



NAVY PUGET SOUND
KINETIC HYDROPOWER SYSTEM
(NPS-KHPS)
Demonstration Project



NAVFAC
ENGINEERING SERVICE CENTER



Provided to the Puget Sound Harbor Safety Committee

May 15, 2009





Project Team

Navy Region Northwest (NRNW)

Action Proponent, National Environmental Policy Act (NEPA) documents and environmental permitting

Naval Facilities Engineering Services Center

Project Manager

Verdant Power, Inc.

KHPS turbine technology

Sound & Sea Technology, Inc.

System engineering, design and installation

Quercus Consultants, Inc.

Environmental impact analysis and environmental planning support





Background

Navy Puget Sound Kinetic Hydropower System (NPS-KHPS)

- ✦ A Congressionally directed and funded demonstration of the Verdant Power KHPS in Puget Sound
- ✦ Consistent with National directives to
 - ✦ Develop alternative energy technologies
 - ✦ Reduce dependence on fossil fuels



Demonstration

- ✦ Focused on a specific pre-commercial technology
- ✦ Independent of full scale commercial production
- ✦ A cost-effective step in gathering technological and environmental knowledge



Renewable Energy Directives

Federal policy encourages developing renewable energy technology

- ✦ National Defense Authorization Act of 2007
 - Generate 25% of electricity from renewable sources by 2025
- ✦ Energy Policy Act of 2005
 - Required to purchase 3% renewable electricity in FY's 07-12, 7% by FY13 and thereafter
- ✦ Executive Order 13423, Energy and Water Efficiency
 - Reduce energy consumption by 3% annually or by 30% by 2015



NPS-KHPS Proposal

✦ Design the Verdant Power KHPS Generation 5 technology for installation in Puget Sound

- Design seafloor mounting system
- Select cable routing and design interface connections
- Develop environmental monitoring techniques

✦ Demonstrate the KHPS in Puget Sound for 9-12 months

- Monitor operations
- Monitor environmental effects

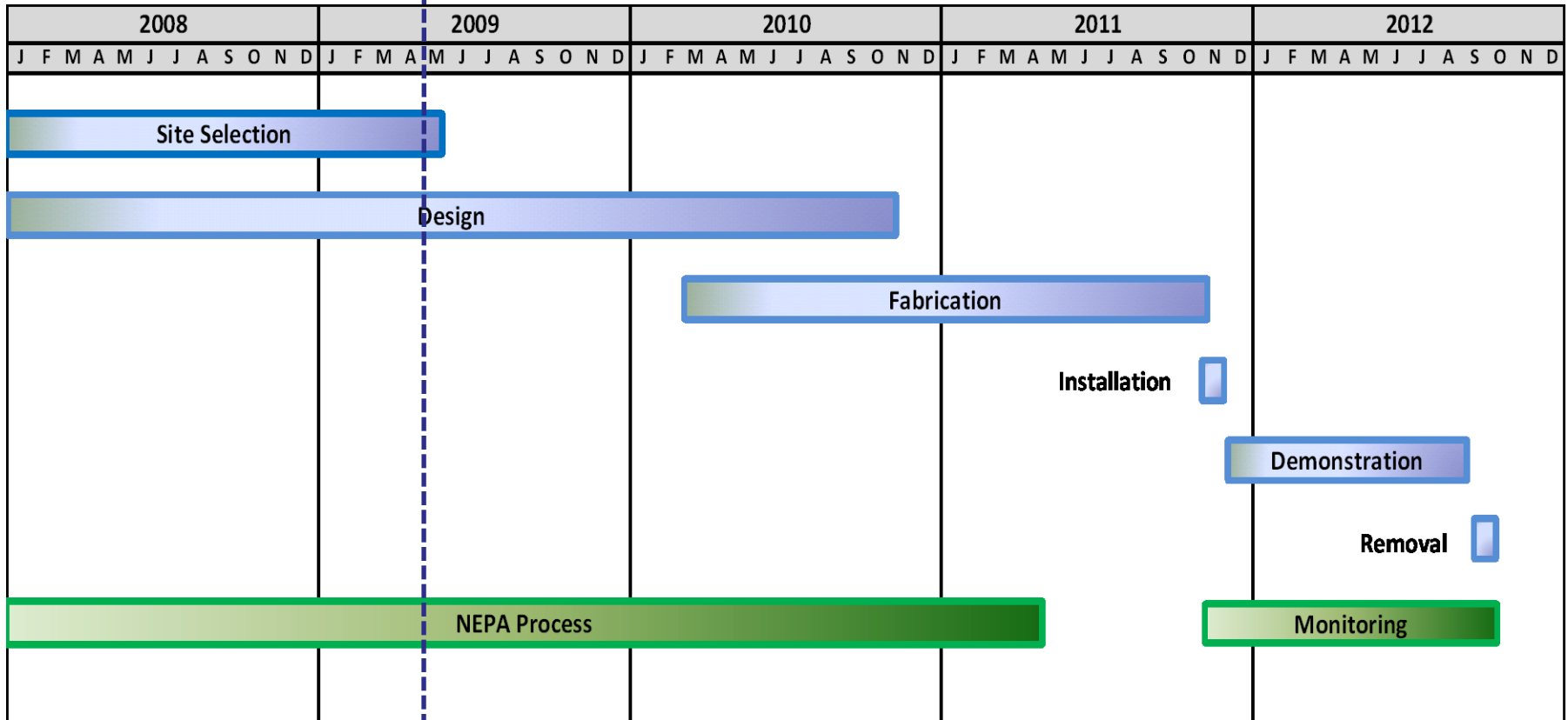
✦ Remove KHPS upon completion





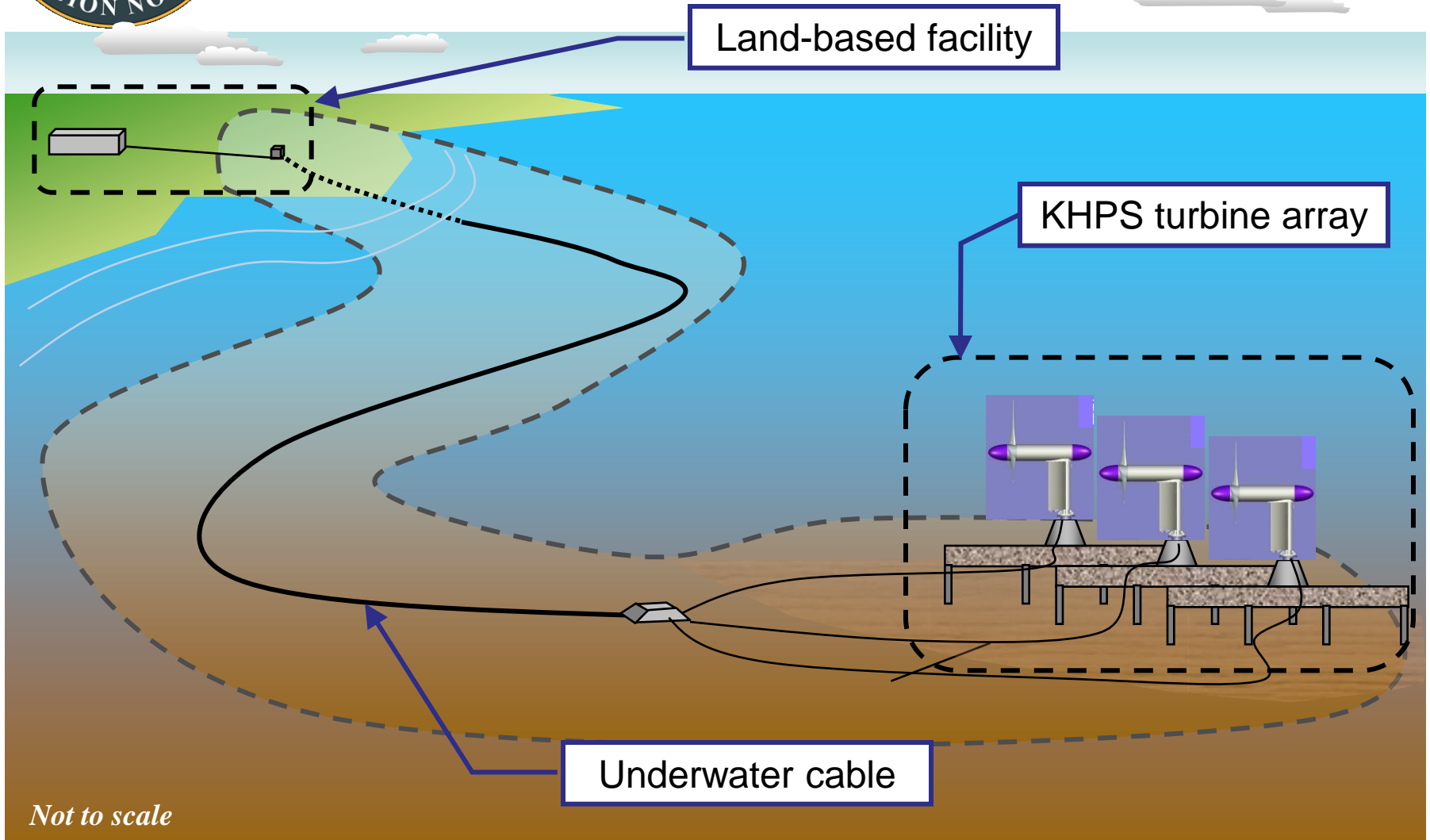
Timeline

Today





NPS-KHPS Components





NPS-KHPS Components

Underwater KHPS turbine array

- KHPS turbines and enclosed generator
- Gravity foundation “triframe” structure
- KHPS operation and environmental monitoring
- USCG surface buoy marking system

Underwater cabling

- Service cables, junction box, trunk undersea cable and shoreline landing

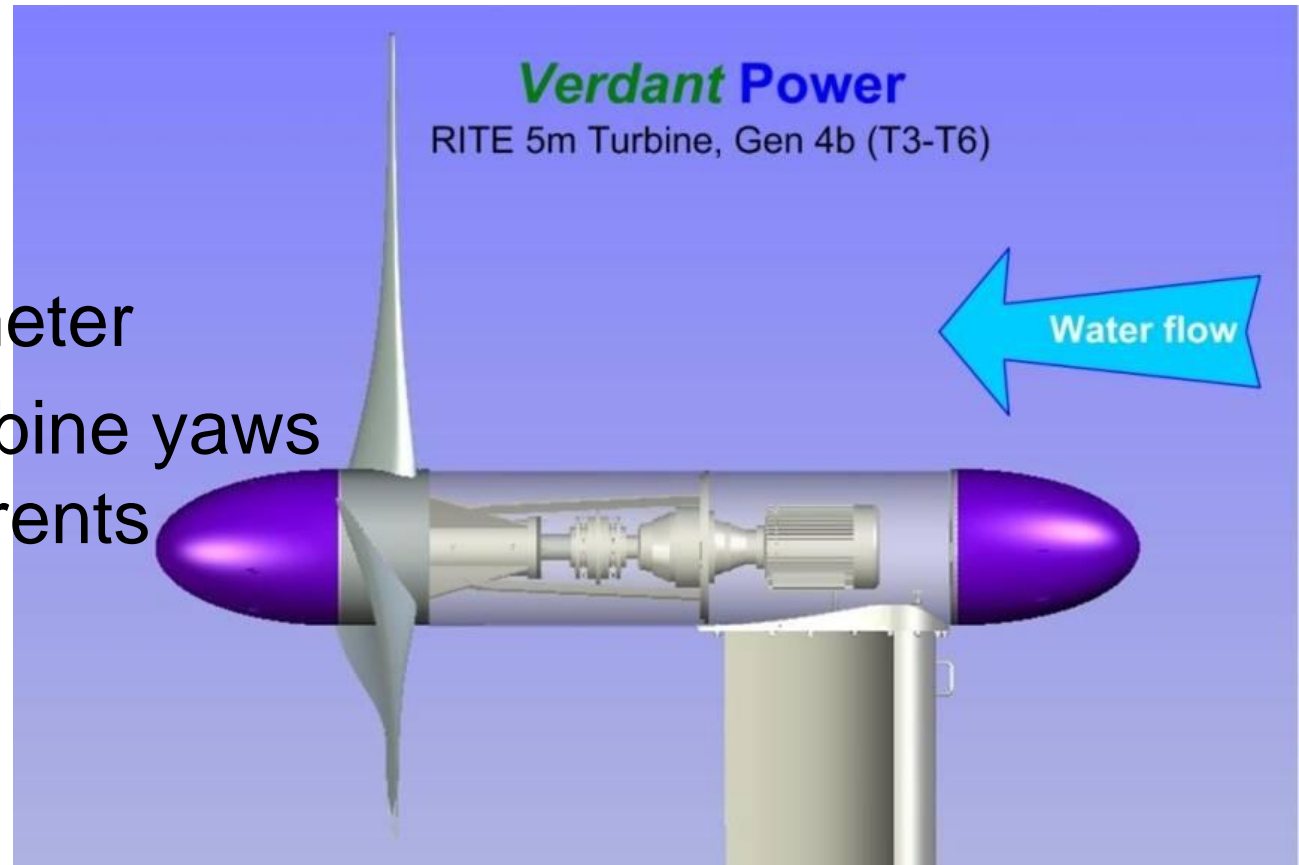
Land-based facilities

- Shoreline utility junction vault (10 sf)
- Control room/equipment shelter (160 sf)
- Minimal backhaul connection from shoreline to control room



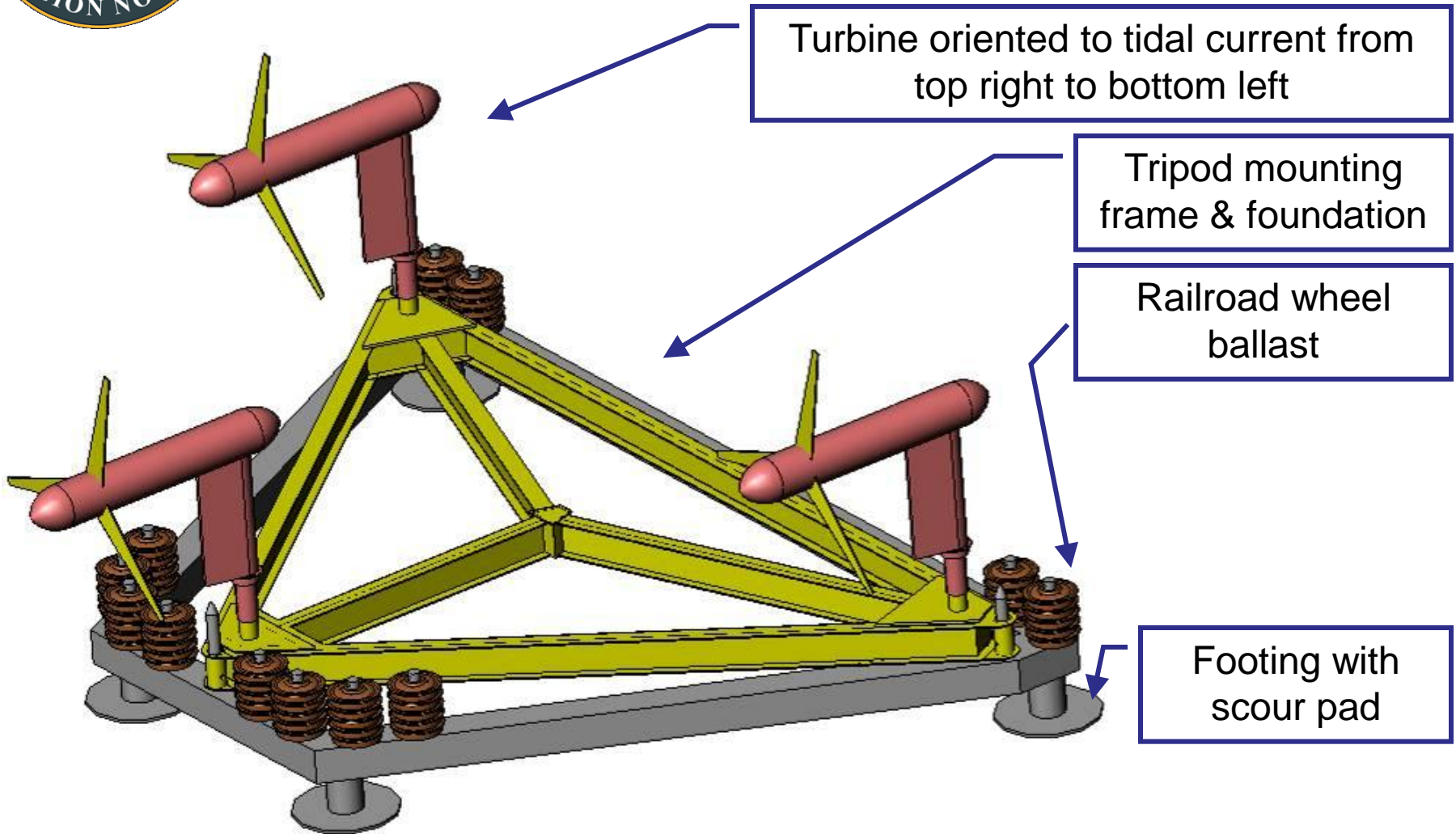
Verdant Power Turbine

- ✦ Open rotor
- ✦ Fixed pitch
- ✦ 3 blades
- ✦ 5 meter diameter
- ✦ Free-flow turbine yaws with tidal currents





Three Turbine Array Mounting and Gravity foundation





Land-based Facilities



Remote operation

- Isolated Navy load and interconnection
- Minimum complexity
- Central data acquisition



Site Screening Criteria

NPS KHPS Demo Requires

- Adequate velocities for power production
- Adequate benign bathymetry, minimal slope, adequate area
- Proximity to Navy installation
- Compliance/compatibility with navigation requirements and with commercial & recreational traffic/ fishing interests and environmental constraints



Siting Terminology

NPS KHPS Siting Terminology

CANDIDATE SITE

[~30-100 ac]

Zone within Puget Sound selected for further study



TIDAL SITE BLOCK ("Block")

[~12 ac, rectangular geometry ~100m x 500m]

Area of adequate velocity/bathymetry/slope



FIELD ARRAY SITE ("Field Array")

[~1-3 ac]

2-10 turbines considering hydrodynamics/navigational buffers



FRAME/MOUNT FOOTPRINT AREA ("Footprint")

[~3-8 m² per turbine]

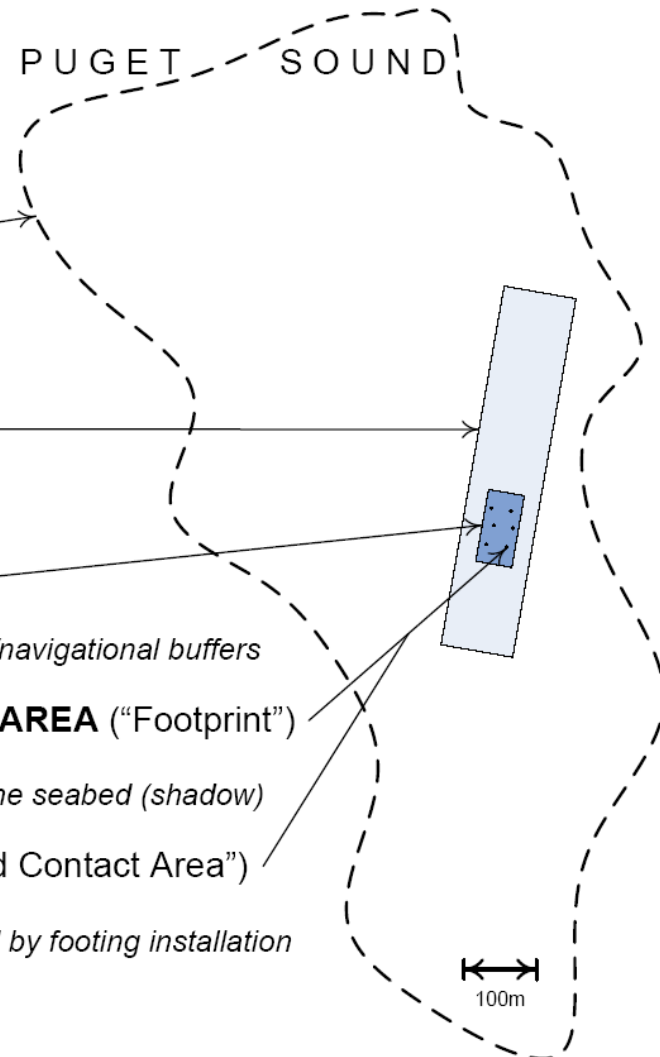
Equipment footprint projected onto the seabed (shadow)



FOOTING AREA ("Seabed Contact Area")

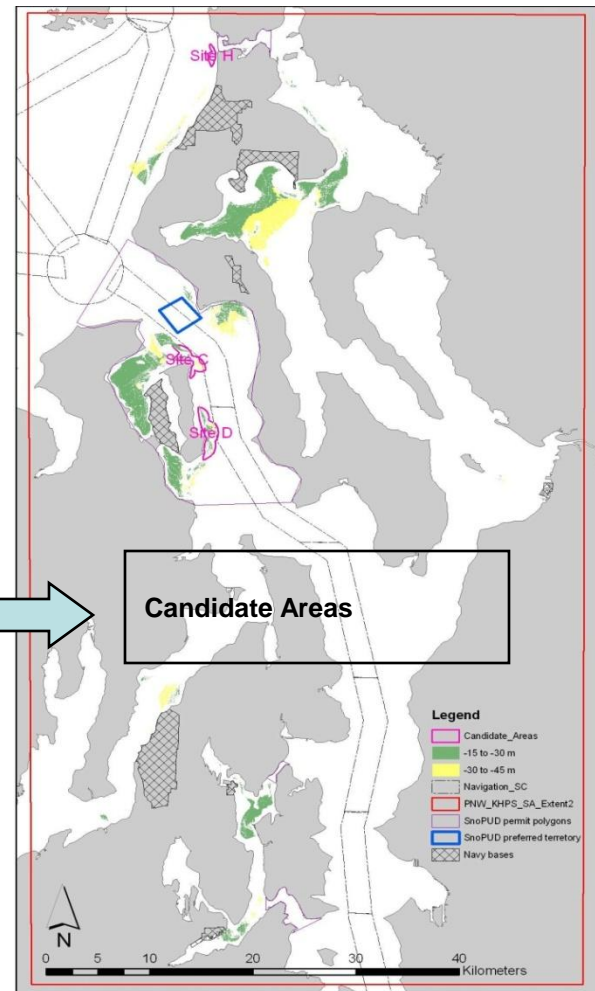
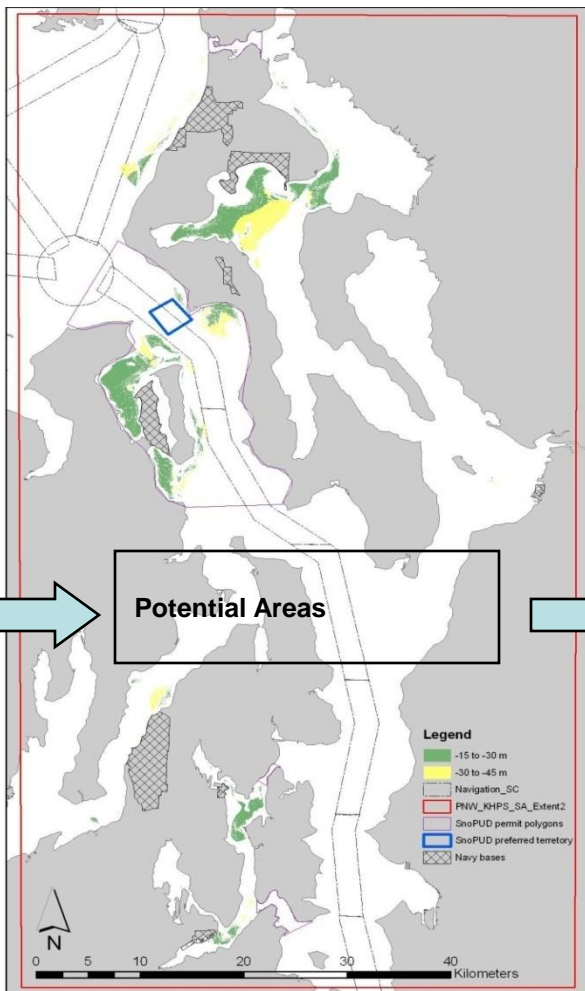
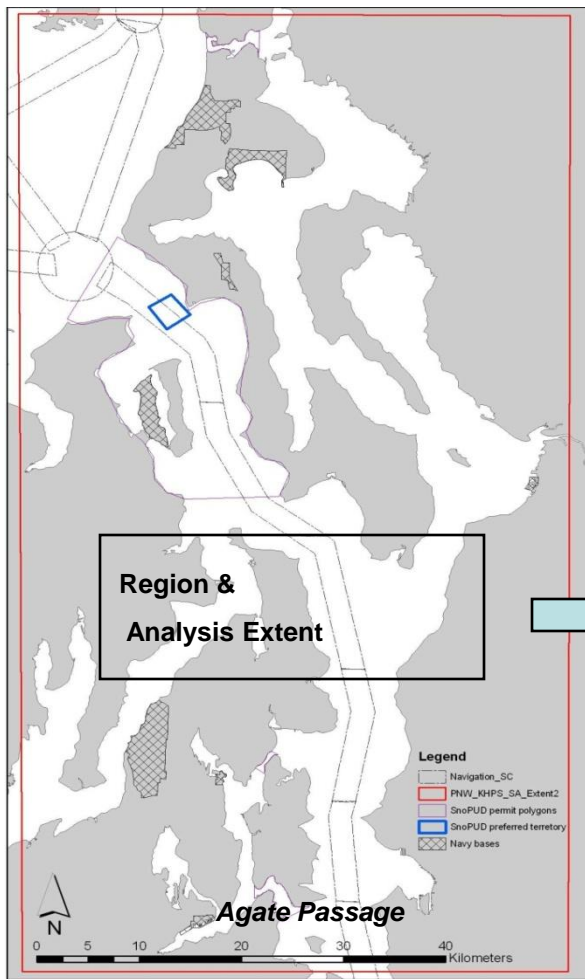
[~1-3 m² per turbine]

Seabed area actually disturbed by footing installation





GIS Site Assessment Process

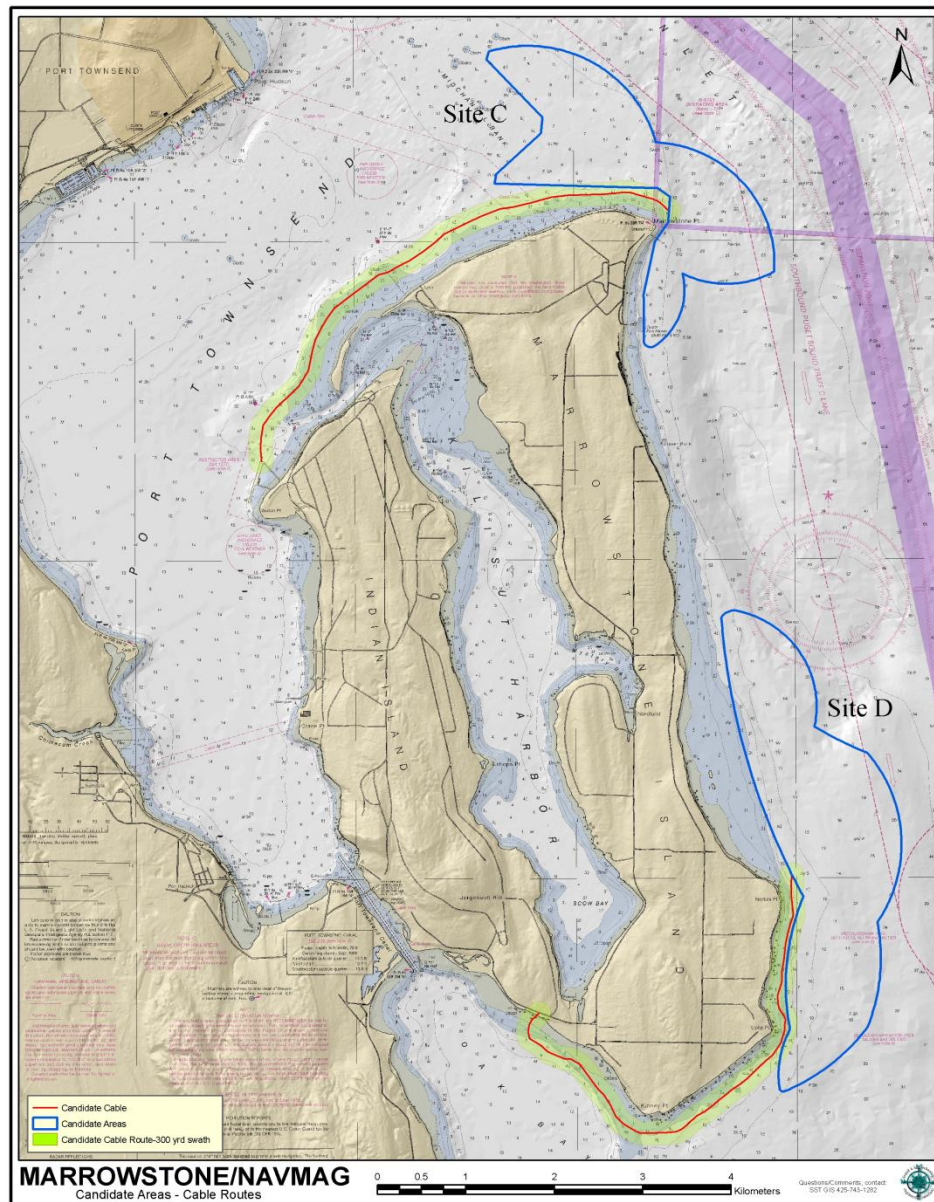




Candidate Areas in Consideration

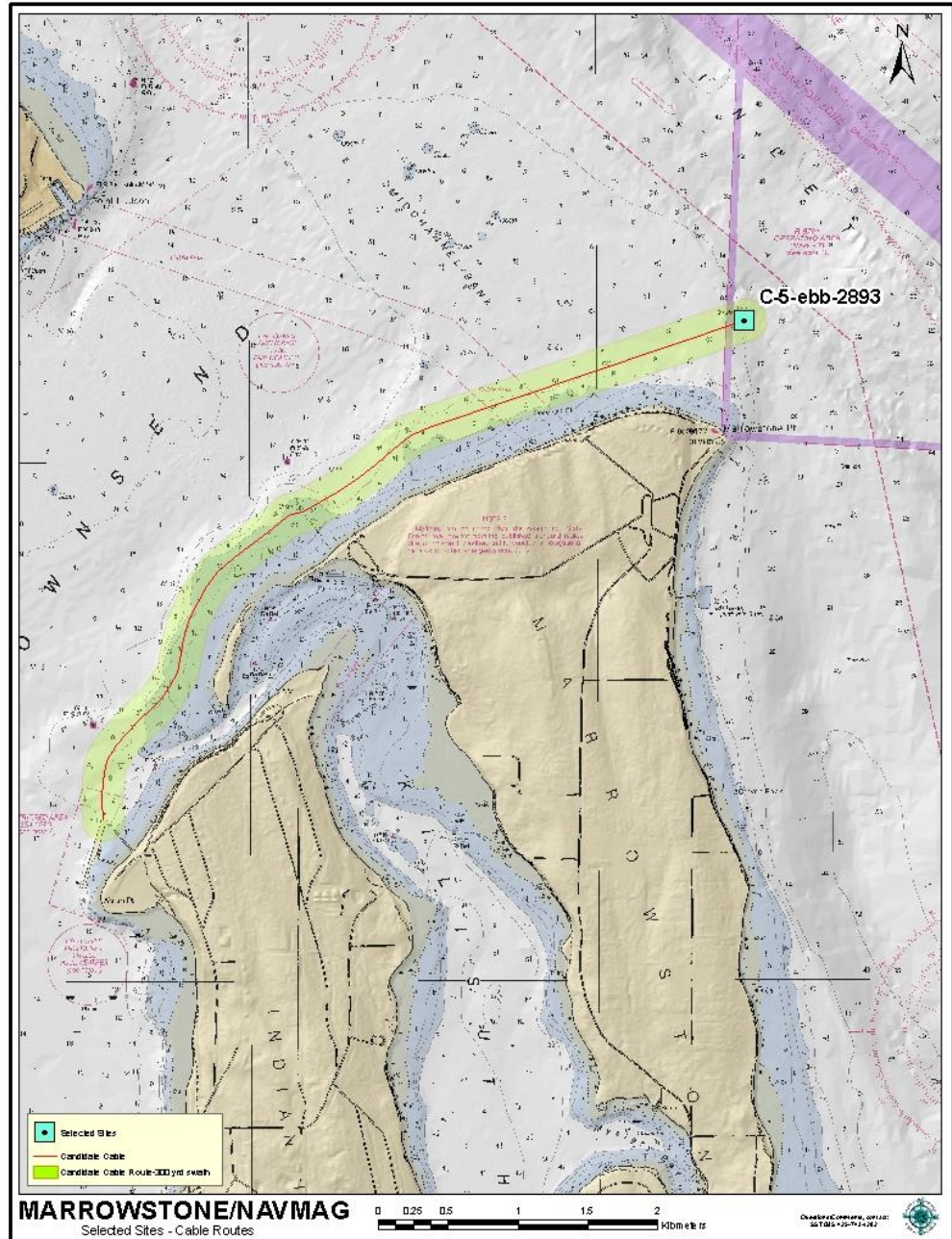
North Marrowstone (4C5)

South Marrowstone (3D11)



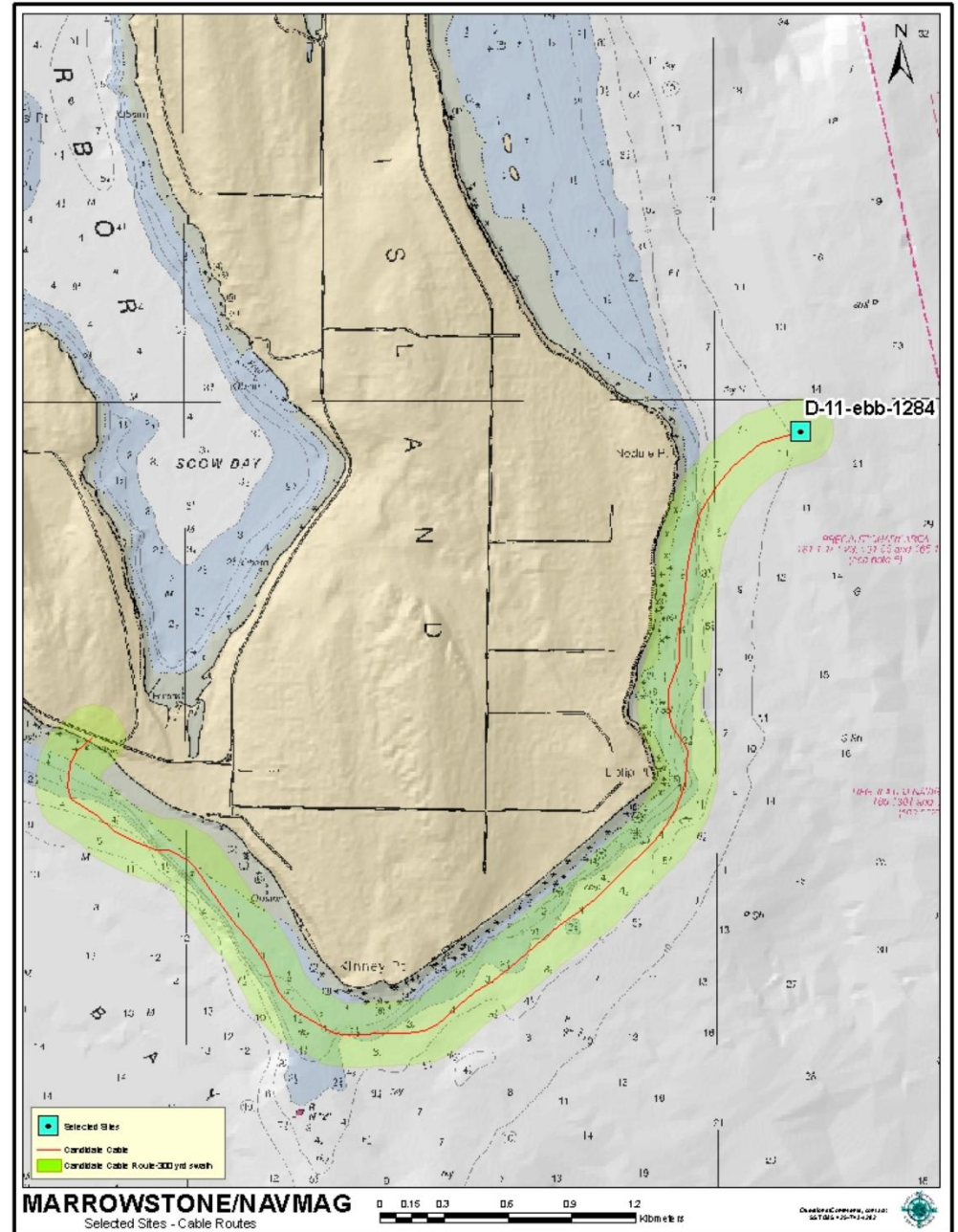


North Marrowstone Cable routing





South Marrowstone Cable routing





Potential Environmental Effects

Physical

- Direct and indirect water quality changes
- Sediment scour and shifts in sedimentation
- Tidal flow volume and velocity changes up and downstream

Biological

- Impact with turbine blade
- Injury during construction
- Loss of habitat
- Shifts in planktonic distributions

Socioeconomic

- Tribal, commercial and private vessel traffic

Cultural

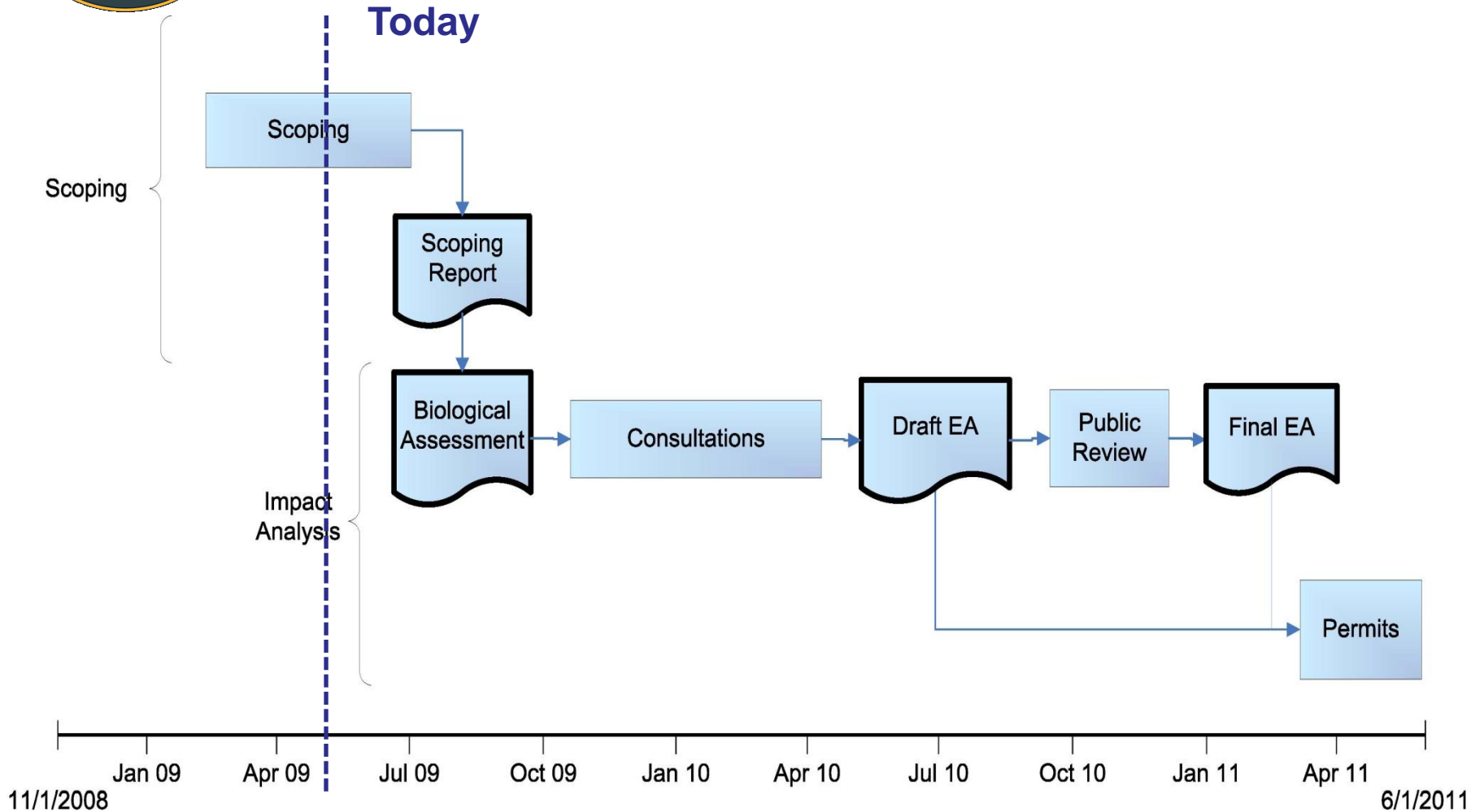
- Usual and Accustomed fishing and Tribal Treaty rights

Cumulative

- Other ongoing tidal hydropower projects in Puget Sound (e.g. Snohomish PUD)
- Other future hydropower projects in Puget Sound



NEPA Process





Scoping and Impact Analysis

- What focus issues should be analyzed and in what priority?
- What other actions or options should be considered?
- What information does your agency need to make an informed decision about the proposed NPS-KHPS demonstration project?
- What information does Navy need to make a decision
 - to implement the proposed demonstration project?
 - to select an option?

Today...site selection and existing conditions studies



Contact the Navy

Captain Robert Schlesinger
Regional Engineer
Navy Region Northwest

Commander Mark Loose
Commanding Officer
Naval Magazine Indian Island

Mr. Peter Havens
Environmental Planning
(360) 396-0916
peter.havens@navy.mil

Mr. Brian Cable
Project Manager
(805) 982-1207
brian.cable@navy.mil

Ms Sheila Murray
Public Affairs
(360) 396-4981
sheila.murray@navy.mil

Ms Cindy O'Hare
Tribal Coordination
(360) 396-0014
cindy.o'hare@navy.mil