

Analysis of Offshore Development in the Great Lakes (Ontario)

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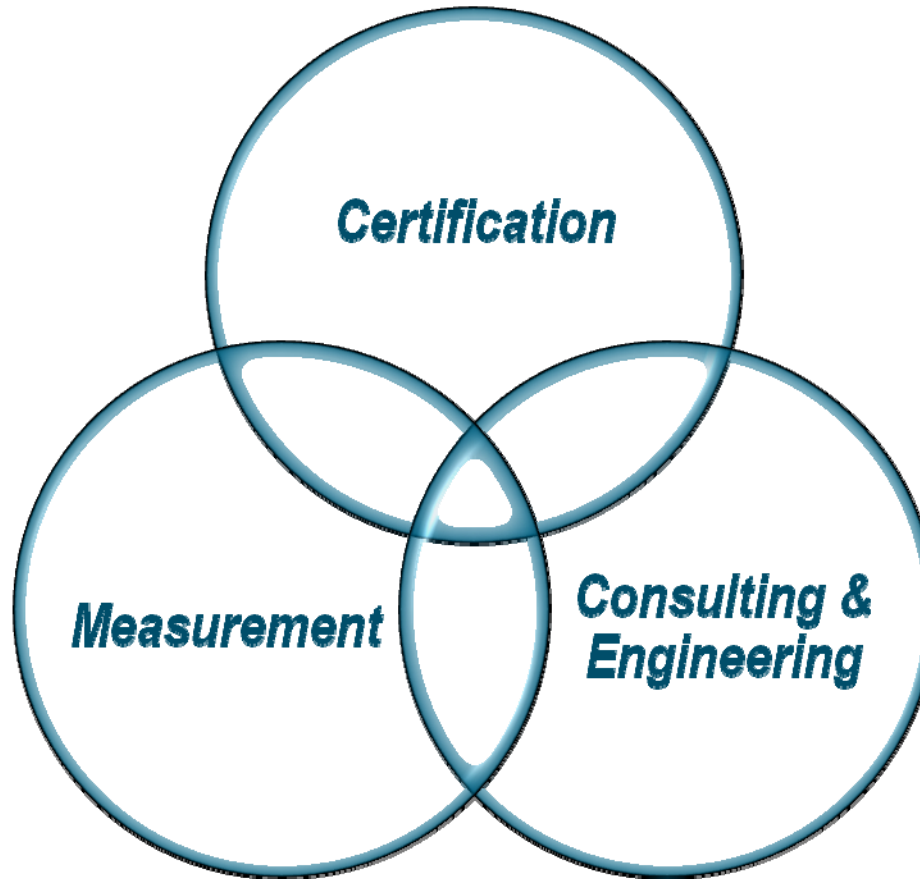
1. Helimax/GL

Helimax

- Wind energy consulting firm offering most services for project development and during operations
 - Site prospecting and prefeasibility studies
 - Wind resource assessments
 - Project design and energy yield assessment
 - Environmental assessment and stakeholder consultation
 - Site suitability studies
 - Asset diagnostics and performance optimization
 - Technical due diligence and independent expert opinion
-
- Worked on several thousand MW of wind projects, throughout Canada and in the United States



GL Renewables Group



2. Study Preamble

Ontario Renewables Context

- Strong push in Ontario for renewables, especially wind
- Ontario Power Authority (OPA) commissioned 3 Helimax wind studies
 - Meso-scale wind mapping and onshore installable capacity
 - Onshore site selection and ranking
 - Offshore site selection and ranking (2008)
- Renewable Energy Supply RFPs
- Renewable Energy Standard Offer Program
- Recently adopted **Green Energy Act**
 - **Feed-In Tariff**
 - 13,5 cents/kWh (onshore large)
 - 14,5 cents/kWh (community projects < 10MW)
 - 19 cents/kWh (offshore)

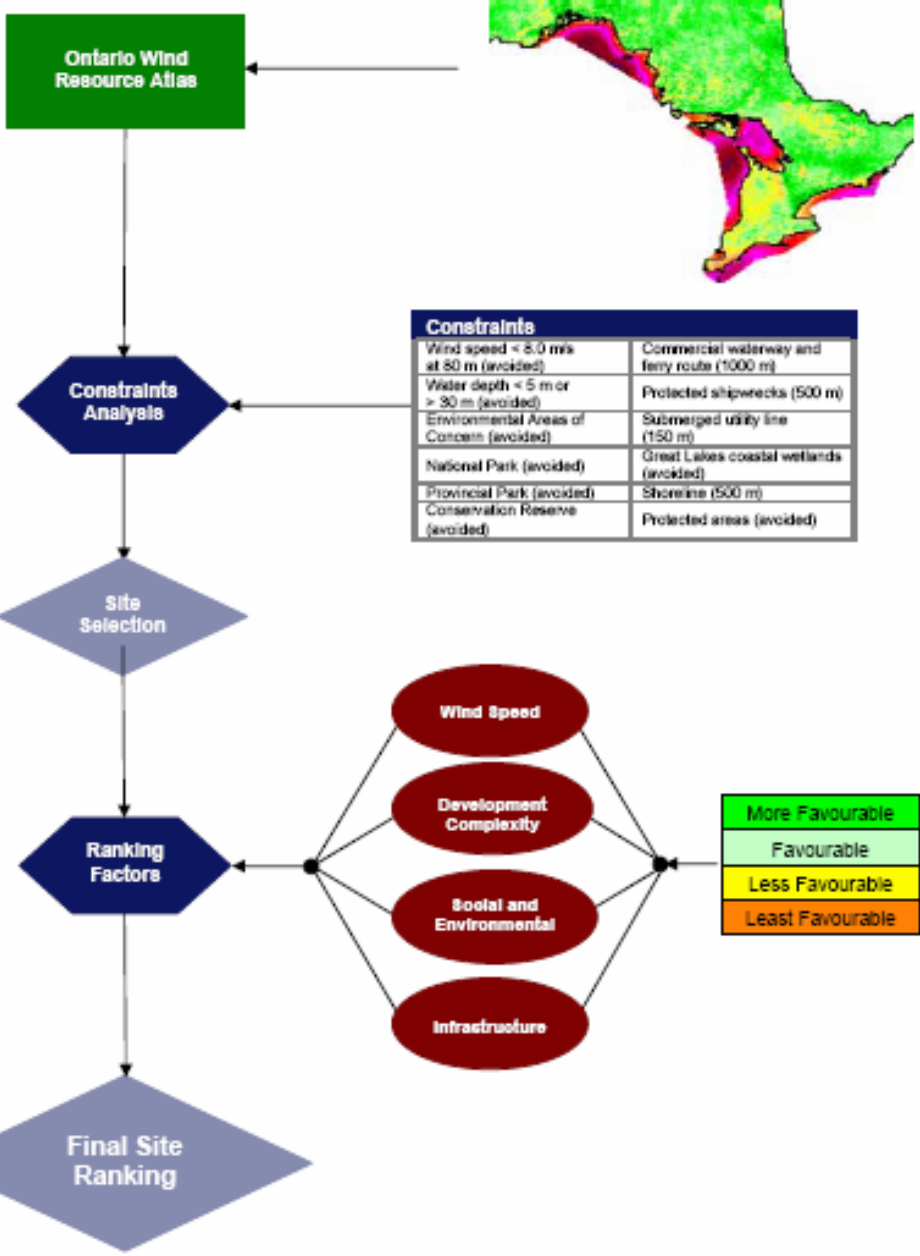


Study Objectives

- Identify sites in the Great Lakes, after considering key constraints
- Rank the sites based on a set of factors
- Calculate the potential installed capacity (MW) per site and energy yield (MWh)



3. Methodology



Exclusion Zones/Constraints Setting

- Constraints
 - Set jointly with OPA
 - List can be much more extensive, region-specific
 - Depends on available data

Feature	Action Taken (buffer zones in m)
Commercial waterway and ferry route	1000
Protected shipwreck	500
Submerged utility line	150
Shoreline	500
Great Lakes coastal wetland	Avoided, no buffer zone
Conservation reserve	Avoided, no buffer zone
Environmental Area of Concern	Avoided, no buffer zone
National/Provincial Park	Avoided, no buffer zone
Protected area	Avoided, no buffer zone
Water depth < 5 m or > 30 m	Avoided, no buffer zone
Wind speed < 8.0 m/s	Avoided, no buffer zone

Ranking Factors

- Factors used in ranking
 - Set jointly with OPA
 - List can be much more extensive, region-specific
 - Depends on available data
 - 4-level weighted ranking (wind speed factor much more important)
- Analysis did not consider interconnection potential or proximity to grid

Wind Speed

Wind Speed [m]	Least Favourable	Less Favourable	Favourable	More Favourable
	8.0 – 8.15	8.15 – 8.35	8.35 – 8.55	8.55 +

Development Complexity

	Least Favourable	Less Favourable	Favourable	More Favourable
Mean Water Depth [m]	20 – 30	18 – 20	15 – 18	5 – 15
Distance to Landfall (mainland) [km]	14+	7 – 14	4 – 7	0.5 – 4

Ranking Factors

Social/environmental

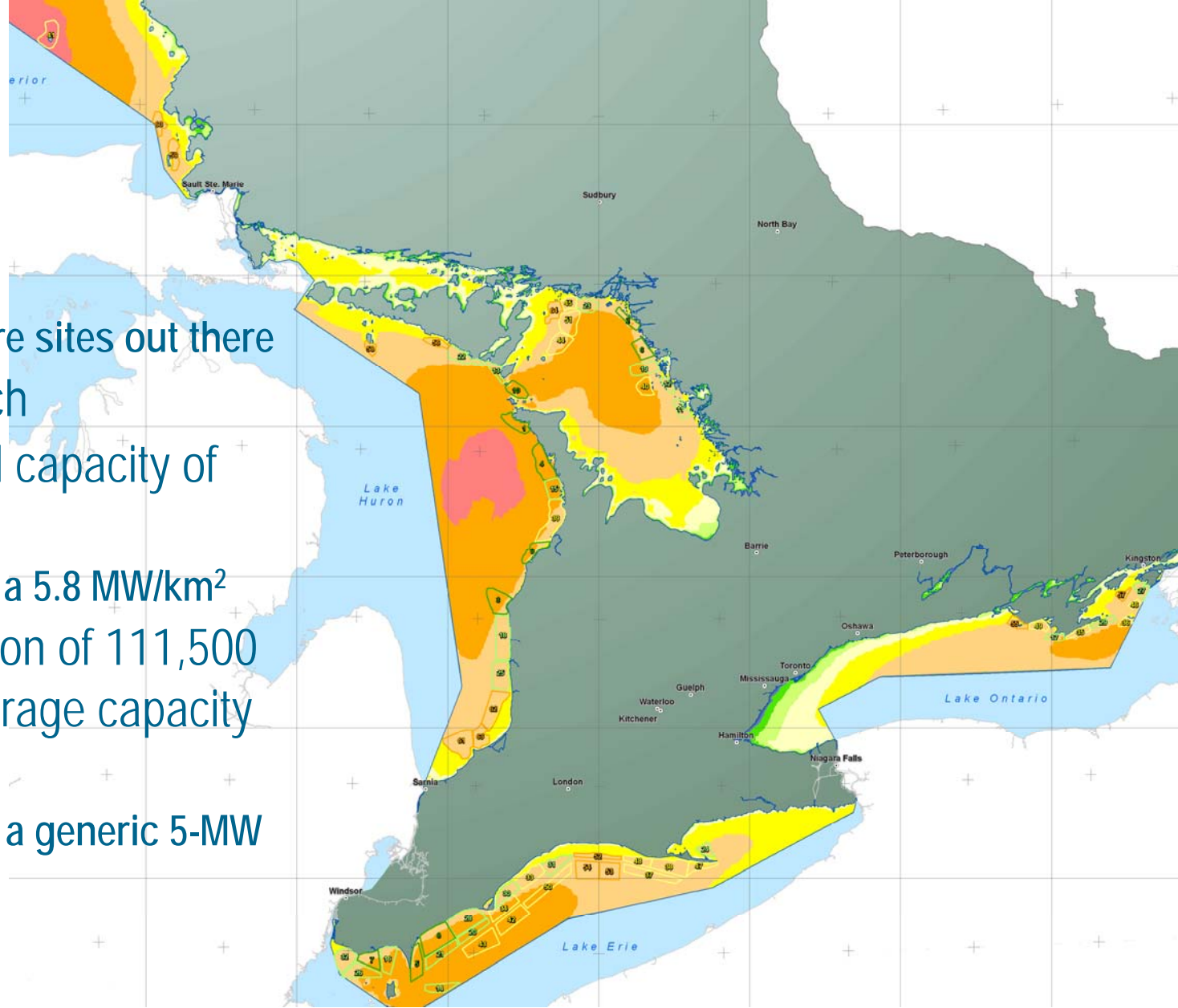
	Least Favourable	Less Favourable	Favourable	More Favourable
Visual Impact [km from shore]	0 – 1	1 – 3	3 – 9	9+
Population Density [residents/km ²]	45+	20 – 45	5 – 20	0 – 5
IBA	Inside	-	-	Outside

Infrastructure

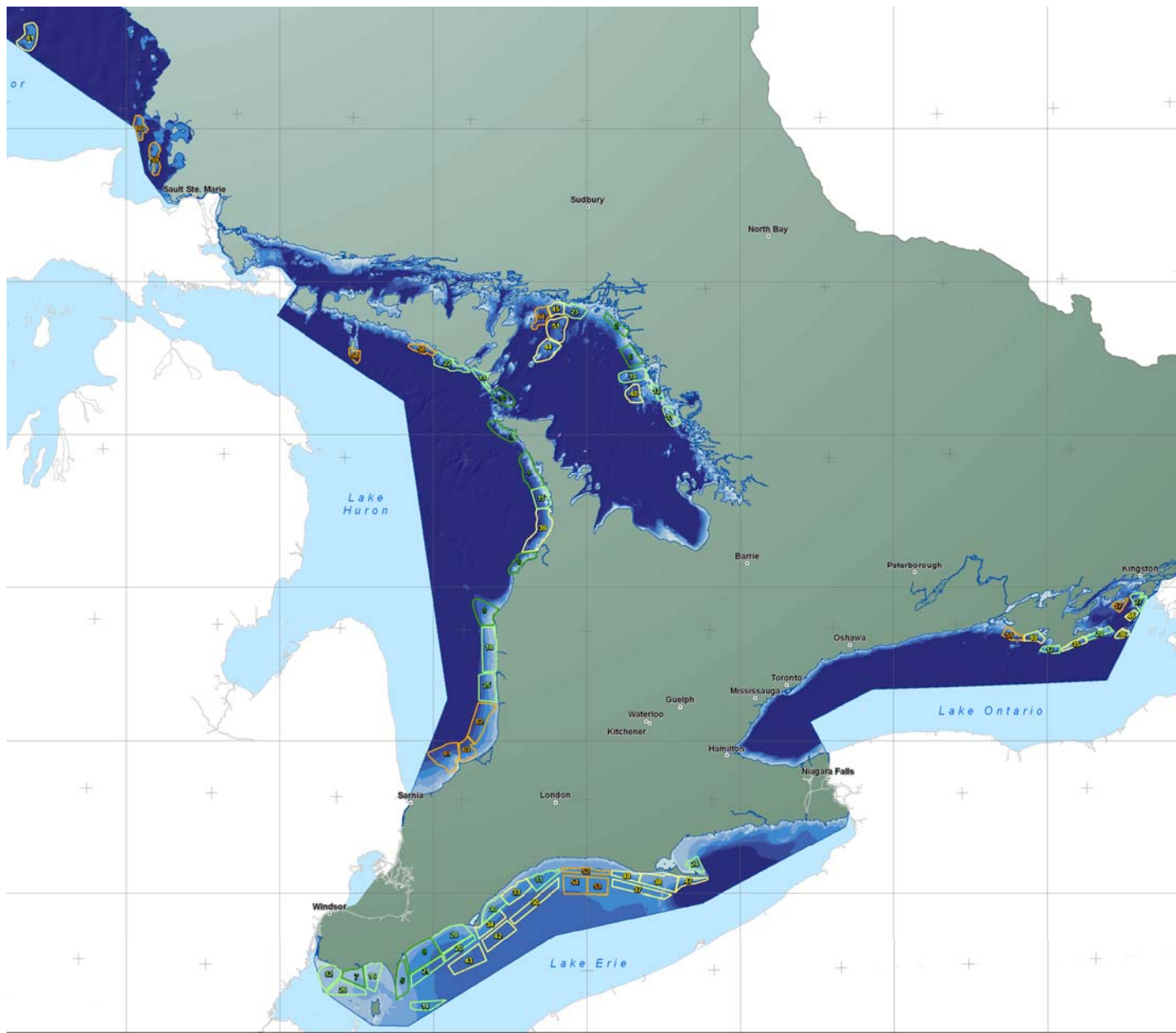
	Least Favourable	Less Favourable	Favourable	More Favourable
Airports [km]	0 – 2	2 – 4	4 – 6	6+
Radiocommunication Systems [km]	0 – 10.0	-	-	10+

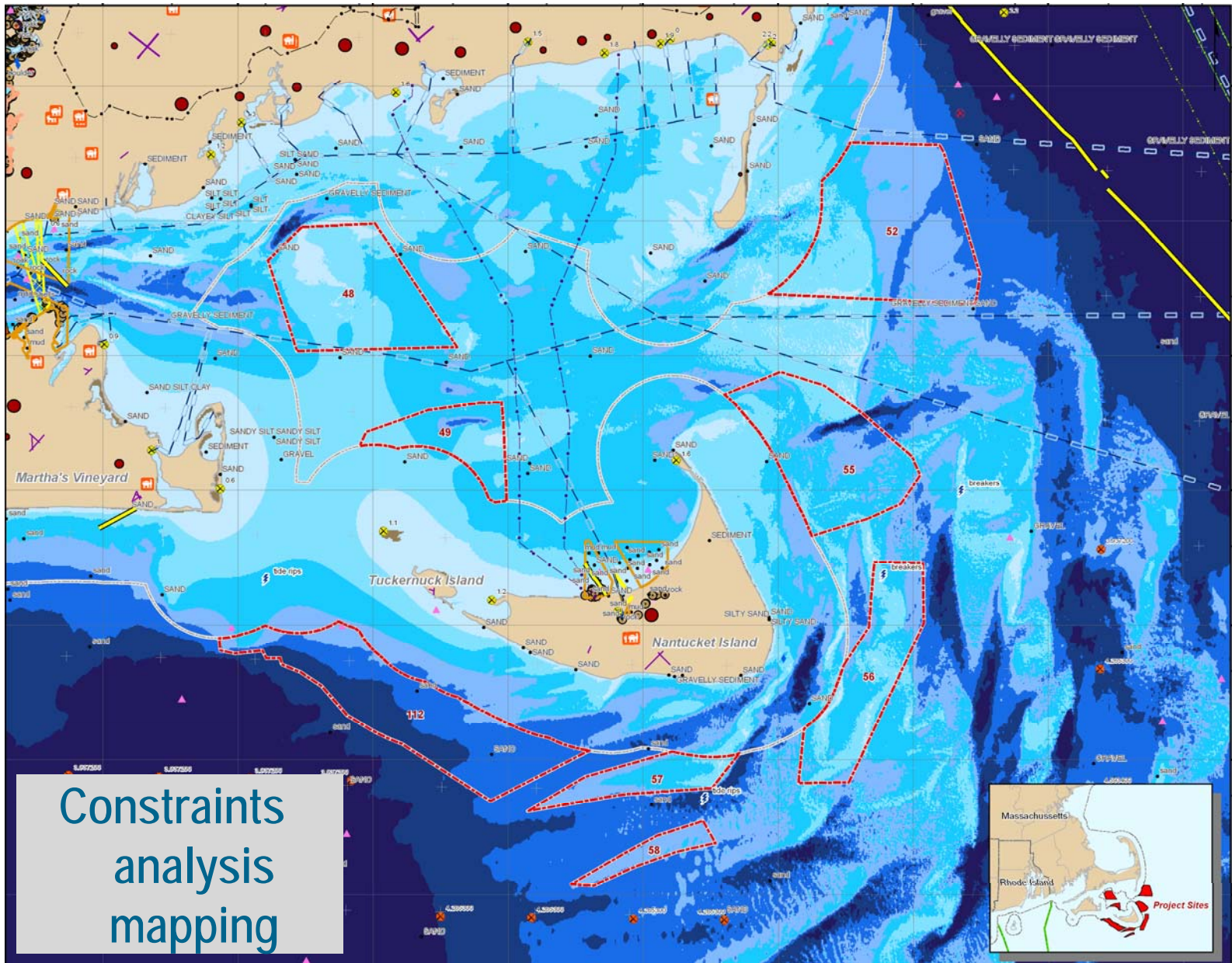
4. Results

- 64 sites
 - many more sites out there
- 100 MW+ each
- Total installed capacity of 34,500 MW
 - Assumes a 5.8 MW/km²
- Total production of 111,500 GWh and average capacity factor 36.7 %
 - Based on a generic 5-MW turbine



Bathymetry





Constraints
analysis
mapping

5. Cost Analysis

- Total project cost estimated between 3.3 M\$/MW and 4.2 M\$/MW (2008 Canadian \$)
 - 200-300 MW wind farm
 - < 20 m water depth
 - 20 km from the coast
 - Does not include collector cables to shore or transmission grid
- O&M costs estimated to be between 2.3 and 3.1 cents/kWh (2008 Canadian \$)
- Prices very variable with time and project specifics – needs updating and adjustments



6. Concluding Comments

Concluding Comments

- Well received tool to evaluate “unconstrained” potential
 - Desktop, affordable
- Adaptable methodology to suit specific needs
 - Setting of constraints, factors, etc. variable
- Good datasets important
- Deepwater technology (> 40 m) also coming along – 2 sites proposed off northeast coast (RI, CT)



Thank You !

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