Great Lakes Wind Feasibility Study
Public Webinar #2

May 19, 2021

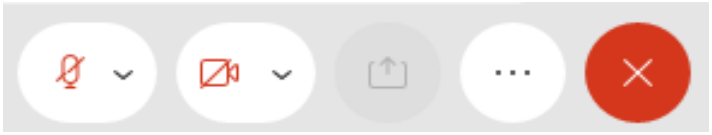
Sherryll Huber

NYSERDA Project Manager

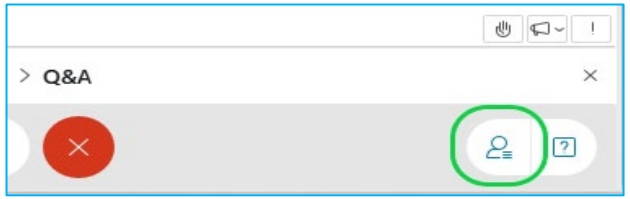
Meeting Procedures

Participation for Members of the Public:

- Members of the public are muted upon entry.
- Questions and comments may be submitted in writing through the Q&A feature at any time during the event.
  - Chat is disabled
  - Today's materials along with a recording of the webinar will be posted to NYSERDA's Great Lakes Wind website.
- If technical problems arise, please contact Sal.Graven@nyserda.ny.gov



You'll see  **when your microphone is muted**



Agenda

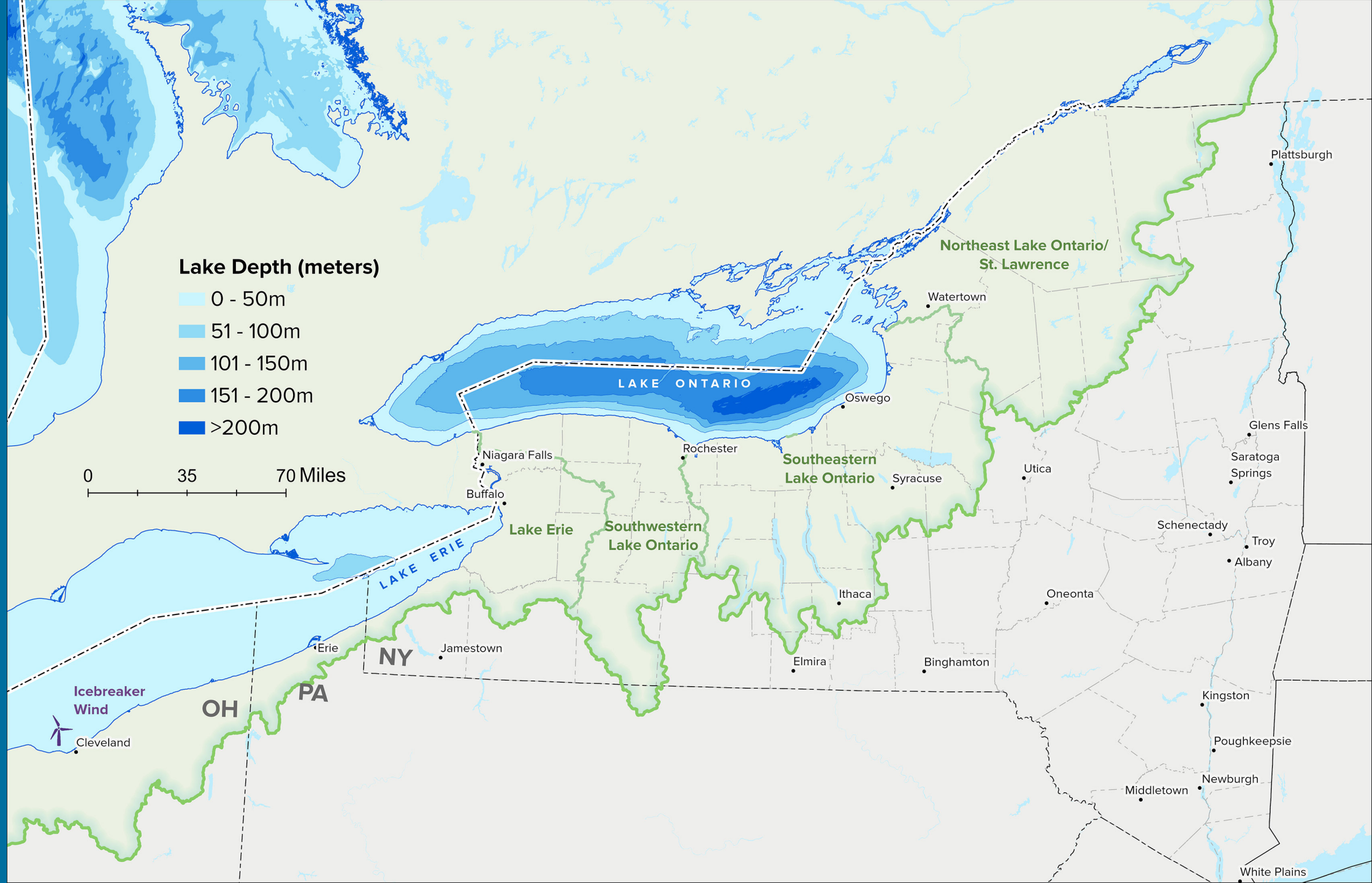
- > Overview of Feasibility Study
- > National Renewable Energy Laboratory Study Topics:
  - Technology and Ice Modeling
  - Costs/Cost Reduction, Economic Development
- > Advisian Study Topics:
  - Permitting, Risk/Benefit and Environmental Sensitivity,
  - Sediments and Geohazards, Visual Impacts
- > Pterra/Brattle Topics: Grid Interconnection
- > Stakeholder Input Opportunities
- > Next Steps
- > Q&A

Recreational Fisherman in Winter, Lake Erie

Today's Objectives

- Reiterate why New York State is conducting the Study
- Provide a summary of comments received thus far
- Provide an introduction to the Study's research teams
- Provide detail on the topics covered by the Study
- Share methodologies and datasets informing the Study
- Allow for Q&A opportunities with the Study's researchers
- Invite stakeholders and the public to a Public Feedback Session to inform the Study
- Present methods for continued engagement

Great Lakes Wind Feasibility Study



Public Service Commission Order

Published 10/15/2020

Directs NYSERDA to:

> Conduct a feasibility study for wind energy generation in the Great Lakes

> Commence work with 180 days of Order within $1 million budget

Viewpoint at Lake Ontario

Public Input

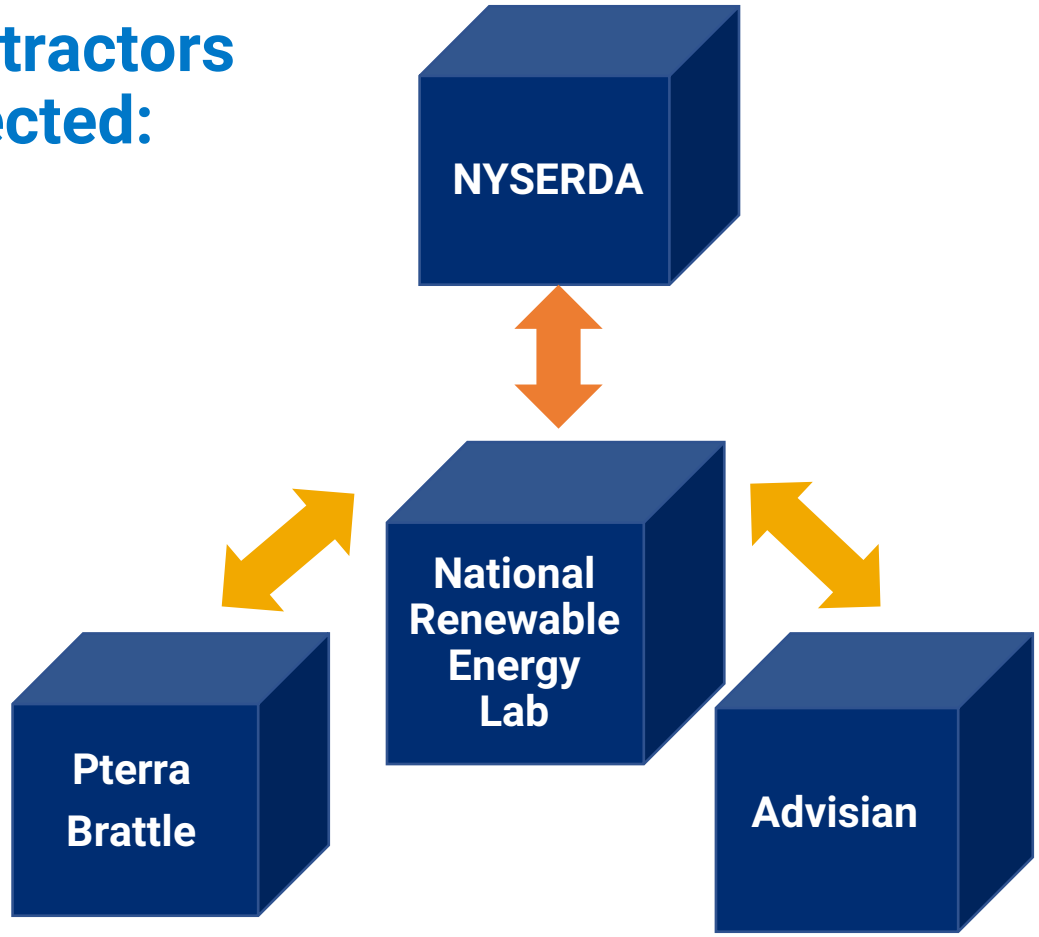
Great Lakes Wind Feasibility Study

What we have heard so far

- Communication preferences include email updates, website resources, and public feedback session
- Interest in potential project details
- Viewshed concerns
- Impacts to wildlife including fish and birds
- Technological solutions to ice floe and ice cover
- Discussions with neighboring states, countries, and tribal nations
- Legacy sediment pollution and impacts to fresh water supplies
- Differentiation between offshore wind in the Atlantic Ocean and the Great Lakes

Great Lakes Wind Feasibility Study

Contractors selected:



Anticipated Timeline:

> Q1 2021 Work began February and public webinar introducing the Study

> Q2 2021 Public webinar on study components and research

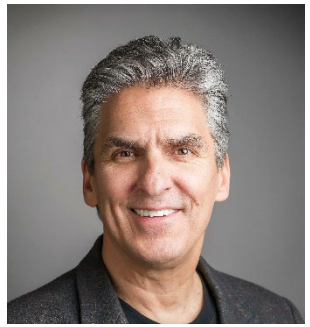
> Q3 2021 Public webinar on Study progress

> Q4 2021 Public Webinar on Draft Study

> Q4 2021 Targeted study completion, released early 2022

Great Lakes Wind Feasibility Study

Rebecca Green, Ph.D.
Senior Project Lead



Walter Musial, M.S.
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Engineering Analyst

Mike Optis, Ph.D.
Senior Atmospheric Scientist

Matt Shields, Ph.D.
Wind Cost Engineer

Aubryn Cooperman, Ph.D.
Wind Engineer

Stein Housner, M.S.
Wind Engineer

Patrick Duffy, M.S.
Wind Cost Engineer

Great Lakes Wind Feasibility Study

Technology, Costs, Economic Development

Contracted Principal Investigator: *National Renewable Energy Laboratory (NREL)*

> **Feasibility Study Overall Coordination & Final Synthesis Report**

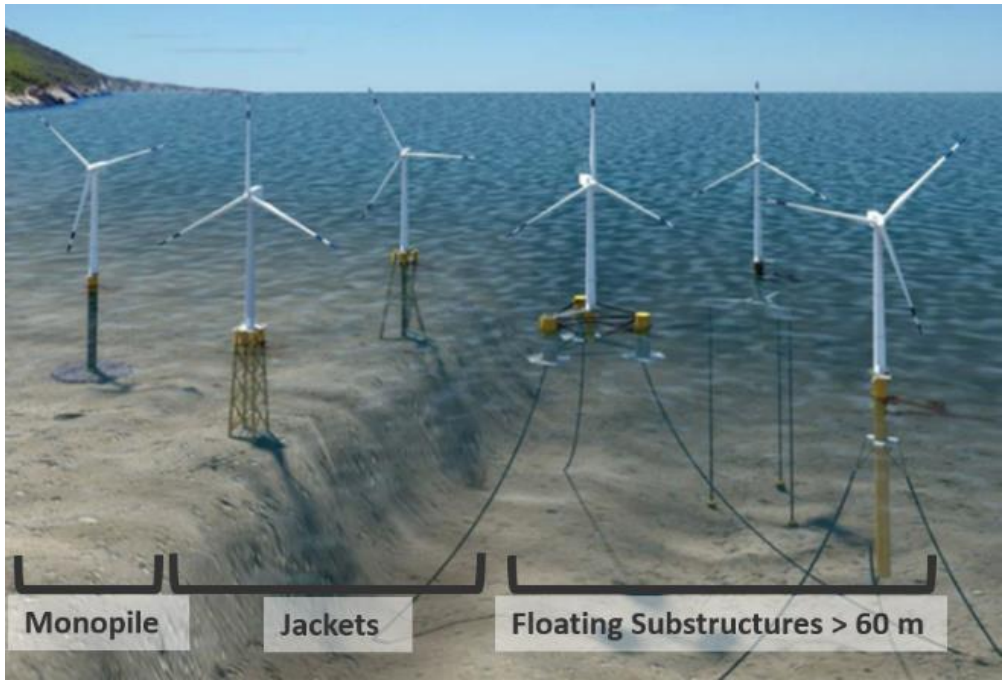
NREL Transforming ENERGY

Topics to be covered in Study:

> **Wind Plant Technology Review**
- Evaluation of Site Conditions
- Technology Options
- Physical Siting Analysis

> **Cost and Cost Reduction Pathways**
- Fixed and Floating Scenario Development
- Model Customization (i.e., ORBIT and ORCA models)
- Costs and Sensitivity Study

> **Economic Development and Workforce Opportunities**
- Jobs and Economic Development Impacts Modeling (JEDI model)
- Workforce Assessment
- Port Infrastructure Considerations



Source: NREL

Site Conditions

Bathymetry

- Water depth and lake bottom slope affect choice of substructure, foundation and/or anchors

Sources

- National Oceanic & Atmospheric Administration (NOAA) National Geophysical Data Center
- Peer-reviewed literature

Wind Resource

- Average wind speeds
- Daily and seasonal patterns
- Variation with height
- Data available this summer

Sources

- New: NREL modeling of 21-year time series wind resource
  - Weather Research and Forecasting model, ERA-5 reanalysis
  - 2 km (1.25 mile) horizontal resolution
  - 9 vertical levels up to 200 m (650 feet)

Ice Climate

- Extent of ice cover
- Ice thickness
- Ice ridges
- Structural icing
- Ice floes limit the type of substructure that can be used

Sources

- U.S. National Ice Center (U.S. Navy, NOAA, U.S. Coast Guard)
- NOAA Great Lakes Environmental Research Laboratory (GLERL)
- U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL)
- Peer-reviewed literature

Photo credit: Pori Offshore Wind Farm taken by Soumen HyÖtotuuli courtesy of Ken Croasdale to NREL

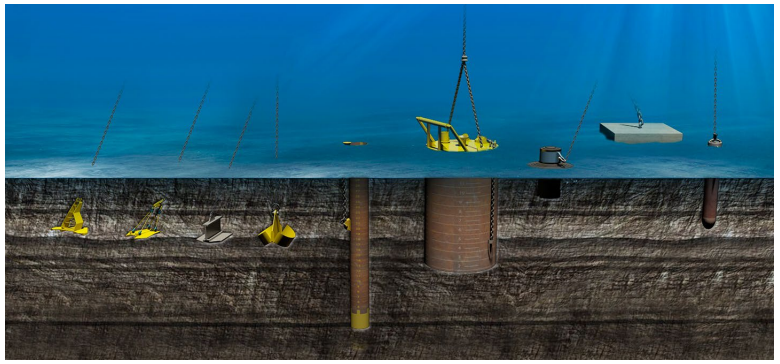
Site Conditions

Lake Bottom

- Lake bottom soil types (bedrock and sediment) affect choice of substructure, foundation and/or anchors

Sources

- U.S. Geological Survey (USGS)
- Great Lakes Aquatic Habitat Framework (GLAHF)
- Peer-reviewed literature



Waves and Currents

- Significant wave heights
- Seasonal currents
- Extreme weather events

Sources

- NOAA National Buoy Data Center
- Peer-reviewed literature

Ports and Transportation

- Physical limitations on size of vessels and components
- Opportunities for development
- Connections to manufacturers

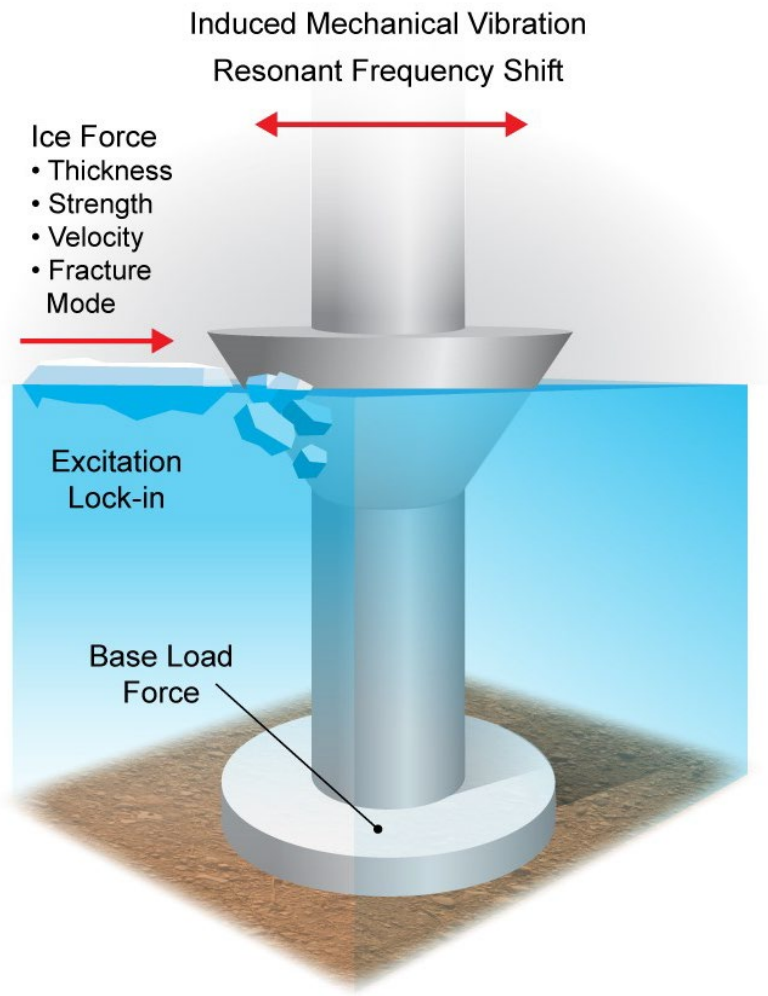
Sources

- U.S. Maritime Administration
- Great Lakes St. Lawrence Seaway
- Port of Oswego Authority

Image credits (clockwise from top): Walt Musial (NREL), Gary Norton (DOE), Dennis Schroeder (NREL), illustration by Joshua Bauer (NREL)

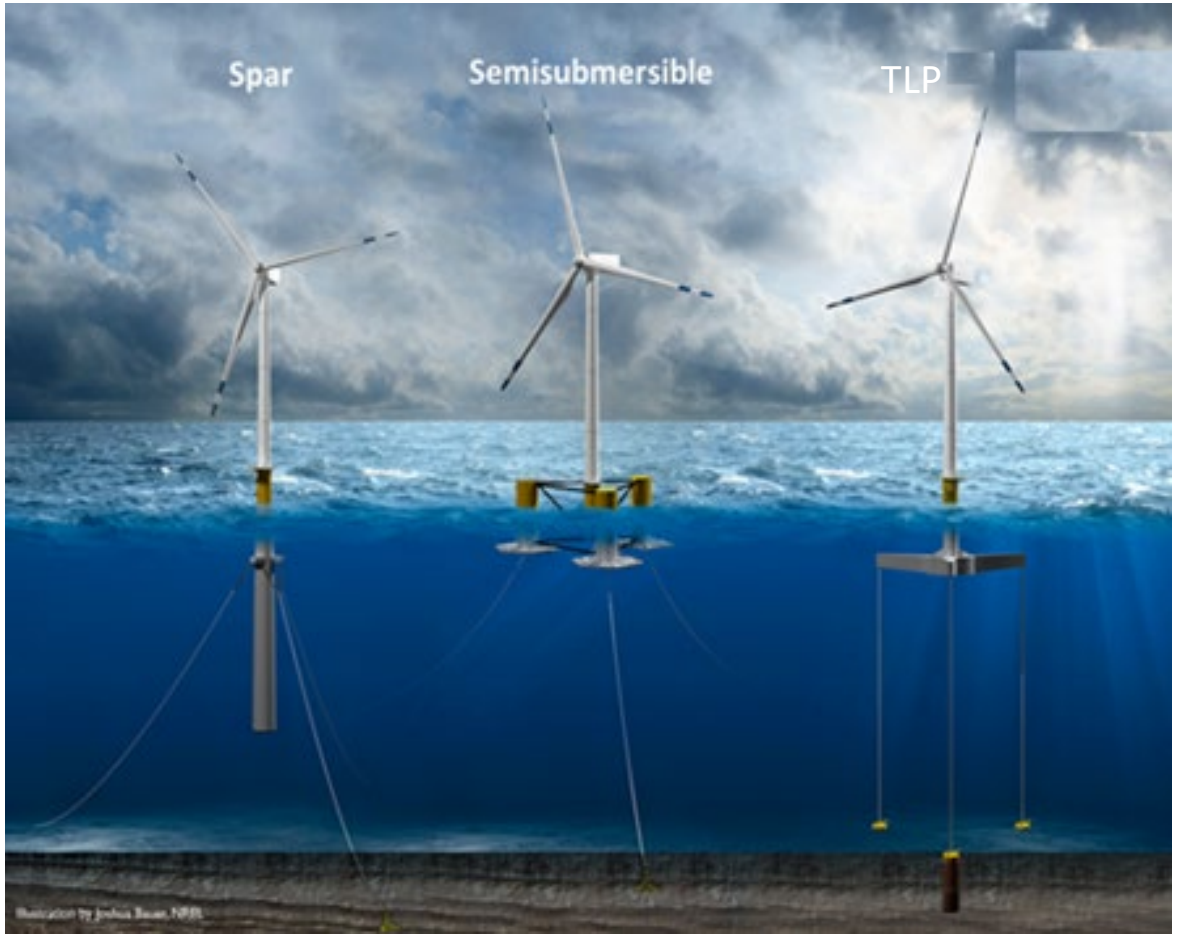
Fixed Bottom Substructure Types

- Fixed bottom substructures attach directly to the lakebed
- Ice cones attached to the structure deflect the ice and reduce the impacts significantly
- Many offshore wind projects have been built in Europe (Baltic Sea) where ice loading is present.
- LEEDCo is developing the Icebreaker project in Lake Erie (near Cleveland) using fixed bottom substructures



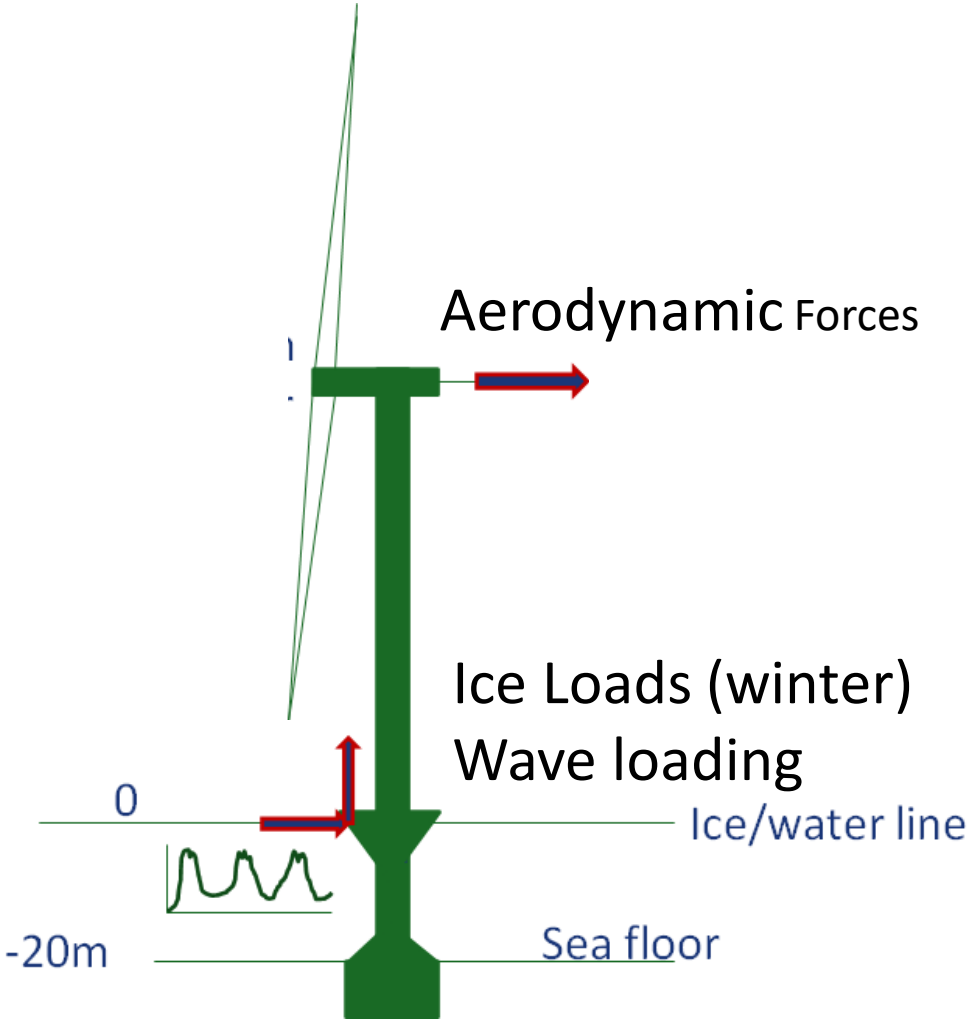
Floating Substructure Types

- Floating substructures are new in ice-covered waters
- Ice forces are transmitted through the mooring lines and anchors
- Slender profiles at the waterline will minimize ice forces (e.g., spar, tension leg platform - see figure)
- Certain substructure types may be excluded to avoid ice jamming



Ice Modeling: Ice Loads Add to Structural Design

- Engineering analysis for offshore wind turbines is relatively mature
- Evaluating status of ice modeling tools to estimate ice load impacts
  - Fixed and Floating substructures
- Reviewing literature on interaction of ice and offshore structures.
- Investigating the status of two well-known ice models that are part of the OpenFAST wind turbine simulation engineering tool:
  - IceDyn – University of Michigan
  - Icefloe - DNV
- **Investigating the extreme load case: Ice Ridges**

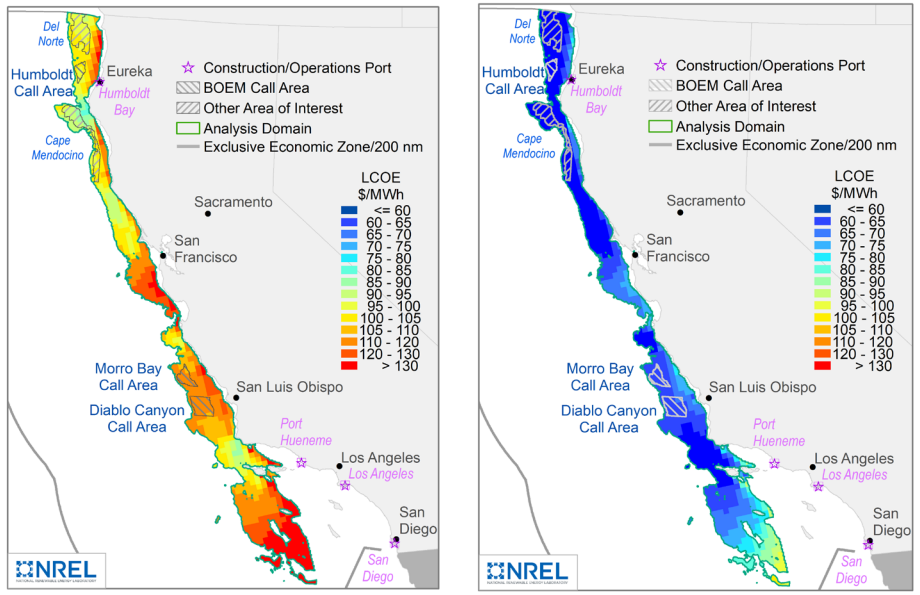


Costs and Cost Reduction Pathways

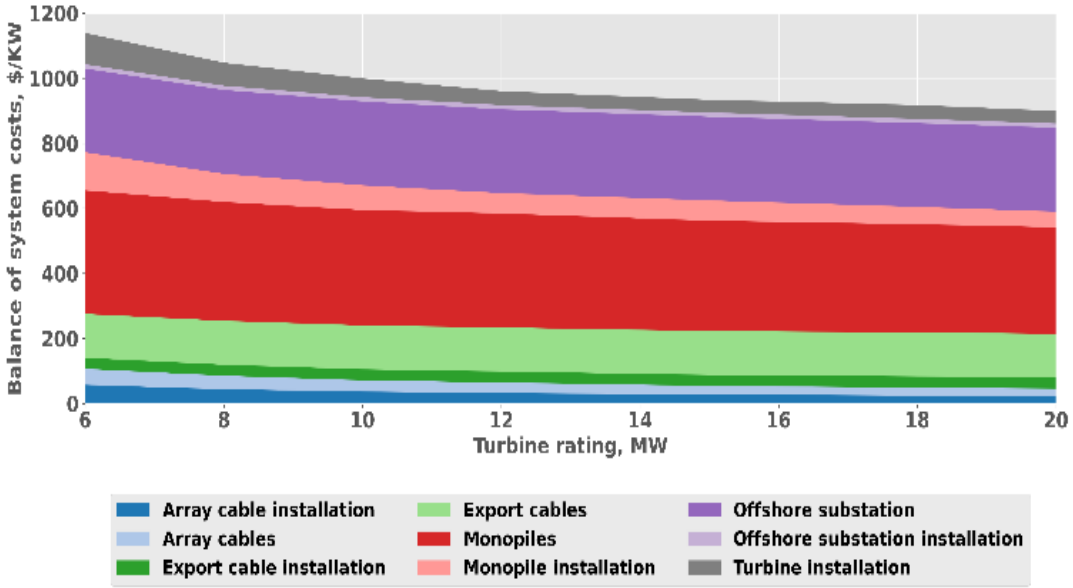
National Renewable Energy Laboratory cost modeling capabilities/options

> **Offshore Regional Cost Analyzer (ORCA)**
- Spatial and temporal LCOE analysis to evaluate technological, financial, and O&M decisions

> **Offshore Renewables Balance-of-system and Installation Tool (ORBIT)**
- Process-based simulation tool for project logistics, port constraints, and vessel capabilities – novel



LCOE modeled in ORCA for offshore wind in California for a commercial operation date in 2019 (left) and 2032 (right). From [Beiter, et al, 2020]



Impact of turbine upsizing on balance-of-system costs modeled in ORBIT
Source: Shields, et al, (under review)

Costs and Cost Reduction Pathways

Scenario development

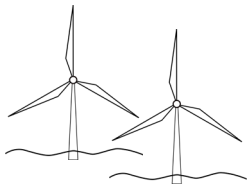
- Fixed and floating scenarios
- Capacities and technologies based on commercial operation date
- Work with NYSERDA to locate projects

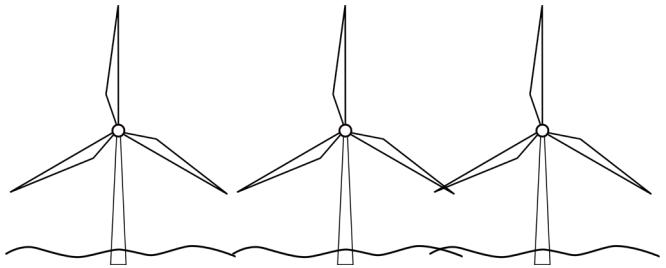
Model customization

- Update generic assumptions in ORCA and ORBIT for the Great Lakes
- Ports, vessels, grid, turbine rating, capacity factors, ice protection

Cost and sensitivity study

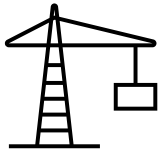
- ORBIT: Installation timelines and costs
- ORCA: LCOE heat maps, cost projections, detailed cost breakdowns

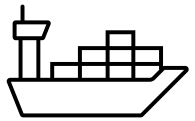


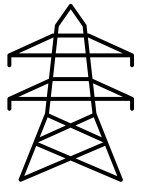


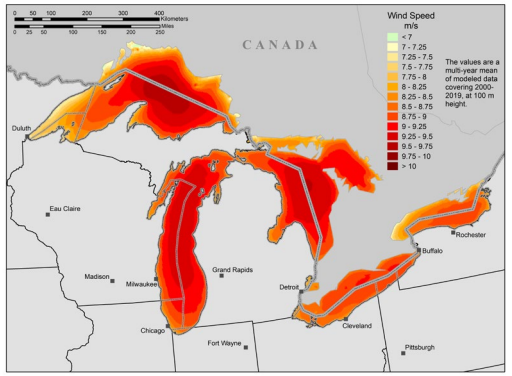
Near-term COD

Long-term COD









Economic Development and Workforce

Jobs and Economic Development Impact Model (JEDI)

- Wind-specific input-output model (developed by NREL)
- Estimates gross economic impacts at the state level
- Incorporates cost and supply chain
- Estimates jobs, earnings, economic output, and gross domestic product
- Considers manufacturing, installation, and operations

Workforce Assessment

- Identify worker types, timing, and skill requirements for installation, port infrastructure, and operation
- Conduct workforce supply evaluation and skills assessment
- Assess labor requirements, education institutions and programs for the Lake Erie and Ontario area

Economic Development and Workforce

Investigate New York Opportunities

- Engage with stakeholders on Lake Erie and Lake Ontario to understand existing port capabilities and infrastructure upgrades
- Conduct a comparative analysis using Jobs and Economic Development Impact (JEDI) to understand the jobs, earnings, economic output, and gross domestic product supported from using New York port infrastructure
- Qualitatively assess the workforce and economic development impacts from port upgrades to support the technology, staging, and wind installation in Lakes

Source: New York's Offshore Wind Energy Development Potential in the Great Lakes, 2010.

Thank you

For more information, please contact:

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Great Lakes Wind Feasibility Study

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Great Lakes Wind Feasibility Study

Permitting Roadmap and Study

> Describe the Federal and State permitting and regulatory requirements for New York Great Lakes Wind

- Major Federal and New York State permitting authorities
- Map permitting requirements from a process perspective
- Required submission materials and studies
- Opportunities for streamlining or efficiencies
- Challenges and roadblocks experienced by similar wind projects

Great Lakes Wind Feasibility Study

Permitting Roadmap Methodology

> Desktop study to identify major permitting and regulatory requirements
  - State and federal agency websites
  - Prior NYSERDA studies (e.g., 2010 Great Lakes Study)
  - Icebreaker National Environmental Policy Act (NEPA) documents from Department of Energy

> Phone interviews to confirm and enhance understanding from desktop study. Have conducted agency interviews with
  - New York State Department of State (NYSDOS)
  - New York State Department of Environmental Conservation (NYSDEC)
  - New York State Office of General Service (NYSOGS)
  - U.S. Army Corps of Engineers – Buffalo District
  - U.S. Fish and Wildlife Service – New York Field Office

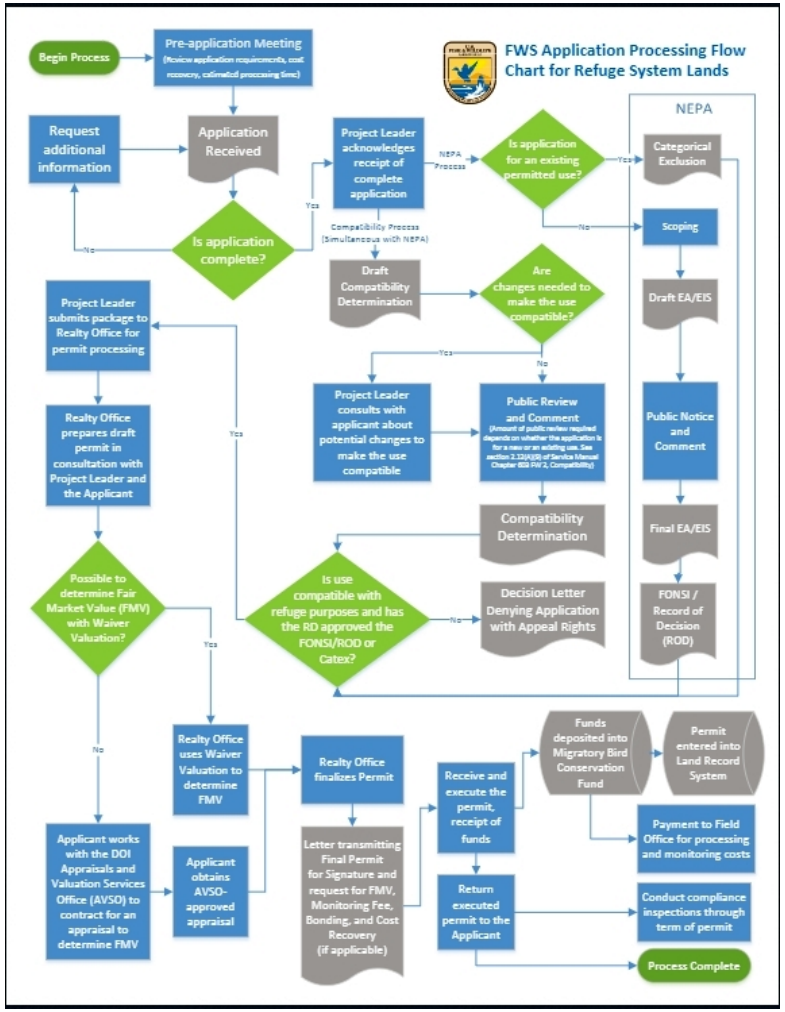
Great Lakes Wind Feasibility Study

Outputs and Deliverables

> Study describing permitting requirements, key players, challenges, and opportunities

> Flowchart (or series of flowcharts/scenarios) demonstrating:

- Permitting processes
- Key players
- Materials and studies needed
- Opportunities for public involvement
- Example from U.S. Fish and Wildlife Service



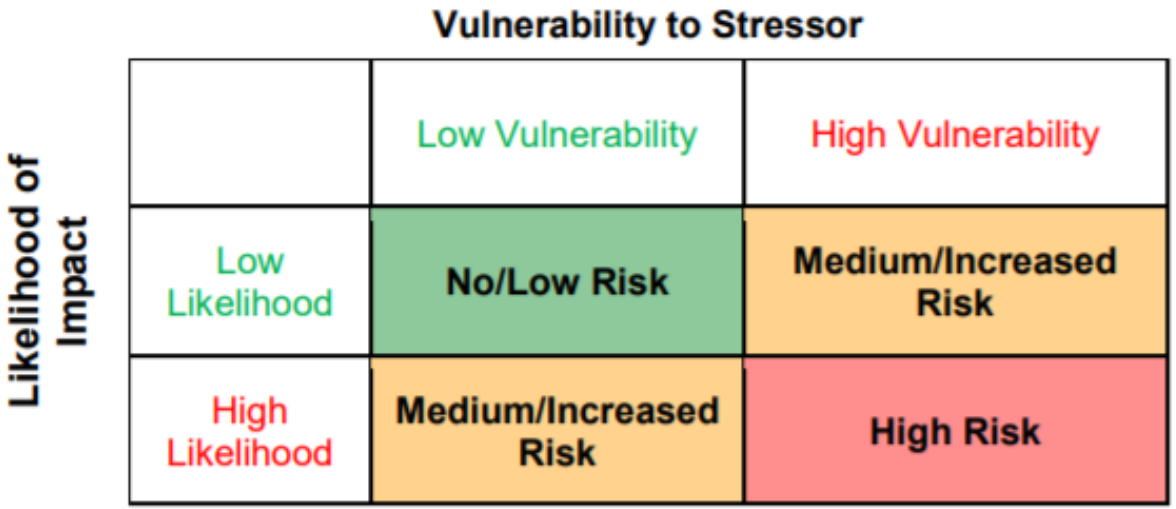
Great Lakes Wind Feasibility Study

Relative Risks, Mitigations, and Benefits

- **Identify**
  - **Distribution and habitat use**
  - **Potential environmental and health benefits to the region from Great Lakes Wind**
  - **Potential stressors, impacts, and mitigations**
  - **Develop a sensitivity map overlaying datasets to show relative risk areas**

Photo credit: Block Island Wind Farm taken by Dennis Schroeder to NREL

Great Lakes Wind Feasibility Study



Scores describe sensitivity and will range between 1 (low risk) and 5 (high risk).

NYSERDA OSW Master Plan

Relative Risks, Mitigations, and Benefits Methodology

> Distribution and habitat use

> Environmental and health benefits

> Stressors, impacts, and mitigations

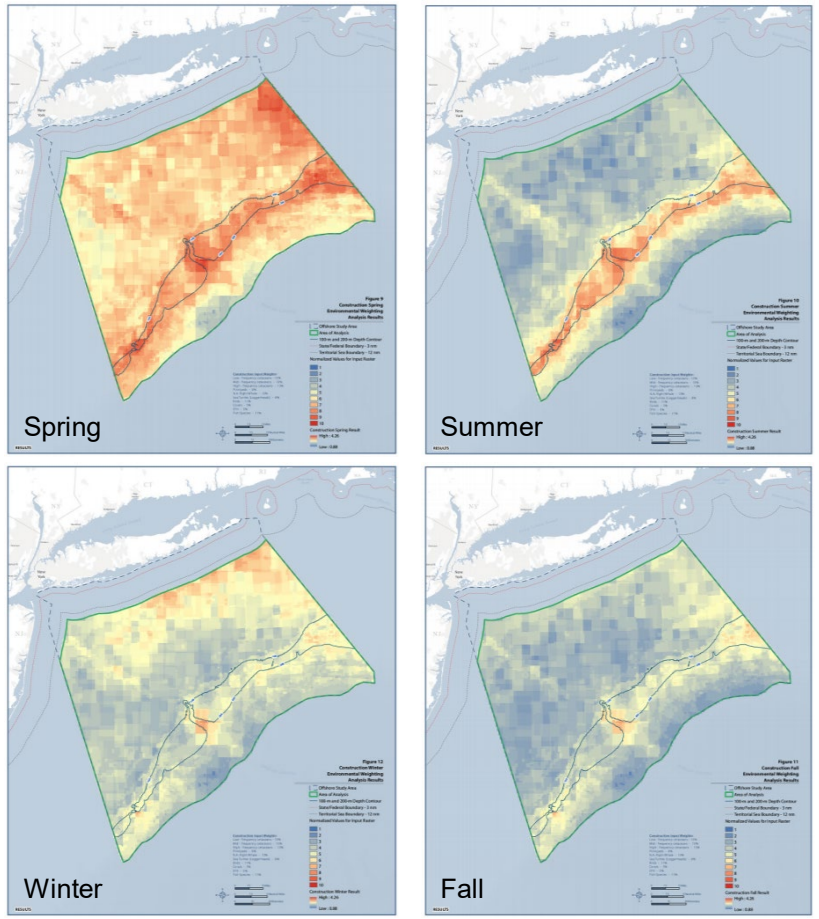
> Sensitivity Study

- Identify risk groups
  - Such as: fisheries, vulnerable species, military areas, sensitive habitats, cultural areas, etc.
- Weight data layers for each group based on vulnerability and the likelihood of impact
- Perform an analysis in GIS using weighted inputs to give outputs showing relative risk

Great Lakes Wind Feasibility Study

NYSERDA Offshore Wind Environmental Sensitivity Study Example

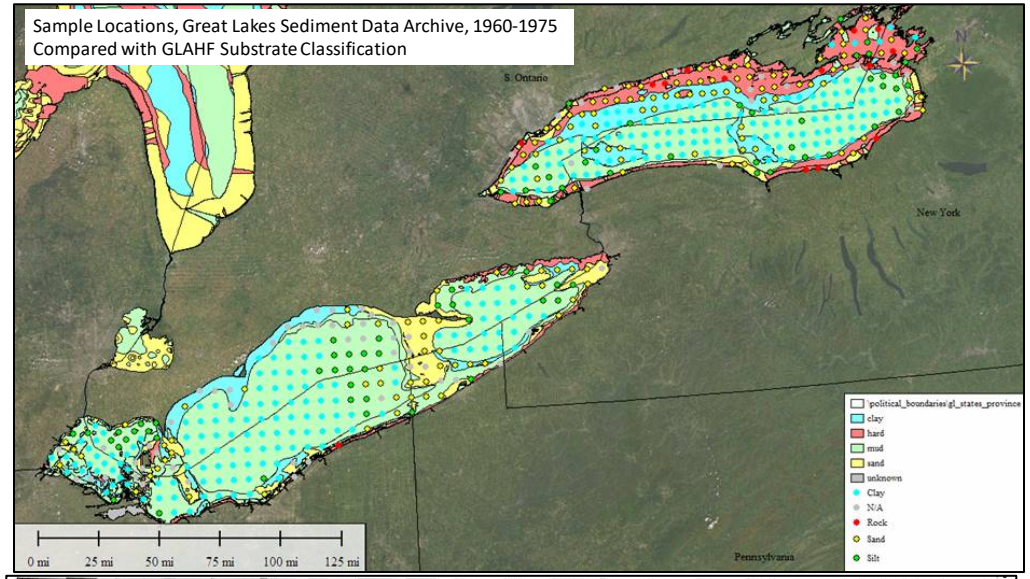
- Characterized a location to identify potentially suitable areas to consider for wind energy development
- This was based on biological sensitivity
- Produced maps of relative sensitivity in the area, which accounted for seasonality

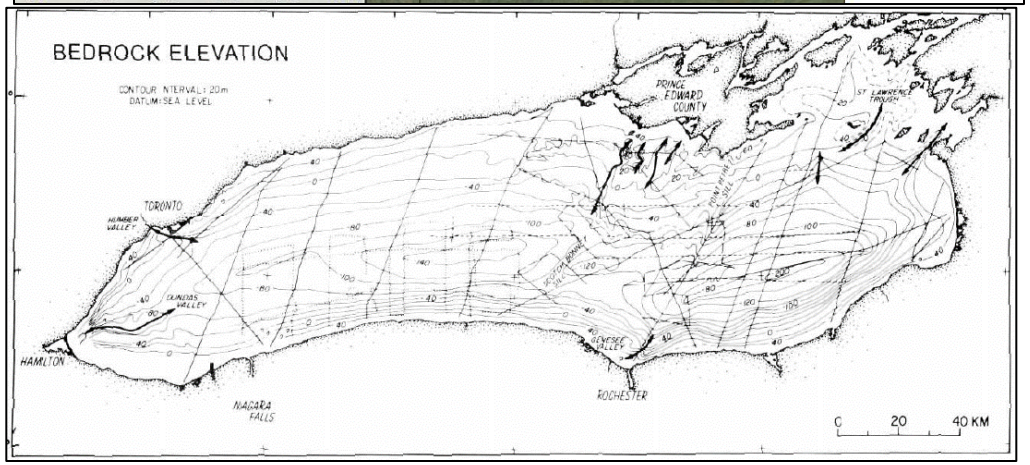


Great Lakes Wind Feasibility Study

Geohazards & Site Characterization

- Collaborative effort w/ National Renewable Energy Lab
- Advisian to develop notional lakebed & subsurface soil and geologic conditions and constraints relevant to siting for offshore wind development
- Surficial and very shallow soils relevant to infield and export cable systems
- Deeper subsurface soils & depth to bedrock relevant to feasibility of offshore wind foundation type, capacity, and installability





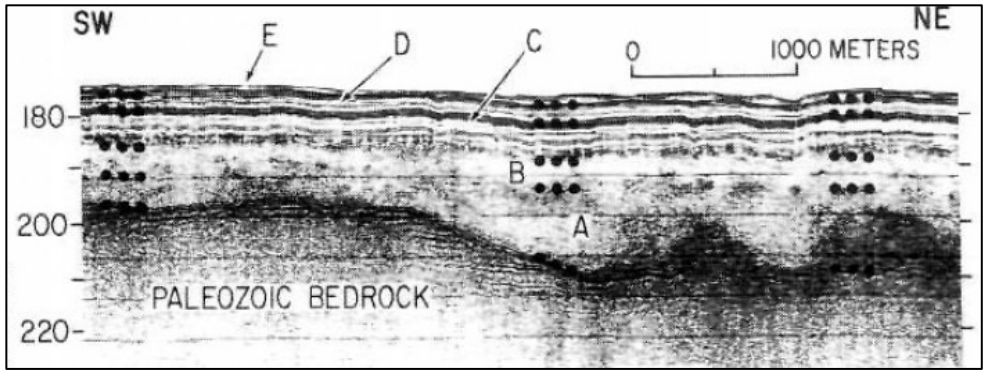
Great Lakes Wind Feasibility Study

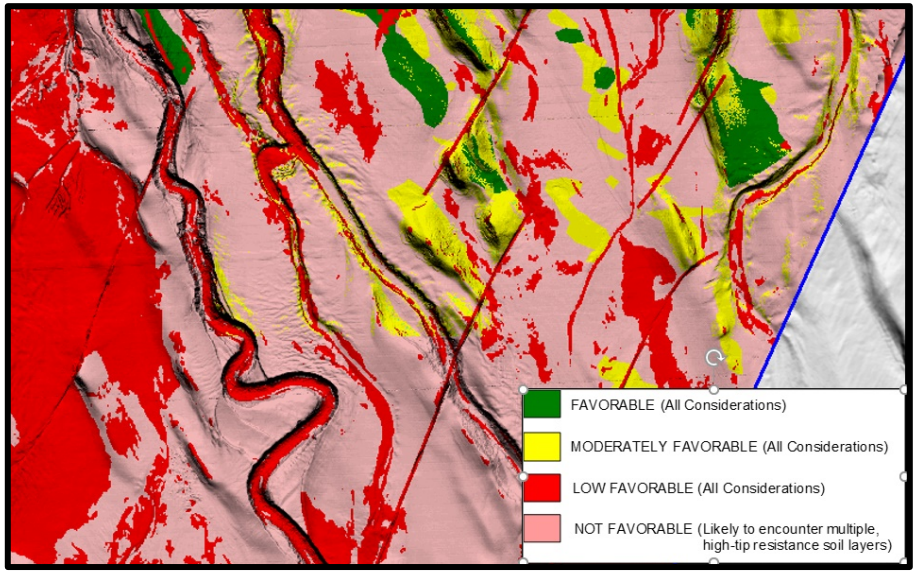
Methodology

> Mine available datasets for relevant information
> Aggregate surficial soils data and align on final mapping
> Review mapping of bedrock elevations and subsurface stratigraphy
> Geo-position all relevant data in GIS
> Assess conditions for known hazards or constraints to fixed and floating wind foundation concepts as well as cable routing and burial
> Infer soil conditions from mapped geophysical data & interpretations
> Develop relative feasibility ranking criteria for inputs to overall site characterization assessment performed by NREL

Example

- Offshore foundation zone siting feasibility assessment





Great Lakes Wind Feasibility Study

Visual Impact Study

> Three main stages of the study
  - Viewshed Analysis
  - Cumulative Visibility
  - Visual Sensitivity

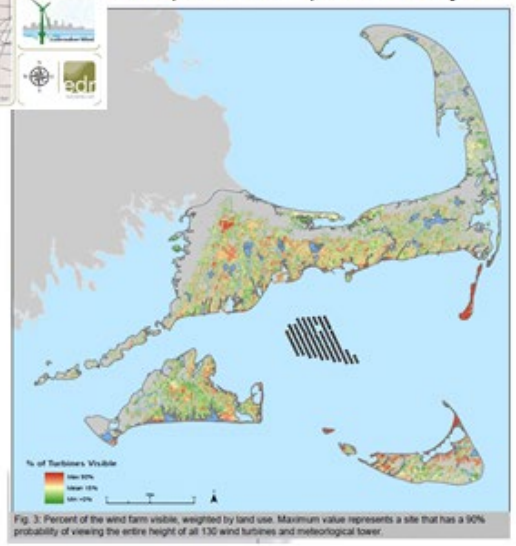
Methodology

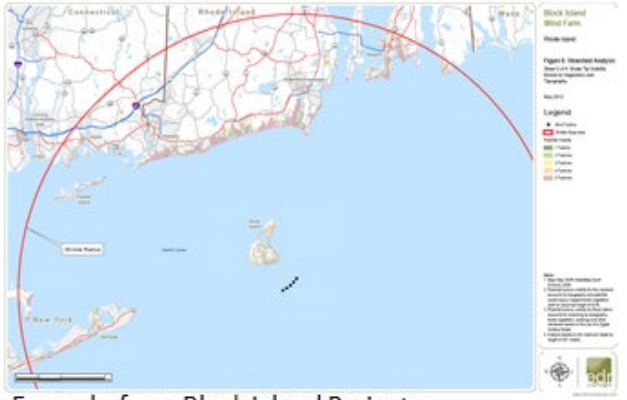
> Traditional viewshed analysis will involve the following inputs:
  - Elevation data (land & marine)
  - ~Turbine dimensions and standard observer height (TBD)
  - Curvature of the Earth and standard atmospheric conditions

> Viewshed analyses variables
  - Radius of viewshed analyses based on ~turbine dimensions (TBD)
  - Height scenarios to estimate full/partial views, etc.
  - Land cover data may be used to ~viewshed screening (bare earth models result in worst-case visibility scenarios)

Example from Icebreaker Project

Example from Cape Wind Project





Example from Block Island Project

eat Lakes Wind Feasibility Study

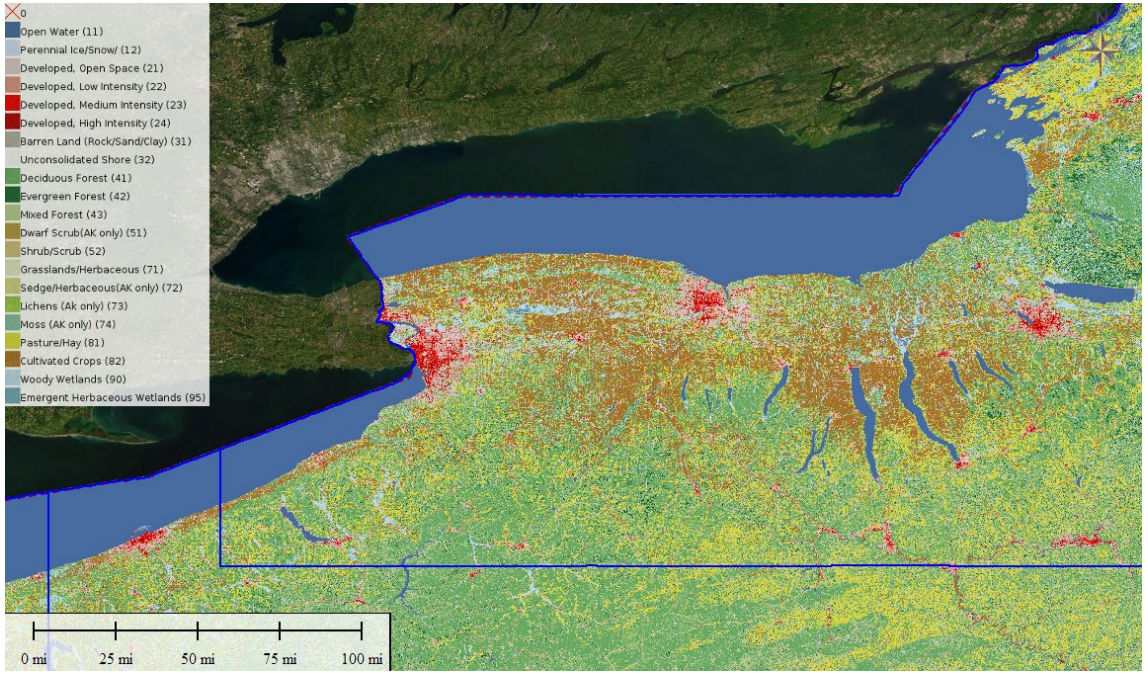
odology (Cont.).

pre-selected site(s) or layout(s) require different proach:

- Shoreline location spacing and elevation, land-use considerations for observer perspective
- Offshore grid pattern of test points starting furthest from shore and working analyses “in”
- Aggregate test point results developing a composite assessment of potential impacts
- Translate results into relative feasibility criteria

ual Sensitivity

- Study will establish initial visible sensitivity for siting turbines within the Lakes related to land-based observations
- Visual impacts study will also identify additional parameters to be included in more-detailed future studies



US National Land Cover Database CONUS 2016

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erconnection Feasibility

Brattle Group Lead: Hannes Pfeifenberger

Pterra Consulting Lead: Ric Austria

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erconnection Feasibility

tives:

evelop a preliminary understanding of the feasibility of interconnection of Great Lakes
d resources to New York State Bulk Power System (NYSBPS)

entify critical information that may inform the general feasibility of Great Lakes Wind
rgy from an interconnection perspective

ovide guidance to NREL on determining Points of Interconnection (POI) on the NYS
, including any needed transmission upgrades

stria of Pterra Consulting
senting Pterra Consulting and Brattle Group

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erconnection Feasibility

odology:

evelop power flow models representing future electric system conditions (2025 and
0 summer, winter and light load) on the NYSBPS

mulate the potential GLW interconnection capacity for selected POI close to the Lake
and Lake Ontario shoreline subject to factors such as other land-based generation
urce development, potential transmission grid upgrades, and potential retirement of
-renewable power plants

oordinate with other study teams to determine location and timing of GLW
elopment and water and land routes for electrical connections

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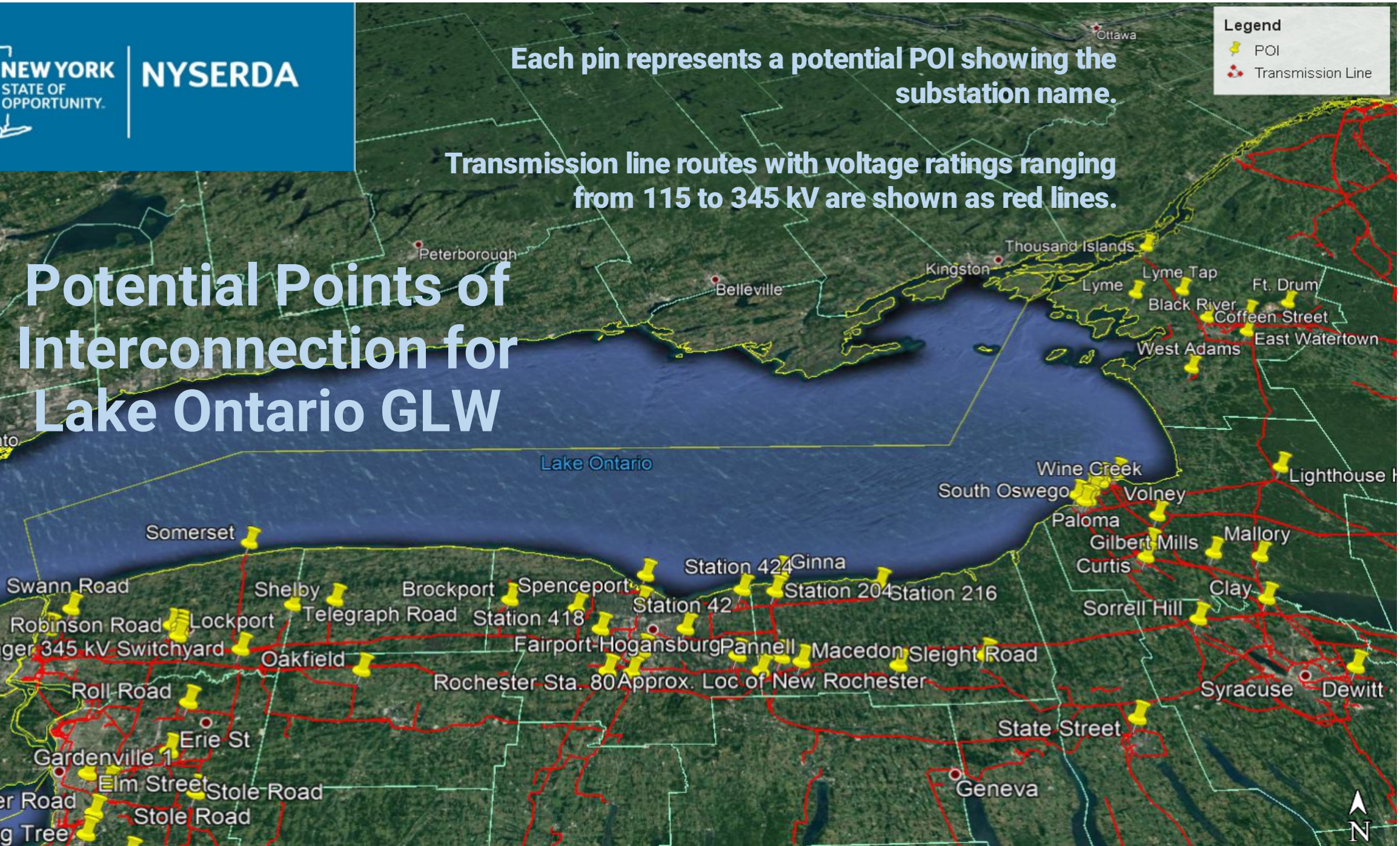
Potential Points of Interconnection for Lake Ontario GLW

Each pin represents a potential POI showing the substation name.

Transmission line routes with voltage ratings ranging from 115 to 345 kV are shown as red lines.



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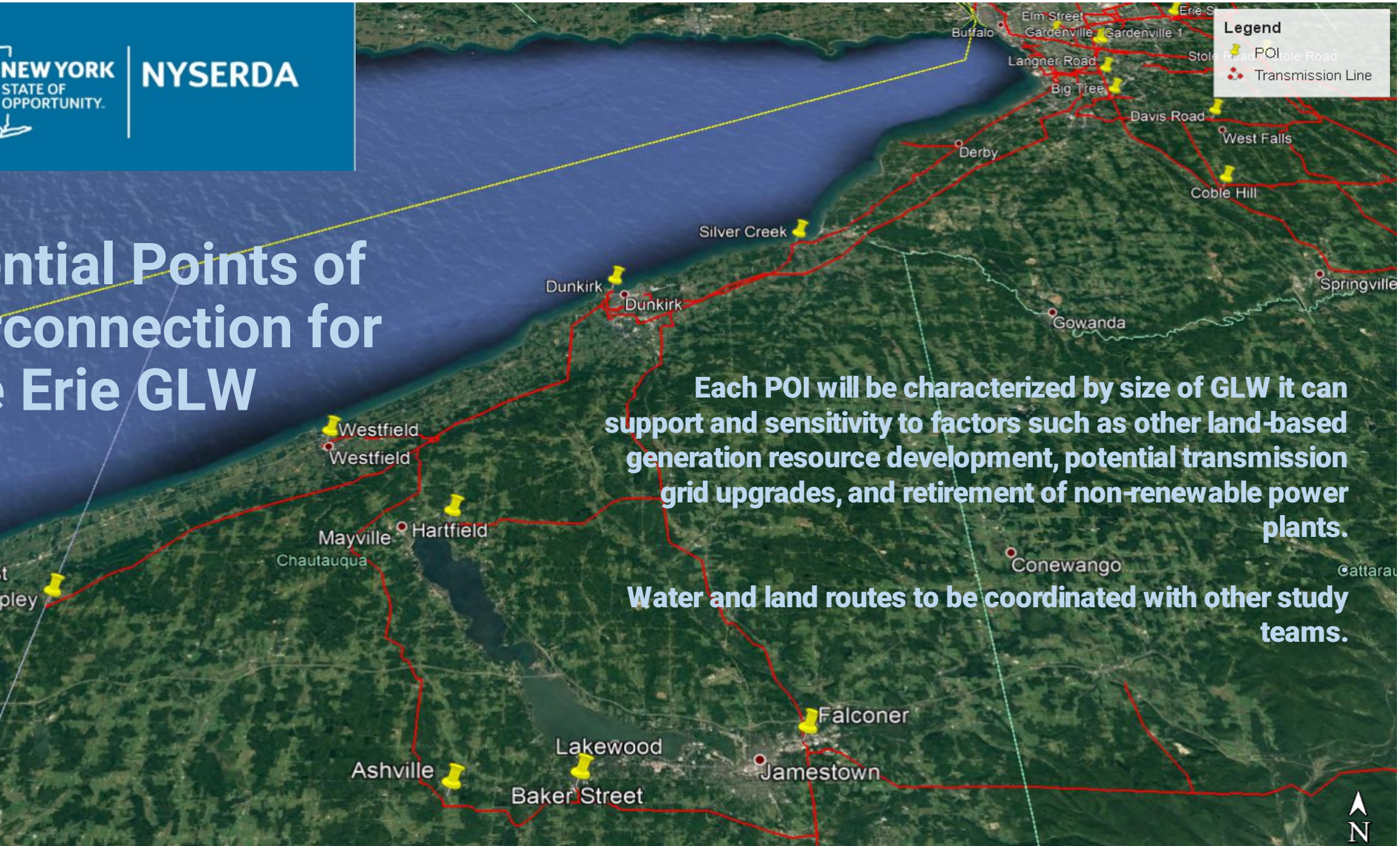

Each POI will be characterized by size of GLW it can support and sensitivity to factors such as other land-based generation resource development, potential transmission grid upgrades, and retirement of non-renewable power plants.

Water and land routes to be coordinated with other study teams.

hank you

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ultiple opportunities to stay engaged!

blic Input Opportunity: June 9, 2021 NYSERDA is scheduling a Virtual Public Feedback ssion to gather feedback on the content and methodologies for the Study. *More information follow*. **Please stay tuned!**

ebinar #3: August 2021 - Will offer project updates and preliminary results each study component with help of subject matter experts

ebinar #4: October 2021– Presentation of the draft Study by NYSERDA and the Study searchers

gn-up for email updates and get the latest on study progress at the YSERDA Great Lakes Wind website **nyserda.ny.gov/Great-Lakes-Wind-Feasibility-Study**

nail the Great Lakes Wind Team at **greatlakeswind@nyserda.ny.gov**

hank you

ore information, please contact:

RDA Great Lakes Wind Team
lakeswind@nyserda.ny.gov

the project website at:
rda.ny.gov/Great-Lakes-Wind-ibility-Study

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