



Integrating Nature-Based Design into Port Engineering

Engineering with Nature: Building Climate-Resilient Ports

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Venterra Group: Proven Expertise in ORE, Ports, and Nature-Based Design

Our Experience

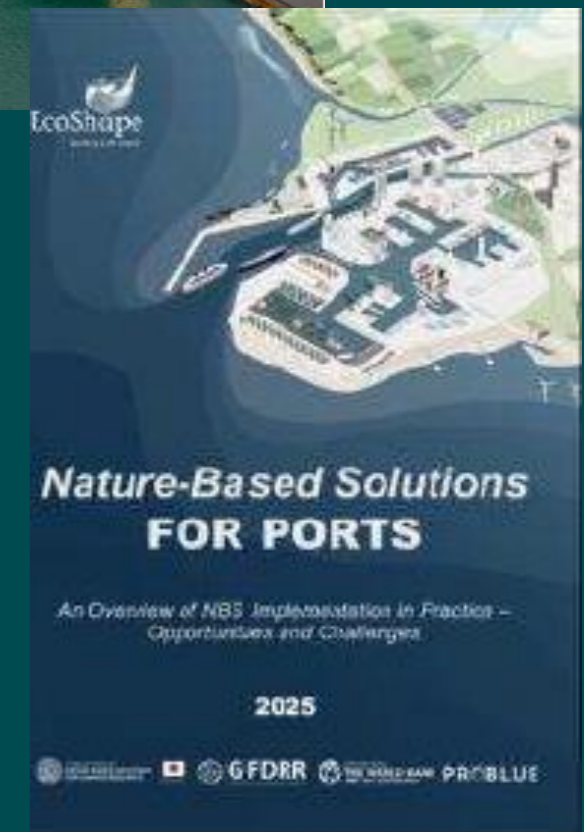
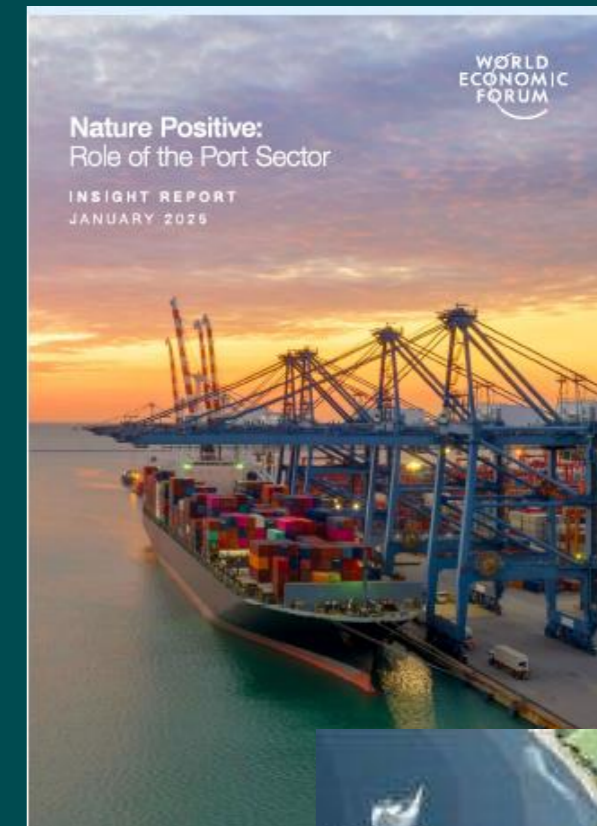
- **Geoscience Foundation:** Builds on decades of sediment dynamics, coastal processes, and seabed mobility expertise.
- **Design Heritage:** Delivers complex foundation and port and harbour designs across Ireland, UK, and Europe (such as Rosslare, Greenock, Dublin, Killybegs).
- **Science Leadership:** Specialists in benthic and hard-structure ecology, sediment processes, fisheries, dredged material monitoring, and marine acoustics; lead experts in non-extractive survey and monitoring technologies
- **Integrated delivery** — geoscience + design + ecology + data → measurable co-benefits.

Track Record Highlights

- Integrated Port and Harbour Design
- Beneficial Reuse of Dredged Sediments
- Sediment Mobility and Seabed Process Modelling
- Ecological Enhancement of Hard Structures
- Nature-Based Coastal Protection
- Non-Extractive Environmental and Dredged Material Monitoring
- Fisheries and Habitat Integration
- Geophysical–Ecological Data Integration
- Data-Driven Master Planning
- Collaborative Demonstration Projects

The Global Shift: Nature-Based Design in Ports

- **Ports worldwide are adopting nature-based solutions (NBS)** such as ecological breakwaters, living shorelines, sediment reuse and habitat-enhancing quay walls — documented in 2025 in publications by the World Bank and the World Economic Forum.
- **Canada's policy signals:**
 - **National Adaptation Strategy and Adaptation Action Plan** both highlight natural and hybrid infrastructure for coastal resilience.
 - **Advances Canada's Ocean Protection Plan, Net-Zero 2050, and Blue Economy Strategy** by embedding ecological restoration and climate adaptation in port and coastal development.
 - **Supports Indigenous reconciliation** through co-design and integration of traditional ecological knowledge into coastal resilience and restoration projects making NBS directly relevant in the Canadian context.
- **Finance Rewards NBS:** ports using NBS can tap into emerging ESG-linked and resilience-oriented finance mechanisms.
- **Technology and practice enablers:** monitoring, hydrodynamic and ecological modelling now make NBD port designs viable and verifiable — seen in cases like the Living Breakwaters (NY) and the Halifax Port Authority (HPA) commitment to a strategy including ecosystem restoration as part of its operations at the Port of Halifax.



What Nature-Based Design in Ports Means

True resilience comes from designing with nature

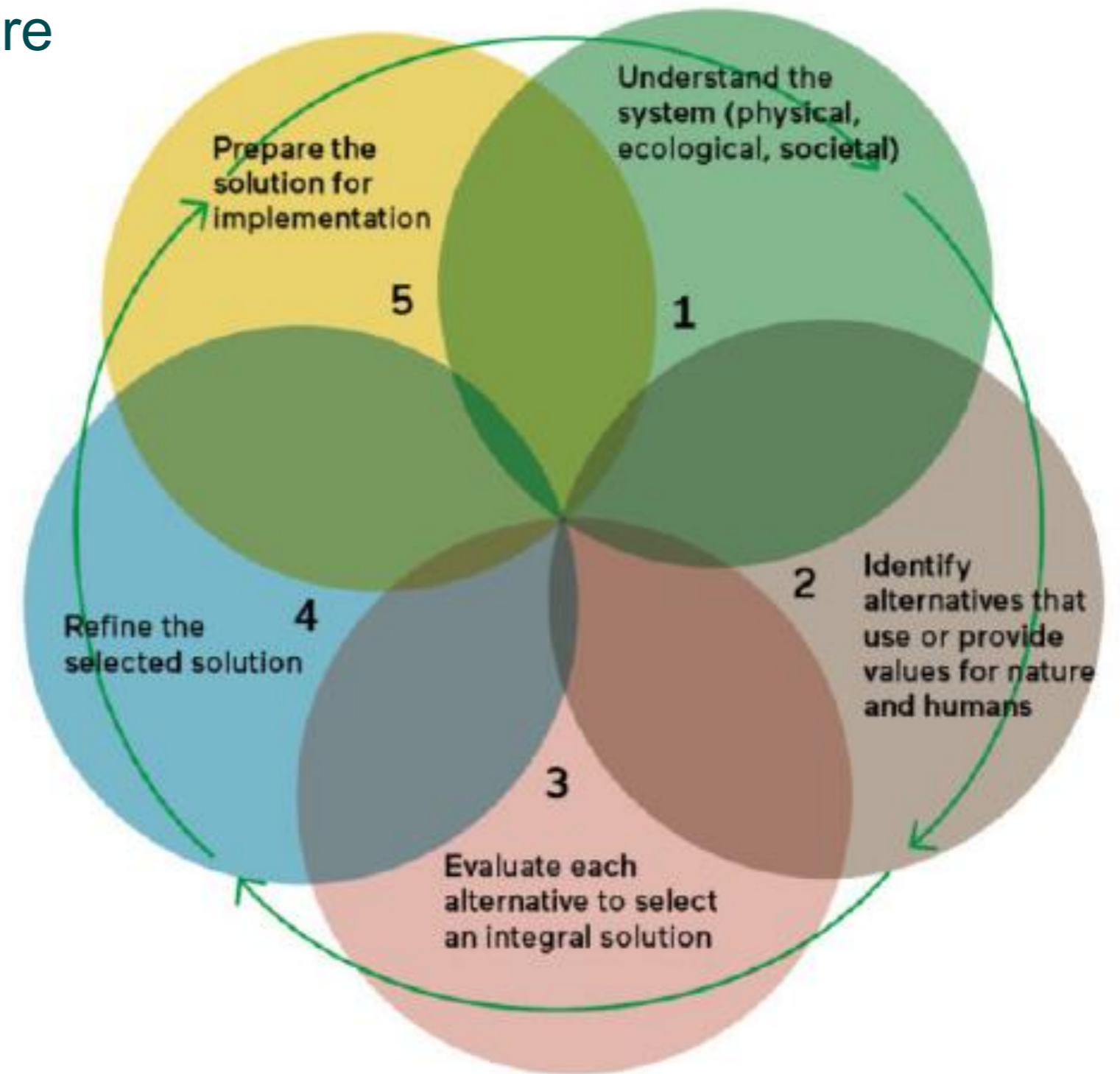
Applied in Port Development

Working with Coastal Systems: Port siting and layout, Restoring riverine ecosystems, Sustainable sediment management.

Wave and Coastal Dynamics Attenuation: Use saltmarsh fringes, seagrass meadows, and ecological breakwaters to absorb wave energy and buffer storm surges.

Beneficial Reuse of Dredged Sediment: Foreshore and land reclamation from dredged sediments, Construction material, Creation of habitats.

Enhanced Hard Structures: Enhanced quay walls, Hanging and floating structures, Habitat creation units.



Source: van Eekelen and Bouw 2020

Case Study: Evaluating Beneficial-Use of Dredged Material Placement Offshore USACE DAMOS Program



- Created a framework for monitoring programs to evaluate the value in creating reef habitat in offshore New England waters
- Incentivize the practice of keeping coarse material (e.g., blasted rock) separate from finer dredged material for intentional placement offshore
- Developed metrics of success to monitor habitat value over time for ecologically and commercially important species (e.g., lobster, cod)
- Selecting the monitoring tools to match the objectives (hypotheses) and environment



Sediment
Profile & Plan
View Imaging
(SPI/PV)



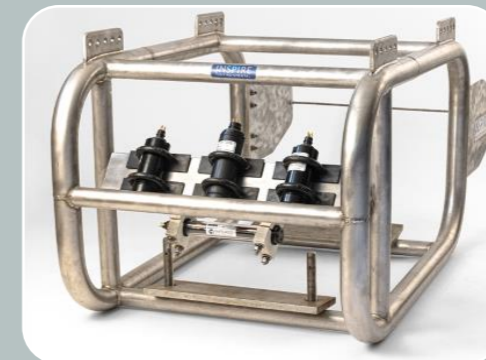
Video from
Remotely
Operated
Vehicles
(ROV Video)



Small
Underwater
Drones



Stereo Imagery



Towed Video



Baited Remote
Underwater
Video
(BRUV)

Case Study: Post-Construction Benthic Monitoring Demonstrates the Turbine Reef Effect at South For Wind Farm



- Wind farms add new structure to the marine environment that marine invertebrates attach to and grow on.
- The new habitat and availability of food resources brings fish and shellfish to the area in what is known as a “reef effect”.
- These SFW benthic visual surveys documented this effect, revealing numerous commercially, recreationally, and ecologically important species such as black sea bass, lobster, and flounder near the new structures.
- Some other species observed include Atlantic cod, scup, cunner, barrelfish, flounder, butterfish, jack, mahi mahi, triggerfish, Bermuda chub, winter and summer flounder, sculpin, spotted and red hake, ocean pout, and Atlantic rock/Jonah crabs.



Explore the results yourself at:

<https://www.inspireenvironmental.com/resource/story-maps>

From Policy to Portside Practice

Delivering Nature-Based Design for Ports

Canada has the policy framework, science capacity, and engineering talent to make its ports global models of **climate-resilient, nature-positive infrastructure**. What's needed now is delivery.

Venterra delivers.

We unite **ecological science, coastal engineering, and advanced monitoring** to embed Nature-Based Design in real port expansion and renewal projects.

Our value for Canadian Partners

To prove that ports can **protect coastlines, enable trade, and restore ecosystems**, where every cubic meter of dredged sediment, every quay wall, and every shoreline intervention adds measurable ecological and economic value.

For More Information:

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