose Whale

Protected and Conserved Areas
- Marine Protected Area
- Migratory Bird Sanctuary
- National Park
- Other Effective Area-Based Conservation Measure

Offshore Wells
- Gas well
- Injection well
- Abandoned/Suspended Wellhead

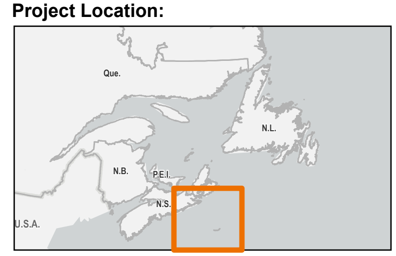
Offshore Infrastructure
- Subsea Cables (Active)
- Subsea Cables (Inactive)
- EXA Express (formerly Hibernia Express) Subsea Cable
- Abandoned Subsea Pipelines (SOEP, Deep Panuke)

Onshore Infrastructure
- Highway
- Onshore Pipeline

Vessel Traffic
- Traffic Separation Scheme Lane (CHS, 2019)
- Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km$^2$)
- High Density Vessel Traffic (>0.6 vessels per day/km$^2$)

Other Features
- Bathymetry Contour
- Sea Ice Extent 2023 (NSIDC)

**Project Location:**




***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); Environment and Climate Change Canada, Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; TeleGeography Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada
**3.** Background: ESRI; NRCan CanVec; GEBCO 2024

Stantec

\\CA0151-PPFSS01\stjohns$\DATA\DB\CADDATA\JOBS\NetZeroAtlantic\126560144\gis_data\mapping\aprx\nza_base_data_v2.aprx Revised: 2025-04-11 By: nwhite

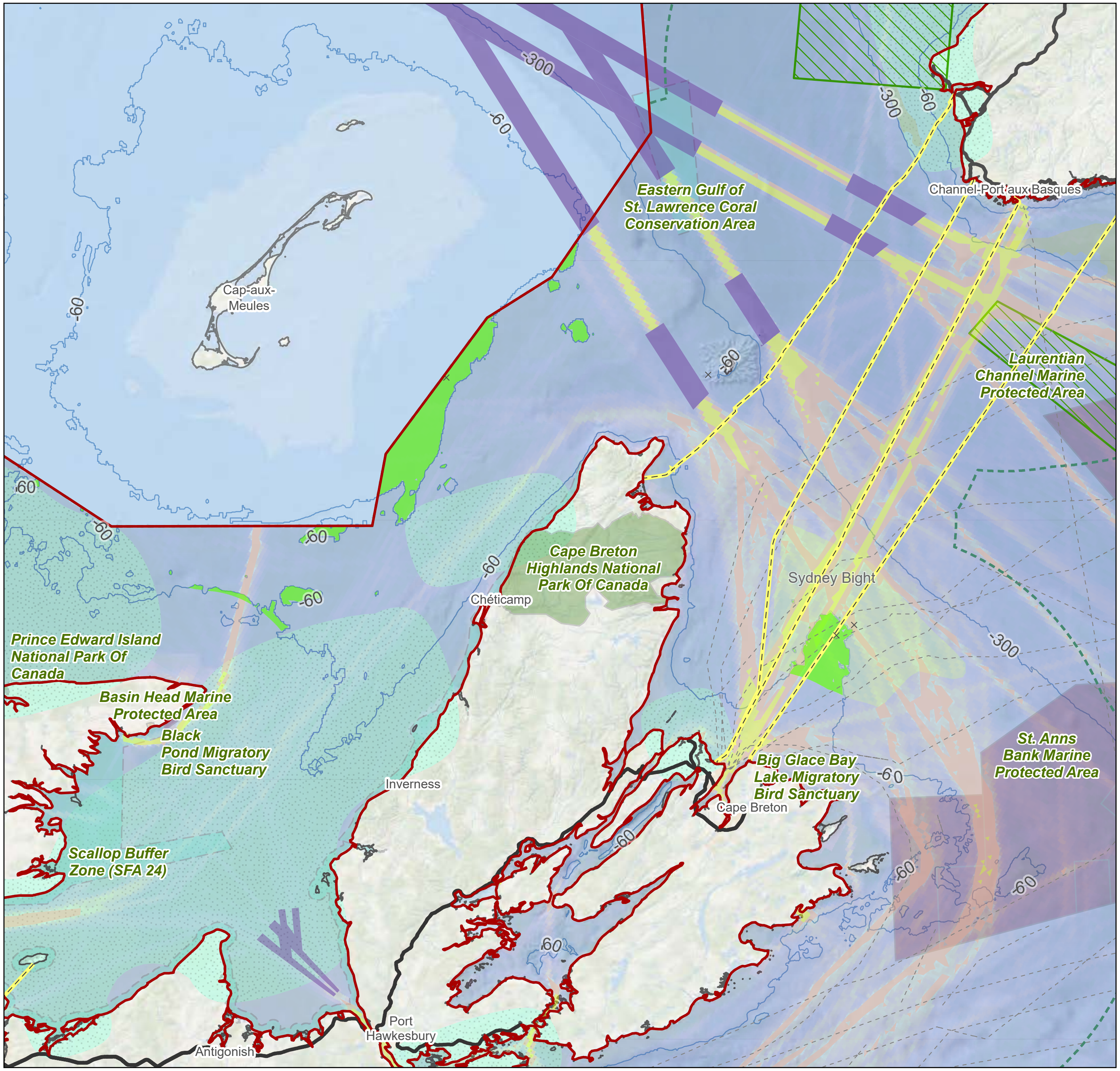



Figure No.
**16.3**

**DRAFT**

Title
**Buildable Area - Fixed Platform Constraints Analysis (Sydney Bight)**

Client/Project 126560144_016a

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location Prepared by NW on 2025-03-31

Atlantic Canada

N

0 10 20 30 km
(At original document size of 8.5x11)
1:1,590,000

Legend

- Buildable Area - Fixed Platform (Stantec)
- Potential Development Areas (Nova Scotia OSW RA)
- Preliminary Offshore Wind Licensing (NL OSW RA)
- Proposed NZA Study Area (V2.2)
- Fixed Platform Technical Development Limit (70 km)

Critical Habitat for Aquatic Species at Risk
- Northern Wolffish

Protected and Conserved Areas
- Marine Protected Area
- Migratory Bird Sanctuary
- National Park
- Other Effective Area-Based Conservation Measure

Offshore Wells
- Abandoned/Suspended Wellhead

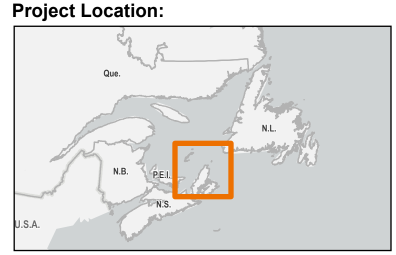
Offshore Infrastructure
- Subsea Cables (Active)
- Subsea Cables (Inactive)

Onshore Infrastructure
- Highway
- Onshore Pipeline

Vessel Traffic
- Traffic Separation Scheme Lane (CHS, 2019)
- Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km$^2$)
- High Density Vessel Traffic (>0.6 vessels per day/km$^2$)

Other Features
- Bathymetry Contour
- Sea Ice Extent 2023 (NSIDC)

**Project Location:**




***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); Environment and Climate Change Canada, Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; TeleGeography Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada
**3.** Background: ESRI; NRCan CanVec; GEBCO 2024

Stantec

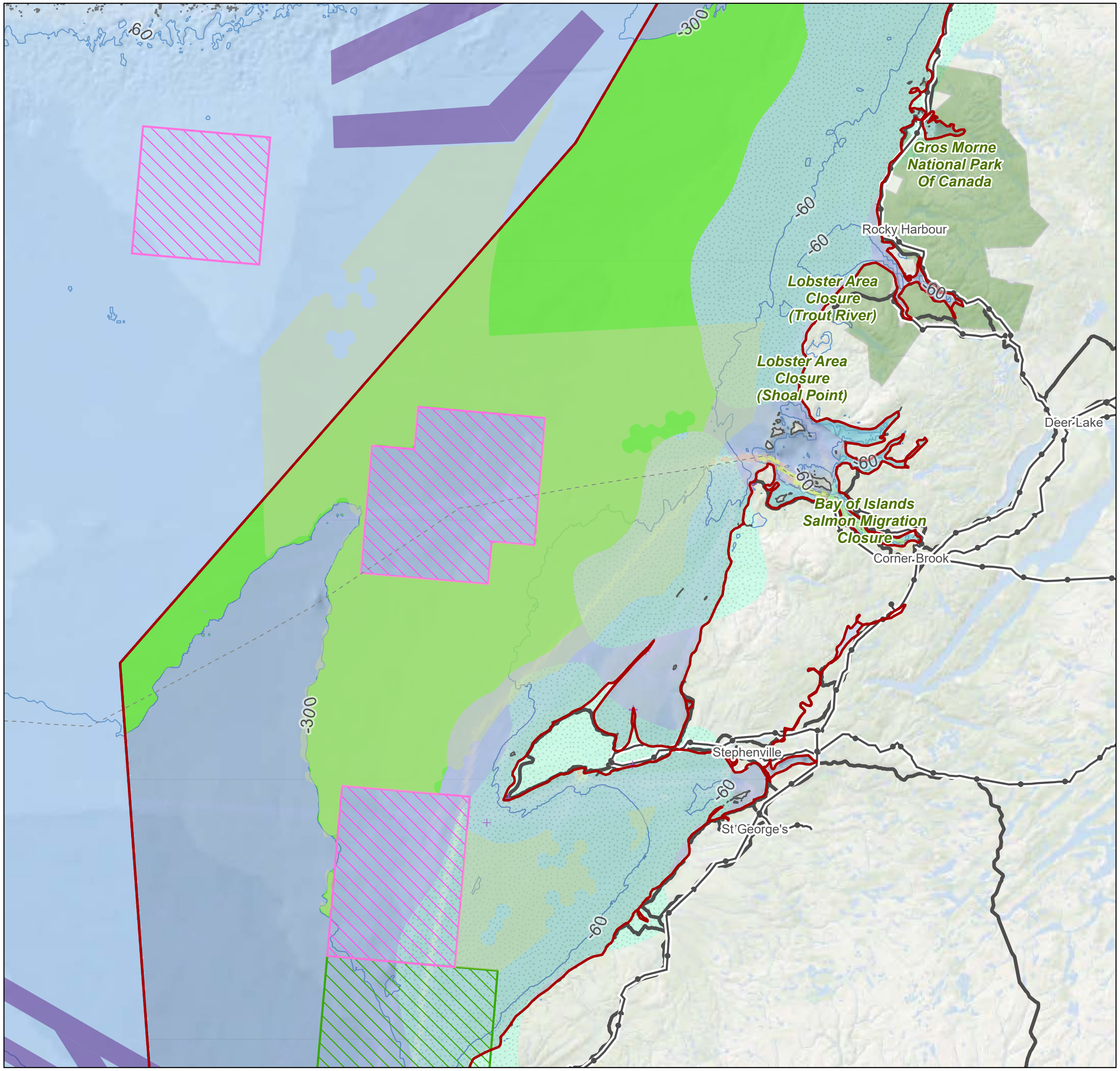



Figure No.
**17.1**

**DRAFT**

Title
**Buildable Area - Floating Platform Constraints Analysis (Eastern Gulf)**

Client/Project 126560144_017a

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location Prepared by NW on 2025-03-31

Atlantic Canada

N

0 10 20 30 km
(At original document size of 8.5x11)
1:1,410,000

Legend

- Buildable Area - Floating Platform (Stantec)
- Preliminary Offshore Wind Licensing (NL OSW RA)
- Proposed NZA Study Area (V2.2)
- Floating Platform Technical Development Limit (195 km)

Critical Habitat for Aquatic Species at Risk
- Northern Wolffish
- Spotted Wolffish

Protected and Conserved Areas
- National Park
- Other Effective Area-Based Conservation Measure

Offshore Wells
- Exploration Wells

Offshore Infrastructure
- Subsea Cables (Active)
- Subsea Cables (Inactive)

Onshore Infrastructure
- Road
- Highway
- Tranmission Line

Vessel Traffic
- Traffic Separation Scheme Lane (CHS, 2019)
- Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km$^2$)
- High Density Vessel Traffic (>0.6 vessels per day/km$^2$)

Other Features
- Bathymetry Contour
- Sea Ice Extent 2023 (NSIDC)

**Project Location:**


***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); Environment and Climate Change Canada, Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; TeleGeography Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada
**3.** Background: ESRI; NRCan CanVec; GEBCO 2024

Stantec

\\CA0151-PPFSS01\stjohns$\DATA\DB\CADDATA\JOBS\NetZeroAtlantic\126560144\gis_data\mapping\aprx\nza_base_data_v2.aprx Revised: 2025-04-11 By: niwhite

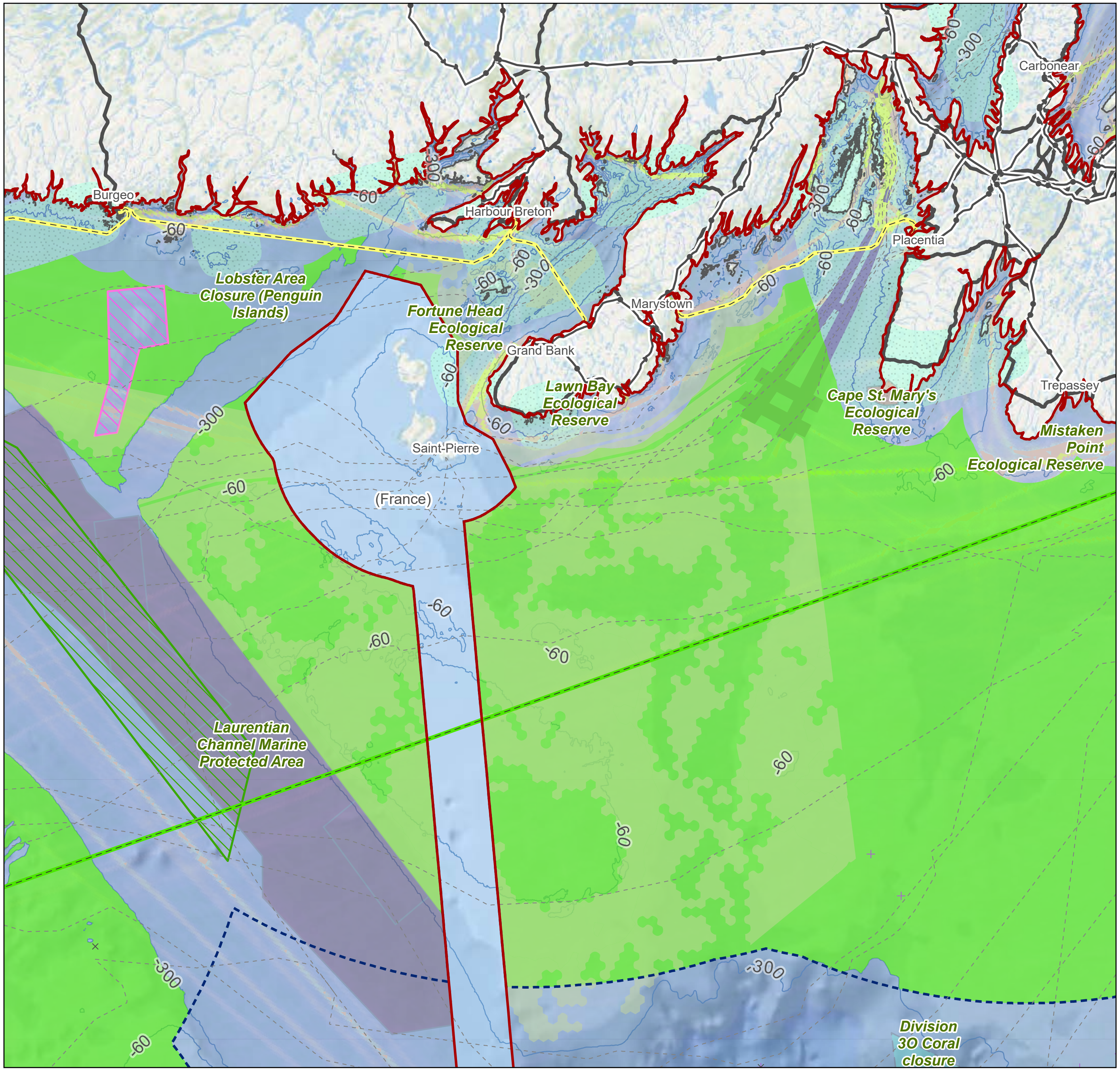



*Figure No.*
**17.2**

**DRAFT**

*Title*
**Buildable Area - Floating Platform Constraints Analysis (South Coast of Newfoundland)**

*Client/Project* 126560144_017a

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location* Prepared by NW on 2025-03-31

Atlantic Canada

N

0 10 20 30 km
(At original document size of 8.5x11)
1:2,100,000

Legend

- Buildable Area - Floating Platform (Stantec)
- Preliminary Offshore Wind Licensing (NL OSW RA)
- Proposed NZA Study Area (V2.2)
- Floating Platform Technical Development Limit (195 km)

Critical Habitat for Aquatic Species at Risk
- Northern Wolffish
- Spotted Wolffish

Protected and Conserved Areas
- Ecological Reserve
- Marine Protected Area
- Other Effective Area-Based Conservation Measure

Offshore Wells
- Abandoned/Suspended Wellhead
- Exploration Wells

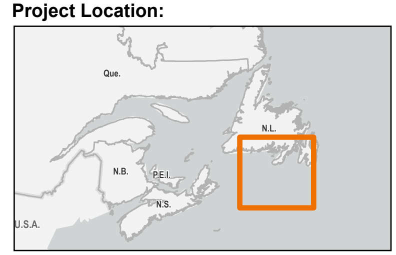
Offshore Infrastructure
- EXA Express (formerly Hibernia Express) Subsea Cable
- Subsea Cables (Active)
- Subsea Cables (Inactive)

Onshore Infrastructure
- Road
- Highway
- Tranmission Line

Vessel Traffic
- Traffic Separation Scheme Lane (CHS, 2019)
- Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km$^2$)
- High Density Vessel Traffic (>0.6 vessels per day/km$^2$

Other Features
- Bathymetry Contour
- Sea Ice Extent 2023 (NSIDC)

**Project Location:**




***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); Environment and Climate Change Canada, Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; TeleGeography Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada
**3.** Background: ESRI; NRCan CanVec; GEBCO 2024

Stantec

Figure No.
17.3
**DRAFT**

Title
**Buildable Area - Floating Platform Constraints Analysis (Sable Island and Middle Bank)**

Client/Project 126560144_017a

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location Prepared by NW on 2025-03-31

Atlantic Canada

N
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(At original document size of 8.5x11)
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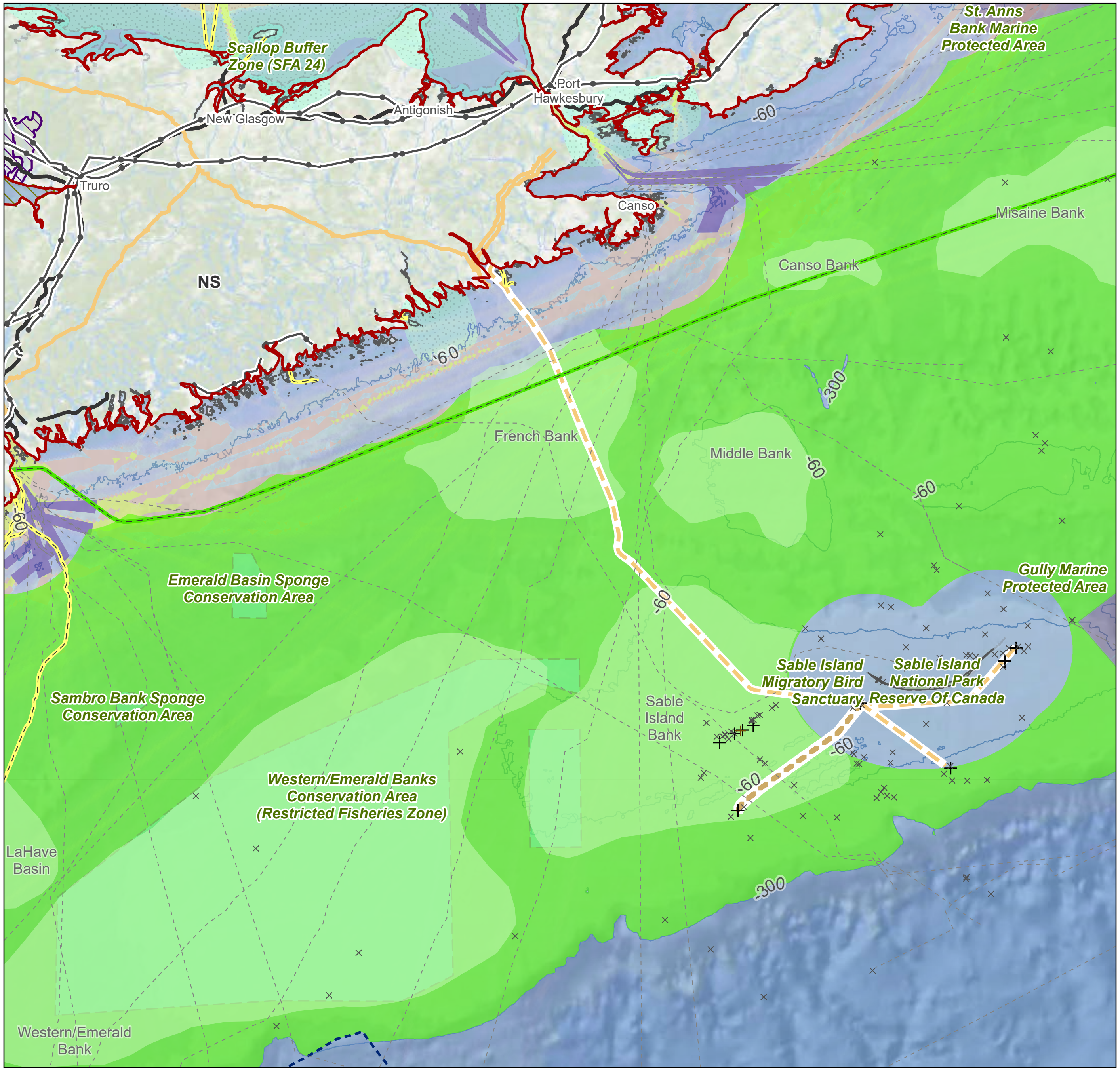



Legend

Buildable Area - Floating Platform (Stantec)
Potential Development Areas (Nova Scotia OSW RA)
Proposed NZA Study Area (V2.2)
Floating Platform Technical Development Limit (195 km)

Critical Habitat for Aquatic Species at Risk
Atlantic Mud-piddock
Atlantic Salmon

Protected and Conserved Areas
Marine Protected Area
Migratory Bird Sanctuary
National Park
Other Effective Area-Based Conservation Measure

Offshore Wells
Gas well
Injection well
Abandoned/Suspended Wellhead

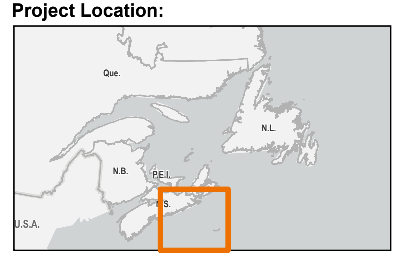
Offshore Infrastructure
EXA Express (formerly Hibernia Express) Subsea Cable
Abandoned Subsea Pipelines (SOEP, Deep Panuke)
Subsea Cables (Active)
Subsea Cables (Inactive)

Onshore Infrastructure
Road
Highway
Tranmission Line
Onshore Pipeline

Vessel Traffic
Traffic Separation Scheme Lane (CHS, 2019)
Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km$^2$)
High Density Vessel Traffic (>0.6 vessels per day/km$^2$)

Other Features
Bathymetry Contour
Sea Ice Extent 2023 (NSIDC)

**Project Location:**




***Notes***
**1.** Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
**2.** Data Sources: Stantec; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); Environment and Climate Change Canada, Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; TeleGeography Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada
**3.** Background: ESRI; NRCan CanVec; GEBCO 2024

Stantec

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Figure No.
35

DRAFT

Title
# Grid Optimization Clusters and Time Series Data Reference

Client/Project 126560144_035

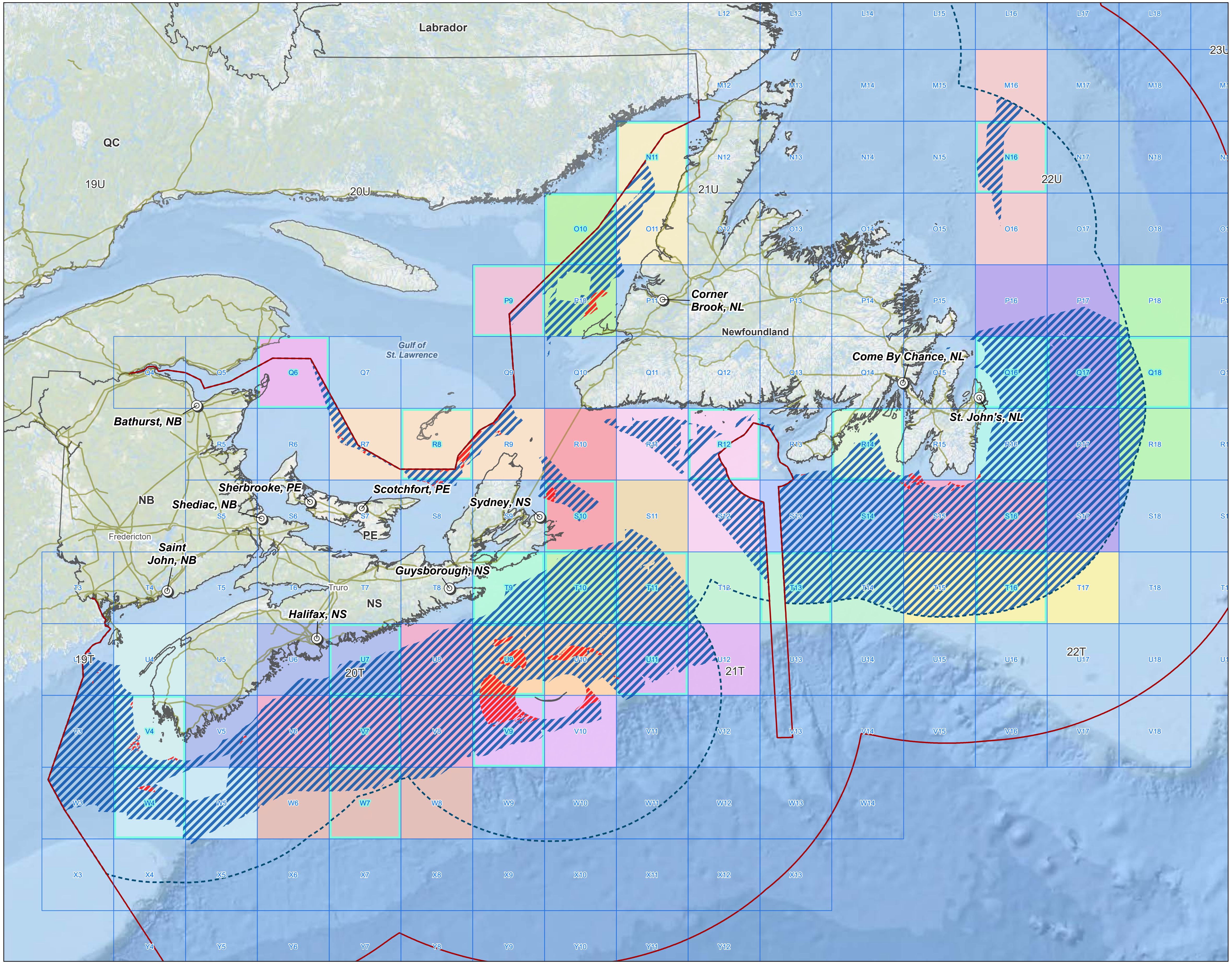
Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Atlantic Canada

Prepared by NW on 2025-07-17

N

0 100 200 Kilometres
(At original document size of 11x17)
1:5,500,000




**Legend**

- Point of Intersection
- Transmission Line
- NZA Study Area (V2.2)
- Floating Platform Technical Development Limit (195 km)
- Buildable Area - Floating Platform
- Buildable Area - Fixed Platform
- Processing Grid (100 km x 100 km)
- Time Series Data Reference Cell

Optimization Cluster: C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27

***Notes***
**1.** Coordinate System: WGS
**2.** Data Sources: Stantec
**3.** Background: NRCan CanVec; Statistics Canada; Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, CHS, Esri, GEBCO, Garmin, NaturalVue

Stantec

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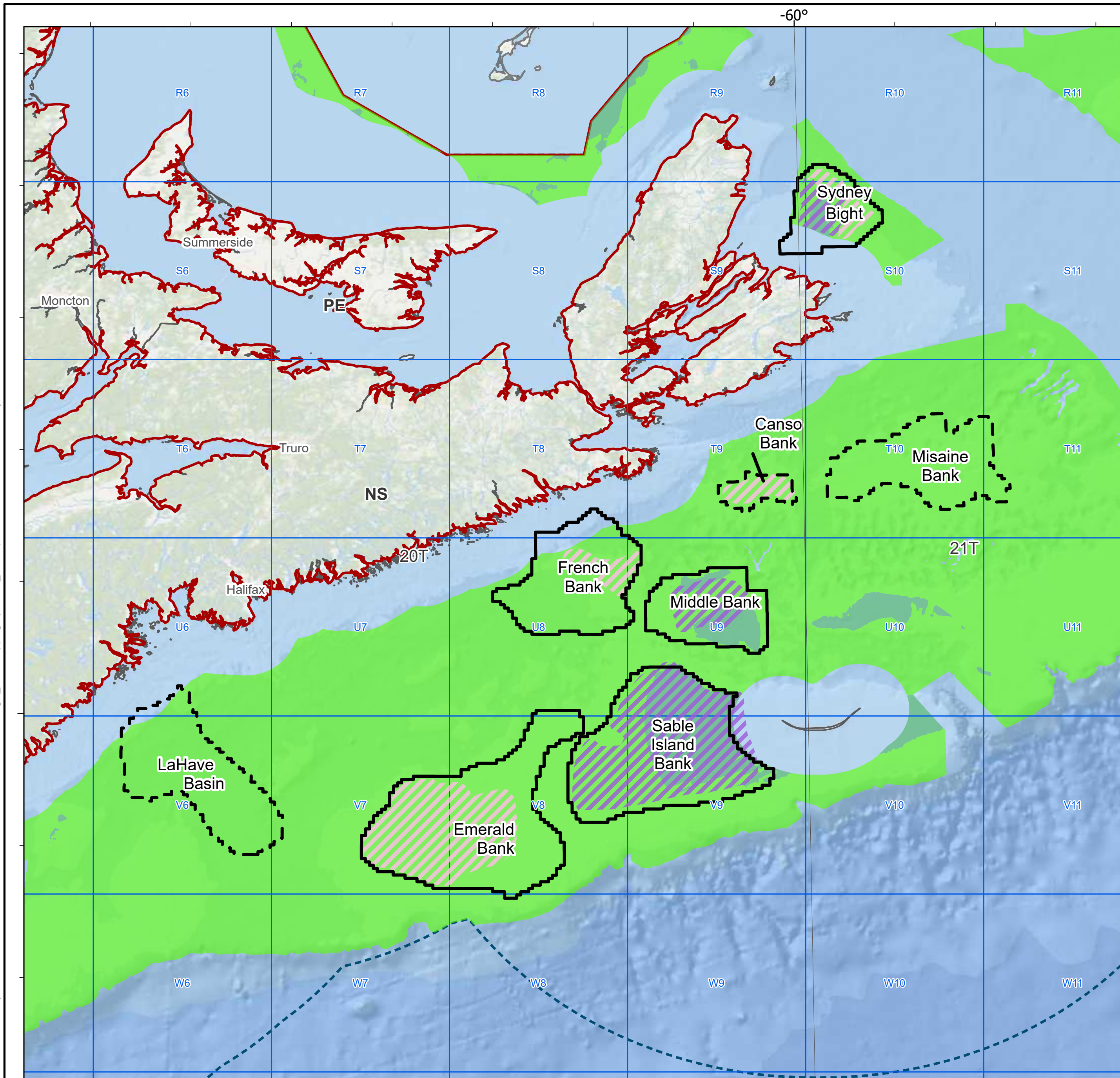



*Figure No.*
**32**

**DRAFT**

*Title*
## Nova Scotia Wind Energy Areas and Potential Future Development Areas

*Client/Project* 126560144_034

Net Zero Atlantic
Offshore Wind Resource Potential Study

*Project Location* Prepared by NW on 2025-06-09

Atlantic Canada

N

0 50 100 km
(At original document size of 8.5x11)
1:3,328,000

Legend

- Proposed NZA Study Area (V2.2)
- Processing Grid (100 km x 100 km)
- Floating Platform Technical Development Limit (195 km)

Nova Scotia Wind Energy Areas (WEAs)

- Tier 1
- Tier 2
- PFDA - Fixed Platform (NS WEAs)
- PFDA - Floating Platform (NS WEA)
- Buildable Area - Fixed Platform
- Buildable Area - Floating Platform

**Project Location:**

***Notes***
**1.** Coordinate System: WGS 84 Azimuthal Equidistant Projection, Central Meridian -62
**2.** Data Sources: Stantec; Nova Scotia Department of Energy; Windsim / NASA MERRA reanalysis dataset
**3.** Background: ESRI; NRCan CanVec; Statistics Canada

Stantec

\\CA0151-PPFSS01\stjohns$\DATA\DB\CADDATA\JOBS\NetZeroAtlantic\126560144\gis_data\mapping\aprx\nza_wind.aprx Revised: 2025-06-09 By: niwhite

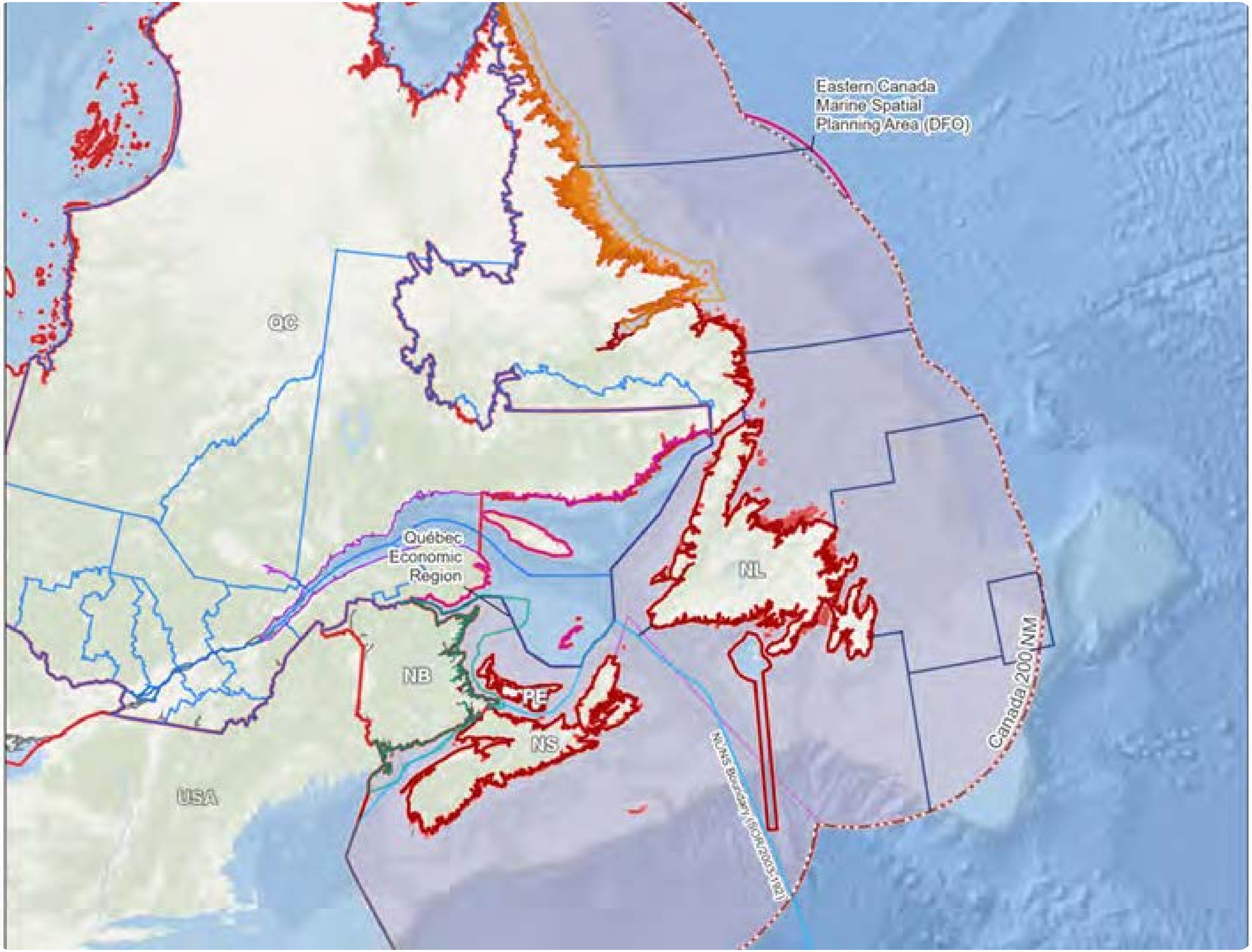
# Appendix B – Webinar Slides

# Technical and Locational Potential of Atlantic Canada's Offshore Wind Resource

Stantec

# Why This Study Matters?

- First offshore wind potential study of this size in Canada
- 4 provinces, over 1.5 million sq km
- Multi-year, multi-partner project
- Essential first step for future OSW development
- Foundation for policy, investment, and project siting



# This presentation covers phase 2 of three study phases

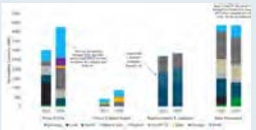
*Offshore wind portfolios*

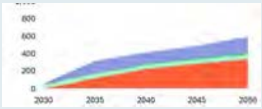
*Hourly outputs & costs*

## Phase 1: Market Opportunity

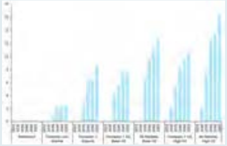
Define **policy** and **resource** assessment

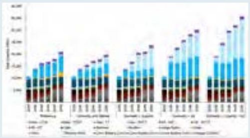
Identify potential **domestic**, **export** & **hydrogen** offshore wind export opportunity





Identify **offshore wind targets** aligned with assessments and develop resource portfolios

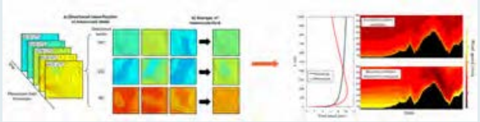




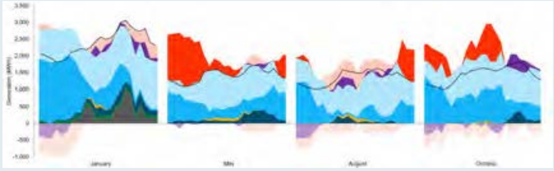
*Iterative with subsequent phases*

## Phase 2: Resource Potential

Characterize the OSW **technical, locational, and economic potential** across provinces



Perform **hourly operational modeling** with unit commitment and dispatch



Create **public database & visual graphic interface** for developers

## Phase 3: Grid Integration

Detailed **operational modeling** of transmission system needs and **points of interconnection**

Identify **transmission costs** to integrate offshore wind

Create **final coordinated transmission solutions to enable offshore wind**

Synthesize three phases into **final Roadmap and Action Plan** & final **Data Visualization**

*Offshore wind potential & power curve*

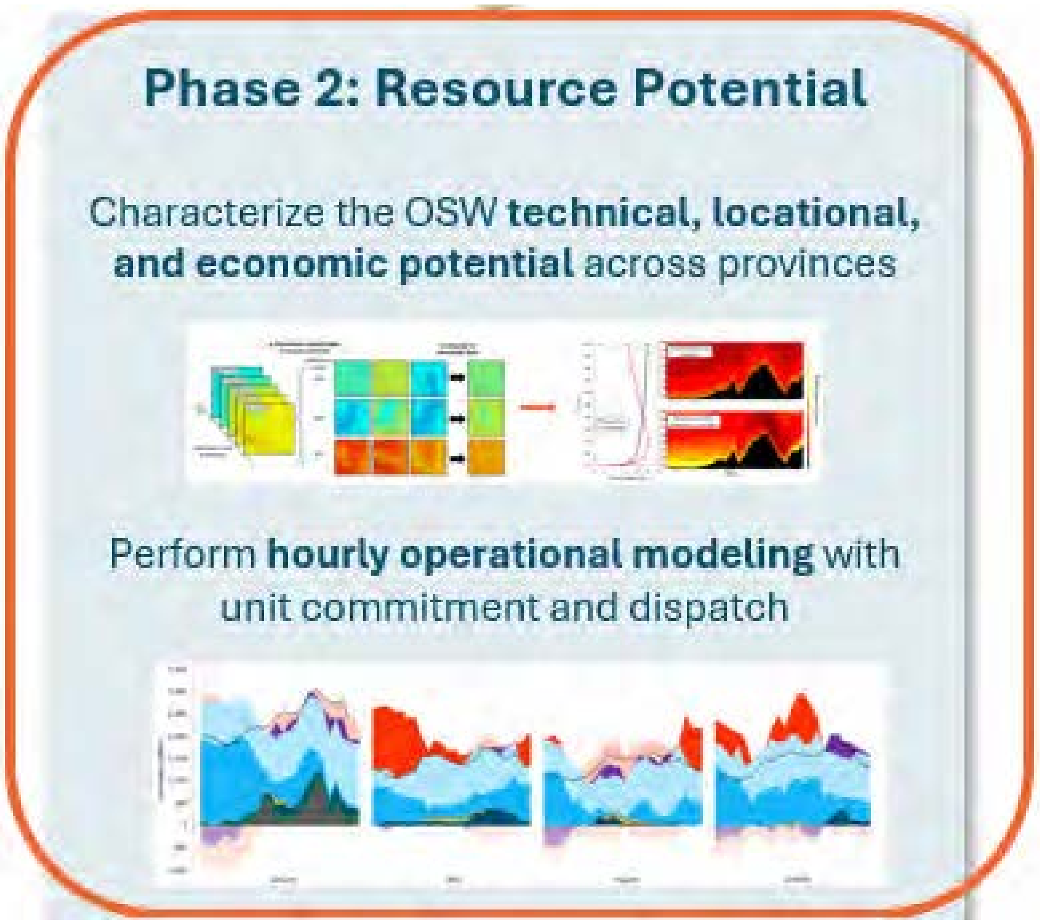
*Updated costs & operational constraints from power flow modeling*

# Objective of Phase 2

**Characterize the Offshore Wind (OSW) resource potential of Atlantic Canada with a focus on Technical and Locational Potential to support future energy development.**

**Key Goals:**

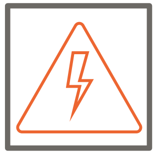
- Assess the *Technical* Potential → Wind Resource & Energy Production
- Assess the *Locational* Potential → Feasibility considering environmental, technical, and regulatory constraints
- Identify areas suitable for *Fixed* and *Floating* technologies
- Develop high-resolution wind resource mapping
- Provide technical inputs for grid integration and economic modeling



# The Challenge

Limited offshore met data

No previous roadmap for a study of this scale

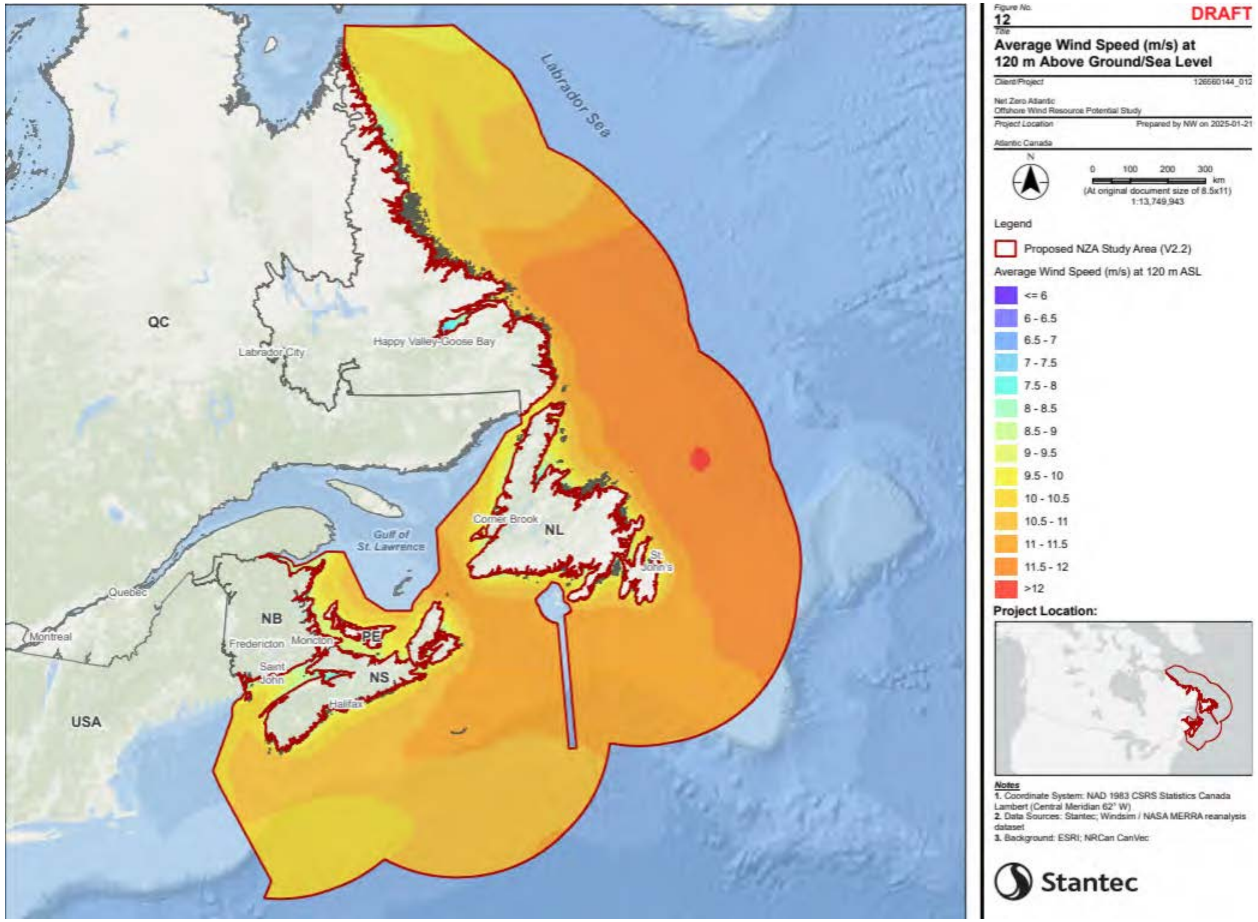


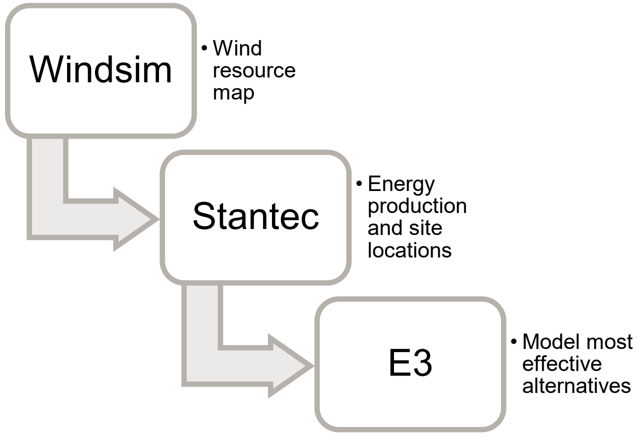
Identifying constrains and POI’s

Wind Turbine Power Specifications

Harsh Environmental Conditions

# Methodology Overview

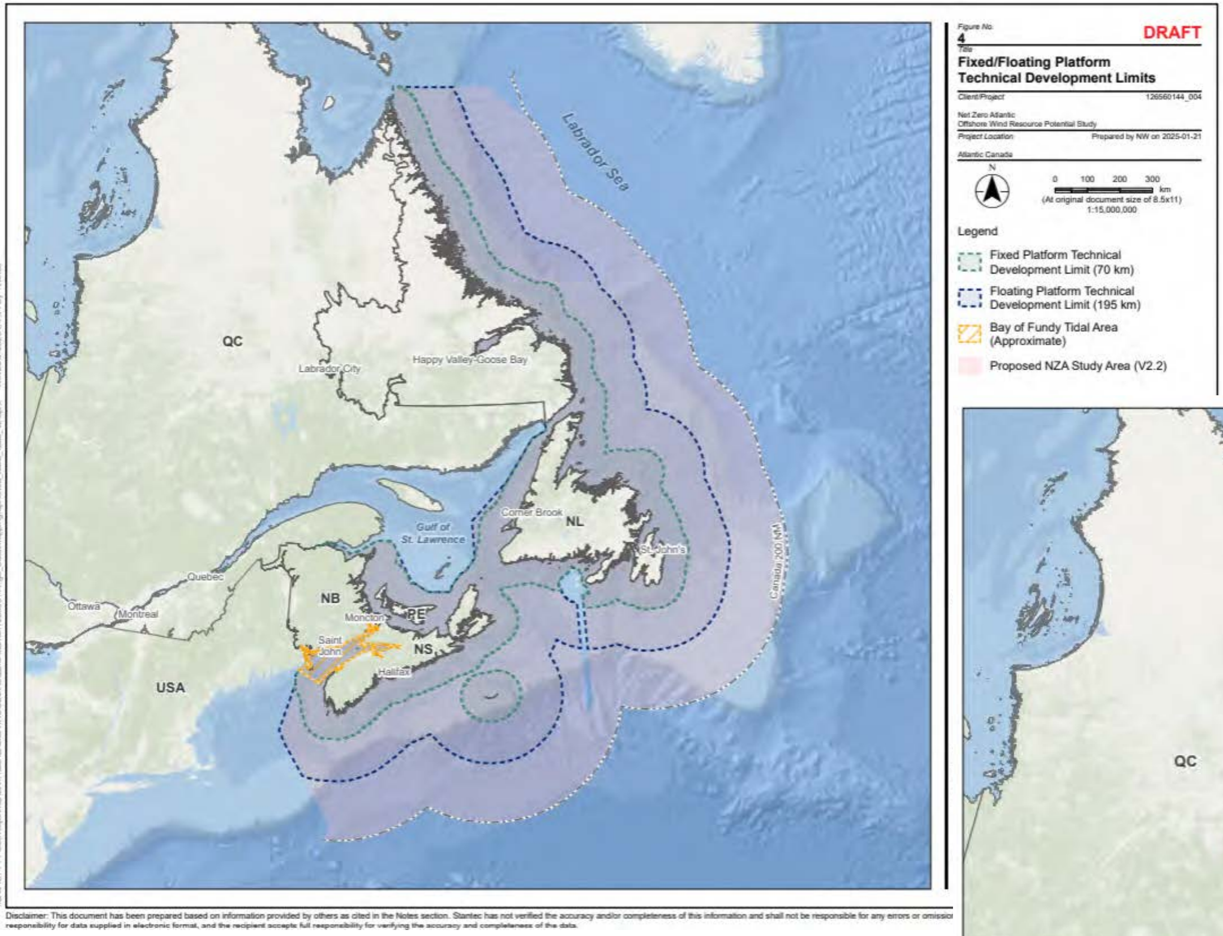



- Define and refine study area
- Identify primary and secondary constraints
- Determine fixed vs floating potential
- Model wind resource using WRF and CFD - WindSim
- Create grid of potential development areas
- Group results in clusters for future modeling

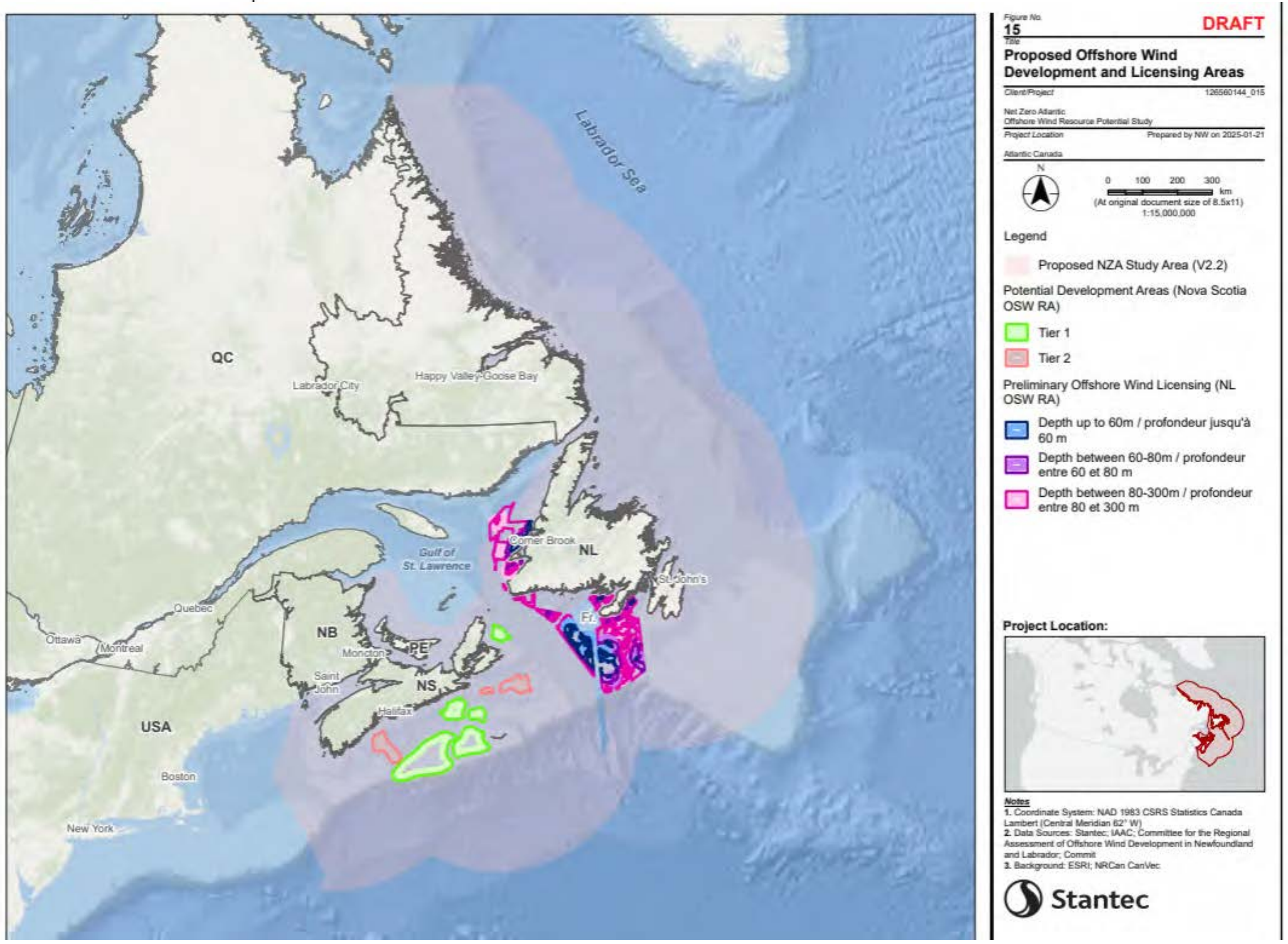
**Strategy:**

- Iterative mapping
- Refine feasible areas step-by-step
- Iterative modeling

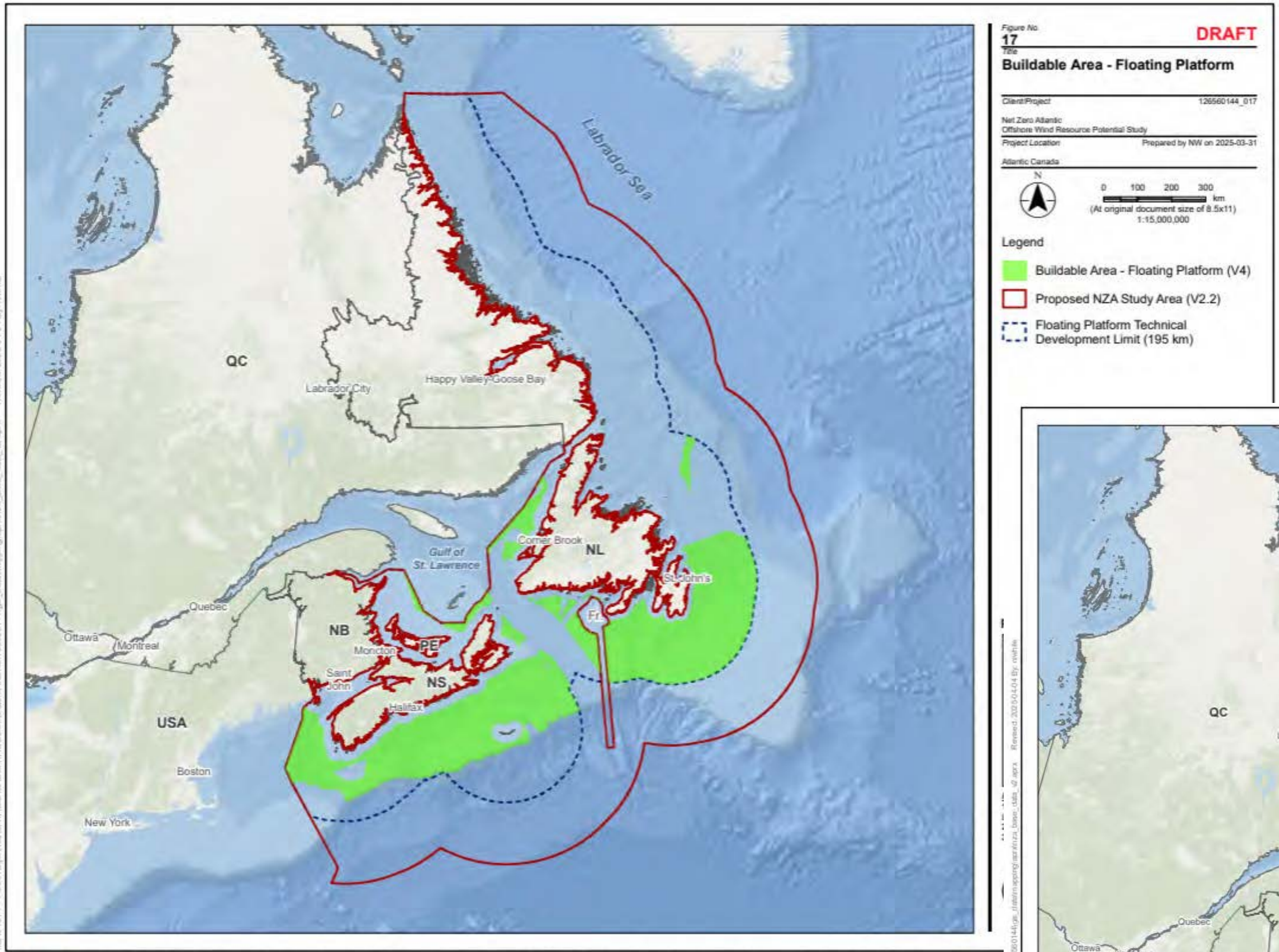



| | |
|---|---|
| Technical Development Limit Fixed Bathymetry | 60-80 m depth |

| Area Name | Area (sq. km) |
|---|---|
| Study Area Boundary | 1,563,285 |
| Technical Development Limit (195 km) | 940,327 |



| Area Name | Area (sq. km) |
|---|---|
| Buildable Area Fixed | 6,377 |
| Buildable Area Floating | 280,959 |

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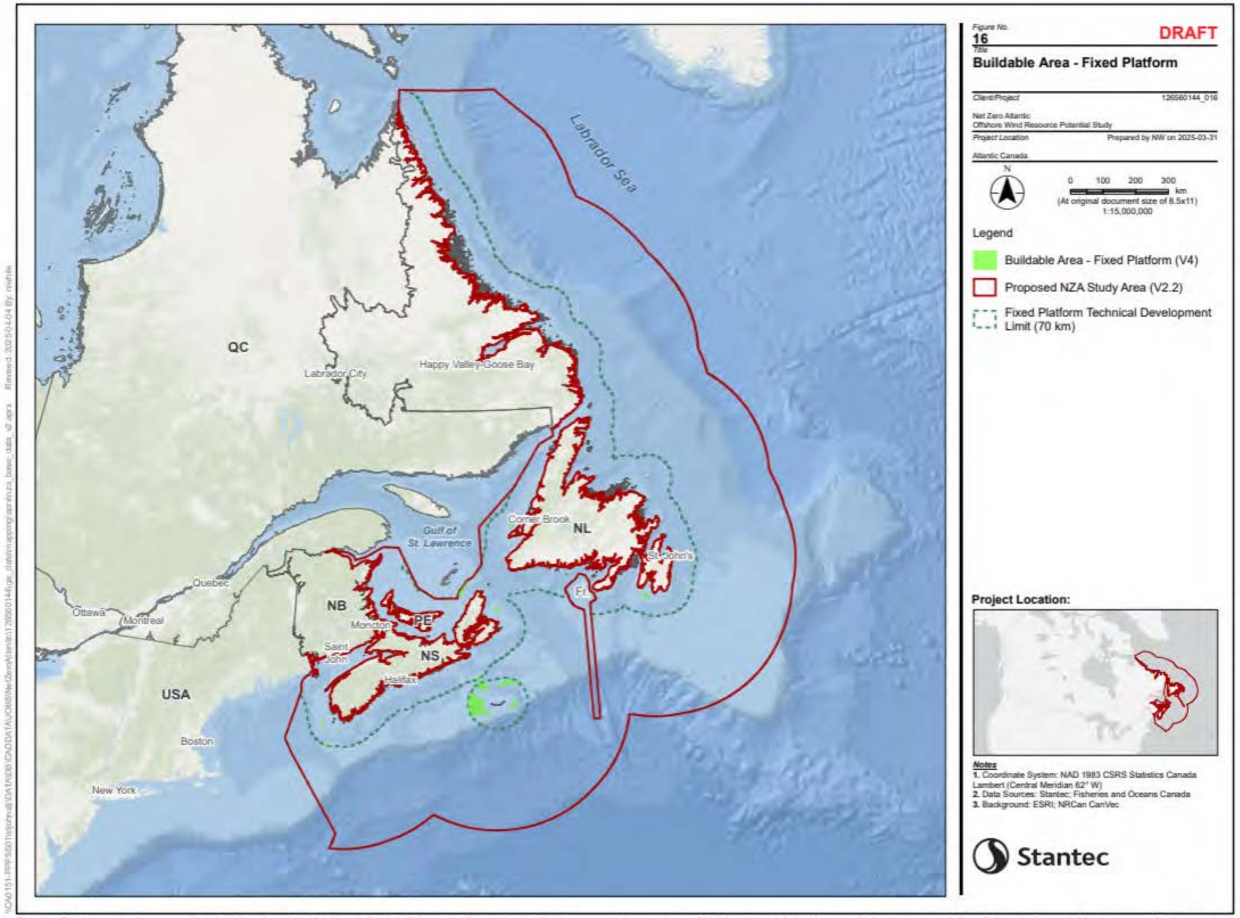


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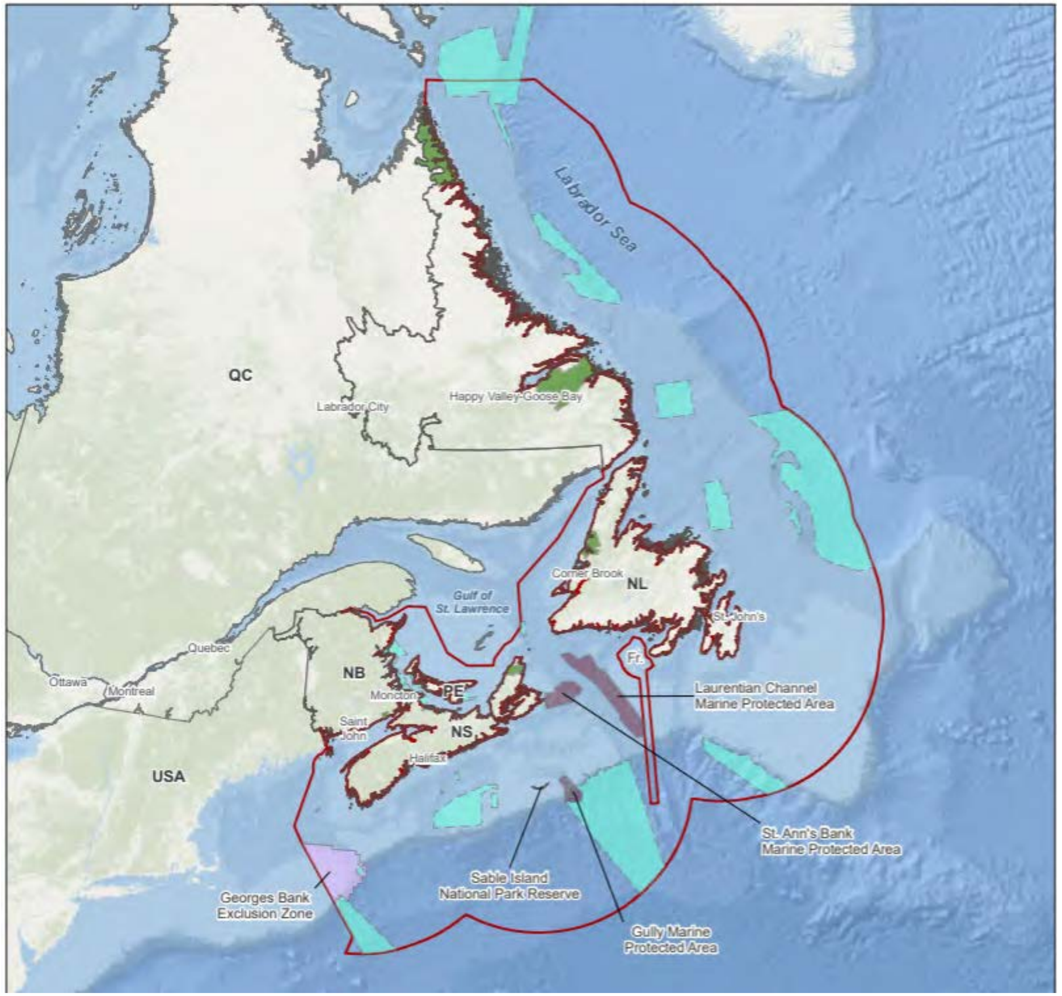
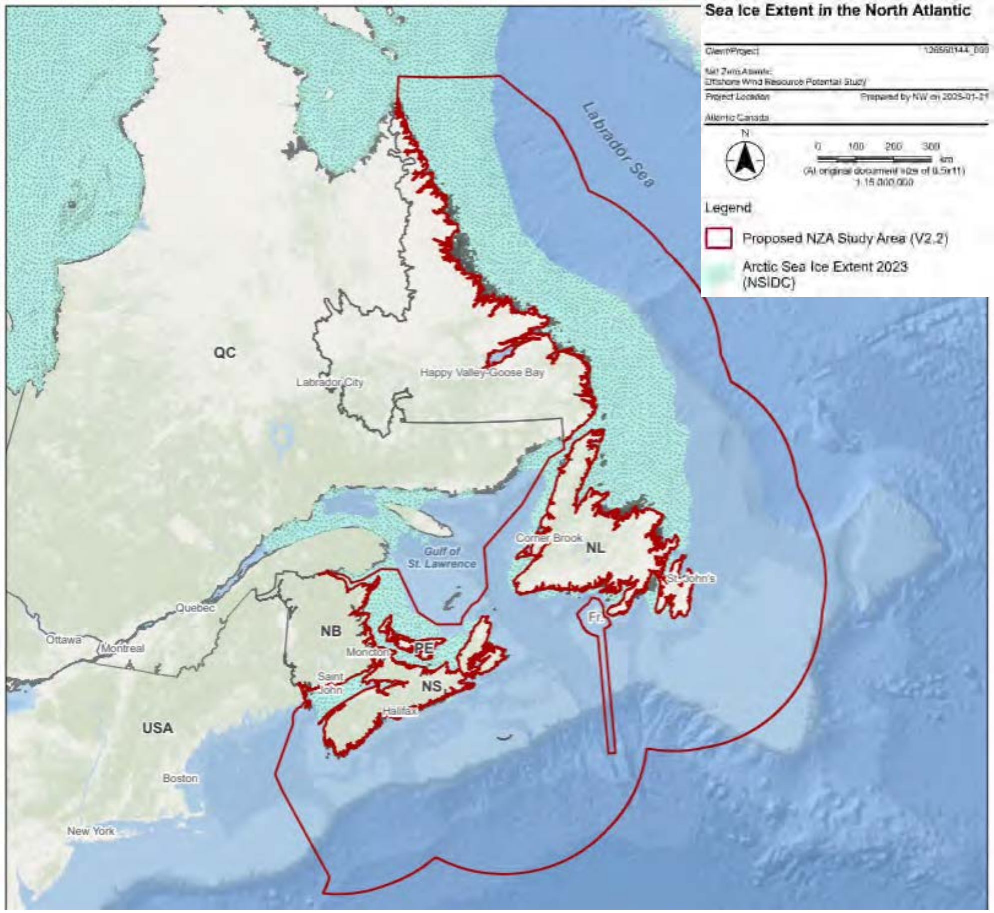
# Mapping Constraints – Defining Feasible Offshore Wind Areas

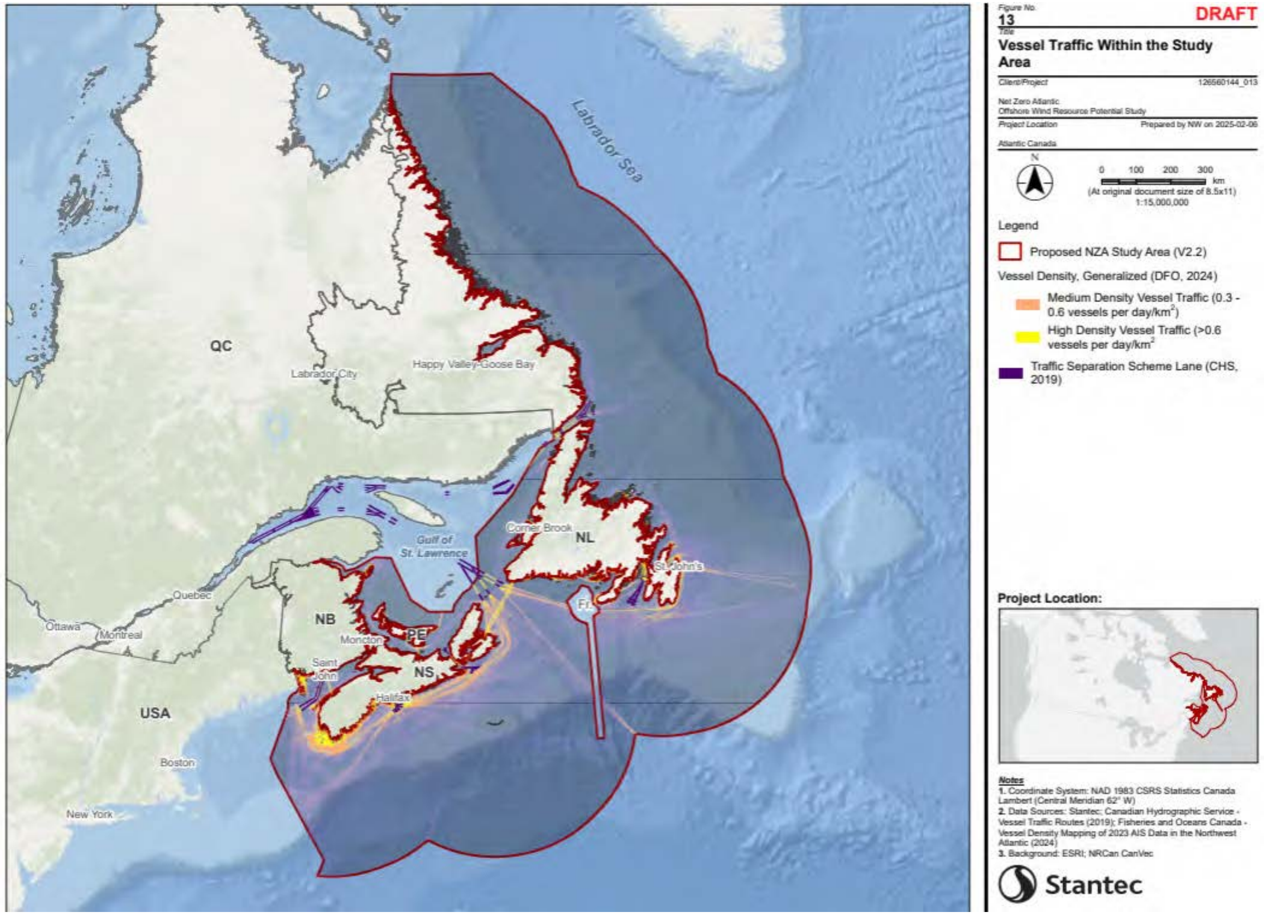
**Key Constraint Categories Considered:**

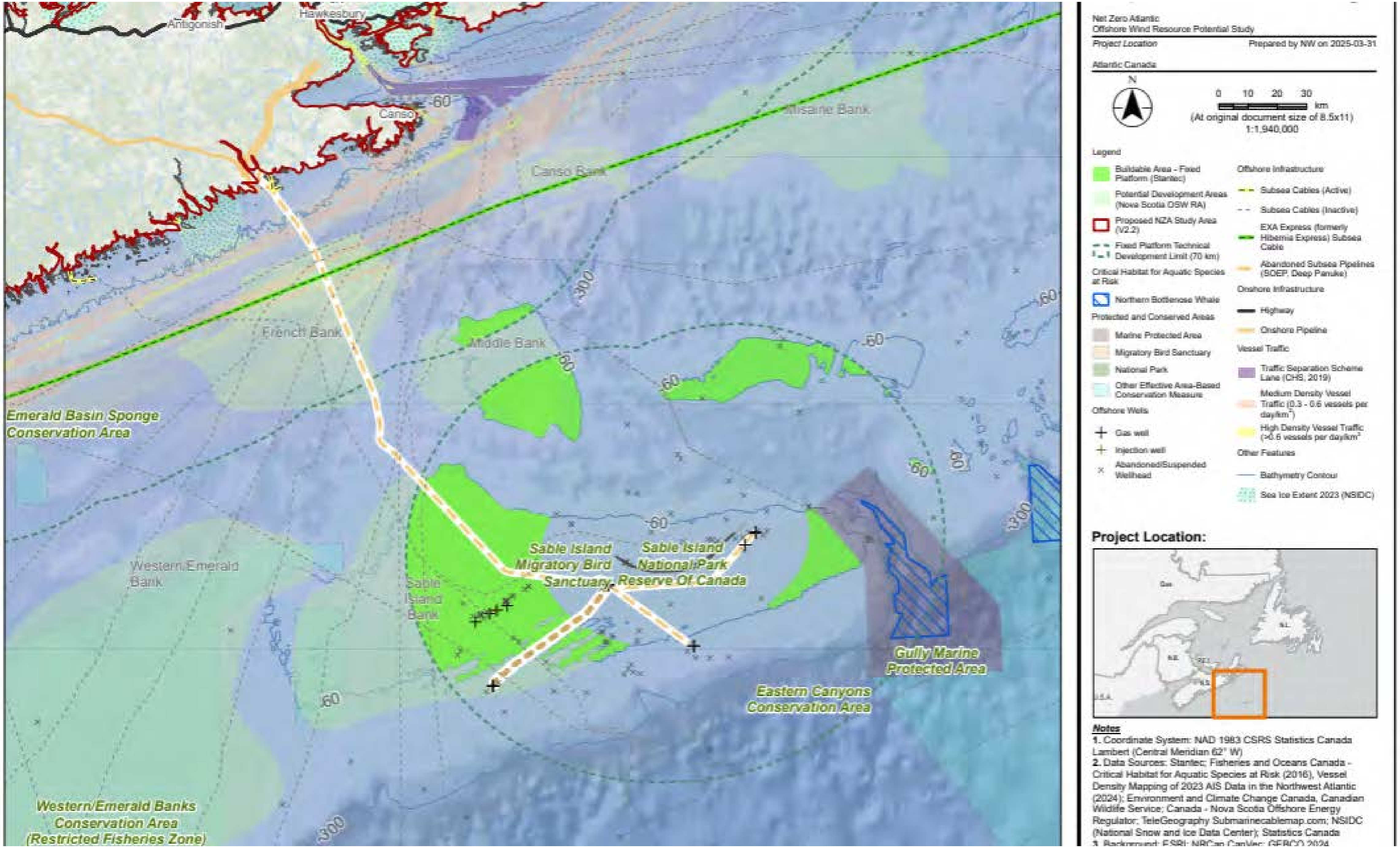
- Environmental & Ecological Areas
- Critical Habitats for Species at Risk
- Bathymetry & Ice Conditions
- Marine Use & Navigation
- Infrastructure & Development Zones

# Mapping Constraints – Defining Feasible Offshore Wind Areas





Hawkesbury
Antigonish
Canso
Misaine Bank
Canso Bank
French Bank
Middle Bank
Emerald Basin Sponge Conservation Area
Western/Emerald Bank
Sable Island Bank
Sable Island Migratory Bird Sanctuary
Sable Island National Park Reserve Of Canada
Gully Marine Protected Area
Eastern Canyons Conservation Area
Western/Emerald Banks Conservation Area (Restricted Fisheries Zone)
Net Zero Atlantic
Offshore Wind Resource Potential Study
Project Location
Prepared by NW on 2025-03-31
Atlantic Canada
N
0 10 20 30 km
(At original document size of 8.5x11)
1:1,940,000
Legend
Buildable Area - Fixed Platform (Stantec)
Potential Development Areas (Nova Scotia OSW RA)
Proposed NZA Study Area (V2.2)
Fixed Platform Technical Development Limit (70 km)
Critical Habitat for Aquatic Species at Risk
Northern Bottlenose Whale
Protected and Conserved Areas
Marine Protected Area
Migratory Bird Sanctuary
National Park
Other Effective Area-Based Conservation Measure
Offshore Wells
Gas well
Injection well
Abandoned/Suspended Wellhead
Offshore Infrastructure
Subsea Cables (Active)
Subsea Cables (Inactive)
EXA Express (formerly Hibernia Express) Subsea Cable
Abandoned Subsea Pipelines (SOEP, Deep Panuke)
Onshore Infrastructure
Highway
Onshore Pipeline
Vessel Traffic
Traffic Separation Scheme Lane (CHS, 2019)
Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km²)
High Density Vessel Traffic (>0.6 vessels per day/km²
Other Features
Bathymetry Contour
Sea Ice Extent 2023 (NSIDC)
Project Location:
Notes
1. Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
2. Data Sources: Stantec; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); Environment and Climate Change Canada, Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; TeleGeography Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada

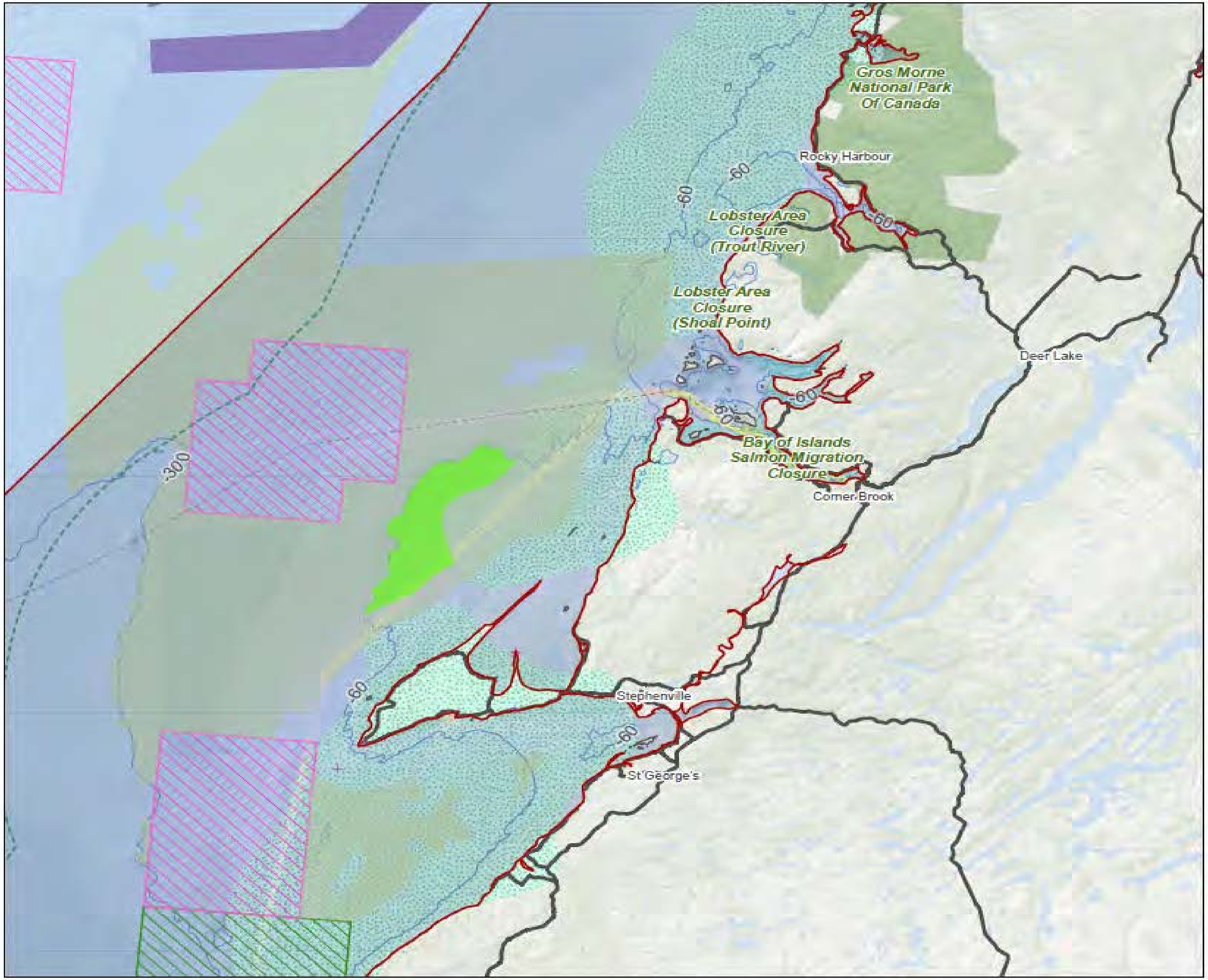



Figure No.
**16.1**

DRAFT

Title
**Buildable Area - Fixed Platform Constraints Analysis (Eastern Gulf)**

Client/Project 126560144_016a

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location Prepared by NW on 2025-03-31

Atlantic Canada

0 10 20 30 km
(At original document size of 8.5x11)
1:1,250,000

Legend

- Buildable Area - Fixed Platform (Stantec)
- Preliminary Offshore Wind Licensing (NL OSW RA)
- Proposed NZA Study Area (V2.2)
- Fixed Platform Technical Development Limit (70 km)

Critical Habitat for Aquatic Species at Risk

- Northern Wolffish
- Spotted Wolffish

Protected and Conserved Areas

- National Park
- Other Effective Area-Based Conservation Measure

Offshore Wells

- Exploration Wells

- Subsea Cables (Inactive)

Onshore Infrastructure

- Onshore Pipeline

Vessel Traffic

- Traffic Separation Scheme Lane (CHS, 2019)
- Medium Density Vessel Traffic (0.3 - 0.6 vessels per day/km²)
- High Density Vessel Traffic (>0.6 vessels per day/km²)

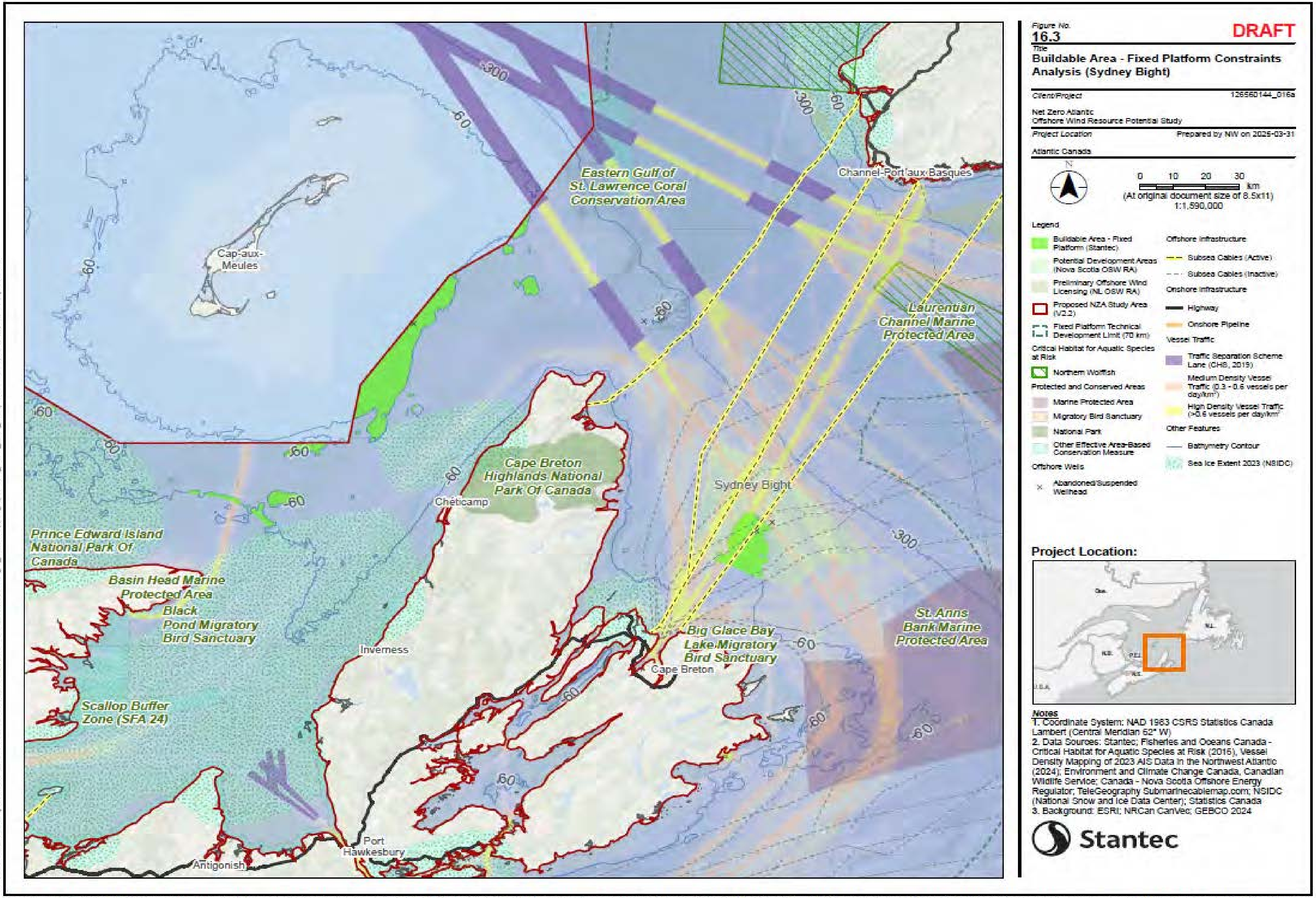
Other Features

- Bathymetry Contour
- Sea Ice Extent 2023 (NSIDC)

**Project Location:**


*Notes*
1. Coordinate System: NAD 1983 CSRS Statistics Canada Lambert (Central Meridian 62° W)
2. Data Sources: Stantec; Fisheries and Oceans Canada - Critical Habitat for Aquatic Species at Risk (2016), Vessel Density Mapping of 2023 AIS Data in the Northwest Atlantic (2024); Environment and Climate Change Canada, Canadian Wildlife Service; Canada - Nova Scotia Offshore Energy Regulator; TeleGeography Submarinecablemap.com; NSIDC (National Snow and Ice Data Center); Statistics Canada
3. Background: ESRI; NRCan CanVec; GEBCO 2024

Stantec

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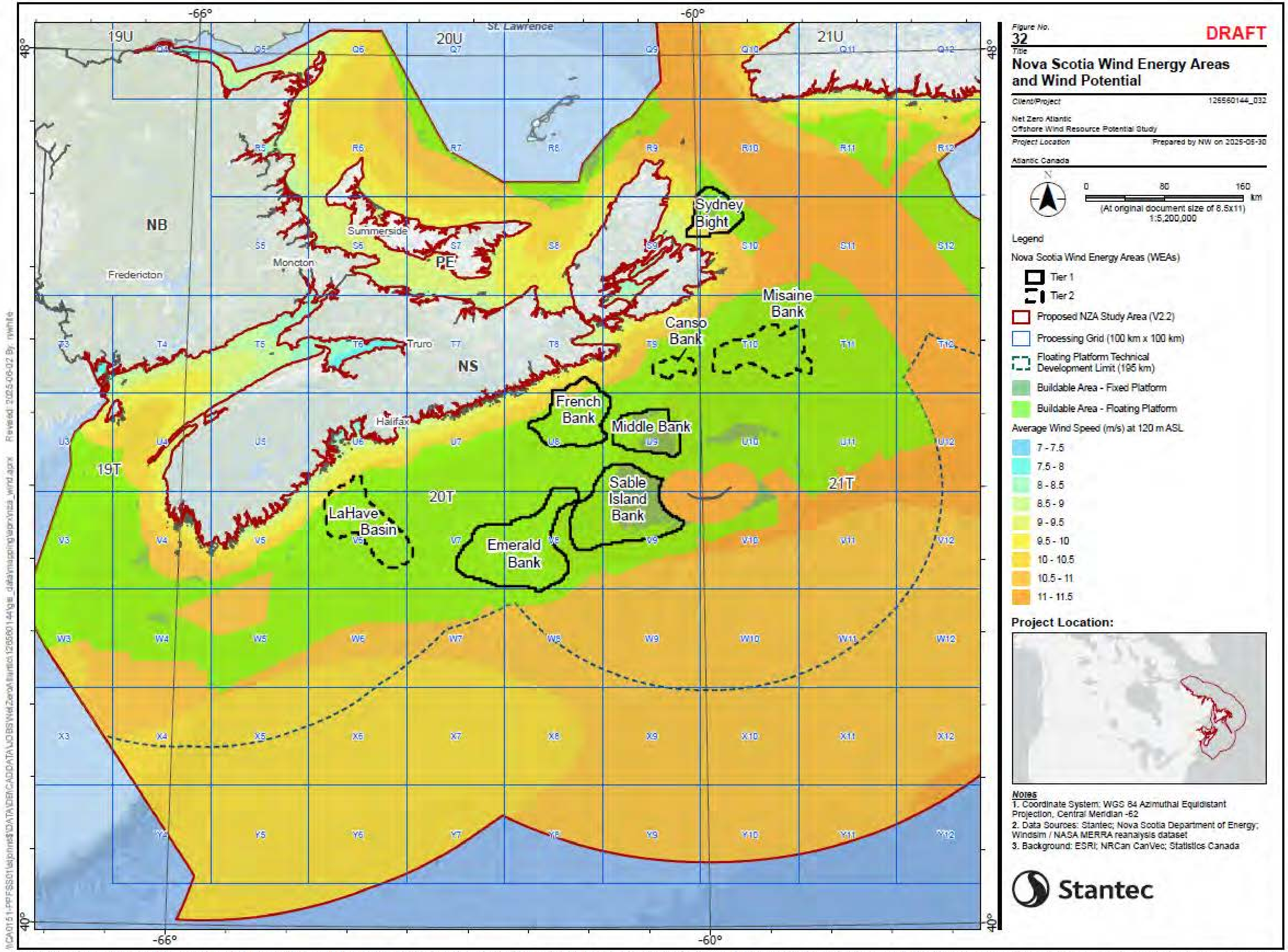


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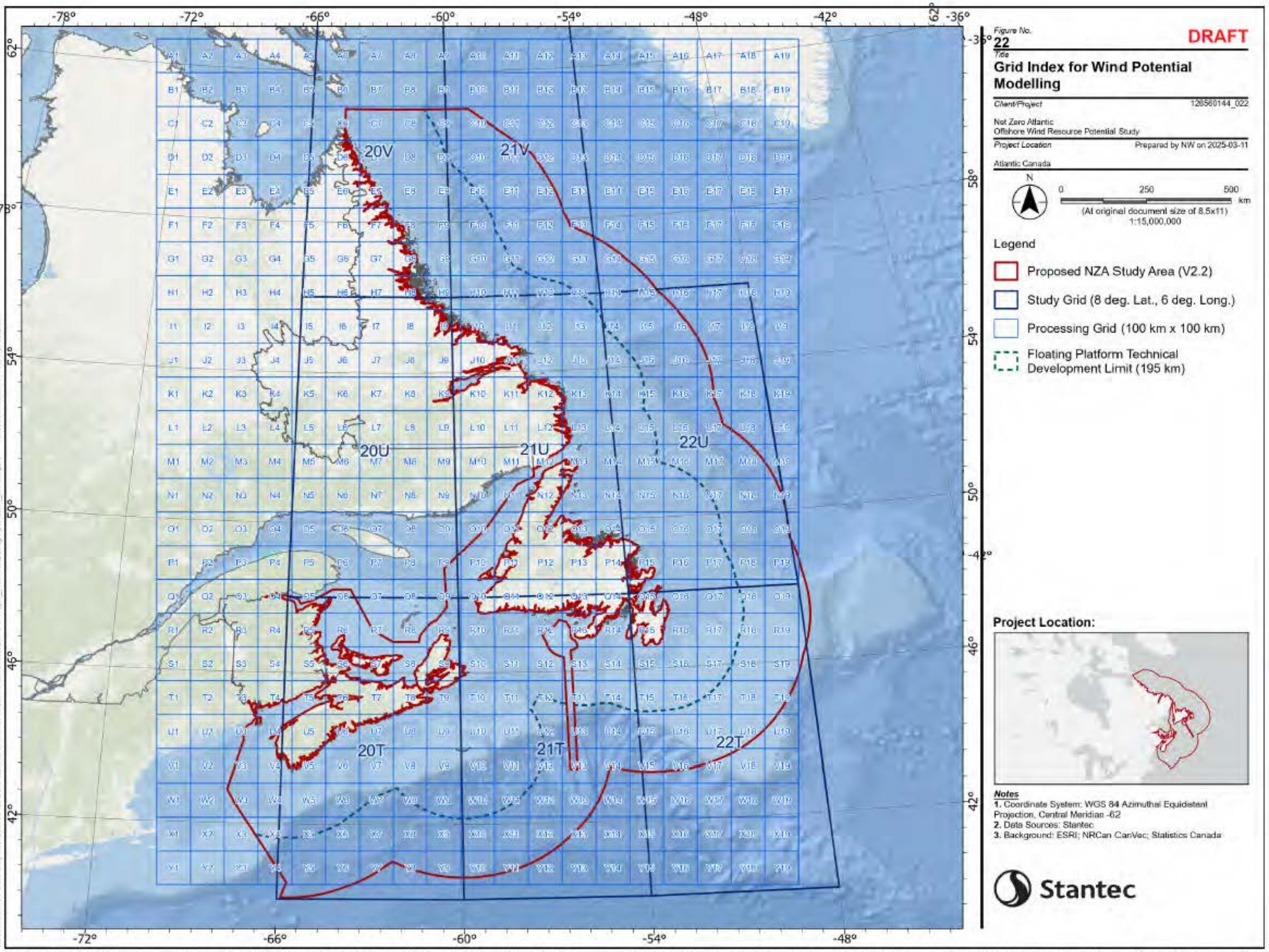


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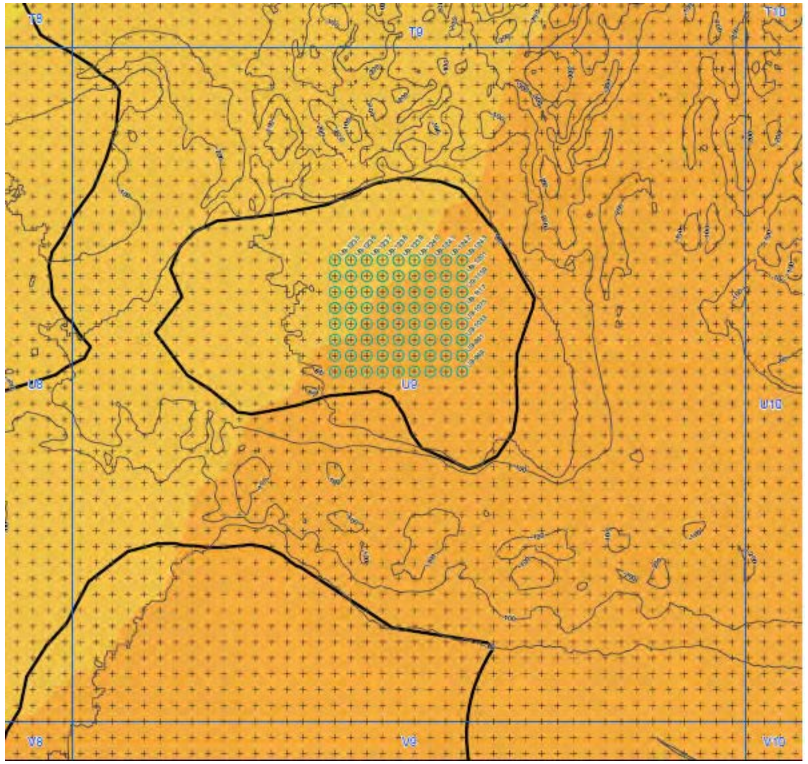
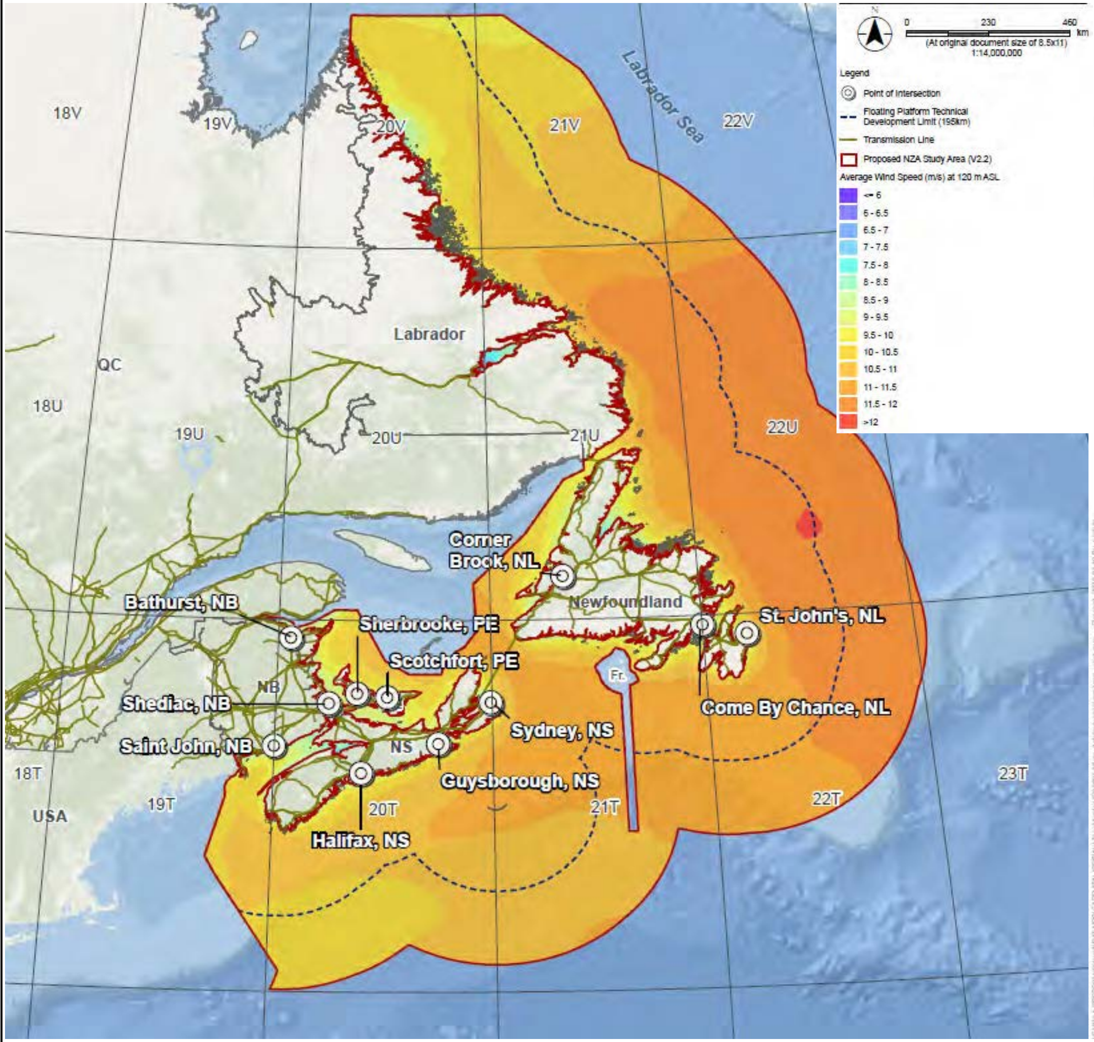
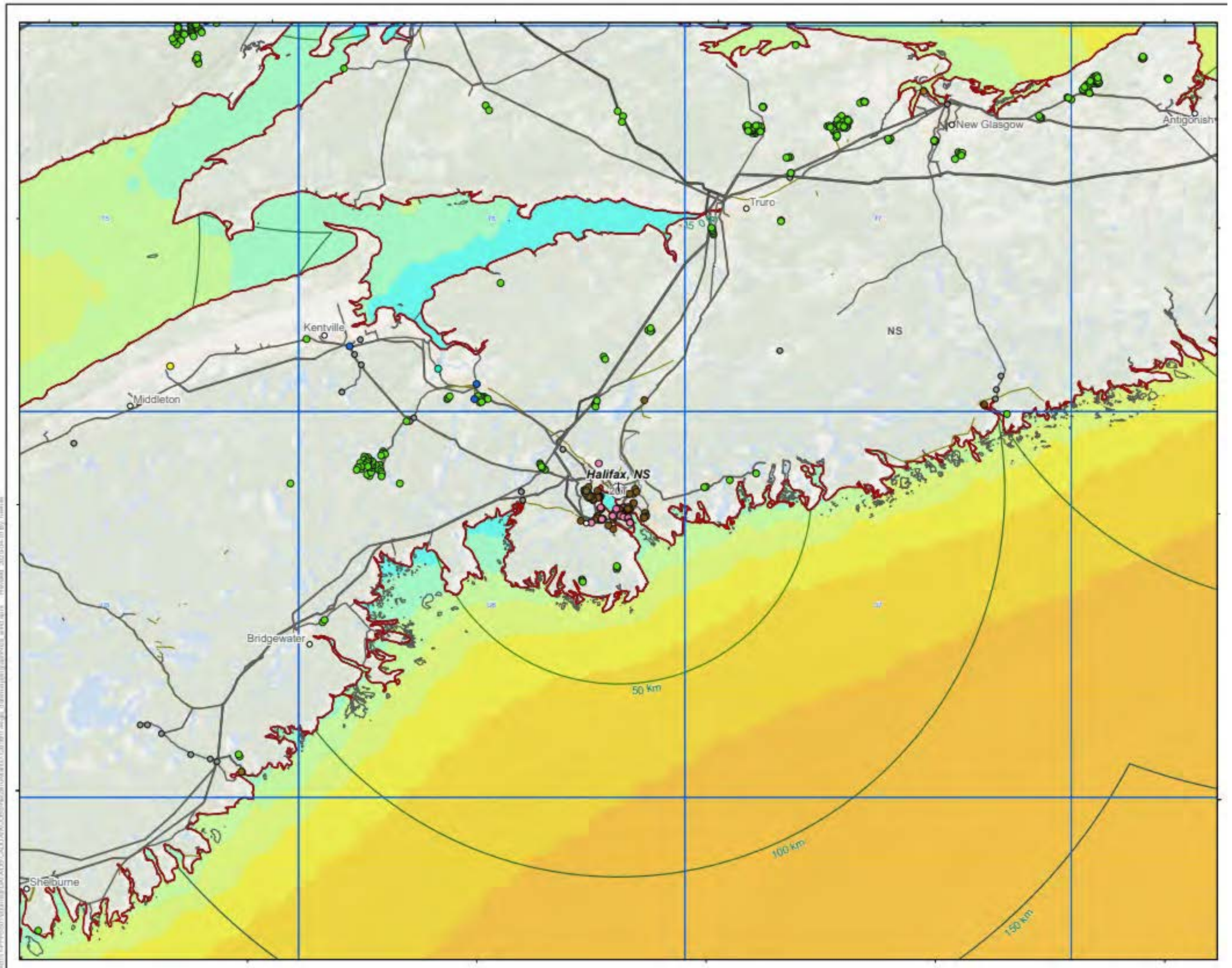



N
0
230
460
km
(At original document size of 8.5x11)
1:14,000,000
Legend
Point of Intersection
Floating Platform Technical Development Limit (195km)
Transmission Line
Proposed NZA Study Area (V2.2)
Average Wind Speed (m/s) at 120 m ASL
<= 6
6 - 6.5
6.5 - 7
7 - 7.5
7.5 - 8
8 - 8.5
8.5 - 9
9 - 9.5
9.5 - 10
10 - 10.5
10.5 - 11
11 - 11.5
11.5 - 12
>12
Labrador Sea
Labrador
Newfoundland
QC
NB
NS
USA
18V
19V
20V
21V
22V
18U
19U
20U
21U
22U
18T
19T
20T
21T
22T
23T
Corner Brook, NL
Bathurst, NB
Sherbrooke, PE
Scotchfort, PE
Shediac, NB
Saint John, NB
Sydney, NS
Guysborough, NS
Halifax, NS
St. John's, NL
Come By Chance, NL


N.B.
P.E.I.
N.S.


New Glasgow
Antigonish
Truro
Kentville
Middleton
NS
Halifax, NS
Bridgewater
Shelburne
50 km
100 km
150 km

# Modeling the Wind Resource

Hybrid Approach:

- WRF mesoscale modeling at 9x9 km resolution
- WindSim CFD microscale modeling at 1x1 km resolution
- Focused on hub heights 80m and 120m
- Time resolution of 5 minutes over 3 years
- Lifted available met mast data
- Validated against global datasets

*Table 2-10 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors*

| | | | |
|---|---|---|---|
| File name | transfer_ref001_W8205092_80m | | |
| Period, # records | 01/01/2019 00:00 - 01/01/2020 00:00 | 8747 | |
| Position: easting, northing, z (agl) | 459281.7 | 4941946.5 | 80.0 |
| Average wind speed, Weibull k, A | 6.65 | 1.81 | 7.57 |

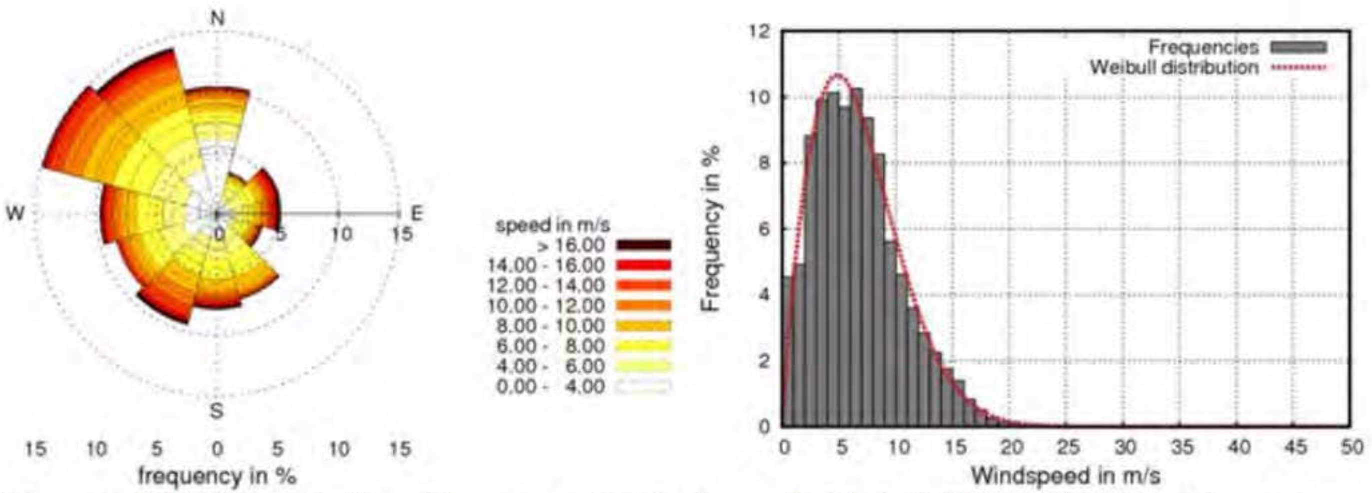



*Figure 2-6 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors*

*Table 2-11 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sectors*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 3.93 | 5.61 | 7.71 | 7.91 | 6.65 | 6.40 | 6.90 | 7.83 | 5.95 | 6.72 | 7.33 | 6.94 |
| Frequency (%) | 10.44 | 3.52 | 5.34 | 5.25 | 3.88 | 7.24 | 7.83 | 9.41 | 8.54 | 9.60 | 14.87 | 14.08 |
| Weibull shape, k | 1.17 | 2.28 | 1.62 | 1.72 | 1.97 | 2.33 | 1.67 | 1.99 | 1.87 | 1.94 | 2.23 | 1.84 |
| Weibull scale, A | 4.41 | 6.26 | 8.26 | 8.82 | 7.59 | 7.25 | 7.62 | 8.92 | 6.69 | 7.58 | 8.25 | 7.80 |

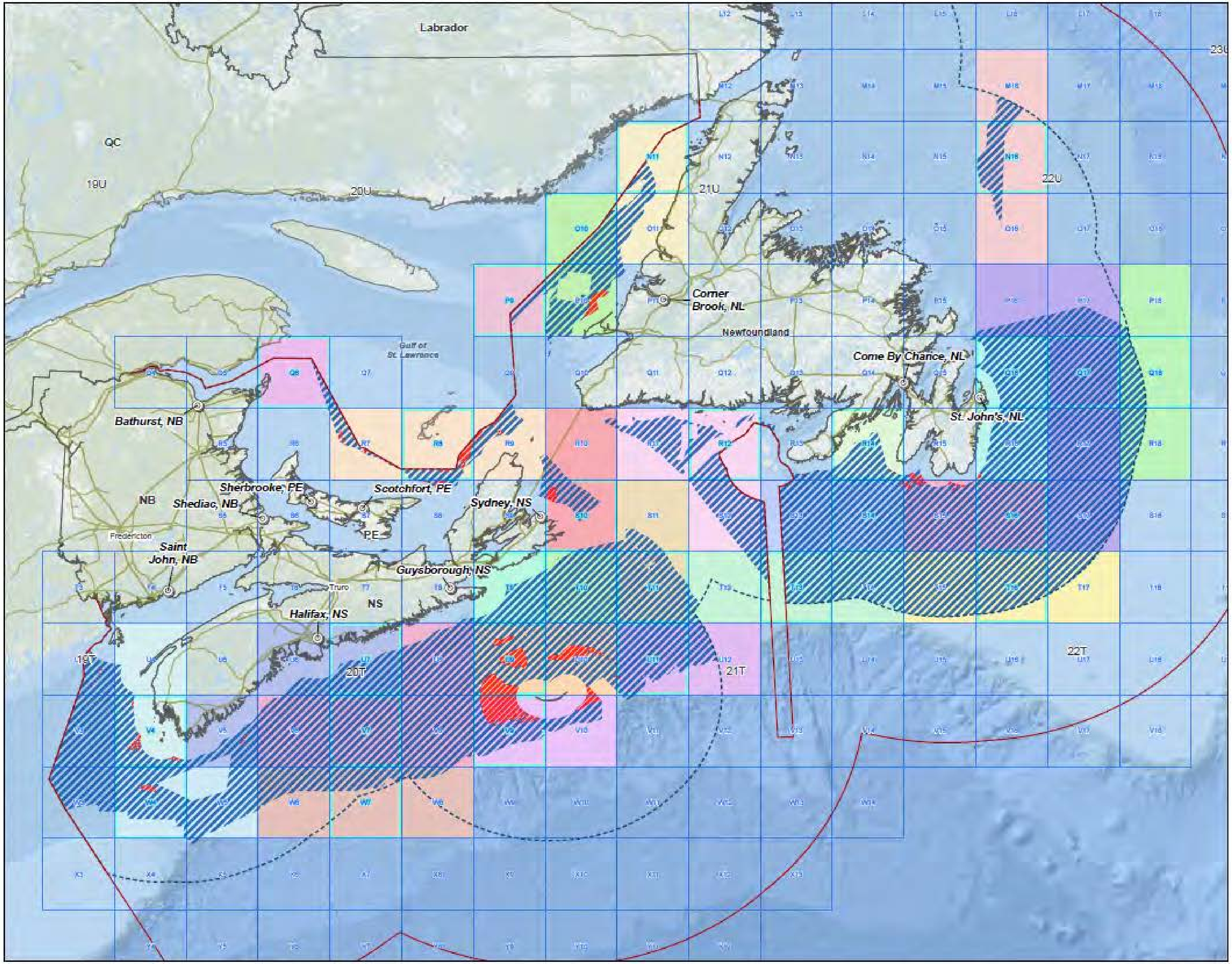



Figure No.
35

**DRAFT**

Title
## Grid Optimization Clusters and Time Series Data Reference

Client/Project
128560144_035

Net Zero Atlantic
Offshore Wind Resource Potential Study

Project Location
Prepared by NW on 2025-07-17

Atlantic Canada

N

0 100 200 Kilometres
(At original document size of 11x17)
1:5,500,000

**Legend**

- Point of Intersection
- Transmission Line
- NZA Study Area (V2.2)
- Floating Platform Technical Development Limit (185 km)
- Buildable Area - Floating Platform
- Buildable Area - Fixed Platform
- Processing Grid (100 km x 100 km)
- Time Series Data Reference Cell

Optimization Cluster
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27

Notes
1. Coordinate System: WGS
2. Data Sources: Stantec
3. Background: NRCan CanVec; Statistics Canada; Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community CHS, Esri, GEBCO, Garmin, NaturalVue

Stantec

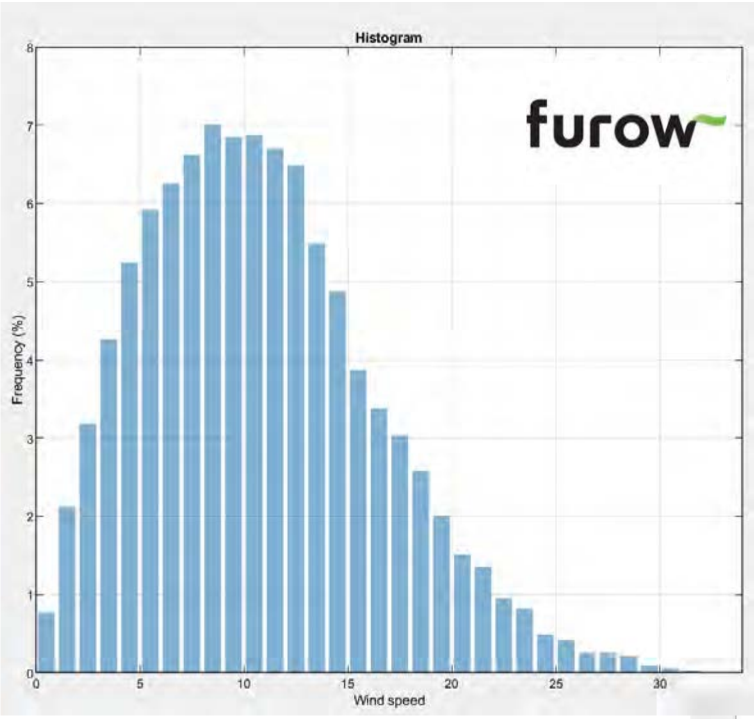
Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

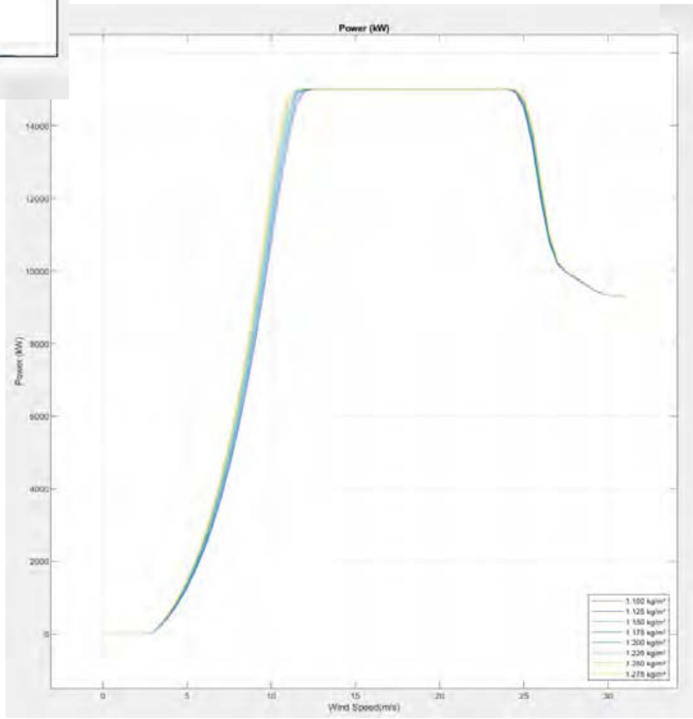
# Results

Modeling with Furow

Wind Farm in Zone 20T at 120m:

- Installed Capacity: 1080 MW ~ 1 GW
- Gross Capacity Factor: 63.88%
- Net Capacity Factor: **49.42%**
- Net Annual Energy Production: ~4,675 GWh

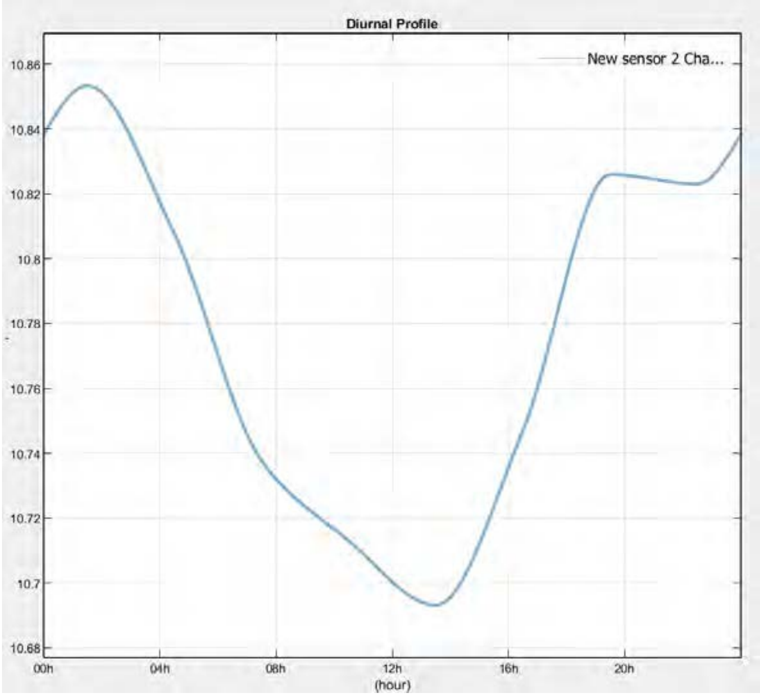


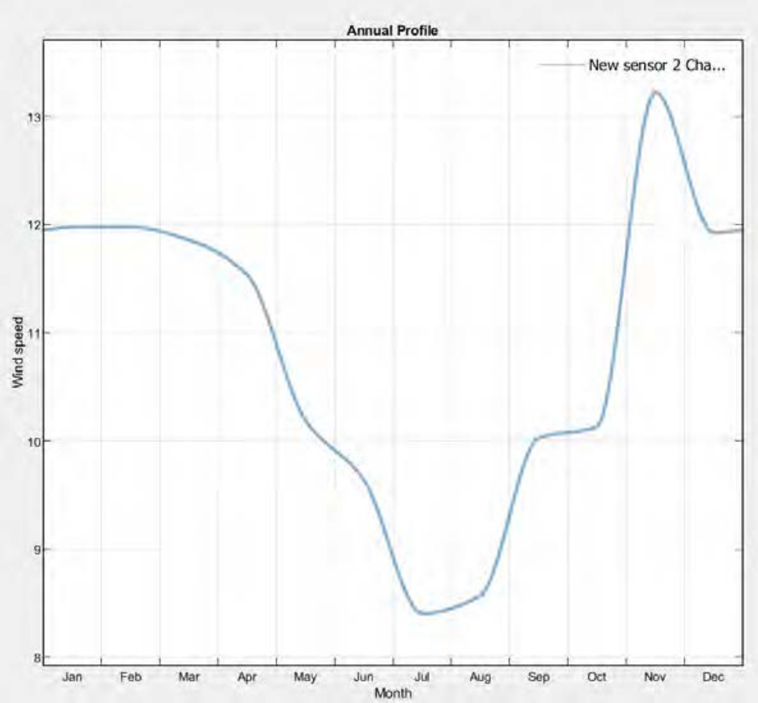



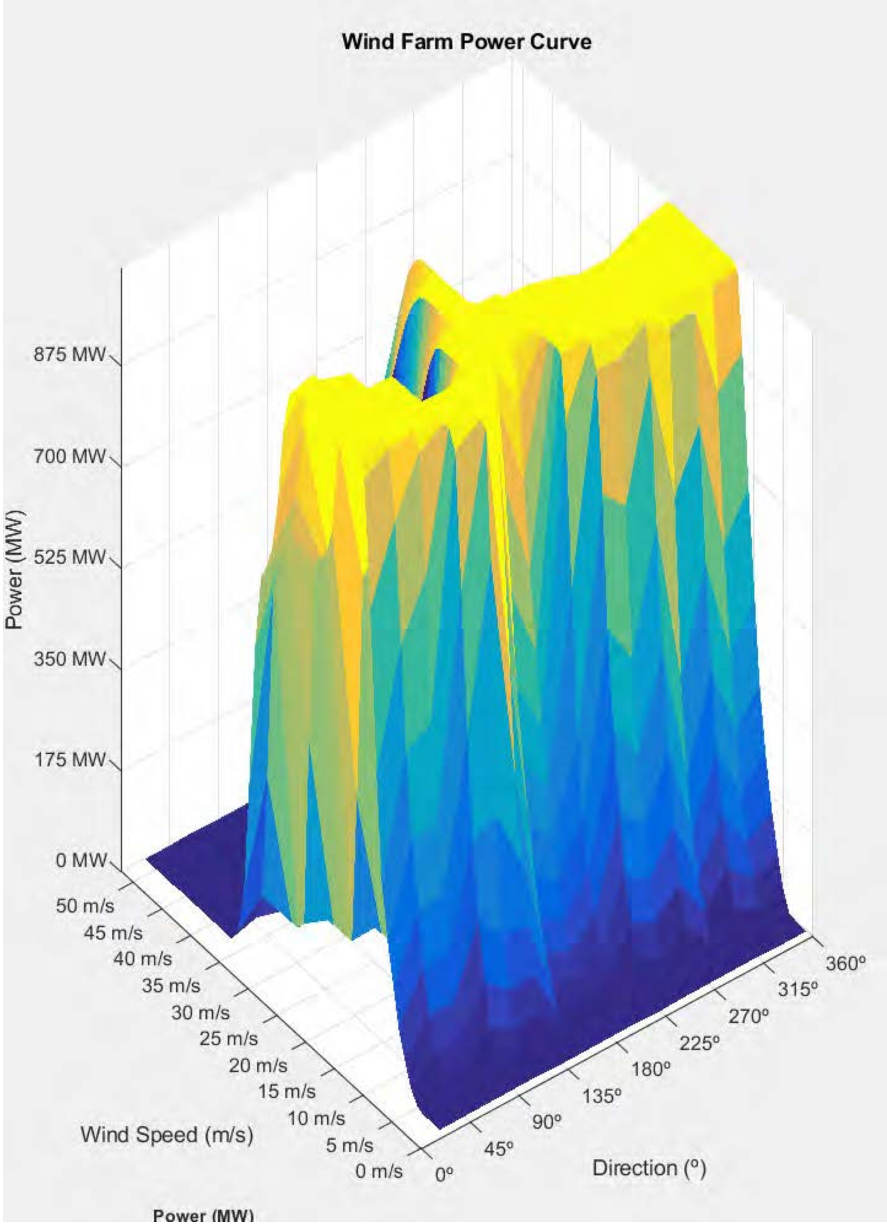
# Results

Highlights:

- Confirms the technical viability of OSW in Atlantic Canada
- Significant offshore resource
- High full load hours
- Results includes wake losses and energy losses



# Results

Losses included for simulation:

- Unavailability losses: 4.98%
- Electrical losses: 2.87%
- Turbine performance: 1.68%
- Environmental losses: 1.49%

| Entire Project Area | | |
|---|---|---|
| | Maximum | Minimum |
| **Gross AEP (MWh/year)** | 6,709,402 | 5,614,365 |
| **Net AEP (MWh/year)** | 5,657,016 | 4,739,458 |
| **Gross CF (%)** | 70.92 | 59.34 |
| **Net CF (%)** | 59.79 | 50.09 |

# Results

| Nova Scotia | | |
|---|---|---|
| | Maximum | Minimum |
| Gross AEP (MWh/year) | 6,248,097 | 5,795,312 |
| Net AEP (MWh/year) | 5,288,419 | 4,868,879 |
| Gross CF (%) | 66.04 | 61.26 |
| Net CF (%) | 55.90 | 51.46 |

| New Brunswick | | |
|---|---|---|
| | Maximum | Minimum |
| Gross AEP (MWh/year) | 5,896,577 | 5,703,218 |
| Net AEP (MWh/year) | 4,992,987 | 4,789,188 |
| Gross CF (%) | 62.33 | 60.28 |
| Net CF (%) | 52.78 | 50.62 |

# Results

| New Foundland and Labrador | | |
| --- | --- | --- |
| | Maximum | Minimum |
| Gross AEP (MWh/year) | 6,709,402 | 5,614,365 |
| Net AEP (MWh/year) | 5,657,016 | 4,739,458 |
| Gross CF (%) | 70.92 | 59.34 |
| Net CF (%) | 59.79 | 50.09 |

| Prince Edward Island | |
| --- | --- |
| | Reference Value |
| Gross AEP (MWh/year) | 5,805,763 |
| Net AEP (MWh/year) | 5,497,178 |
| Gross CF (%) | 61.37 |
| Net CF (%) | 58.10 |

# Results

Hourly profile generation and potential generation

- Average area of wind farm 1 GW= 311 $km^2$
- Extrapolated to available buildable area for the different clusters.

| Cluster | C27 | | C11 | |
|---|---|---|---|---|
| Grid cell | U9- Middle Bank fixed | | S10 - Sydney Bright floating | |
| Date/Time | Net Power Production (KWh) | Wind speed (m/s) | Net Power Production (KWh) | Wind speed (m/s) |
| 1/1/2018 0:00 | 1,080,000 | 14.01 | 1,031,665 | 13.58 |
| 1/1/2018 1:00 | 1,080,000 | 13.78 | 1,026,388 | 13.29 |
| 1/1/2018 2:00 | 1,080,000 | 13.69 | 1,030,440 | 13.45 |
| 1/1/2018 3:00 | 1,080,000 | 13.55 | 1,043,843 | 15.36 |
| 1/1/2018 4:00 | 1,080,000 | 13.43 | 1,043,843 | 17.13 |
| 1/1/2018 5:00 | 1,079,993 | 13.14 | 1,043,843 | 15.98 |
| 1/1/2018 6:00 | 1,079,958 | 12.71 | 1,043,840 | 14.84 |
| 1/1/2018 7:00 | 1,077,379 | 12.15 | 1,043,843 | 15.18 |
| 1/1/2018 8:00 | 1,062,927 | 11.62 | 1,043,843 | 14.93 |
| 1/1/2018 9:00 | 1,011,709 | 11.05 | 1,043,843 | 14.56 |
| 1/1/2018 10:00 | 912,477 | 10.48 | 1,043,843 | 13.99 |
| 1/1/2018 11:00 | 740,339 | 9.63 | 1,043,843 | 13.36 |
| 1/1/2018 12:00 | 566,899 | 8.79 | 1,043,801 | 12.58 |
| 1/1/2018 13:00 | 434,031 | 8.08 | 1,033,859 | 11.61 |
| 1/1/2018 14:00 | 397,253 | 7.93 | 1,005,534 | 11.12 |
| 1/1/2018 15:00 | 404,938 | 8.08 | 1,032,028 | 11.51 |
| 1/1/2018 16:00 | 410,606 | 8.2 | 1,040,606 | 12.06 |
| 1/1/2018 17:00 | 400,451 | 8.16 | 1,040,123 | 12.5 |
| 1/1/2018 18:00 | 371,780 | 7.95 | 1,032,442 | 12.44 |
| 1/1/2018 19:00 | 343,675 | 7.74 | 1,025,279 | 12.01 |
| 1/1/2018 20:00 | 317,875 | 7.54 | 997,246 | 11.37 |
| 1/1/2018 21:00 | 278,982 | 7.24 | 905,912 | 10.84 |
| 1/1/2018 22:00 | 253,101 | 6.9 | 838,800 | 10.51 |
| 1/1/2018 23:00 | 212,208 | 6.4 | 735,974 | 10.09 |

# Integration with Grid & Economic Modeling

**Partnering with E3 to use results in PLEXOS:**

- Clustered technical outputs feed operational modeling
- Understanding energy production patterns
- Evaluating grid needs for integration
- Informing future infrastructure planning
- Supporting economic dispatch, exports, and hydrogen scenarios

**What's Next?**

•Integration with E3 economic modeling

- Informing policy, investment, and future projects
- Continuing cross-disciplinary collaboration

Turning uncharted waters into Canada's clean energy opportunity.

# Conclusions

- First offshore wind resource study of this scale in Canada
- Innovative technical approach to overcome data limitations
- Detailed assessment of Technical & Locational Potential
- Integration of environmental, technical constraints
- Collaboration across teams and disciplines was critical
- Results show world-class offshore wind resources in Atlantic Canada, capacity factors (50–60%), competitive with leading global markets
- This is a foundational step towards future offshore wind development

Stantec

# Thank you


**DANIELA PANTOJA**

**Renewable Energy Analyst**

Daniela.Pantoja@stantec.com


SCAN ME

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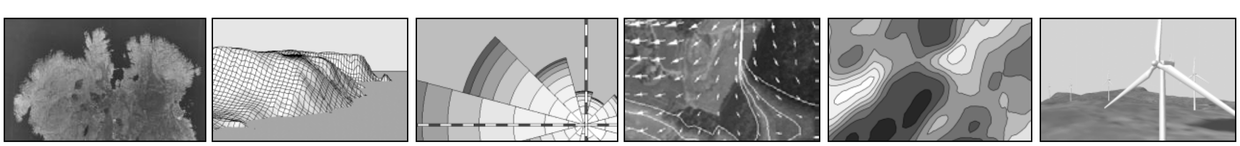
Stantec Atlantic Offshore Wind Study™

# Appendix C – WindSim Report

# TECHNICAL REPORT

| | | | |
|---|---|---|---|
| Title: | Atlantic Canada Offshore Wind Integration and Transmission Study, Offshore Wind Resource Potential Study | | |
| Client: | Stantec | | |
| Contact: | Daniela Pantoja Cabrera,<br>Joaquin Moran,<br>Ivor Shaw | | |
| Classification: | Client's Discretion | | |
| Archive code: | 250605_STANTEC_100 | Number of pages: | 50 |
| Date: | 05/06/2025 | Version: | A |

| | |
|---|---|
| Author: | Mohammadreza Mohammadpour Penchah |
| Checked: | Torstein Sæter, Gullik Killie |
| Approved: | |



WindSim AS • Tollbodgaten 22 N-3111 Tønsberg Norway • Phone +47 33 38 18 00 • www.windsim.com

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This report, to the best of our knowledge, represents the state-of-art in wind energy assessment methods, and the efforts have been made to secure reliable results, WindSim AS cannot in any way be held responsible neither to the use of the findings in the report nor for any direct or indirect losses arising from such use or from errors of any kind in the contents.

Wind measurements were not under the responsibility of WindSim AS, therefore we cannot be responsible for the accuracy of data provided as input to our analysis.

## BACKGROUND:

This report is based on work done by WindSim (Consultant) under a contract with Stantec (Client) as part of a delivery to the Net Zero Atlantic (NZA - https://netzeroatlantic.ca/) initiative from the Canadian

## KEY TO DOCUMENT CLASSIFICATION

| | |
|---|---|
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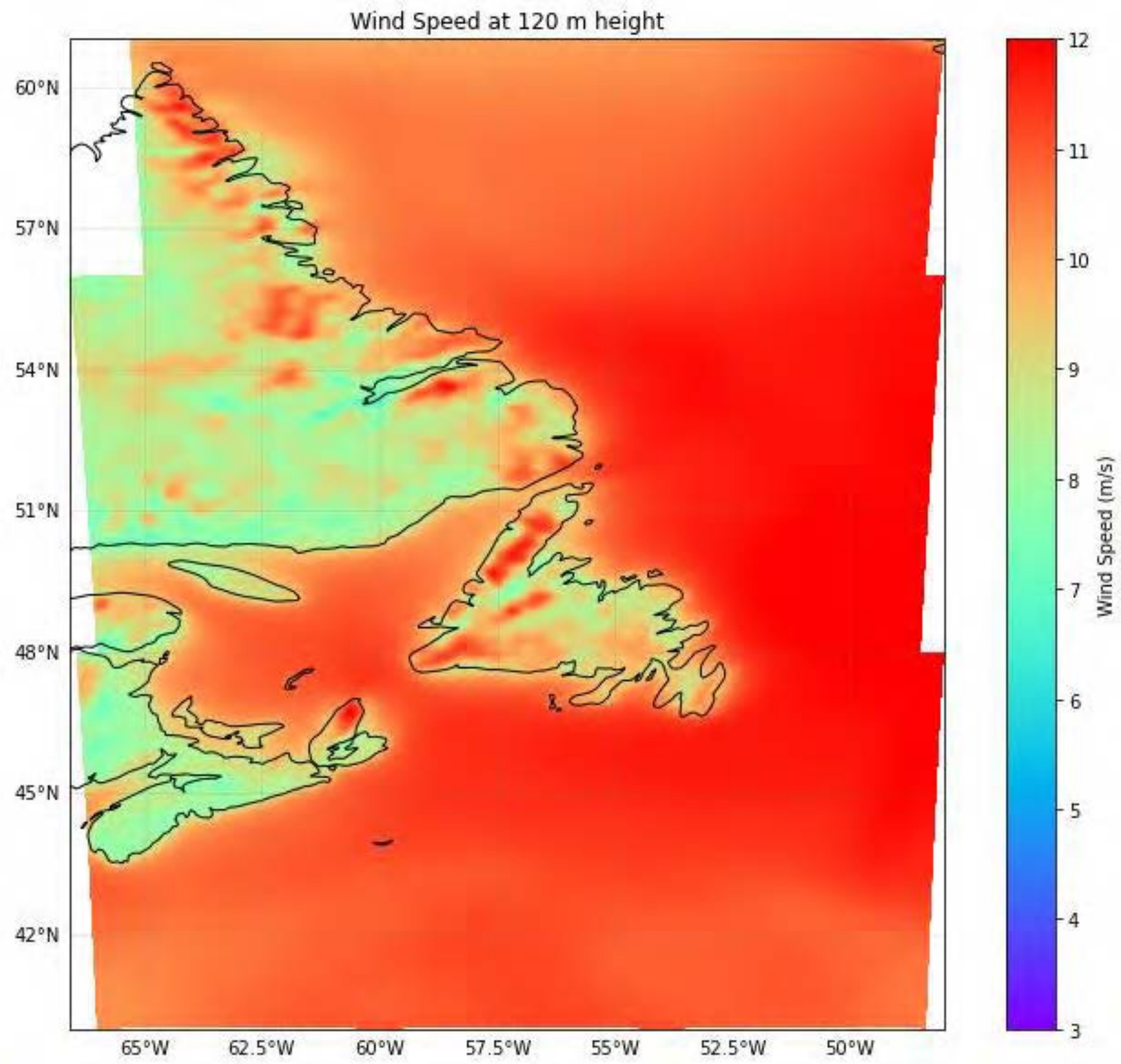
| Confidential | For disclosure only to Client's organization |
| WindSim AS Only | For disclosure only to WindSim AS |
| Client's Discretion | Distribution at the Client's discretion |
| For Public | Available for information to general public |

# REVISION HISTORY

| version | Date | summary |
|---|---|---|
| A | 12/04/2025 | Original issue |
| | | |

# EXECUTIVE SUMMARY

The combination of meso- and microscale models was applied to produce wind resource maps and time series data for the Canadian east coast, nearshore and offshore.
The Weather Research and Forecasting (WRF) model and CFD-based wind flow modeling using WindSim software were utilized to simulate wind conditions for a three-years period (2018-2020). More than 100 CFD simulations with horizontal resolution of 100 m have been run to cover nearshore areas. Results have been presented in Wind Resource Grids (WRG) and time-series dataset. Temporal and horizontal resolution of the final dataset are 5 minutes and 1 km respectively.




**Mean wind speed at 120 m height for the whole study area, extracted from mesoscale model simulation**

# CONTENTS

# 1. Introduction

This project aims to establish a wind resource map and time series data for the entire Canadian east coast. The wind resource map illustrates the long-term average wind speed at a specified height above ground, serving as a foundation for identifying suitable areas for wind energy development.
At the request of the client, WindSim AS conducted the following:

- Ran the WRF model for three years (2018–2020), extracting wind speed and direction time series data at a 5-minute temporal resolution.
- Performed over 100 CFD simulations, covering all nearshore areas.
- Scaled the CFD simulations using mesoscale WRF data to generate high-resolution wind resource maps.

WRF is a mesoscale meteorological model designed to simulate atmospheric processes over large geographic areas and longer timescales, it typically uses coarser grid spacing (kilometers), limiting its accuracy for detailed flow structures. While CFD offers higher resolution and accuracy for local, small-scale phenomena, such as near-coastal areas with high topographic gradients. But CFD models are computationally expensive and time-consuming, often requiring significant computational resources, high-performance computing clusters, and long simulation times.

Key Deliverables are:

- WRF simulations interpolated to a 1 km horizontal resolution for the entire Canadian east coast (nearshore and offshore).
- Merged CFD and WRF datasets for nearshore regions.
- Filtered observational data from meteorological wind stations.
- Detailed documentation of the methodology, parameter settings, modeling assumptions, and limitations.
- Generated 5-minute timeseries data and high-resolution wind resource maps.

## *1.1 Study area*

Study area includes most part of the Canadian east coast which is shown with red polygon in Figure 1-1. Due to the vast extent of the study area and the large size of modelling dataset, the entire study region has been divided into 8 zones (20T, 20U, 20V, 21T, 21U, 21V, 22T, 22U) covering the three UTM zones 20, 21 and 22, as illustrated in the Figure 1-2.

*Figure 1-1 Study area, red polygon shows the boundaries of the study area.*

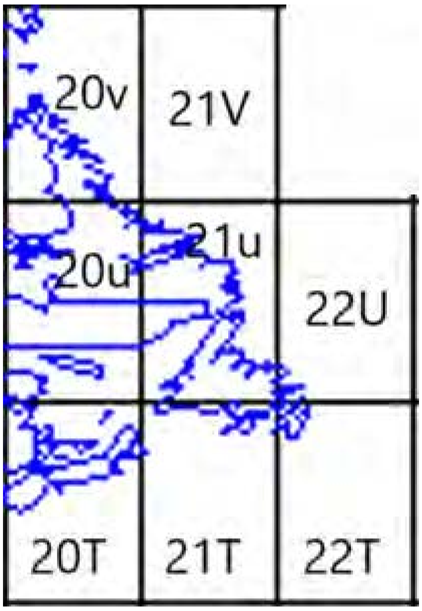



*Figure 1-2 The entire study area is divided into 8 zones.*

## 1.2 Methodology

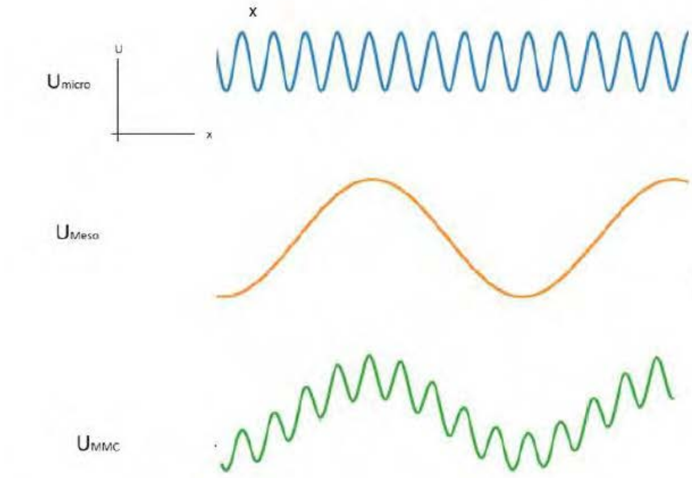
The study area has been divided in two main parts: 1- nearshore and 2-offshore. To capture local and microscale topographic effects on the wind field—such as terrain-induced flow variations, surface roughness influences, and localized turbulence—we employed a high-resolution CFD model for the nearshore area. This approach allows us to resolve fine-scale wind structures influenced by complex coastal terrain features, which are typically not well-represented in coarser mesoscale models, thereby enhancing the accuracy of wind field simulations in regions critical for coastal planning and wind resource assessment.
For the offshore area, WRF model has been run and for the nearshore area, WindSim CFD simulation has been used to prepare very high-resolution dataset and wind resource map. The horizontal resolution of the final simulated dataset is 1 km × 1 km. In offshore areas, it is obtained through interpolation of the mesoscale model output, while in nearshore areas, it results from a combination

of the interpolated mesoscale model output (with a horizontal resolution of 1 km by 1 km) and the microscale model with a horizontal resolution of 100 meters. The temporal resolution of the simulated data is 5 minutes, which includes 315648 time steps over a period of 3 years. Given the extensive number of time steps and the large size of the study area, generating a single time series for an entire zone was computationally impractical. Consequently, each zone was subdivided into multiple smaller regions (subzones) for analysis.
In this report MMC is used for more than 100 CFD simulations. In the MMC method, mesoscale (WRF) dataset is used to scale microscale (WindSim) dataset. Scaling technique applies a directional shift and speedup factor to WindSim CFD results. The velocity enhancement factor has been calculated as a ratio of wind speed in mesoscale and microscale simulations.

The wind flow is affected by the local terrain. The digital terrain model including elevation and roughness has been established, and grid for the flow domain is generated for the air above it. RANS (Reynolds Averaged Navier-Stokes) equations have been applied to numerically solve the wind flow for every wind direction.

### 1.2.1 Meso-Micro coupling (MMC)

MMC has been used to scale CFD results at two heights of 80 and 120 m. At first WRF simulation results converted to appropriate format to be read by WindSim software then CFD results scaled using a simple scaling technique in which the CFD is used to model microscale variability from the mesoscale mean (similar to
Bechmann 2015, also Duran et al., 2020), see Figure 1-3.




$$U_{MMC} = \langle U_{MESO} \rangle \frac{U_{micro}}{\langle U_{micro} \rangle}$$

$\langle \cdot \rangle$ Spatial average at large scale

***Figure 1-3 Illustration of scaling technique used for MMC (Iipponen et al., 2024)***

### 1.2.2 Merging WRF and MMC results

The MMC results offer a high spatial resolution of 100 meters, which we integrate with the WRF data to better represent terrain influences along the coastline. This fine resolution is particularly valuable for capturing small-scale features such as coastal topography, land–sea contrasts, and localized wind patterns that coarser models may miss. To merge these two datasets, we employed a Gaussian weighting technique, which allows for a smooth spatial blending between the high-resolution MMC outputs and the broader-scale WRF data. In this method, the influence of the MMC data is strongest near the coastline and gradually diminishes with increasing distance offshore. The Gaussian function acts as a distance-based filter, assigning higher weights to MMC data closer to the shore while favoring WRF data farther away. This approach ensures a seamless transition and minimizes abrupt changes or inconsistencies in the merged dataset, ultimately improving the accuracy of terrain-influenced atmospheric parameters across the coastal zone. For more details of merging technique refer to Appendix 2.

### *1.3 Quality control check and model evaluation*

During the interpolation of simulated data across different heights and vertical coordinate systems, instances of infinities or missing values were encountered. These invalid data points were systematically addressed and interpolated to ensure data integrity.

The model's performance was evaluated by comparing its output against a lifted-up observational dataset. This comparison included analyses of both time series and wind rose plots.

## 2. Observation data

This chapter describes the observation data and method for filtering it. The observation data we have received from Stantec includes some meteorological wind mast at 10 m height and some buoy data at less than 10 m height. Wind field data at 10 m or less is not appropriate for wind resource assessment studies, so we have done a filtering method to lift up this dataset. In this report, 5 met mast data have been lifted up at 80 m and 120 m heights.

### *2.1 Method for filtering or lifting up observation data*

Numerical flow modelling, based on Computational Fluid Dynamics (CFD), is used to transfer the wind conditions from a measurement point to the wind turbine positions at hub height. In this method, a very high-resolution WindSim CFD model is defined around the wind mast location, and WindSim transfers the dataset to higher heights, considering the effects of topography and roughness.
Figure 2-1 shows the locations of five measurement sites and Table 2-1 shows some characteristics of the selected sites.


***Figure 2-1 Locations of the five selected measurement sites on Google Earth***

*Table 2-1 Key climatology selected object characteristics*

| Station name | Station ID | Representative period | Measurement height (m) | Average wind speed (m/s) |
|---|---|---|---|---|
| Halifax | 8202252 | 01/01/2018 00:00 - 01/01/2021 00:00 | 10.00 | 4.58 |
| Shearwater | 8205092 | 01/01/2018 00:00 - 01/01/2021 00:00 | 10.00 | 3.71 |
| Cape Race | 8401000 | 01/01/2018 00:00 - 01/01/2021 00:00 | 10.00 | 7.98 |
| Marys Harbour | 8502592 | 01/01/2018 00:00 - 01/01/2021 00:00 | 10.00 | 4.91 |
| Saglek | 8503249 | 01/01/2018 00:00 - 01/01/2021 00:00 | 10.00 | 7.92 |

To lift up observation data, WindSim CFD has been launched with very high horizontal resolution, for example in Halifax area horizontal resolution is about 5 m. Here, the grid is generated and optimized from the digital terrain model. Figure 2-2 shows an example of the horizontal and vertical grids in the CFD simulation in Halifax area.

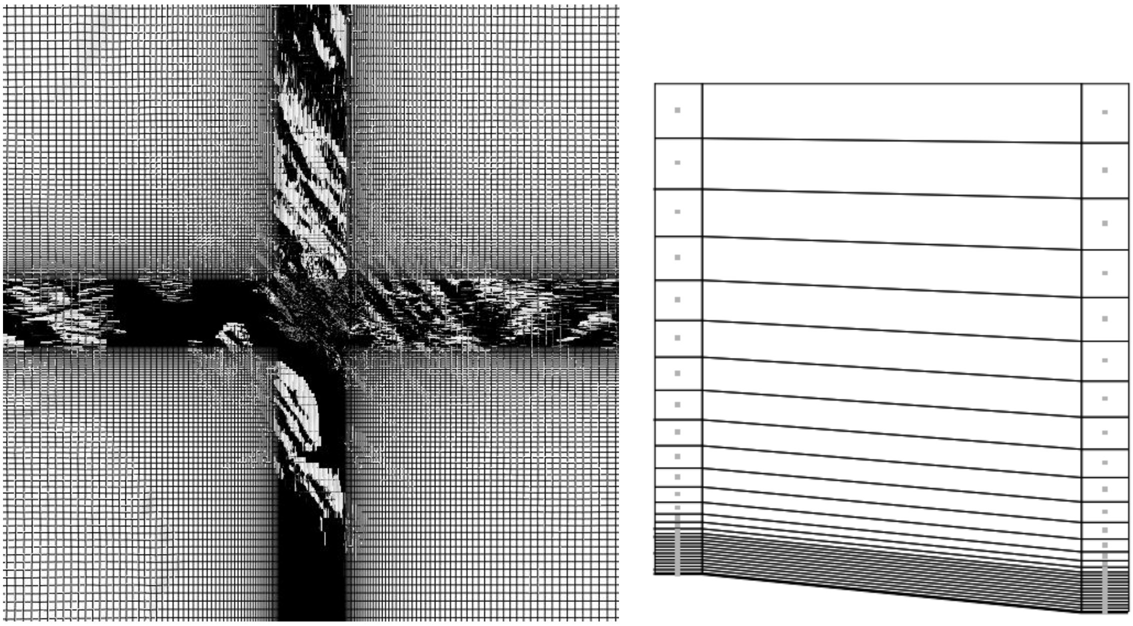


*Figure 2-2 Horizontal grid resolution (left) and schematic view of the vertical grid resolution (right).*

The grid extends 3000 (m) above the point in the terrain with the highest elevation. The grid is refined towards the ground.

## 2.2 Uncertainties in observation data

The meteorological mast observation data contains integer values of wind speed and does not include decimal numbers. And the wind direction is divided into 36 segments. These can increase the uncertainty in the observation data.

As mentioned earlier, lifting the observation data requires running a high-resolution CFD model, with the vertical interpolation method based on topography and surface roughness changes.

The accuracy of the CFD simulation depends heavily on the precise location of the wind mast, as this determines the local elevation and roughness parameters. However, when attempting to verify the mast coordinates using Google Earth, we found that some stations could not be pinpointed with certainty.

Since the filtered data (derived from these measurements) is used to validate the final simulation results, positional uncertainties in the mast locations propagate into the data processing chain, leading to significant uncertainty in the final assessment. Figure 2-3 and Figure 2-4 show some screenshots from Google Earth for two met masts 8401000 and 8503249. In these figures we tried to find the possible location of met masts using Google earth images.

***Figure 2-3 Location of the wind mast (Cape Race) 8401000 on google earth and possible location of the station from a Google Earth image***


***Figure 2-4 Location of the wind mast Saglek (8503249) on google earth and possible location of the station on Google Earth image***

## *2.3 Local wind climate*

The average wind condition at the site is used in the calibration of the wind resources. Wind climatology is presented as a wind rose, giving the average wind speed distribution divided in velocity

intervals (bins) and wind directions (sectors). The original wind speed data are divided into one meter per second bin. In the graphical wind rose presentation all occurrences of wind speeds above 16 m/s have been accumulated in the bin above 16 m/s. Incoming wind directions are divided into 12 sectors, where the first sector is centered around the north.
The Weibull distribution appears to be an appropriate model for fitting the wind speed histogram, particularly because it captures the skewed nature of wind speed distributions observed at the tower location. Using maximum likelihood estimation (MLE) to determine the Weibull parameters ensures that the fit is statistically optimal under the assumed distribution, minimizing bias and variance in the parameter estimates.
Upon visual comparison, the fitted Weibull curve aligns well with the observed wind speed histogram, especially in the central range of wind speeds. Some discrepancies may appear in the tails (very low or high wind speeds), which is common due to limited data in those regions. Overall, the fit suggests that the Weibull model is a suitable and practical choice for wind energy analysis and resource assessment. In the following we presented some characteristics of observation data.

### 2.3.1 Climatology: Halifax - 8202252

***Table 2-2 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 10 m height.***

| | | | |
|---|---|---|---|
| Station ID | 8202252 | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 25815 | |
| Position: easting, northing, z (agl) | 456275.6 | 4937291.5 | 10.0 |
| Average wind speed, Weibull k, A | 4.58 | 1.813 | 5.633 |

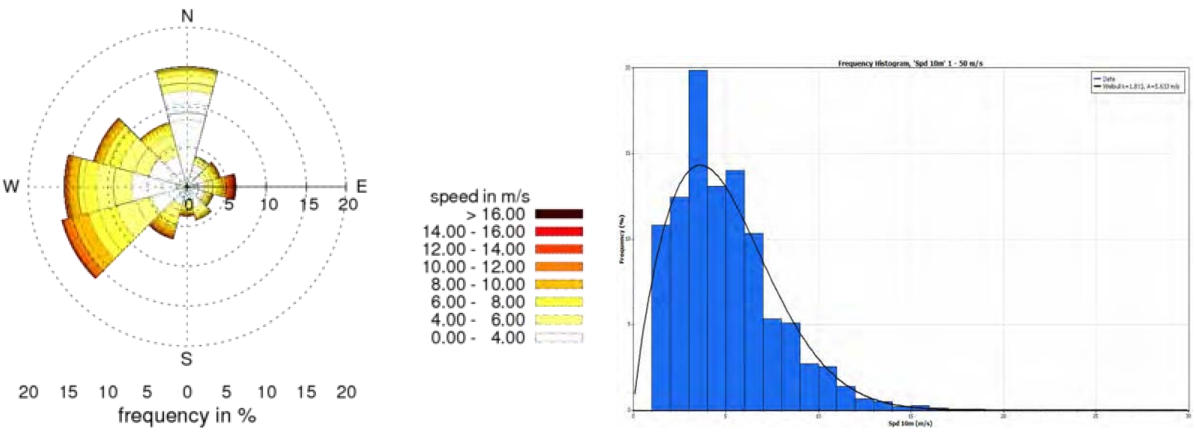



***Figure 2-5 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 10 m height.***

***Table 2-3 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sectors at 10 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 2.11 | 3.08 | 4.84 | 6.64 | 3.90 | 3.89 | 4.78 | 5.60 | 5.83 | 4.84 | 4.86 | 4.39 |
| Frequency (%) | 15.01 | 3.94 | 4.35 | 6.19 | 3.44 | 4.32 | 3.67 | 6.78 | 16.31 | 15.45 | 12.18 | 8.37 |
| Weibull shape, k | 1.01 | 1.87 | 1.48 | 1.48 | 1.34 | 1.44 | 1.61 | 1.94 | 2.18 | 1.82 | 2.21 | 2.21 |
| Weibull scale, A | 2.13 | 3.47 | 5.30 | 7.25 | 3.90 | 4.01 | 5.23 | 6.35 | 6.58 | 5.27 | 5.46 | 4.89 |

### 2.3.2 Climatology: Shearwater - 8205092

***Table 2-4 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 10 m height.***

| | | | |
|---|---|---|---|
| Station ID | 8205092 | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 26215 | |
| Position: easting, northing, z (agl) | 459281.7 | 4941946.5 | 10.0 |
| Average wind speed, Weibull k, A | 3.71 | 1.703 | 4.110 |

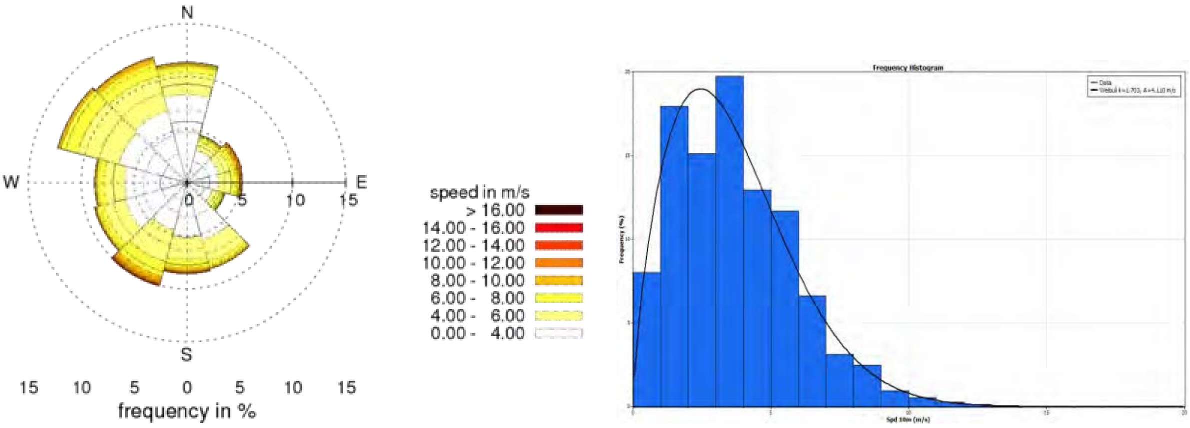



***Figure 2-6 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 10 m height.***

***Table 2-5 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sectors at 10 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 2.58 | 3.54 | 4.21 | 4.04 | 3.46 | 3.60 | 3.89 | 4.55 | 3.48 | 3.41 | 4.00 | 3.88 |
| Frequency (%) | 11.34 | 4.65 | 5.34 | 5.26 | 3.73 | 8.38 | 8.56 | 10.06 | 9.06 | 8.72 | 12.63 | 12.27 |
| Weibull shape, k | 1.33 | 1.74 | 1.45 | 1.60 | 1.71 | 2.02 | 1.65 | 1.94 | 1.75 | 1.86 | 2.28 | 1.96 |
| Weibull scale, A | 2.97 | 3.85 | 4.41 | 4.48 | 3.88 | 4.05 | 4.28 | 5.21 | 3.89 | 3.83 | 4.54 | 4.38 |

### 2.3.3 Climatology: Cape Race - 8401000

***Table 2-6 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 10 m height.***

| | | | |
|---|---|---|---|
| Station ID | 8401000 | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 11874 | |
| Position: easting, northing, z (agl) | 341365.6 | 5169244.0 | 10.0 |
| Average wind speed, Weibull k, A | 7.98 | 1.849 | 8.399 |

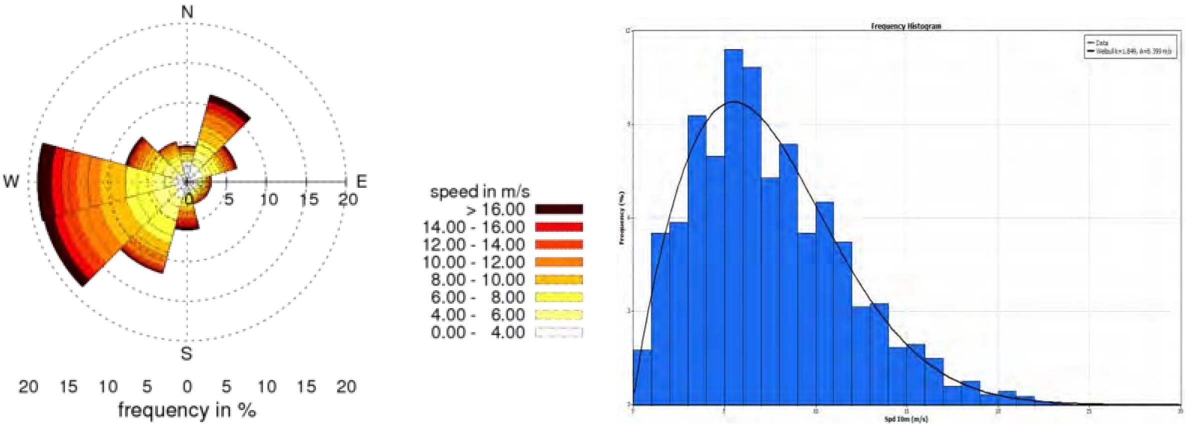



*Figure 2-7 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 10 m height.*

*Table 2-7 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sectors at 10 m height.*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 4.86 | 8.55 | 6.91 | 5.67 | 5.84 | 6.11 | 8.44 | 6.98 | 9.21 | 9.50 | 7.62 | 6.81 |
| Frequency (%) | 4.56 | 11.35 | 6.54 | 3.07 | 2.99 | 2.91 | 6.02 | 11.87 | 18.63 | 18.84 | 8.01 | 5.21 |
| Weibull shape, k | 1.23 | 1.86 | 1.62 | 1.41 | 1.60 | 1.85 | 1.92 | 1.91 | 2.20 | 2.13 | 1.85 | 2.17 |
| Weibull scale, A | 5.50 | 9.70 | 7.60 | 5.98 | 6.38 | 6.91 | 9.59 | 7.51 | 10.22 | 10.56 | 8.33 | 7.53 |

### 2.3.4 Climatology: Marys Harbour - 8502592

*Table 2-8 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 10 m height.*

| | | | |
|---|---|---|---|
| Station ID | 8502592 | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 25051 | |
| Position: easting, northing, z (agl) | 578563.0 | 5795342.0 | 10.0 |
| Average wind speed, Weibull k, A | 4.91 | 1.962 | 5.49 |

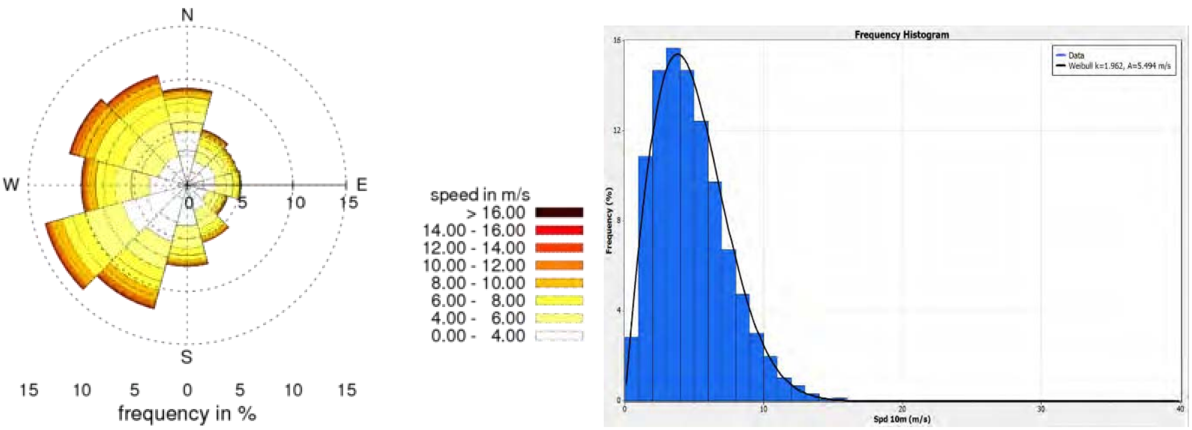



*Figure 2-8 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 10 m height.*

***Table 2-9 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sectors at 10 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 3.79 | 4.88 | 4.18 | 4.12 | 4.50 | 4.73 | 4.49 | 4.97 | 4.85 | 5.19 | 5.97 | 5.78 |
| Frequency (%) | 9.14 | 5.44 | 4.92 | 5.11 | 4.00 | 5.56 | 7.64 | 12.06 | 13.90 | 9.98 | 11.49 | 10.75 |
| Weibull shape, k | 1.51 | 1.79 | 1.79 | 2.22 | 1.80 | 1.92 | 1.83 | 1.71 | 1.79 | 2.00 | 2.25 | 2.14 |
| Weibull scale, A | 4.52 | 5.27 | 4.48 | 4.61 | 4.81 | 5.15 | 4.89 | 5.41 | 5.35 | 5.74 | 6.63 | 6.40 |

### 2.3.5 Climatology: Saglek - 8503249

***Table 2-10 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 10 m height.***

| | | | |
|---|---|---|---|
| Station ID | 8503249 | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 11855 | |
| Position: easting, northing, z (agl) | 524230.8 | 6483172.0 | 10.0 |
| Average wind speed, Weibull k, A | 7.92 | 1.576 | 8.845 |

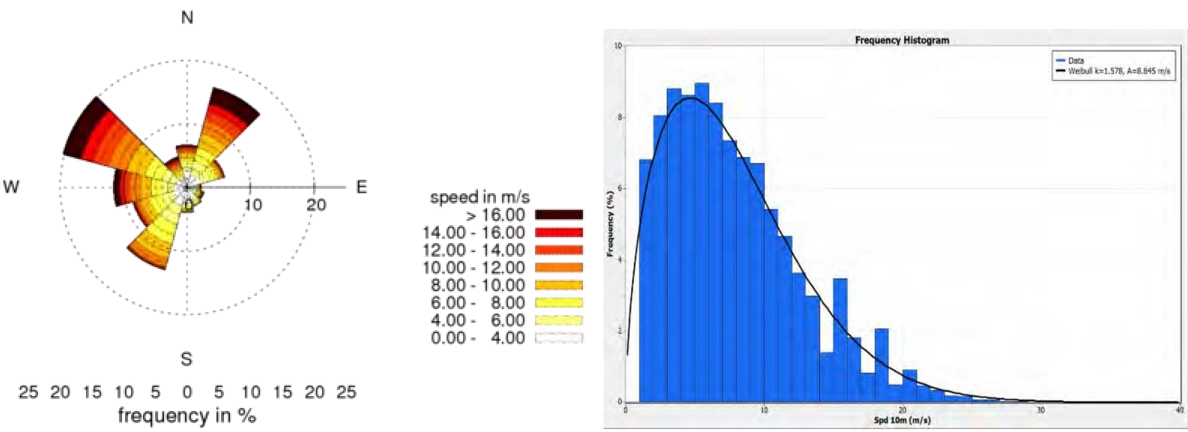



***Figure 2-9 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 10 m height.***

***Table 2-11 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sectors at 10 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 6.04 | 10.25 | 5.46 | 3.75 | 5.38 | 3.66 | 3.92 | 6.60 | 6.61 | 8.71 | 10.56 | 8.31 |
| Frequency (%) | 6.66 | 16.25 | 6.15 | 2.23 | 2.78 | 3.12 | 3.96 | 13.34 | 8.80 | 11.52 | 20.19 | 4.99 |
| Weibull shape, k | 1.46 | 1.82 | 1.59 | 1.24 | 1.35 | 1.45 | 1.27 | 2.08 | 1.83 | 1.89 | 2.27 | 1.75 |
| Weibull scale, A | 6.81 | 11.37 | 6.03 | 3.71 | 5.73 | 4.02 | 4.11 | 7.59 | 7.54 | 9.96 | 12.00 | 9.44 |

## *2.4 Filtered wind climate*

Here lifted up climatologies to higher heights are presented. We used very high resolution CFD model to calculate effects of topography and roughness on the wind field and transferred observation data to 80 m and 120 m heights.

### 2.4.1 Climatology: Halifax - 8202252_80m

***Table 2-12 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 80 m height.***

| | | | |
|---|---|---|---|
| File name | 8202252_80m | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 25815 | |
| Position: easting, northing, z (agl) | 456341.7 | 4937275.5 | 80.0 |
| Average wind speed, Weibull k, A | 6.19 | 1.751 | 7.375 |

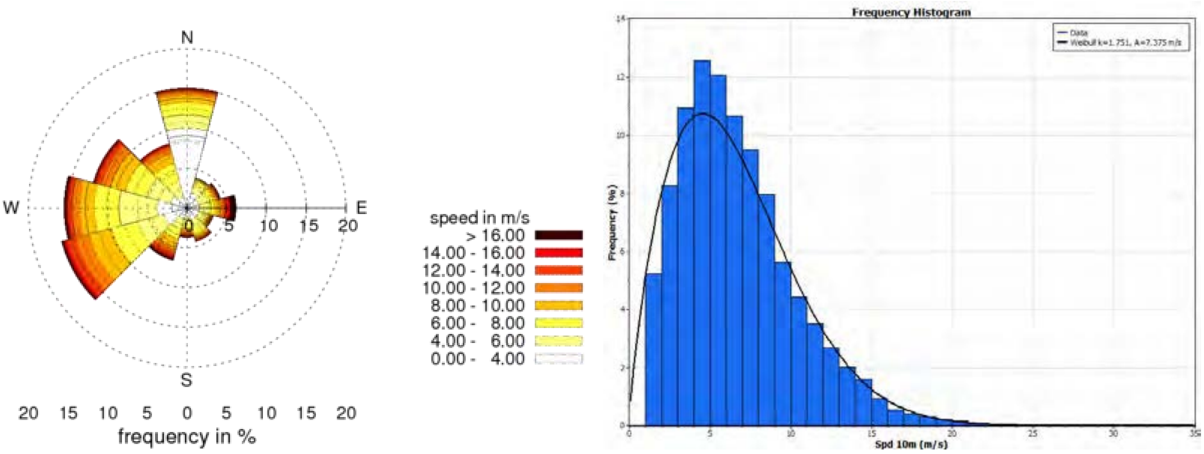



***Figure 2-10 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 80 m height.***

***Table 2-13 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sectors at 80 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 3.14 | 4.33 | 5.99 | 8.36 | 5.32 | 5.62 | 6.69 | 7.44 | 7.35 | 6.30 | 6.96 | 6.83 |
| Frequency (%) | 15.01 | 3.94 | 4.35 | 6.19 | 3.44 | 4.32 | 3.67 | 6.78 | 16.31 | 15.45 | 12.18 | 8.37 |
| Weibull shape, k | 1.01 | 1.84 | 1.44 | 1.52 | 1.35 | 1.47 | 1.54 | 1.87 | 2.18 | 1.76 | 2.10 | 2.34 |
| Weibull scale, A | 3.29 | 4.84 | 6.41 | 9.21 | 5.34 | 5.86 | 7.11 | 8.32 | 8.32 | 6.77 | 7.68 | 7.71 |

### 2.4.2 Climatology: Halifax - 8202252_120m

***Table 2-14 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 120 m height.***

| | | | |
|---|---|---|---|
| File name | 8202252_120m | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 25815 | |
| Position: easting, northing, z (agl) | 456341.7 | 4937275.5 | 120.0 |
| Average wind speed, Weibull k, A | 6.50 | 1.756 | 7.747 |

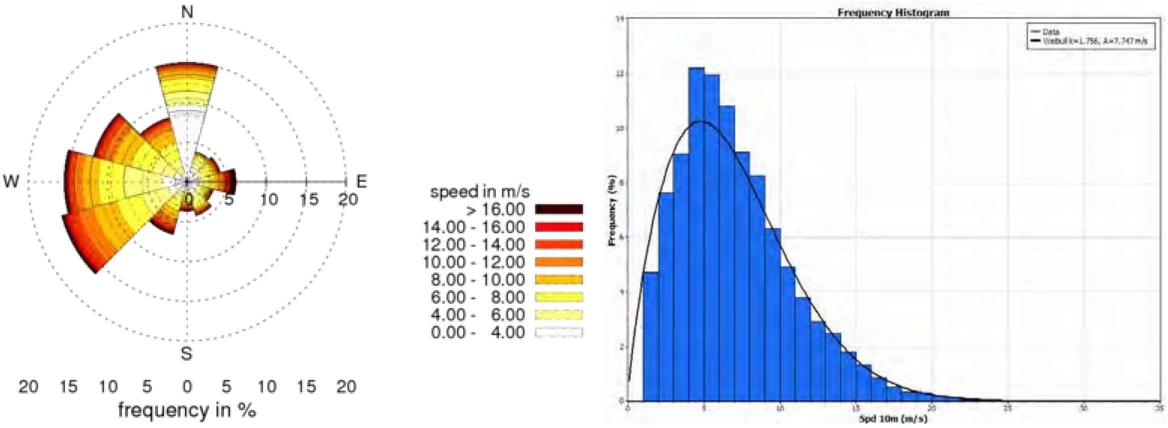



***Figure 2-11 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 120 m height.***

***Table 2-15 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sectors at 120 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 3.28 | 4.53 | 6.16 | 8.52 | 5.52 | 5.79 | 7.07 | 7.90 | 7.70 | 6.64 | 7.45 | 7.35 |
| Frequency (%) | 15.01 | 3.94 | 4.35 | 6.19 | 3.44 | 4.32 | 3.67 | 6.77 | 16.31 | 15.45 | 12.18 | 8.37 |
| Weibull shape, k | 1.01 | 1.85 | 1.44 | 1.53 | 1.36 | 1.45 | 1.58 | 1.90 | 2.17 | 1.77 | 2.13 | 2.23 |
| Weibull scale, A | 3.45 | 5.05 | 6.59 | 9.43 | 5.53 | 6.00 | 7.60 | 8.88 | 8.70 | 7.16 | 8.25 | 8.20 |

### 2.4.3 Climatology: Shearwater - 8205092_80m

***Table 2-16 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 80 m height.***

| | | | |
|---|---|---|---|
| File name | 8205092_80m | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 26215 | |
| Position: easting, northing, z (agl) | 459284.8 | 4941957.0 | 80.0 |
| Average wind speed, Weibull k, A | 6.67 | 1.837 | 7.768 |

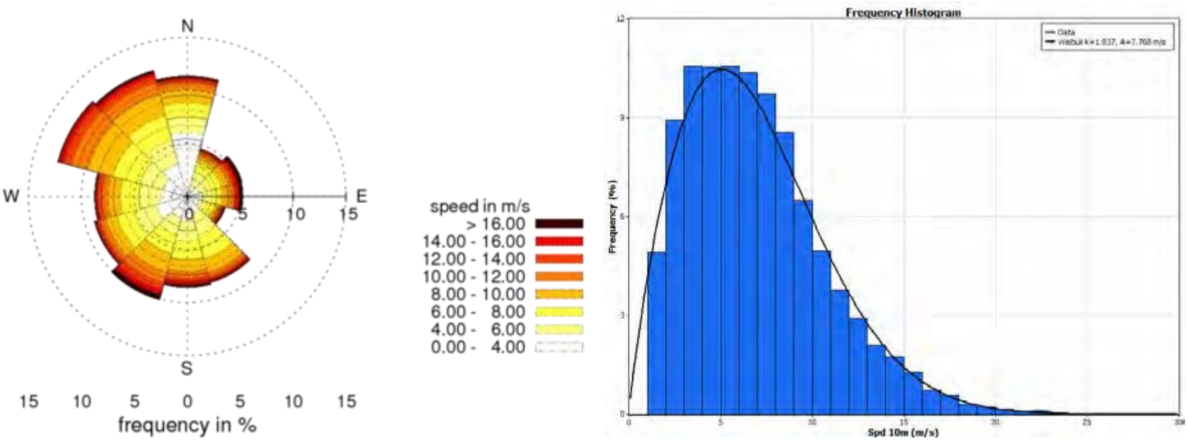



***Figure 2-12 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 80 m height.***

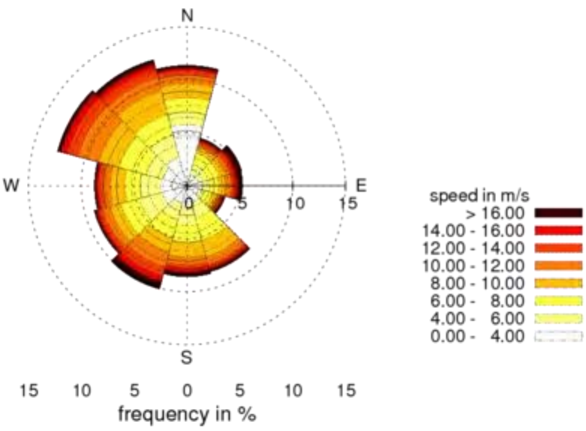
*Table 2-17 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sectors at 80 m height.*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 4.39 | 6.59 | 7.81 | 7.50 | 6.48 | 6.69 | 6.75 | 7.89 | 6.00 | 6.36 | 7.41 | 6.89 |
| Frequency (%) | 11.34 | 4.65 | 5.34 | 5.26 | 3.73 | 8.38 | 8.56 | 10.06 | 9.06 | 8.72 | 12.63 | 12.27 |
| Weibull shape, k | 1.30 | 1.70 | 1.49 | 1.67 | 1.73 | 2.04 | 1.65 | 1.88 | 1.66 | 1.89 | 2.43 | 1.98 |
| Weibull scale, A | 5.17 | 6.95 | 8.19 | 8.34 | 7.16 | 7.51 | 7.45 | 8.95 | 6.60 | 7.08 | 8.46 | 7.81 |

### 2.4.4 Climatology: Shearwater - 8205092_120m

*Table 2-18 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 120 m height.*

| | | | |
|---|---|---|---|
| File name | 8205092_120m | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 26215 | |
| Position: easting, northing, z (agl) | 459284.8 | 4941957.0 | 120.0 |
| Average wind speed, Weibull k, A | 7.24 | 1.818 | 8.440 |



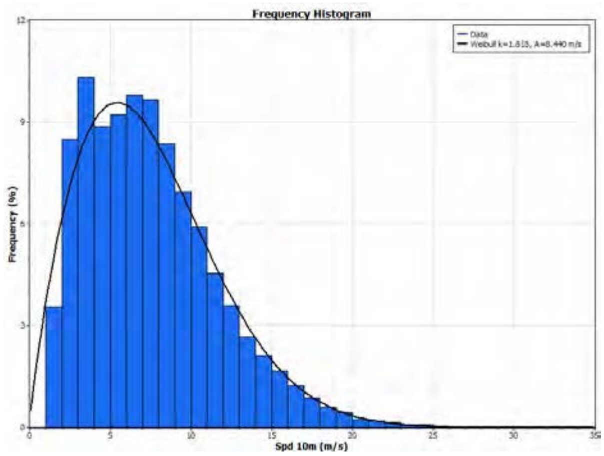




*Figure 2-13 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 120 m height.*

*Table 2-19 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sector at 120 m height.*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 4.85 | 7.03 | 8.40 | 7.98 | 6.89 | 7.25 | 7.40 | 8.66 | 6.63 | 6.61 | 8.04 | 7.57 |
| Frequency (%) | 11.34 | 4.65 | 5.34 | 5.26 | 3.73 | 8.38 | 8.56 | 10.06 | 9.06 | 8.72 | 12.63 | 12.27 |
| Weibull shape, k | 1.29 | 1.68 | 1.43 | 1.64 | 1.67 | 1.98 | 1.71 | 1.89 | 1.66 | 1.80 | 2.26 | 2.09 |
| Weibull scale, A | 5.66 | 7.49 | 8.69 | 8.92 | 7.63 | 8.12 | 8.25 | 9.81 | 7.19 | 7.34 | 9.10 | 8.70 |

### 2.4.5 Climatology: Saglek - 8503249_80m

*Table 2-20 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 80 m height.*

| | | | |
|---|---|---|---|
| File name | 8503249_80m | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 11855 | |

| | | | |
|---|---|---|---|
| Position: easting, northing, z (agl) | 524230.8 | 6483172.0 | 80.0 |
| Average wind speed, Weibull k, A | 9.20 | 1.542 | 10.186 |

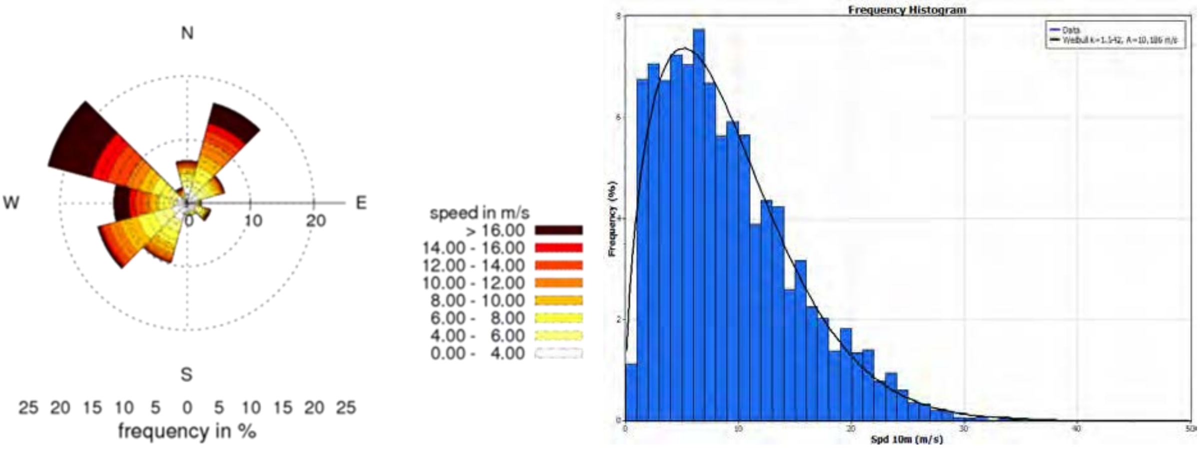



*Figure 2-14 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 80 m height.*

*Table 2-21 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sector at 80 m height.*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 5.94 | 10.92 | 6.03 | 4.12 | 5.76 | 3.46 | 2.93 | 6.44 | 7.80 | 11.05 | 13.16 | 8.10 |
| Frequency (%) | 6.66 | 16.25 | 6.15 | 2.23 | 3.87 | 2.03 | 1.84 | 9.74 | 14.52 | 11.51 | 22.64 | 2.54 |
| Weibull shape, k | 1.42 | 1.83 | 1.54 | 1.15 | 1.19 | 1.60 | 0.98 | 1.75 | 1.93 | 1.90 | 2.27 | 1.75 |
| Weibull scale, A | 6.64 | 12.12 | 6.64 | 4.05 | 5.81 | 3.63 | 3.20 | 7.38 | 8.96 | 12.55 | 15.08 | 9.40 |

### 2.4.6 Climatology: Saglek - 8503249_120m

*Table 2-22 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 120 m height.*

| | | | |
|---|---|---|---|
| File name | 8503249_120m | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 11855 | |
| Position: easting, northing, z (agl) | 524230.8 | 6483172.0 | 120.0 |
| Average wind speed, Weibull k, A | 9.15 | 1.533 | 10.107 |

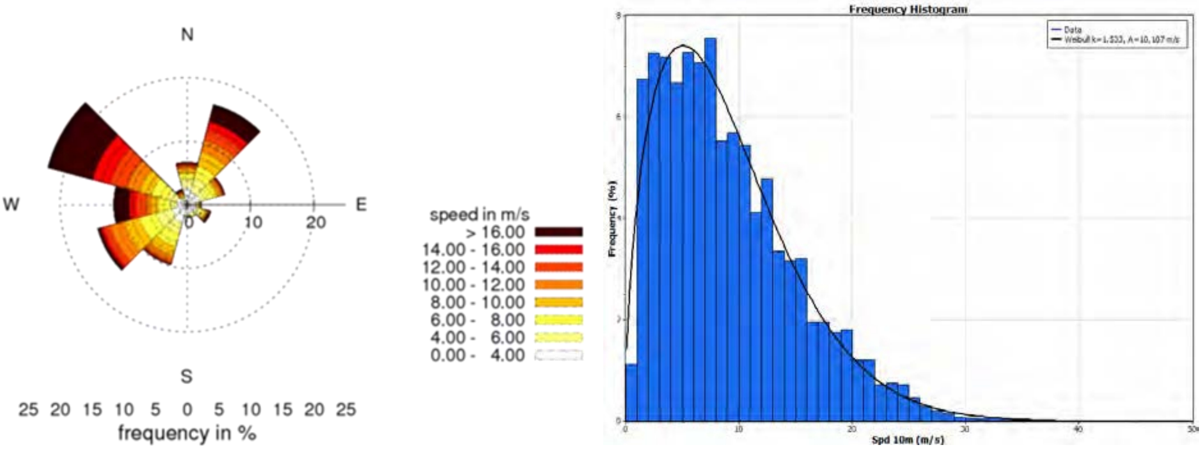



***Figure 2-15 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 120 m height.***

***Table 2-23 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sector at 120 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 5.62 | 10.37 | 5.90 | 4.25 | 5.97 | 3.42 | 2.73 | 6.41 | 8.05 | 11.16 | 13.25 | 7.93 |
| Frequency (%) | 6.66 | 16.25 | 6.15 | 2.23 | 3.87 | 2.03 | 1.84 | 9.74 | 14.52 | 11.51 | 22.64 | 2.54 |
| Weibull shape, k | 1.43 | 1.85 | 1.60 | 1.16 | 1.23 | 1.65 | 0.91 | 1.78 | 1.93 | 1.96 | 2.25 | 1.64 |
| Weibull scale, A | 6.33 | 11.59 | 6.62 | 4.14 | 6.11 | 3.62 | 2.78 | 7.37 | 9.19 | 12.81 | 15.17 | 8.94 |

2.4.7 Climatology: Cape Race - 8401000_80m

***Table 2-24 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 80 m height.***

| | | | |
|---|---|---|---|
| File name | 8401000_80m | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 11874 | |
| Position: easting, northing, z (agl) | 341365.6 | 5169244.0 | 80.0 |
| Average wind speed, Weibull k, A | 11.98 | 1.736 | 13.367 |

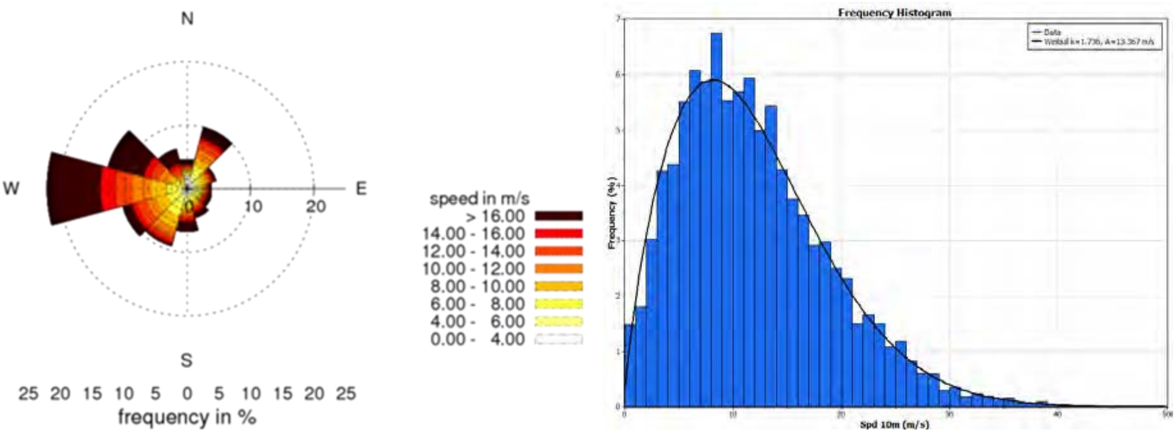



***Figure 2-16 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 80 m height.***

***Table 2-25 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sector at 80 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 8.22 | 10.79 | 8.30 | 8.01 | 9.09 | 10.32 | 10.89 | 8.59 | 10.80 | 14.84 | 16.30 | 14.17 |
| Frequency (%) | 4.62 | 10.03 | 4.73 | 3.87 | 4.00 | 4.74 | 6.76 | 9.29 | 10.49 | 22.06 | 12.94 | 6.48 |
| Weibull shape, k | 1.16 | 1.83 | 1.73 | 1.41 | 1.54 | 1.88 | 1.67 | 2.23 | 2.17 | 2.13 | 1.93 | 2.27 |
| Weibull scale, A | 9.17 | 12.18 | 9.28 | 8.53 | 9.74 | 11.58 | 12.03 | 9.53 | 12.00 | 16.38 | 18.07 | 16.00 |

2.4.8 Climatology: Cape Race - 8401000_120m

***Table 2-26 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 120 m height.***

| | | | |
|---|---|---|---|
| File name | 8401000_120m | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 11874 | |
| Position: easting, northing, z (agl) | 341365.6 | 5169244.0 | 120.0 |
| Average wind speed, Weibull k, A | 12.80 | 1.73 | 14.408 |

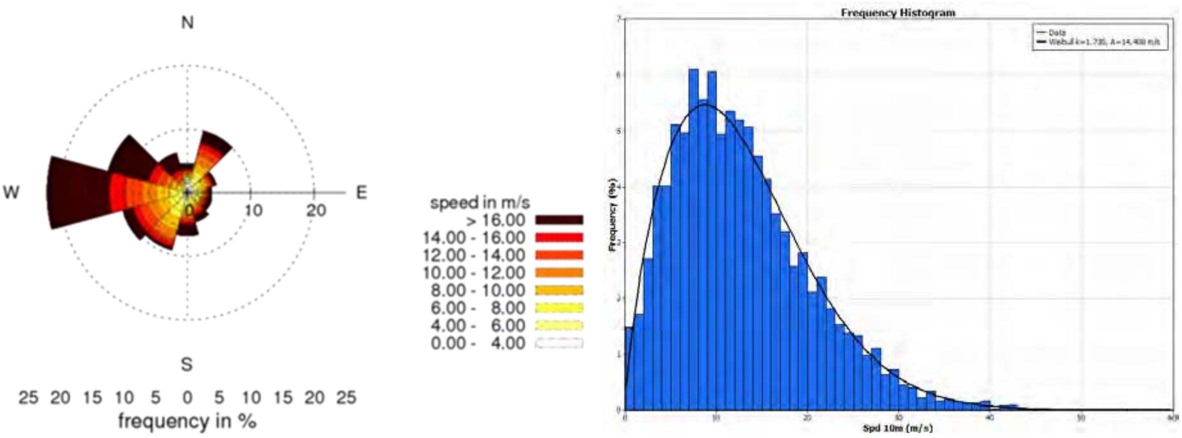



***Figure 2-17 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 120 m height.***

***Table 2-27 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sector at 120 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 8.78 | 11.17 | 8.49 | 8.35 | 9.59 | 10.92 | 11.41 | 8.89 | 11.32 | 16.07 | 17.87 | 15.55 |
| Frequency (%) | 4.62 | 10.03 | 4.73 | 3.87 | 4.00 | 4.74 | 6.76 | 9.29 | 10.49 | 22.06 | 12.92 | 6.48 |
| Weibull shape, k | 1.15 | 1.86 | 1.73 | 1.43 | 1.56 | 1.89 | 1.66 | 2.12 | 2.16 | 2.11 | 1.92 | 2.32 |
| Weibull scale, A | 9.75 | 12.69 | 9.54 | 8.91 | 10.36 | 12.31 | 12.57 | 9.74 | 12.58 | 17.72 | 19.76 | 17.68 |

2.4.9 Climatology: Marys Harbour - 8502592_80m

***Table 2-28 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 80 m height.***

| File name | 8502592_80m | | |
|---|---|---|---|
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 25051 | |
| Position: easting, northing, z (agl) | 578563.0 | 5795342.0 | 80.0 |
| Average wind speed, Weibull k, A | 7.28 | 1.71 | 7.963 |

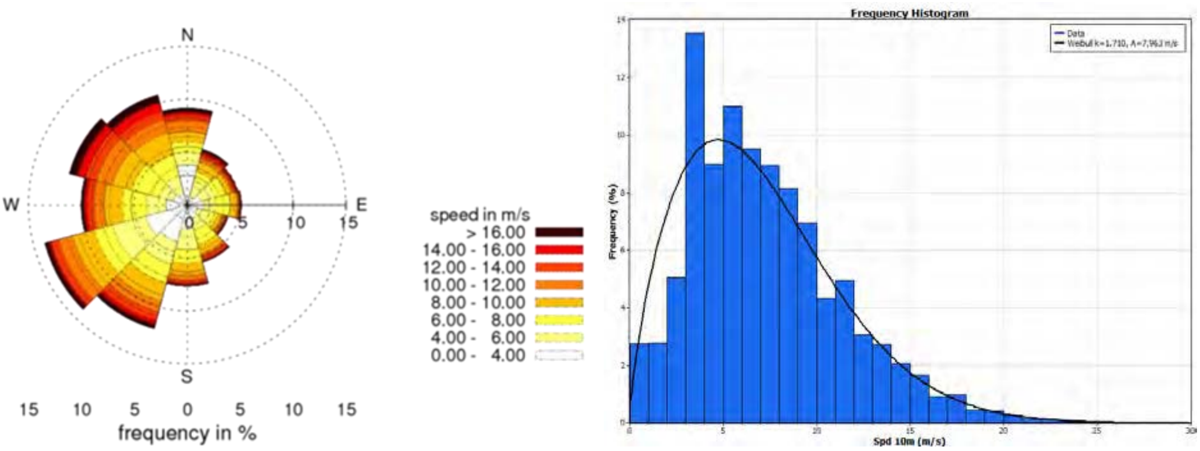



***Figure 2-18 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 80 m height.***

***Table 2-29 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sector at 80 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 6.08 | 7.68 | 6.42 | 6.00 | 6.34 | 6.85 | 6.36 | 7.09 | 6.80 | 7.44 | 9.06 | 9.14 |
| Frequency (%) | 9.14 | 5.45 | 4.92 | 5.11 | 4.00 | 5.56 | 7.64 | 12.06 | 13.90 | 9.98 | 11.49 | 10.75 |
| Weibull shape, k | 1.42 | 1.77 | 1.68 | 2.33 | 1.67 | 1.85 | 1.70 | 1.65 | 1.69 | 1.92 | 2.32 | 2.21 |
| Weibull scale, A | 7.16 | 8.41 | 6.86 | 6.88 | 6.66 | 7.45 | 6.79 | 7.64 | 7.45 | 8.17 | 10.22 | 10.38 |

2.4.10 Climatology: Marys Harbour - 8502592_120m

***Table 2-30 Climatology characteristics including average wind speed (m/s) for all sectors, Weibull shape (k) and scale (A) parameters for all sectors at 120 m height.***

| | | | |
|---|---|---|---|
| File name | 8502592_120m | | |
| Period, # records | 01/01/2018 00:00 - 01/01/2021 00:00 | 25051 | |
| Position: easting, northing, z (agl) | 578563.0 | 5795342.0 | 120.0 |
| Average wind speed, Weibull k, A | 7.88 | 1.712 | 8.628 |

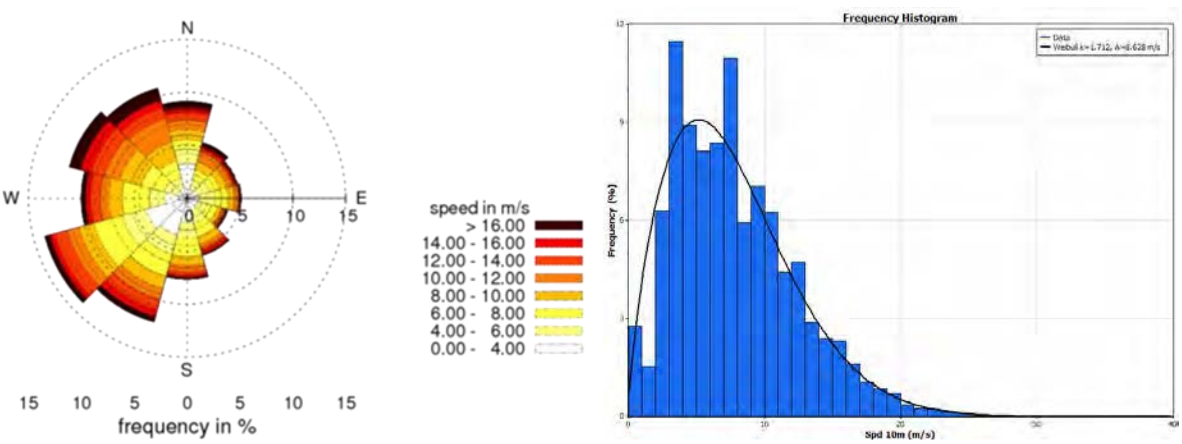



***Figure 2-19 Wind rose (left) and frequency distribution with Weibull fitting (right) for all sectors at 120 m height.***

***Table 2-31 Average wind speed, frequency and Weibull shape (k) and scale (A) parameters versus sector at 120 m height.***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average wind speed (m/s) | 6.75 | 8.41 | 7.11 | 6.43 | 6.79 | 7.28 | 6.75 | 7.56 | 7.31 | 7.95 | 9.85 | 10.02 |
| Frequency (%) | 9.14 | 5.44 | 4.92 | 5.11 | 4.00 | 5.57 | 7.64 | 12.06 | 13.90 | 9.98 | 11.49 | 10.75 |
| Weibull shape, k | 1.43 | 1.80 | 1.87 | 1.94 | 1.76 | 1.78 | 1.80 | 1.64 | 1.72 | 1.67 | 2.13 | 2.37 |
| Weibull scale, A | 8.00 | 9.21 | 7.85 | 7.04 | 7.38 | 7.91 | 7.48 | 8.22 | 8.12 | 8.31 | 10.85 | 11.53 |

## 3. WRF and CFD Modelling

WRF is used to prepare mesoscale wind data for the whole study area (nearshore and offshore) and CFD modeling is used to prepare high resolution wind data for nearshore areas. The CFD model is also used to transfer observed wind conditions at measurements point to higher elevations. This chapter describes the detailed settings for WRF and CFD models.

### *3.1 WRF Model*

The Weather Research and Forecasting (WRF) Model (Skamarock et al., 2019) is an open-source weather prediction model designed for both atmospheric research and operational forecasting applications. The WRF model serves a wide range of multi-scale applications, from the synoptic scale of thousands of kilometers down to microscale of tens of meters. In this study WRF version 4.6.1 has been used which can be download from Github repositories: https://github.com/wrf-model/WRF.
WRF model has been run in non-hydrostatic mode. For upper boundary conditions, radiative boundary condition or sponge layer (Rayleigh damping) is applied to prevent reflection of upward-propagating waves. We have defined one domain with 9km × 9km horizontal resolution (Figure 3-1). 38 vertical layers have been defined in the domain. Initial and lateral boundary conditions for WRF model obtained from ERA5 ECMWF dataset. ERA5 is a reanalysis dataset which combines model data with observations from across the world. ERA5 is available as an hourly dataset with a resolution of 0.25° (roughly 27 km). Some physical parameterizations which have been used in the simulations are shown in Table 3-1.

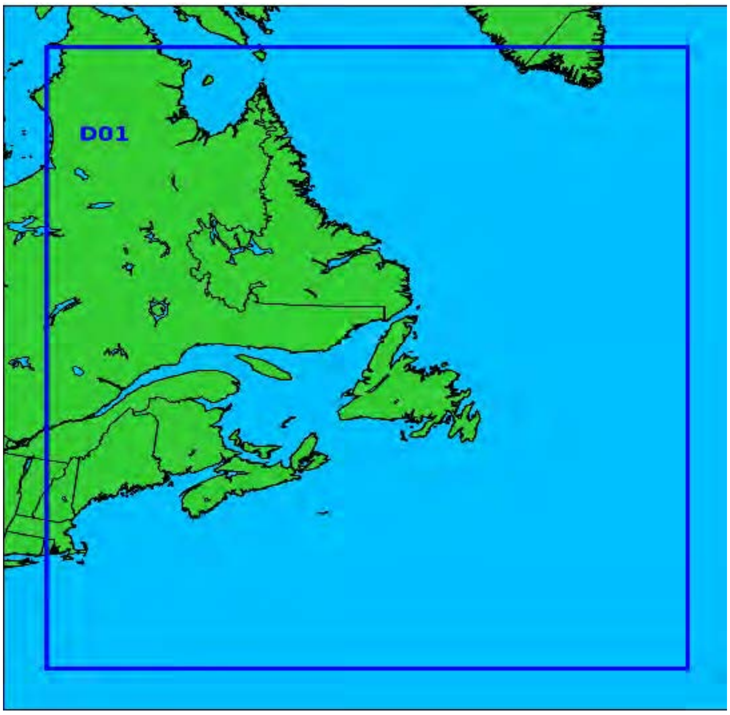



***Figure 3-1 WRF domain***

***Table 3-1 Some physics options used in the WRF simulations***

| Physics | Module |
|---|---|
| Micro physics | Thompson (Thompson et al., 2008) |
| Cumulus | Tiedtke scheme (Zhang et al., 2011) |
| Planetary boundary layer | Mellor – Yamada Nakanishi Niino Level 2.5 (MYNN2) (Nakanishi and Niino, 2006) |
| Surface layer | MYNN |
| Land surface | Unified Noah Land Surface Model |

### *3.2 CFD Model and MMC*

CFD model is used for nearshore wind simulation with a horizontal resolution of less than 100 m × 100 m. More than 100 CFD simulations have been conducted, with domain boundaries as illustrated in Figure 3-2. Some of the CFD models have been excluded from more analysis because of convergence issues in the solution.

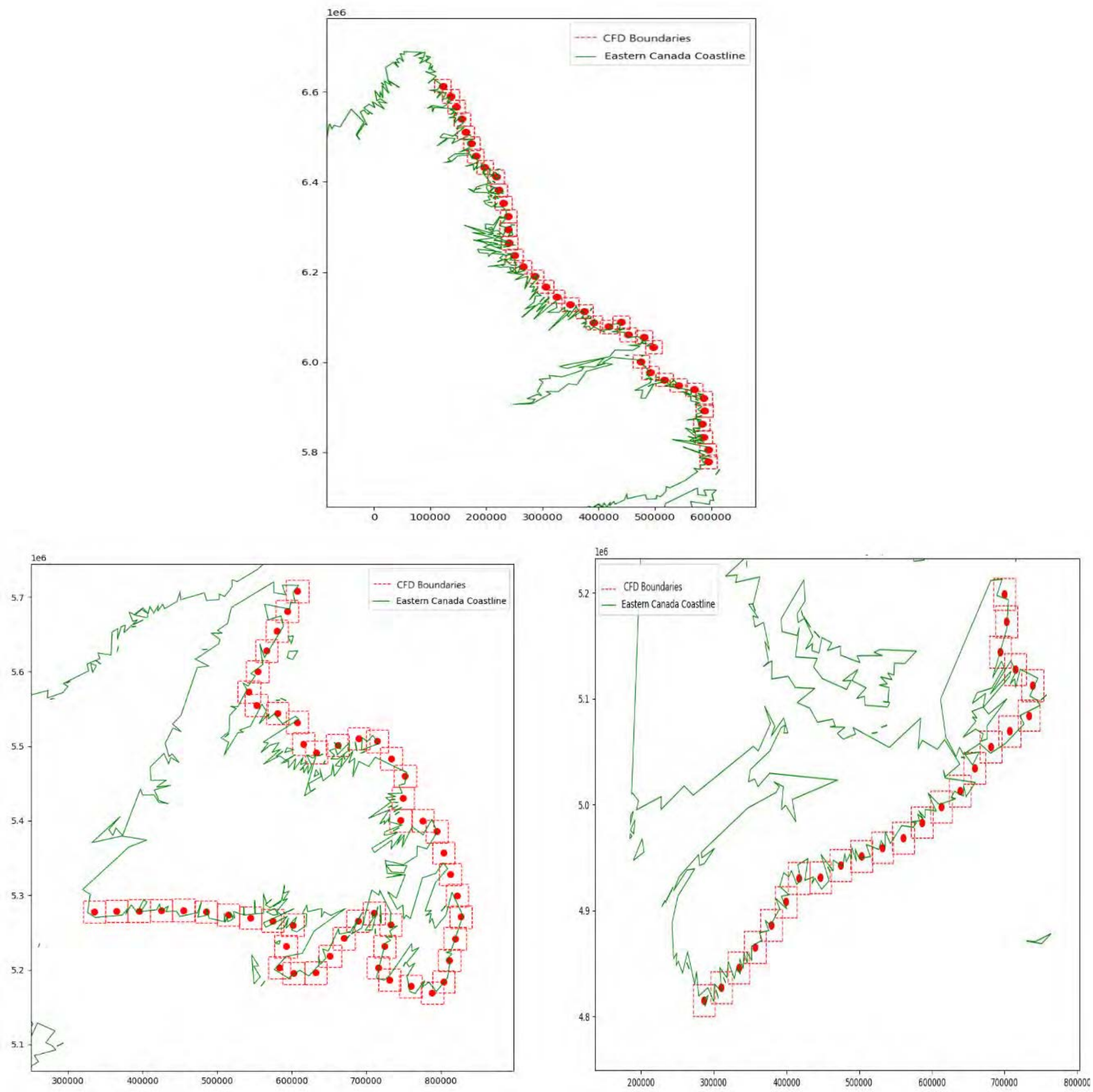



***Figure 3-2 CFD domains boundaries which have been defined in this project***

Since the number of CFD simulations is very large (more than 100 CFD models), for simplicity, we only show a sample setup for one of the CFD simulations.

### 3.2.1 Digital terrain model

To run a CFD simulation, we need high resolution topography and roughness data. A digital terrain model containing elevation and roughness data has been established for the area given in Figure 3-3. Note that the underlying datasets for elevation and roughness might have different resolutions. The ArcGIS online resources have been used for elevation and roughness which have different horizontal resolution in different areas. For example, the resolution of topography features in Nova Scotia is about 1 m and Newfoundland is about 25 m.

***Table 3-2 Coordinates, extensions and resolution of the digital terrain model for one sample CFD simulation***

| | Min (m) | Max (m) | Extension (m) | Resolution Terrain Data (m) |
|---|---|---|---|---|
| Easting (m) | 684356.7 | 720493.1 | 36136.4 | Variable |
| Northing (m) | 5154991.0 | 5191127.0 | 36136.5 | Variable |

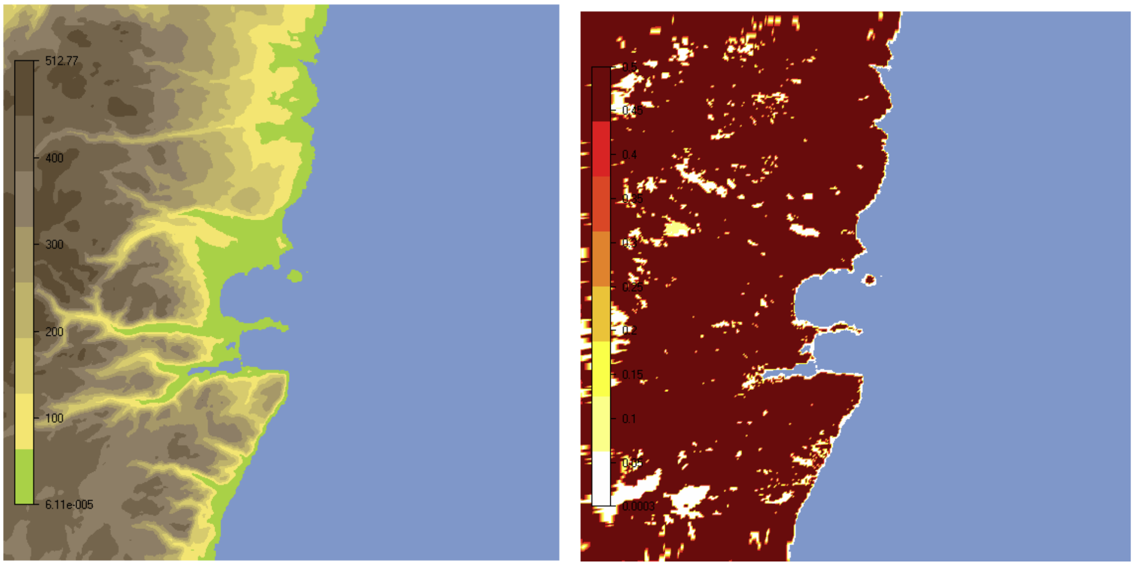



Figure 3-3 Terrain elevation (m) (left) and roughness (m) (right) for one sample CFD simulation

### 3.2.2 3D model setup

The elevation and roughness data defined above is used to define the ground level of a three-dimensional domain divided into cells with a variable horizontal and vertical resolution. The grid is generated and optimized from the digital terrain model, as seen in Figure 3-4.

***Table 3-3 Grid spacing and number of cells***

| | Easting | Northing | Z | Total |
|---|---|---|---|---|
| Grid spacing (m) | 93.0-575.5 | 93.3-480.4 | Variable | - |
| Number of cells | 333 | 350 | 30 | 3496500 |

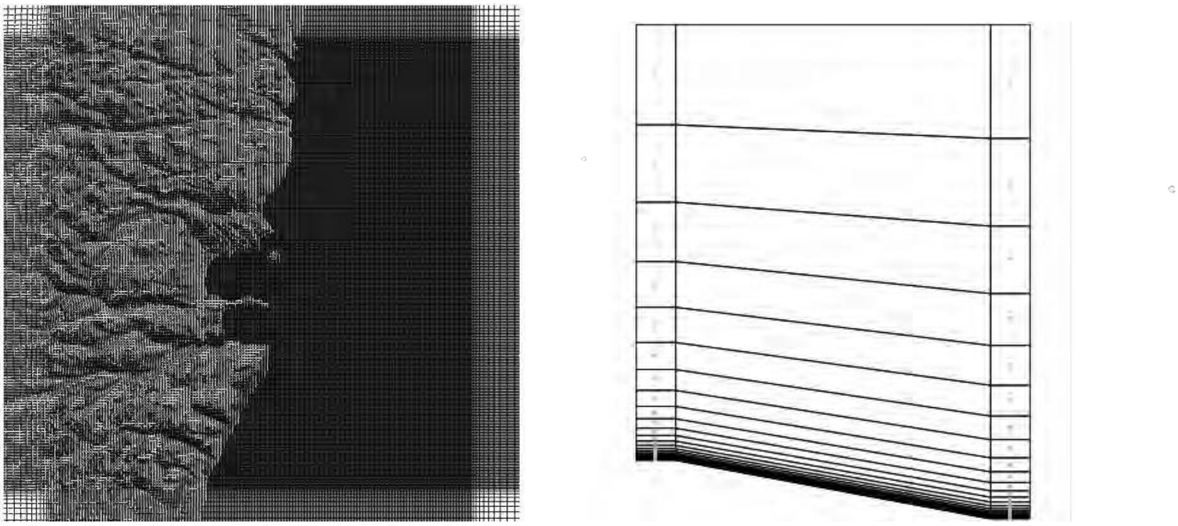


***Figure 3-4 Horizontal grid resolution (left) and schematic view of the vertical grid resolution (right) for one sample CFD simulation***

The grid extends 3826.8 (m) above the point in the terrain with the highest elevation. The grid is refined towards the ground. The left and right columns display a schematic view of the distribution at the position with maximum and minimum elevation respectively. The nodes, where results from the simulations are available, are situated in the cell centers indicated by dots.

***Table 3-4 Distribution of the first 10 nodes in z-direction, relative to the ground, at the position with maximum and minimum elevation for one sample CFD simulation***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| z-dist. max (m) | 1.0 | 3.0 | 5.0 | 7.0 | 9.0 | 11.0 | 13.1 | 15.5 | 18.6 | 22.7 |
| z-dist. min (m) | 1.0 | 3.0 | 5.0 | 7.0 | 9.0 | 11.0 | 13.2 | 15.9 | 19.5 | 24.2 |

### 3.2.3 Simulations

The digital model represents the computational domain where the Reynolds averaged Navier – Stokes equations have been numerically solved. In total 12 simulations have been performed in order to have a 3D wind field for every 30-degree sector. Table 3-5 shows the configuration of the CFD simulations used in all the CFD simulations.

***Table 3-5 Solver settings***

| | |
|---|---|
| Height of boundary layer (m) | 500.0 |
| Speed above boundary layer (m/s) | 10.0 |
| Boundary condition at the top | fix pres. |
| Potential temperature | No |
| Turbulence model | Re-Normalisation Group (RNG) Turbulence model |
| Solver | GCV |
| Maximum iterations | 999 |

# 4. Results

In this section, selected results from the WRF and meso-micro coupling simulations have been presented. As previously mentioned, due to the large dataset size, the study area was divided into eight zones. Here, we provide wind resource maps for each of these zones, derived from three years (2018–2020) of WRF and CFD simulations.

## *4.1 WRF simulation resource map*

The wind resource map is used to identify high wind speed area based on the average wind speed. Wind resource maps at 120m above ground are shown in Figure 4-1 - Figure 4-8.

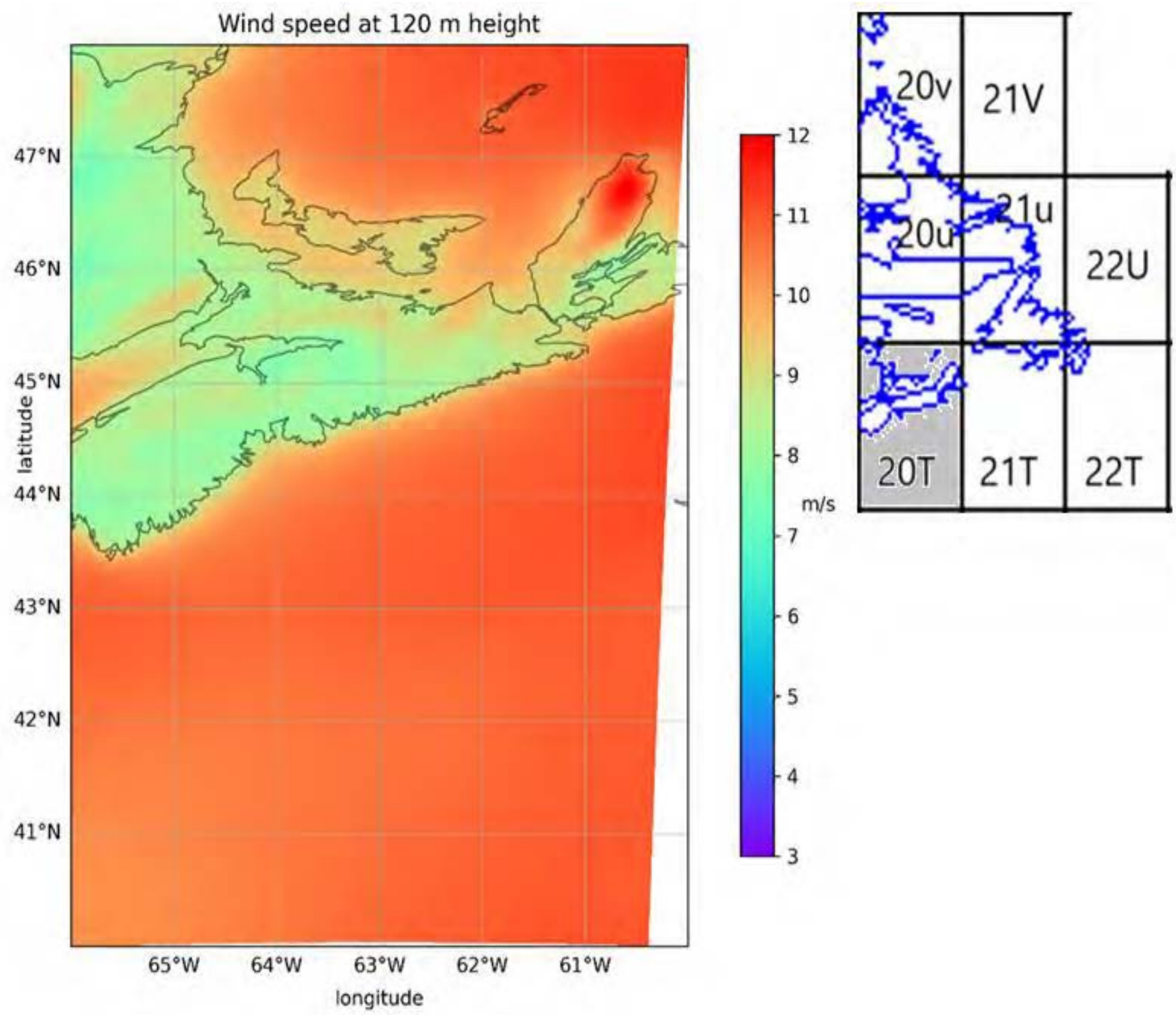



***Figure 4-1 WRF-simulated mean wind speed (during 2018-2020) at 120m height for zone 20T. The grey area in the right panel shows the location of the plotted area.***

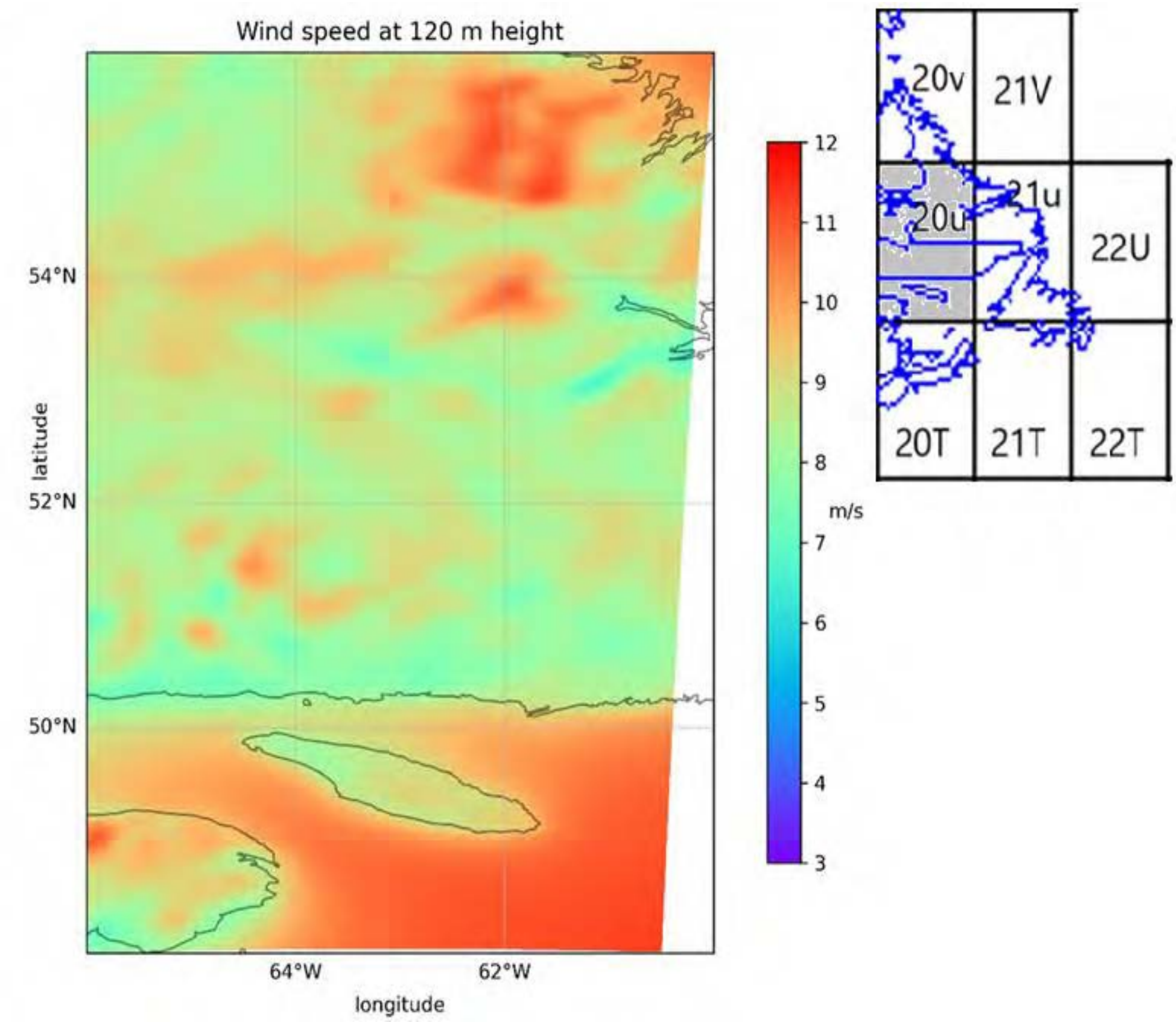



***Figure 4-2 WRF-simulated mean wind speed (during 2018-2020) at 120m height for zone 20U. The grey area in the right panel shows the location of the plotted area.***

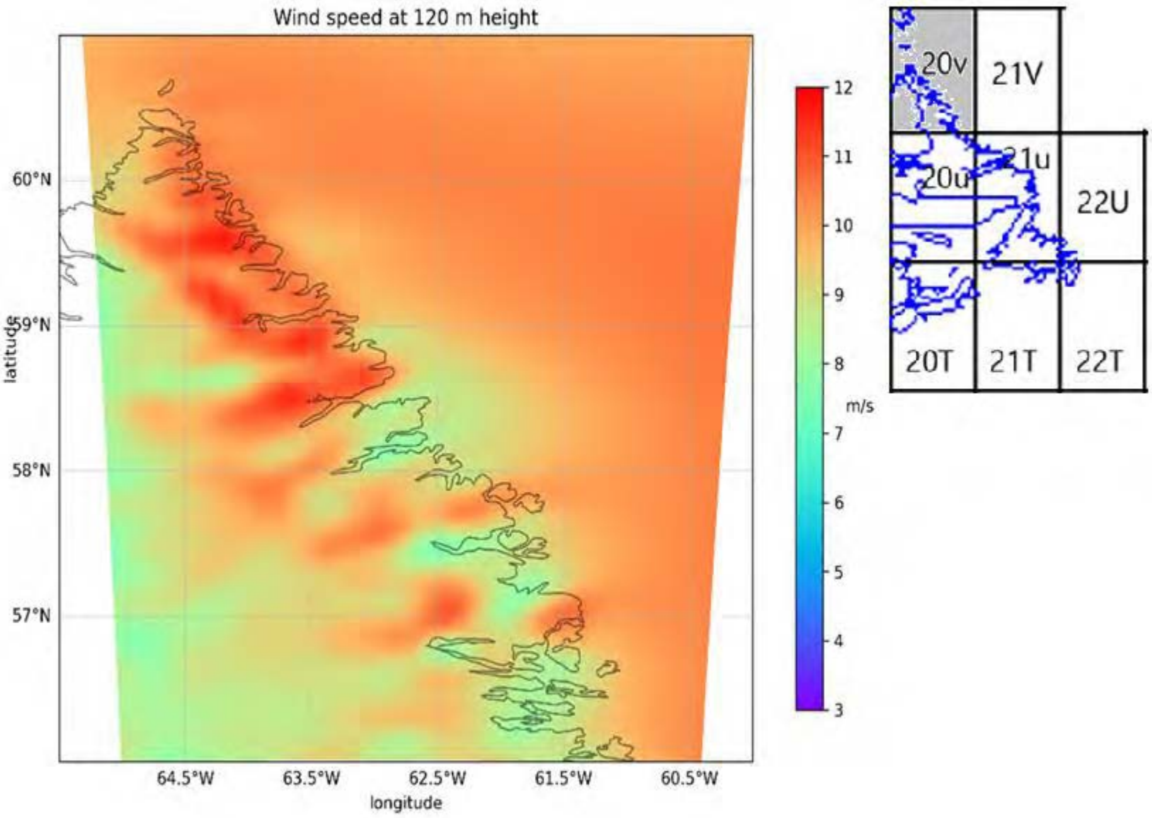



***Figure 4-3 WRF-simulated mean wind speed (during 2018-2020) at 120m height for zone 20V. The grey area in the right panel shows the location of the plotted area.***

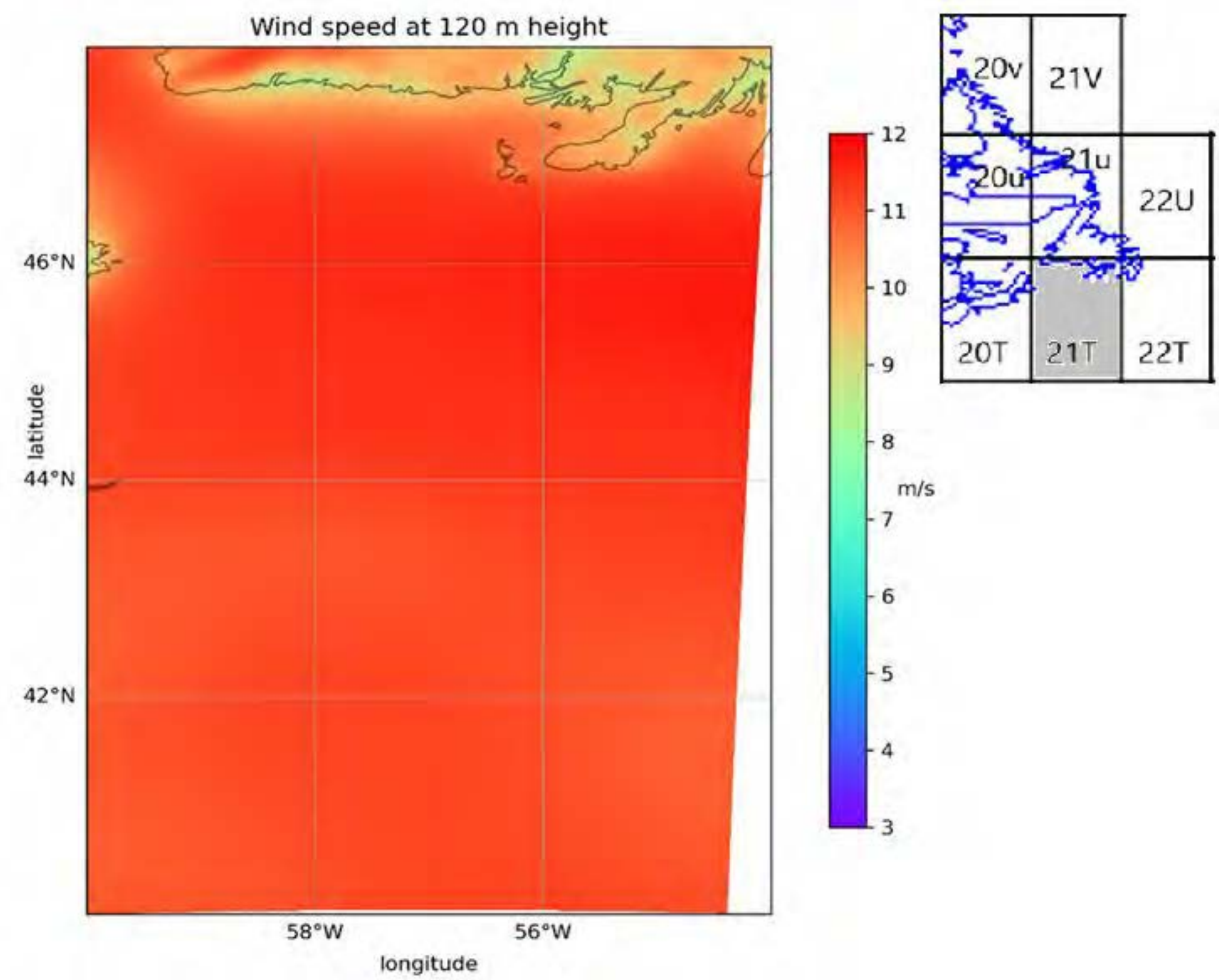



***Figure 4-4 WRF-simulated mean wind speed (during 2018-2020) at 120m height for zone 21T. The grey area in the right panel shows the location of the plotted area.***

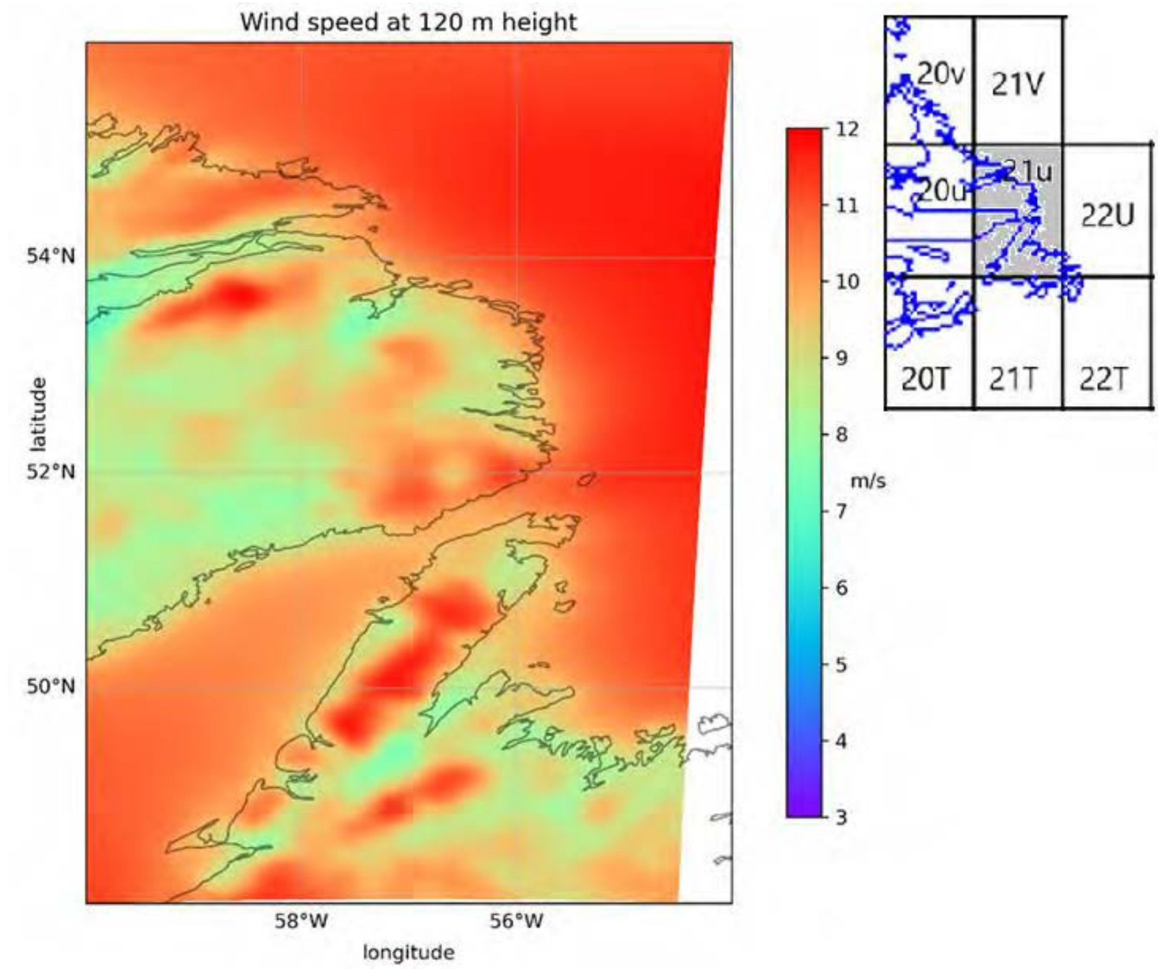



***Figure 4-5 WRF-simulated mean wind speed (during 2018-2020) at 120m height for zone 21U. The grey area in the right panel shows the location of the plotted area.***

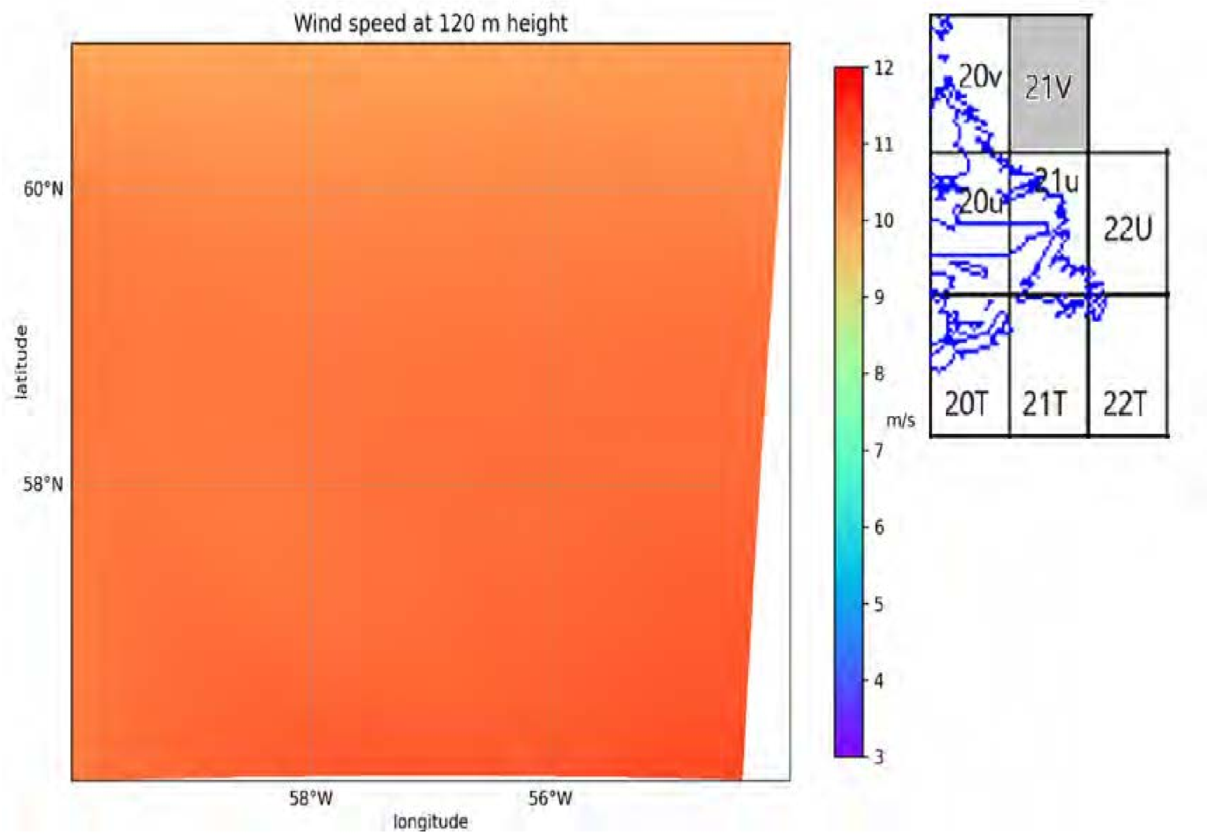



***Figure 4-6 WRF-simulated mean wind speed (during 2018-2020) at 120m height for zone 21V. The grey area in the right panel shows the location of the plotted area.***

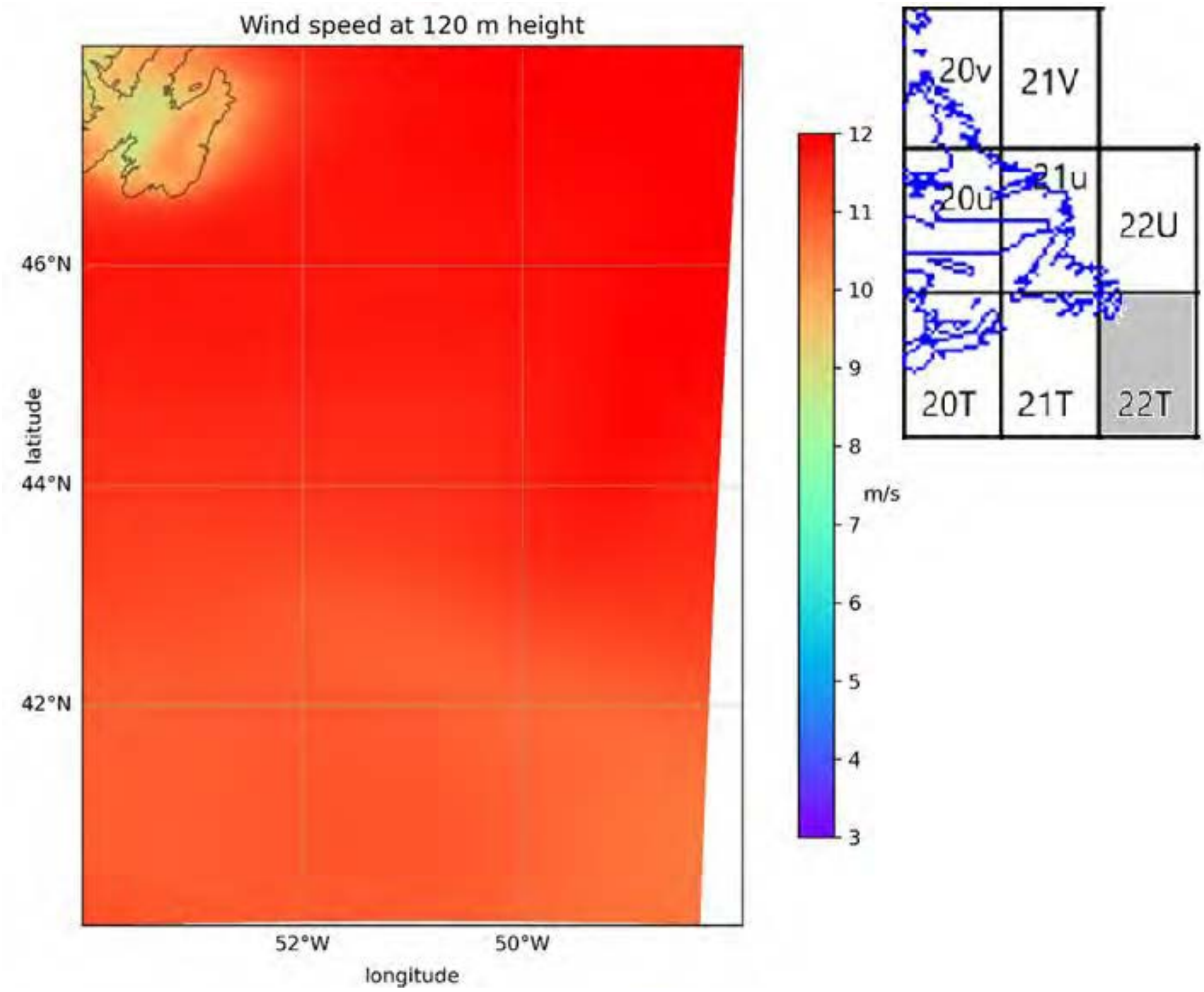



***Figure 4-7 WRF-simulated mean wind speed (during 2018-2020) at 120m height for zone 22T. The grey area in the right panel shows the location of the plotted area.***

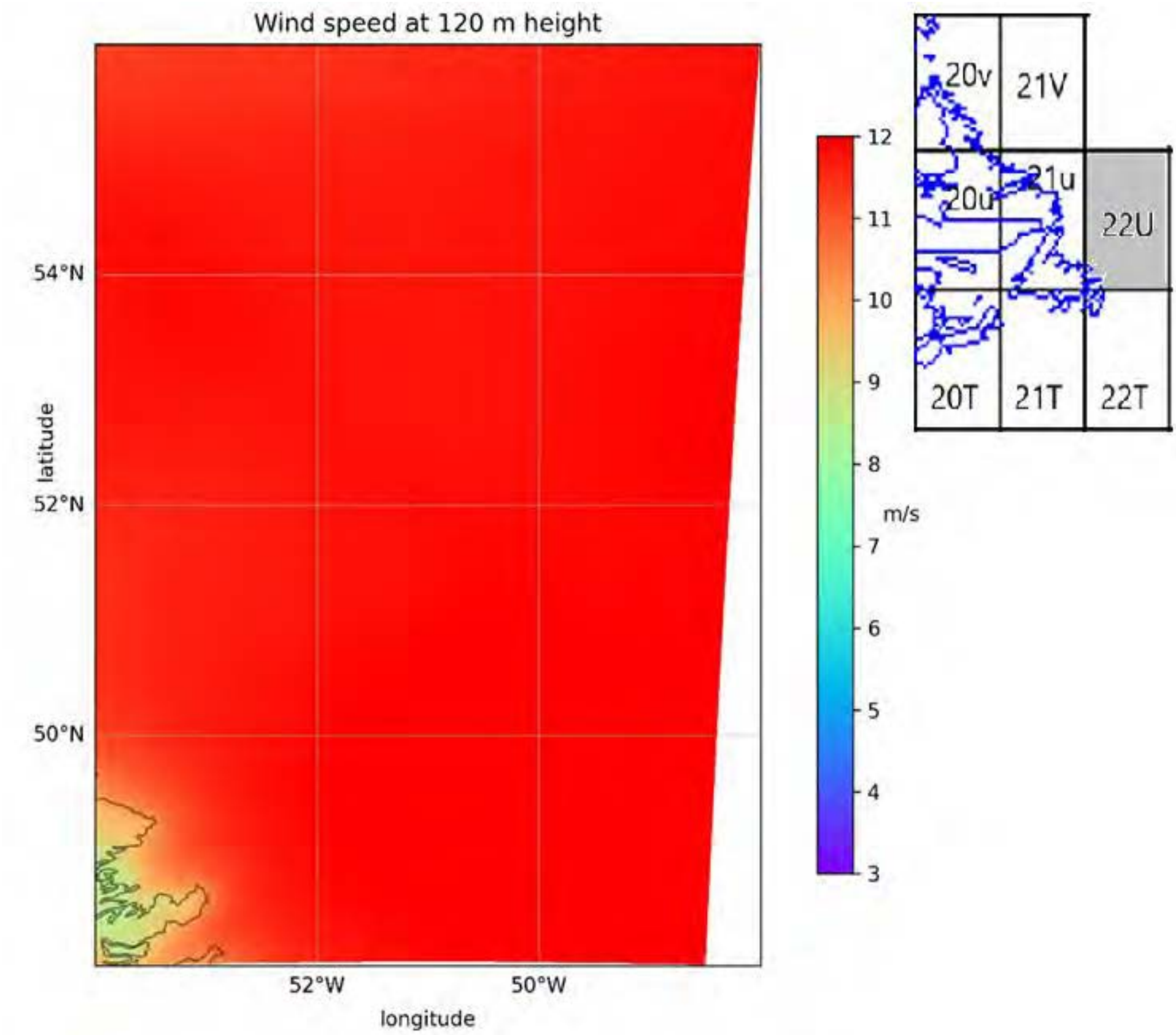



***Figure 4-8 WRF-simulated mean wind speed (during 2018-2020) at 120m height for zone 22U. The grey area in the right panel shows the location of the plotted area.***

### 4.2 Merged WRF and MMC results

For the Meso-Micro Coupling (MMC) approach, CFD simulations were conducted for over 100 domains along the coastline, with results scaled against WRF data. The MMC outputs were then merged with WRF simulations to generate a final time-series dataset. Selected results from this merged dataset are presented here. Figure 4-9 - Figure 4-12 show mean wind speed at 120 m height for some of the subzonesThe merged datasets reveal microscale features along the coastline.

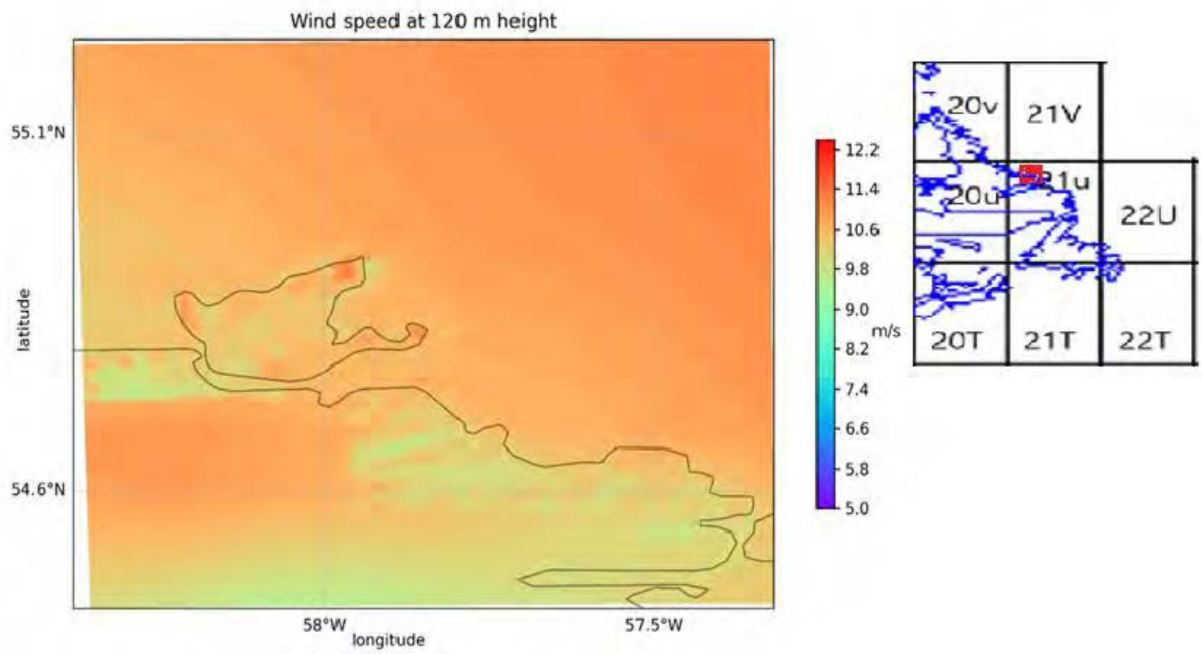



***Figure 4-9 Mean wind speed (during 2018-2020) at 120 m height for the subzone 008_002 in zone 21U in Newfoundland area. Extracted from merged WRF and MMC results. The red box in the right panel indicates the location of the plotted area.***

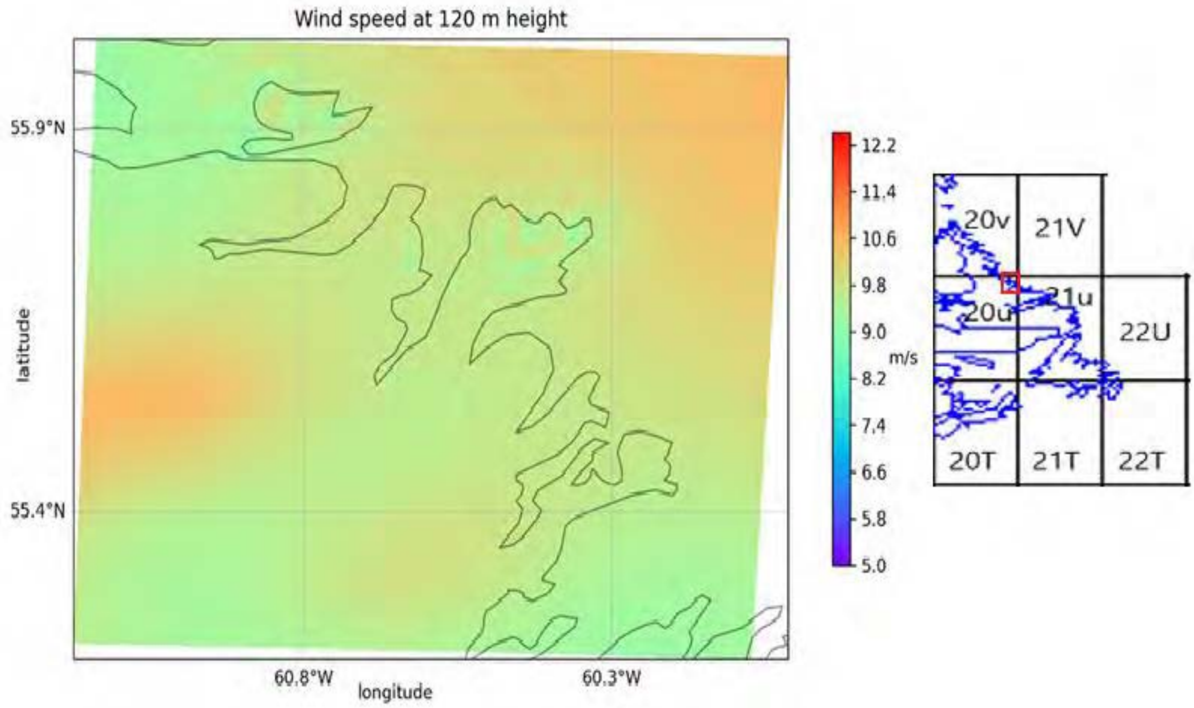



***Figure 4-10 Mean wind speed (during 2018-2020) at 120 m height for subzone 009_005 in zone 20U in Newfoundland area. Extracted from merged WRF and MMC results. The red box in the right panel indicates the location of the plotted area.***

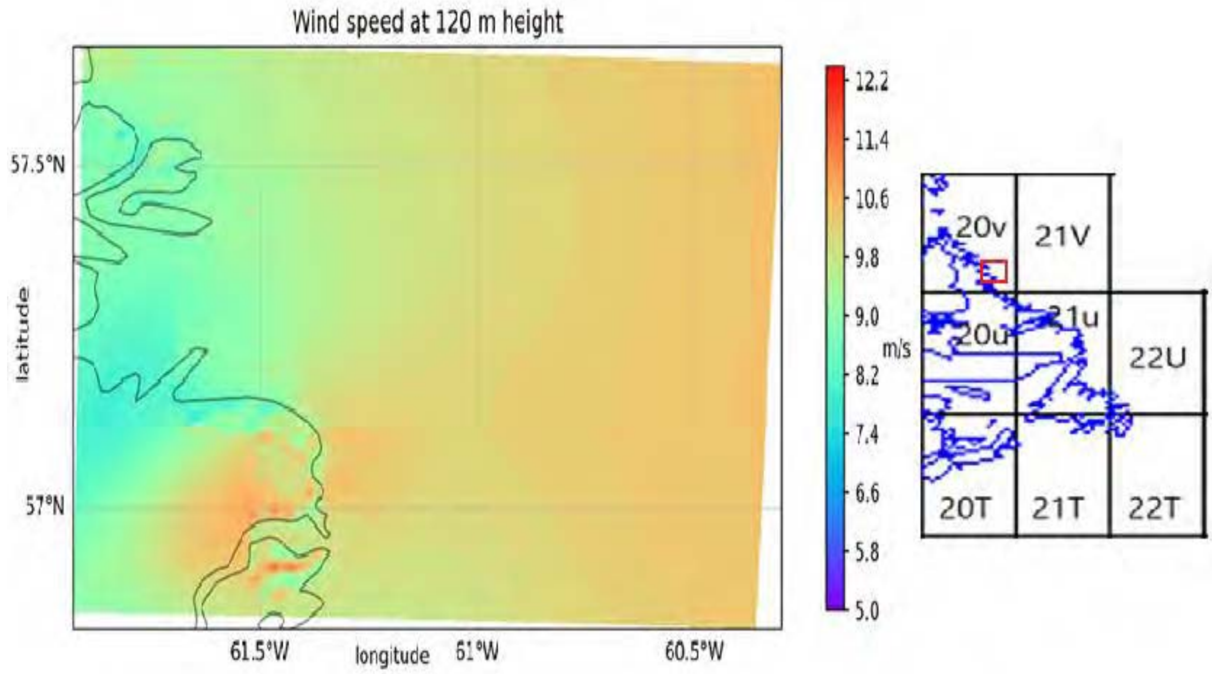



***Figure 4-11 Mean wind speed (during 2018-2020) at 120 m height for subzone 001_002 in zone 20V in Newfoundland area. Extracted from merged WRF and MMC results. The red box in the right panel indicates the location of the plotted area.***

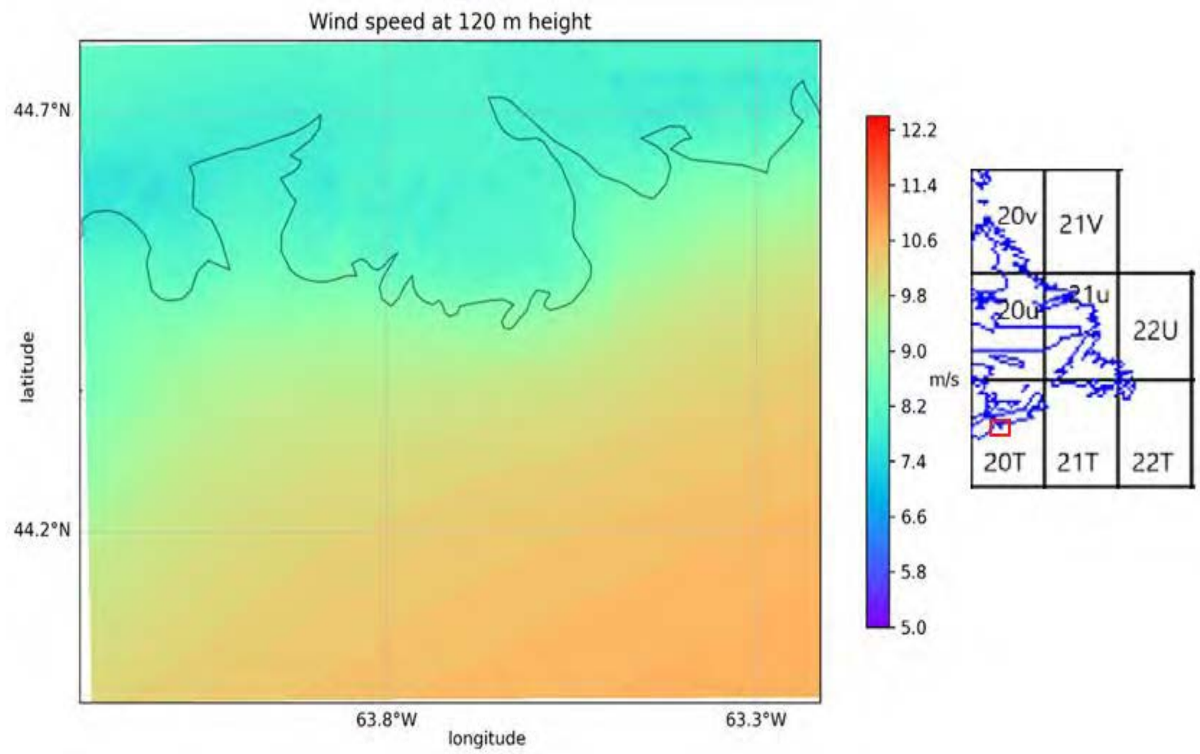



***Figure 4-12 Mean wind speed (during 2018-2020) at 120 m height for subzone 005_002 in zone 20T in Nova Scotia area. Extracted from merged WRF and MMC results. The red box in the right panel indicates the location of the plotted area.***

### 4.3 Evaluation of the model

In this section, we compared the WRF-MMC simulated results and the lifted observation data. Table 1 shows the bias values for the five measurement sites whose data were lifted up to a height of 120 m. Minimum and maximum bias values are at Saglek and Mary's Harbor with 4.9 % and 17 % respectively. High relative bias suggests systematic model errors, which may be due to complexity in terrain or roughness changes, especially along the boundaries and errors in vertical extrapolation from observation height to 120 m. High RMSE at Cape Race and Mary's Harbor shows large fluctuations or error variance that may stem from complex coastal effects and incomplete or noisy observation data. Correlations values range from 60% (Saglek, Cape Race) to 81% (Halifax). Lower correlation (especially around 60%) implies the model does not track the observed temporal trends well, even if the mean or bias is acceptable. For example, Saglek has the lowest bias (4.9%), but also the lowest correlation (60%), indicating that while the mean is accurate, day-to-day variability is poorly captured.
The simulated wind speed time series and wind roses demonstrate good agreement with the observed data in some stations. But as we mentioned earlier, uncertainty in the observational dataset will introduce a lot of uncertainty into our model evaluation analysis.

***Table 4-1 Relative bias at 5 observation sites***

| Station | Relative Bias (%) | RMSE | Correlation (R) % |
|---|---|---|---|
| Halifax | 16 | 2.92 | 81 |
| Shear Water | 7 | 3.10 | 75 |
| Mary's Harbor | 17 | 4.34 | 61 |
| Cape race | 13 | 6.08 | 62 |
| Saglek | 4.9 | 5.17 | 60 |

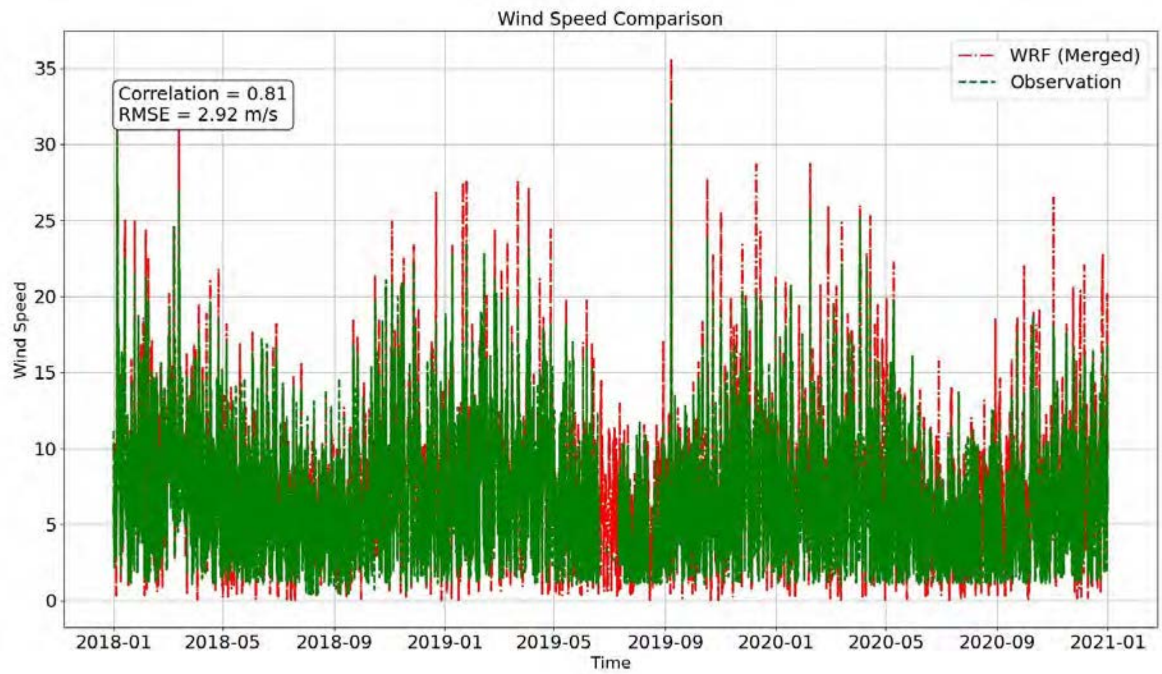



***Figure 4-13 Wind speed time series for station Halifax (8202252). The red line shows WRF-MMC results and green line shows observation data.***

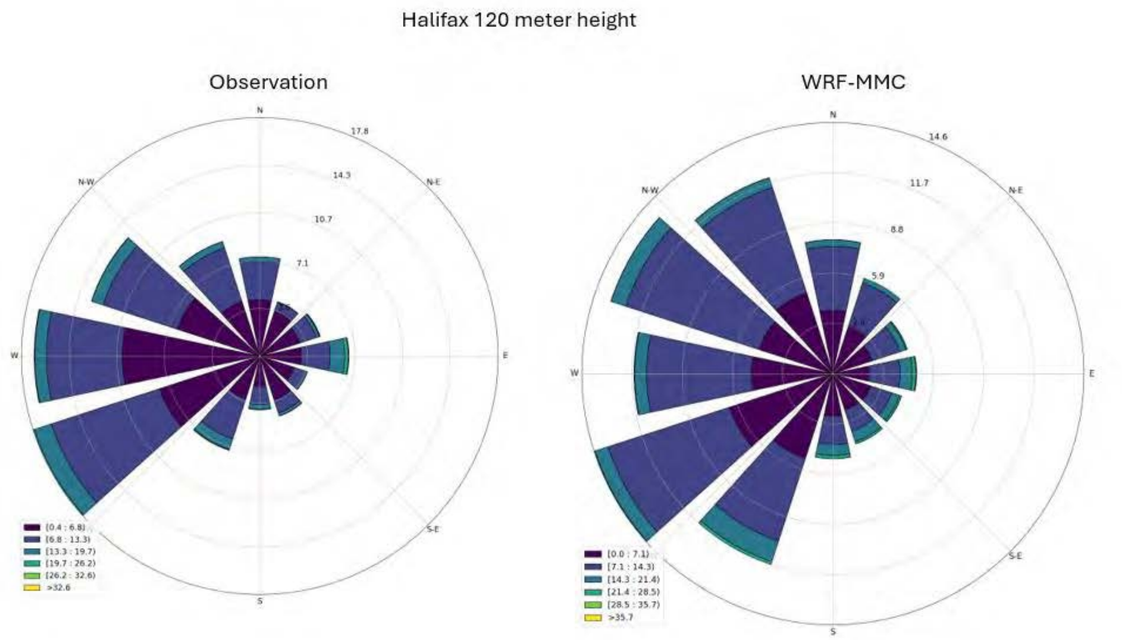



***Figure 4-14 Wind rose for station Halifax (8202252). Left panel: observed data; right panel: WRF-MMC simulation results.***

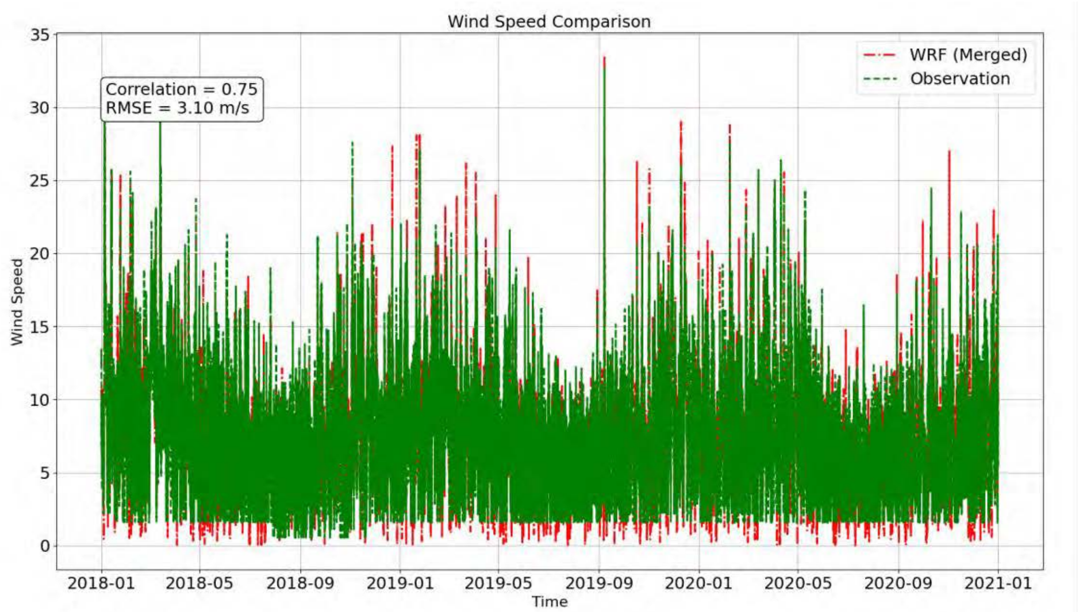



***Figure 4-15 Wind speed time series for station Shearwater (8205092). The red line shows WRF-MMC results and green line shows observation data.***

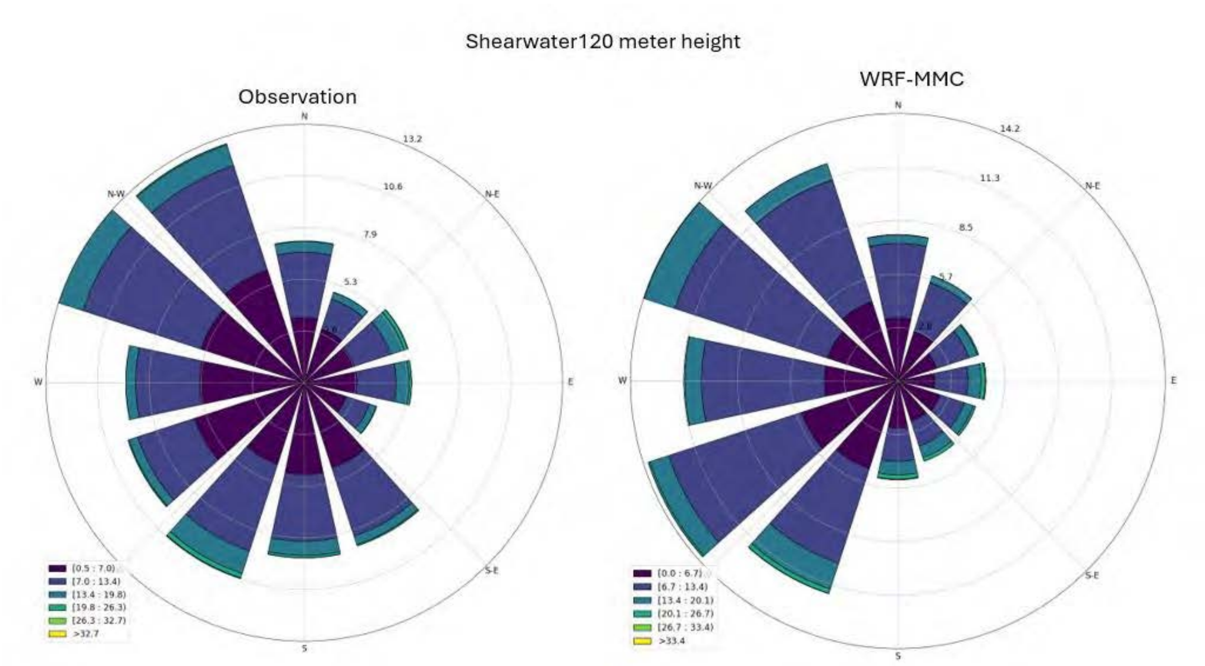



***Figure 4-16 Wind rose for station Shearwater (8205092). Left panel: observed data; right panel: WRF-MMC simulation results.***

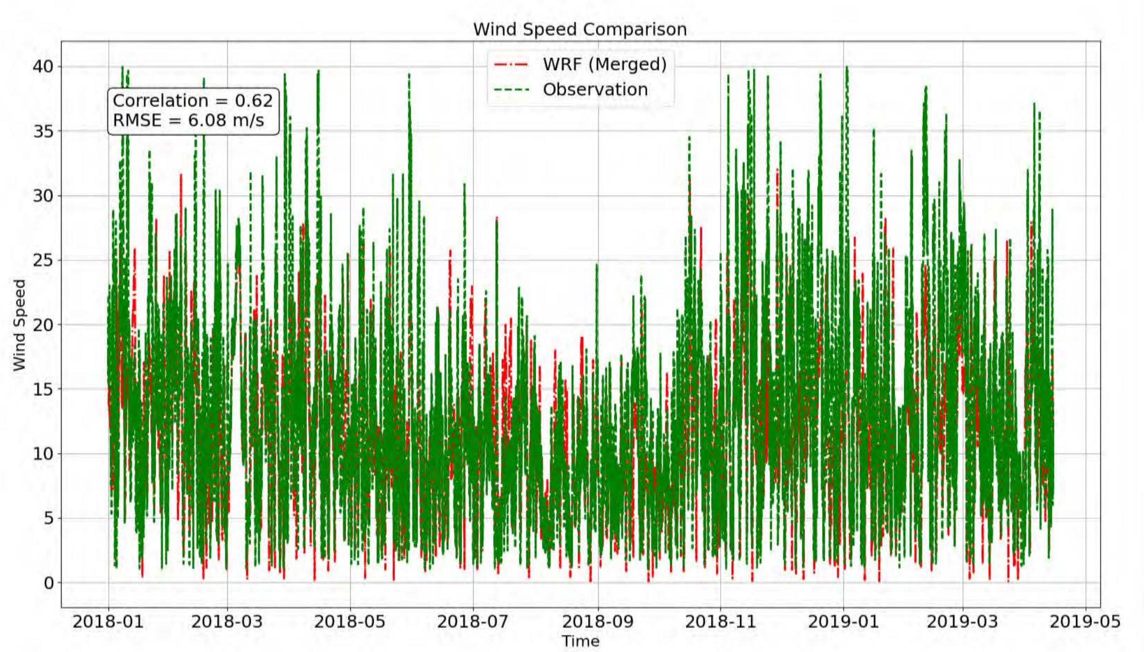



***Figure 4-17 Wind speed time series for station Cape Race (8401000). The red line shows WRF-MMC results and green line shows observation data.***

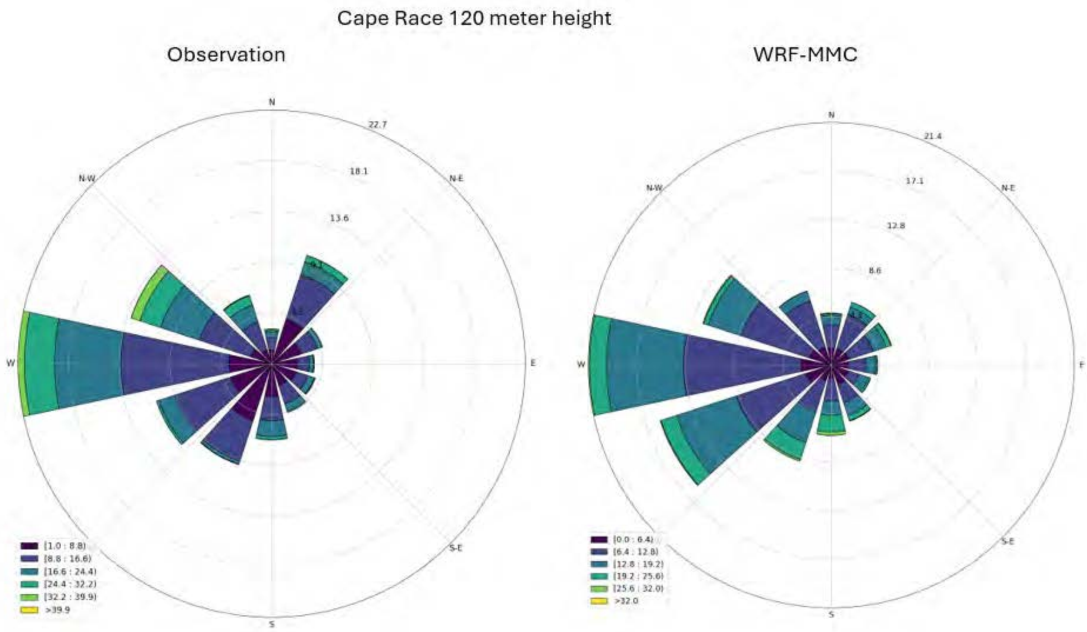



***Figure 4-18 Wind rose for station CapeRace (8401000). Left panel: observed data; right panel: WRF-MMC simulation results.***

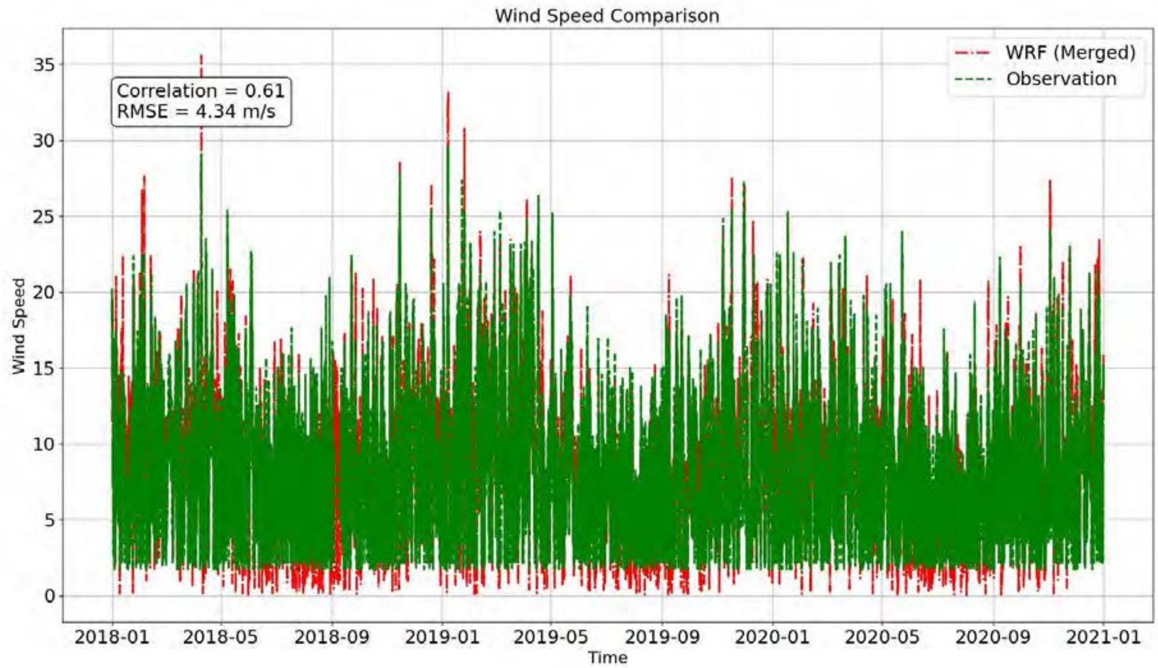



***Figure 4-19 Wind speed time series for station Marys Harbour (8502592). The red line shows WRF-MMC results and green line shows observation data.***

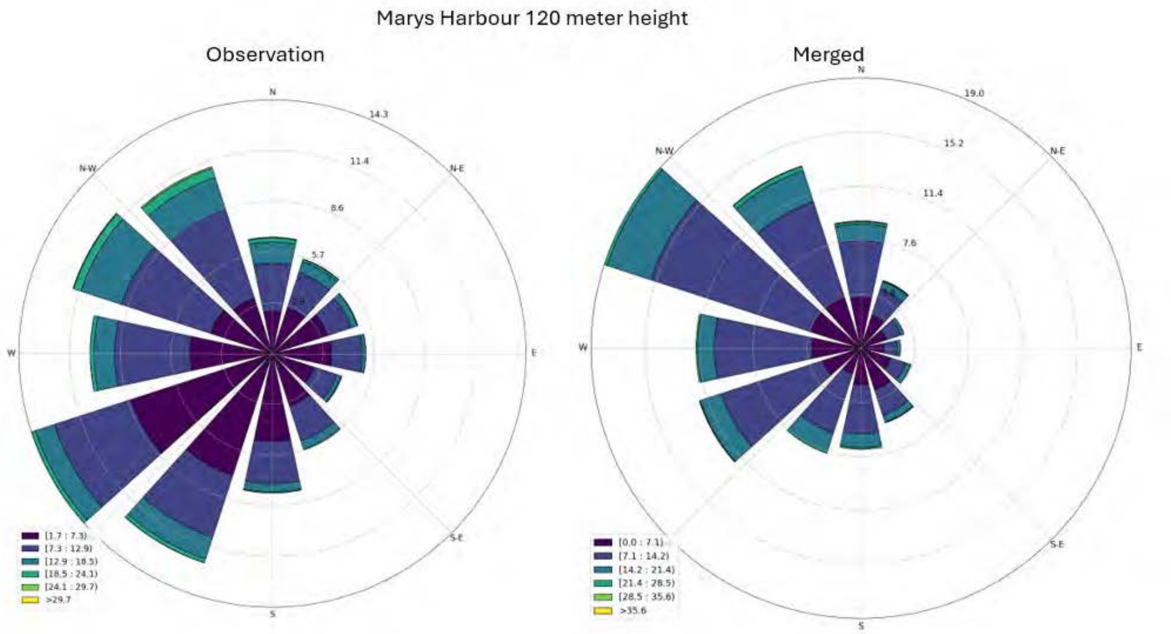



***Figure 4-20 Wind rose for station Marys Harbour (8502592). Left panel: observed data; right panel: WRF-MMC simulation results.***

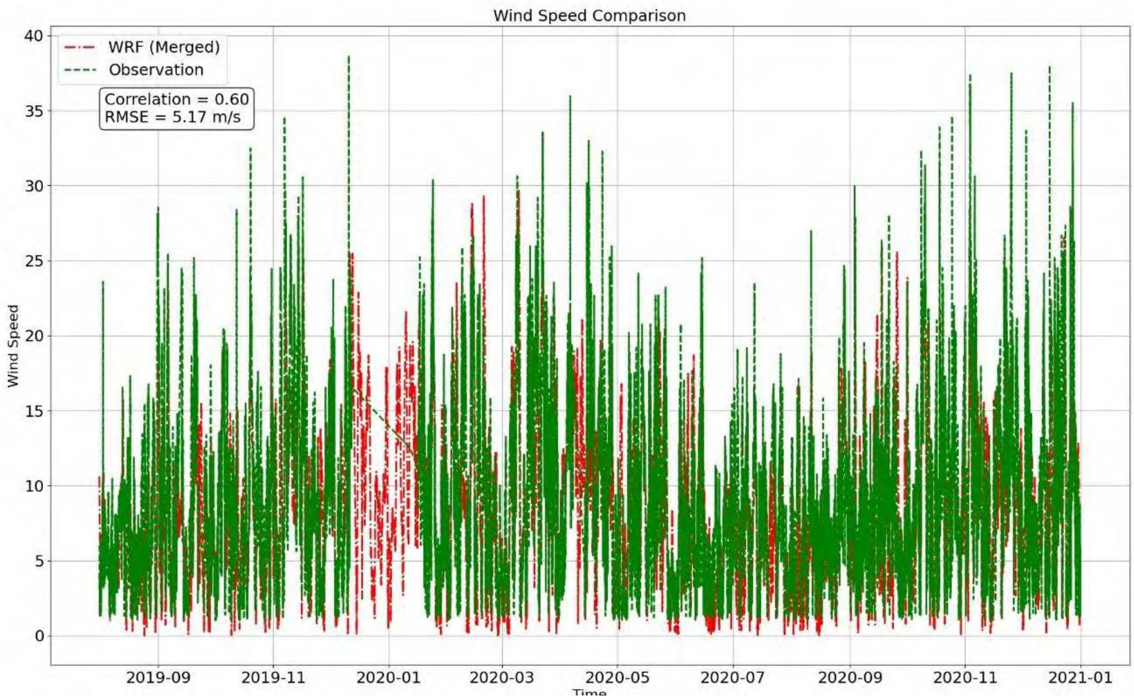



***Figure 4-21 Wind speed time series for station Saglek (8503249). The red line shows WRF-MMC results and green line shows observation data.***

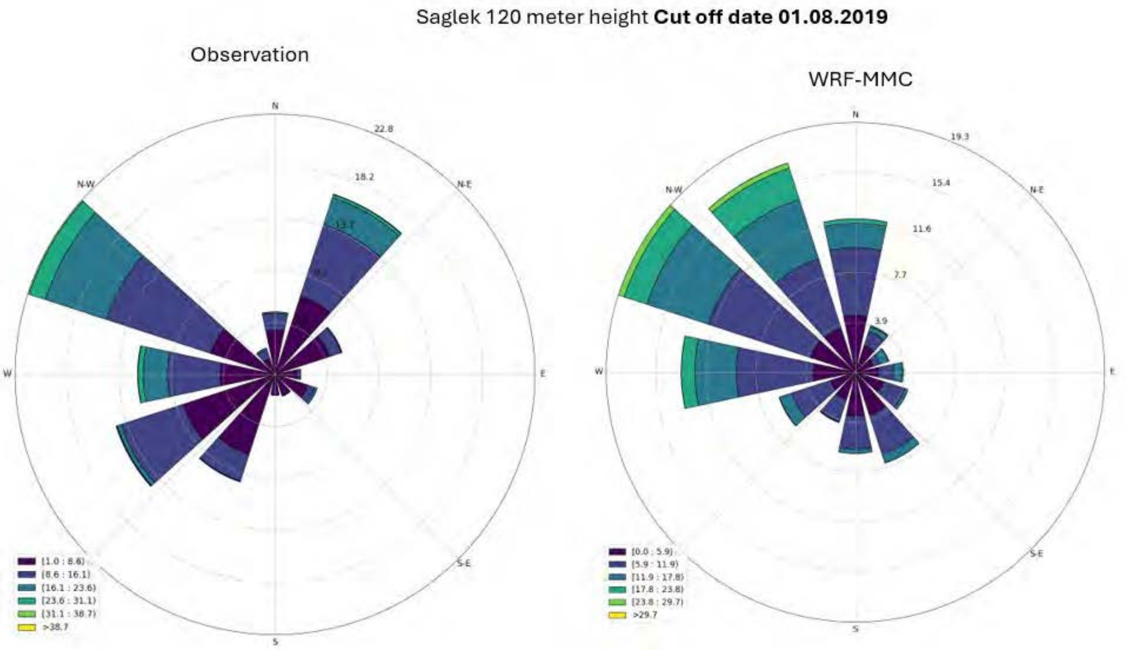



***Figure 4-22 Wind rose for station Saglek (8503249). Left panel: observed data; right panel: WRF-MMC simulation results.***

## 5. Deliverables

The deliverables of this project are in table.

| File(s) name | Descroiption |
|---|---|
| 20250430_Stantec_Offshore Wind Resource Potential Study.pdf | Project report file |
| timeseries_1km_{Height}_{UTM_Zone}_{nnn_mmm}_all.nc | Timeseries dataset from WRF simulations in Netcdf format.<br>{height}: 120m and 80m.<br>{UTM_Zone}: 20t, 20u, 20v, 21t, 21u, 21v, 22t, 22u<br>mmm and nnn: indicate the index of subzones in y- and x- directions |
| merged_timeseries_1km_{Height}_{UTM_Zone}_{nnn_mmm}_all.nc | Merged WRF and CFD simulations timeseries datset in Netcdf format.<br>The naming convention is the same as WRF timeseries. |
| Lifted-up_climatologies.zip | Includes timeseries data at 5 lifted-up observation sites in tws format. |

# 6. Appendix

## *6.1 Appendix 1: Naming convention for subzones*

The naming convention has been used for each subzone shows in Figure 6-1.

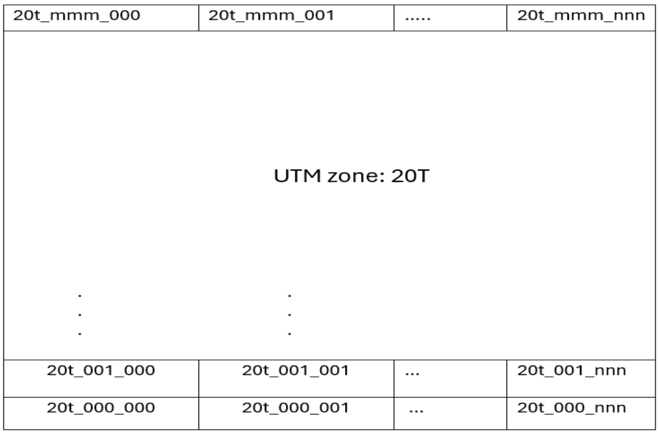



***Figure 6-1 Naming convention for subzones, here for example for zone 20T.***

Each zone is divided to “mmm” parts in y-direction and “nnn” parts in x-direction, where mmm and nnn indicate the index of subzones in y- and x- directions, respectively.

## *6.2 Appendix 2: Merging WRG and MMC results*

To merge the WRG and MMC results datasets, we iterate through each WRF data point and identify m neighboring points within 1000 meters radius. The weight wj of a neighboring MMC point is based on inverse distance weighting,

$$w_j = \frac{\frac{1}{d_j}}{\sum_{k=1}^{m} \frac{1}{d_k}}, \qquad (1)$$

where $\mathrm{d}$ is the distance from neighboring MMC point to the WRF data point (indices referring to the neighbor index), such that

$$\sum_{k=1}^{m} w_k = 1. \qquad (2)$$

The horizontal velocity components $u_{\mathrm{MMC}}$ and $v_{\mathrm{MMC}}$ sums up the results from the $m$ neighboring points

$$u_{\mathrm{MMC}} = \sum_{k=1}^{m} -w_k \, sin(\theta_k)\, U_k, \qquad (3)$$

$$v_{\mathrm{MMC}} = \sum_{k=1}^{m} -w_k \, cos(\theta_k)\, U_k. \qquad (4)$$

Here, $U_k$ is the wind speed at neighbouring point $k$, $\theta_k$ is the wind direction defined according to meteorological convention, with zero degrees from the north increasing clockwise. To account for the overpronounced wake effects in the CFD (MMC) results offshore, we gradually increase the contribution of the MMC data offshore. This is achieved by applying a Gaussian weighting function for WRF data point $i$,

$$W_{\mathrm{WRF},i} = 0.5 + 0.5\left(1 - e^{\frac{d_{coast,i}^{2}}{2\sigma^{2}}}\right), \qquad (5)$$

where $d_{coast,i}$ is the distance from the WRF data point to the coast, and $\sigma = 5\ \mathrm{km}$ is the standard deviation for a point to the coastline. The MMC results at the given data point is weighed with

$$W_{\mathrm{MMC},i} = 1 - W_{\mathrm{WRF},i}. \qquad (6)$$

Figure 6-2 shows distribution of the weights for merging WRF and MMC simulation results in one the subzones.

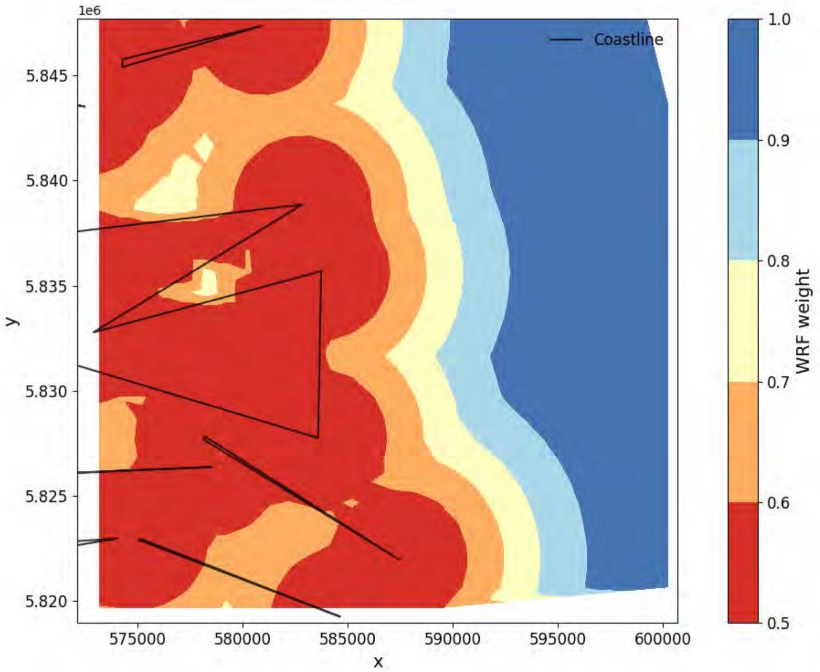



***Figure 6-2 Weights applied to one of the MMC and WRF merged dataset. The black lines show coastlines and shaded colors show weights.***

The velocity components are merged in data point $i$ according to

$$u_{\mathrm{merged},i} = -W_{\mathrm{WRF},i} u_i \sin(\theta_i) + W_{\mathrm{MMC},i} u_{\mathrm{MMC}}, \qquad (7)$$

$$v_{\mathrm{merged},i} = -W_{WRF,i} v_i \cos(\theta_i) + W_{\mathrm{MMC},i} v_{\mathrm{MMC}}. \qquad (8)$$

The wind speed and direction are finally calculated as

$$| u |_i = \sqrt{u^2_{\mathrm{merged},i} + v^2_{\mathrm{merged},i}}, \qquad (9)$$

$$\theta_i = \arctan \frac{u_{\mathrm{merged},i}}{v_{\mathrm{merged},i}}. \qquad (10)$$

### *6.3 Appendix 3: December 2024 report*

Please see attached separate file “20241220_Stantec_Offshore Wind Resource Potential Study_V2.pdf”

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**Stantec Consulting Ltd.**
200-835 Paramount Drive
Stoney Creek ON  L8J 0B4
stantec.com

# Appendix B Economic and Cost Calculation Assumptions (Offshore Wind Economic Report)

# Offshore Wind Economic Report

Offshore Wind - Economic Class 5 Estimate Atlantic Provinces

Stantec

Stantec Consulting Ltd.

Prepared for:
Net Zero Atlantic

Date:
September 10, 2025

Prepared by:
Daniela Pantoja

Project/File:
126560144

# Revision Record

| Revision | Description | Author | Date | Quality Check | Date | Independent Review | Date |
|---|---|---|---|---|---|---|---|
| D1 | **Draft** | **D. Pantoja** | **Aug 7,2025** | **J. Moran** | **Aug 7,2025** | **J. Crowther** | **Aug 8, 2025** |
| D2 | **Initial report** | **D. Pantoja J. Moran** | **Sep 1, 2025** | **I. Shaw** | **Sep 2, 2025** | **E. Wicks. J Crowther** | **Sep 3, 2025** |
| 1.0 | **Reviewed report** | **D. Pantoja J. Moran** | **Sep 10, 2025** | **I. Shaw** | **Sep 10, 2025** | **E. Wicks. J Crowther** | **Sep 10, 2025** |

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Prepared by: ______________________

Signature

______________________

Daniela Pantoja, Joaquin Moran

Reviewed by: ______________________

Signature

______________________

Ivor Shaw

Approved by: ______________________

Signature

John Crowther

# Table of Contents

# Executive Summary

Stantec has been retained to support Net Zero Atlantic (NZA) in evaluating the economic potential of offshore wind energy across prioritized Wind Energy Areas (WEAs) in Atlantic Canada. This analysis builds upon previously completed assessments of technical and locational potentials, in order to identify sites where offshore wind development is economically viable under a range of future deployment scenarios.

This report presents a Class 5 AACE indicative cost assessment for offshore wind facilities, encompassing both fixed-bottom and floating foundation technologies. Estimates are provided at a $/kW (USD) basis for major cost categories, including wind turbine supply, foundation systems, electrical infrastructure, installation, soft costs, and operations & maintenance (O&M).

The economic potential cost model draws from a range of industry-recognized sources, including NREL's 2024 ATB and GOWR25 reports, the Oregon Floating LCOE Study, Gulf of Maine infrastructure assessments, the WOMBAT O&M model, and permitting/export cable assumptions from the CVOW-C public records and Everett Development Report.

The analysis captures both fixed-bottom and floating offshore wind technologies using recent cost assumptions, site-specific constraints, and international benchmarks. It integrates technical (e.g., turbine placement, wind resource availability, buildable area), economic (e.g., CAPEX estimates, learning curves, regional infrastructure complexity) to inform strategic development planning. These inputs are tailored to Atlantic Canada's unique offshore environment and evolving market context.

Indicative estimates for fixed-bottom offshore wind development ranged from $4,315–$7,650/kW, while floating offshore wind estimates ranged from $6,360–$11,295/kW. These estimates are consistent with NREL and international benchmarks.

This assessment excludes several cost drivers that, while important in terms of the total delivered cost of offshore wind, fall outside the scope of the analysis. These include: port and grid interconnection upgrades, capacity studies for points of interconnection (POIs), stakeholder engagement and environmental permitting processes, financing structures and tax incentives (such as those under the Inflation Reduction Act), as well as supply chain limitations and regional labor cost variations.

Future phases of this study should consider additional region-specific risks that could materially influence project costs and development timelines. These include the presence of seasonal ice loading in northern Wind Energy Areas (WEAs), limited availability of large-scale offshore port infrastructure, and the challenges of exporting electricity over extended marine and onshore distances to points of interconnection. Given the early-stage nature of Canada's offshore wind market, initial projects are expected to face higher capital expenditures—likely falling at the upper end of the presented cost ranges for fixed-bottom technology and potentially doubling in cost for floating offshore wind. These costs are anticipated to decline over time as supply chains mature, regulatory processes become standardized, and lessons are incorporated from early project experience and international technological advancements.

# 1 Introduction

This report presents indicative cost estimates to support Net Zero Atlantic's assessment of economic potential for offshore wind development in Atlantic Canada. The estimates focus on representative fixed-bottom and floating scenarios and are intended for high-level planning and comparative analysis.

This cost modeling effort uses a Class 5 level of accuracy as defined by the Association for the Advancement of Cost Engineering (AACE), intended for early-stage planning and comparative analysis. While high-level, the results provide useful benchmarks for evaluating the relative feasibility of fixed and floating offshore wind developments in Canada's emerging offshore wind sector.

As of 2025, no offshore wind projects have been developed in Canadian waters. However, international markets, particularly in Europe and the U.S., have advanced rapidly in both fixed and floating offshore technologies. This study draws from these global benchmarks, adapting cost assumptions to the unique characteristics of the Atlantic Canadian region.

Offshore wind development in Canada will face a different set of challenges and opportunities compared to more mature markets. It is expected that for the first phase of projects development costs are higher than the values presented in this study, approximately 1.25x of the cost today for fixed and even 2x for floating configurations, but there is potential for future reductions  as infrastructure scales, expertise builds, and supply chains mature.

# 2 Methodology, Key Assumptions and Limitations

The economic potential modeling was performed consistent with conceptual design and pre-feasibility standards and include:

- Turbine supply and installation,
- Foundation and substructure costs,
- Electrical infrastructure (export and inter-array cables, offshore and onshore substations),
- Operations & Maintenance (O&M),
- Soft costs (e.g., permitting, engineering, contingency).

This outline enables a comparison between wind energy areas (WEAs) based on cost-efficiency and practical deployment factors. A standardized 1 GW wind farm configuration using 15 MW turbines was used for benchmarking.

To support this modeling effort, Stantec synthesized cost data from a range of peer-reviewed, government, and industry sources, reflecting both U.S. and international offshore wind experience. Key references include the NREL 2024 Annual Technology Baseline (ATB) for turbine capital costs, electrical system components, and operational trends; the NREL 2024 Cost of Wind Energy Review (GOWR25) for foundation, substation, and installation methodologies; and the Oregon Floating LCOE Study and Gulf of Maine assessments for floating platform costs and port infrastructure considerations. The WOMBAT O&M model informed annual operating cost assumptions using site-specific and asset-specific inputs. For export cable and permitting assumptions, inputs were drawn from the CVOW-C Draft Environmental Impact Statement (DEIS) and the Everett Development Report, which provide insights into early-stage U.S. projects and their permitting pathways.

In addition to published sources, Stantec actively engaged in internal and external consultations, including collaboration with in-house electrical engineering teams working on the E3 Atlantic Canada Transmission Study, as well as ongoing conversations with developers, operators, and researchers at NREL. The findings also include a comparison with WindEurope, Fraunhofer ISE, IRENA, LEANWIND. These inputs provided critical insight into evolving O&M strategies, soft costs, and system configuration preferences, including expectations for HV transmission routing and platform interconnection.

A list of key assumptions is presented below:

Assumptions:

- Project capacity: 1 GW (1,080 MW)
- Turbine size: 15 MW
- Distance from shore: 100 km
- Foundation: Monopile for Fixed, Semi-submersible for Floating
- Interconnection: Includes export cable and substations . Closest POI to shore.
- Capacity Factor: 50%
- Estimates follow a Class 5 level of accuracy per AACE standards . [-20% to -50% (low) to +30% to +100% (high)]

All cost estimates presented in this study reflect the economic conditions and technology maturity levels anticipated for offshore wind development in Atlantic Canada over the next 5 years.

Not Included in this estimate: Port upgrades and staging infrastructure, insurance, tax, and financing charges, variation of labor rates, curtailment or integration costs with the electrical grid and environmental mitigation (site-specific). It is important to remark that the first projects will likely have higher cost due to their exploratory nature and lack of some of the infrastructure required, and construction of additional potential projects in the region which could affect supply and availability of services and components.

# 3 Cost Estimate

The indicative opinion of probable cost estimate for offshore wind development in Atlantic Canada was developed by Stantec including capital expenditures (CAPEX) associated with turbine supply and installation, foundations, electrical infrastructure, development costs, and engineering. Annual operations and maintenance costs (OPEX) were estimated separately. All costs are presented in 2025 U.S. dollars (USD) and reflect anticipated conditions for future development in Atlantic Canada.

Table 1 outlines the primary components included in the capital expenditure model for offshore wind development, organized by major system categories. Each subcomponent is briefly described to clarify its role in the overall project scope.

*Table 1. Capital Cost Structure by Subcomponent*

| Main Category | Subcomponent | Description |
|---|---|---|
| Turbine Supply | Nacelle and Tower | Includes generator, gearbox, yaw system, tower sections, internal cabling, and housing. |
| Turbine Supply | Blades | Composite rotor blades |
| Foundation | Monopile | Steel monopile structure |
| Foundation | Floating Platform | Semi-sub or spar-buoy floaters |
| Electrical | Export Cable | Subsea transmission cable to onshore POI |
| Electrical | Inter-array Cable | Subsea collection cabling, installation |
| Electrical | Offshore Substation | Transformers, switchgear, platform, install |
| Electrical | Onshore Substation | Landfall facilities, interconnection upgrades |
| Installation | Turbine Install | Heavy lift vessel mobilization and installation crew |
| O&M | Annual O&M | Operations and maintenance per year |
| Soft Costs | Dev + Permitting | Pre-construction, legal, surveys, environmental, planning |
| Development & PM | Project Management | Owner’s engineering, contracts, oversight, general PM |
| Engineering | Detailed Engineering | System design and integration, certifications, QA/QC |

| Main Category | Subcomponent | Description |
|---|---|---|
| Contingency | Risk management | 15% of total per scenario. Unknowns and uncertainties. contingency is applied afterward as a markup included in the total. |

Tables 2 and 3 summarize the estimated capital expenditures ($/kW) for key offshore wind project components under fixed-bottom (Table 2) and floating (Table 3) configurations. Each table presents a range (minimum, mid, and maximum)—to capture variability and uncertainty. As with any emerging offshore market, early-stage projects in Atlantic Canada may incur premium pricing due to limited local supply chain and permitting precedent, it would be important to consider a learning curve adjustment and based on experts opinions the first projects could be on the high-range fixed costs could assume multipliers of 1.25× for fixed foundations and even 2× for floating foundations.

*Table 2. Offshore Wind: Fixed - Foundation Estimated Costs*

| Main Category | Subcomponent | Fixed Min ($/kW) | Fixed Mid ($/kW) | Fixed Max ($/kW) |
|---|---|---|---|---|
| Turbine Supply | Nacelle and Tower | 1,100 | 1,300 | 1,600 |
| Turbine Supply | Blades | 400 | 500 | 600 |
| Foundation | Monopile | 800 | 1,000 | 1,500 |
| Electrical | Export Cable | 450 | 675 | 900 |
| Electrical | Inter-array Cable | 150 | 225 | 300 |
| Electrical | Offshore Substation | 175 | 300 | 400 |
| Electrical | Onshore Substation | 100 | 150 | 200 |
| Installation | Turbine Install | 250 | 350 | 450 |
| O&M | Annual O&M | 100 | 125 | 150 |
| Soft Costs | Dev + Permitting | 150 | 200 | 300 |
| Development & PM | Project Management | 50 | 100 | 150 |
| Engineering | Detailed Engineering | 30 | 60 | 100 |
| Contingency | Risk management | 560 | 750 | 1000 |
| Total | | 4,315 | 5,735 | 7,650 |

*Table 3. Offshore Wind: Floating Foundation Estimated Costs*

| Main Category | Subcomponent | Floating Min ($/kW) | Floating Mid ($/kW) | Floating Max ($/kW) |
|---|---|---|---|---|
| Turbine Supply | Nacelle and Tower | 1,300 | 1,500 | 1,800 |
| Turbine Supply | Blades | 500 | 600 | 700 |
| Foundation | Floating Platform | 2,000 | 3,000 | 4,000 |
| Electrical | Export Cable | 525 | 750 | 1,050 |

| Main Category | Subcomponent | Floating Min ($/kW) | Floating Mid ($/kW) | Floating Max ($/kW) |
|---|---|---|---|---|
| Electrical | Inter-array Cable | 180 | 300 | 225 |
| Electrical | Offshore Substation | 250 | 350 | 450 |
| Electrical | Onshore Substation | 100 | 150 | 225 |
| Installation | Turbine Install | 300 | 400 | 550 |
| O&M | Annual O&M | 110 | 140 | 200 |
| Soft Costs | Dev + Permitting | 150 | 200 | 300 |
| Development & PM | Project Management | 75 | 150 | 200 |
| Engineering | Detailed Engineering | 40 | 80 | 120 |
| Contingency | Risk management | 830 | 1,150 | 1,475 |
| Total | | 6,360 | 8,770 | 11,295 |

To refine the cost breakdown tables, Table 4 outlines the major cost drivers and scope definitions associated with each subcomponent, providing insight into what is included in the modeled capital cost ranges.

*Table 4. Subcomponent-Level Cost Considerations*

| Main Category | Subcomponent | Cost Components & Considerations |
|---|---|---|
| Turbine Supply | Nacelle and Tower | Fabrication and assembly of generator, gearbox, nacelle housing, yaw & cooling systems, steel tower sections, internal ladders & platforms, logistics, and crane handling prep. |
| Turbine Supply | Blades | Mold production, materials, transportation to port, tip deflection controls |
| Foundation | Monopile | Steel fabrication, pile-driving, scour protection, welding and surface treatment |
| Foundation | Floating Platform | Steel or concrete platform, mooring lines, anchoring system, dynamic cables |
| Electrical | Export Cable | Cable supply, trenching/burial, shore landing, wet storage, voltage conversion |

| Main Category | Subcomponent | Cost Components & Considerations |
| --- | --- | --- |
| Electrical | Inter-array Cable | Cable procurement, trenching, burial, cable protection systems, installation vessels |
| Electrical | Offshore Substation | HV equipment, substructure, access platform, marine installation, electrical integration |
| Electrical | Onshore Substation | Land purchase/prep, transformer installation, breakers, fencing, permitting |
| Installation | Turbine Install | Heavy lift equipment, sea vessel rental, offshore crew logistics, contingency |
| O&M | Annual O&M | Service vessels, personnel, spare parts, SCADA, maintenance base |
| Soft Costs | Dev + Permitting | Geophysical/geotechnical surveys, permitting studies, stakeholder engagement |
| Development & PM | Project Management | Owner's PM staff, consultants, schedule control, site visits |
| Engineering | Detailed Engineering | Engineering, site plan, electrical design, environmental certs |
| Main Category | Subcomponent | Cost Components & Considerations |

# 4 References

All cost categories are derived from the following sources:

- NREL 2024 Annual Technology Baseline (ATB) – CapEx, Electrical, Export cable, O&M
- NREL 2024 Cost of Wind Energy Review (GOWR25) – Foundations, Substations, Installation
- NREL 2024 “The Cost of Offshore Wind Energy in the United States From 2025 to 2050” (Fuchs et al., NREL/TP-5000-88988) – U.S. CAPEX benchmarks and future projections
- Oregon Floating LCOE Study – Floating platform and turbine costs
- Gulf of Maine Reports – Floating-specific infrastructure
- WOMBAT O&M Model – Annual O&M estimation

- CVOW-C DEIS – Export cable assumptions
- Everett Development Report – Soft costs and permitting.
- Meetings with NRELstaff
- Feedback from developers and OEMs provided validation.

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