



UNH CORE Tidal Energy Test Platform v2

Jeff Byrne: Jeff.L.Byrne@gmail.com



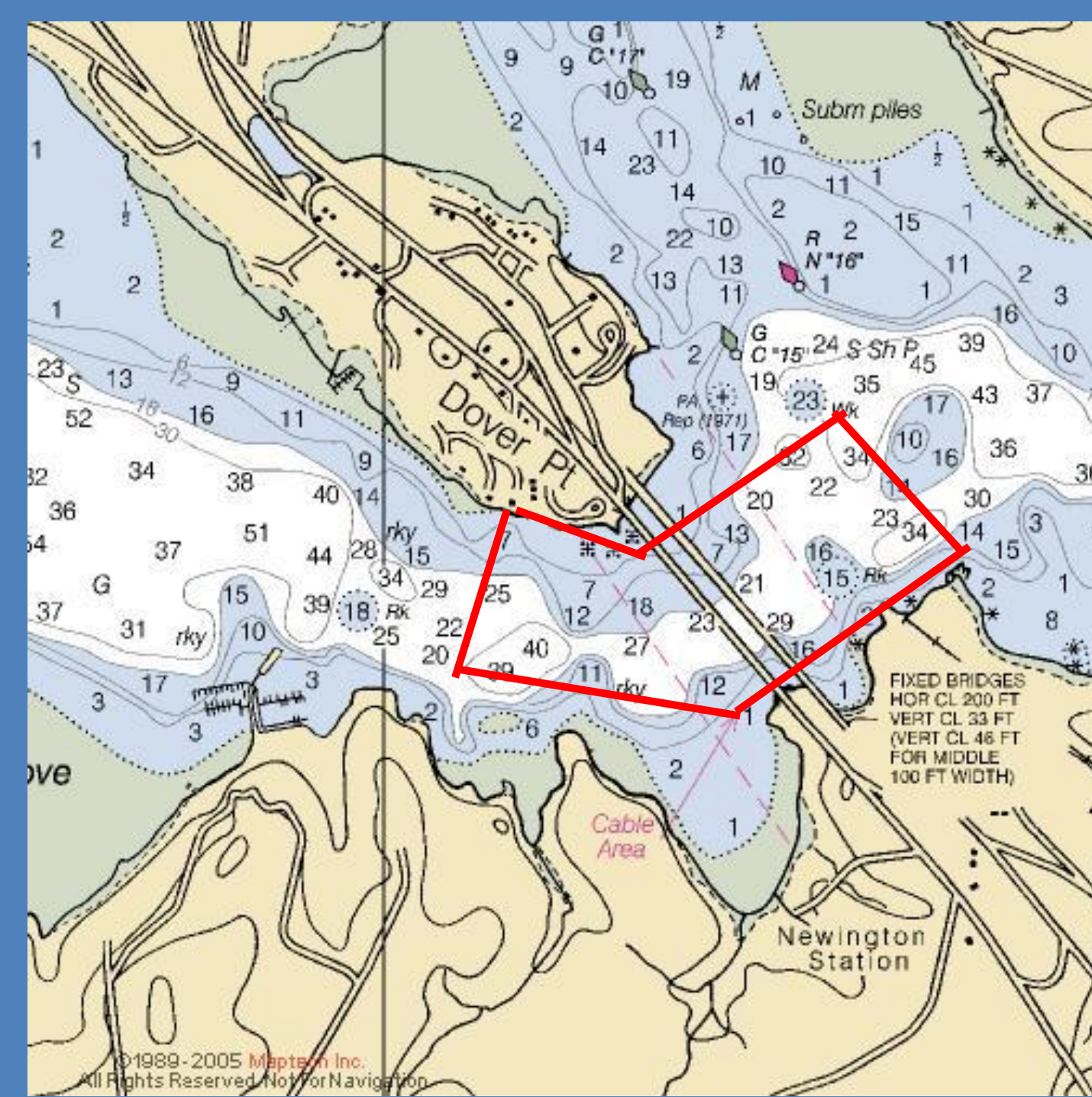
The University of New Hampshire's Center for Ocean Renewable Energy (UNH CORE) provides a testing facility for marine hydro-kinetic turbines that integrates with local and national scale-up infrastructure at DOE TRL levels 5 to 6.

UNH CORE Tidal Energy Test Site

The test site spans between Dover and Newington on the New Hampshire seacoast. This location serves as a natural bottleneck between the Great Bay Estuary and the Atlantic Ocean.

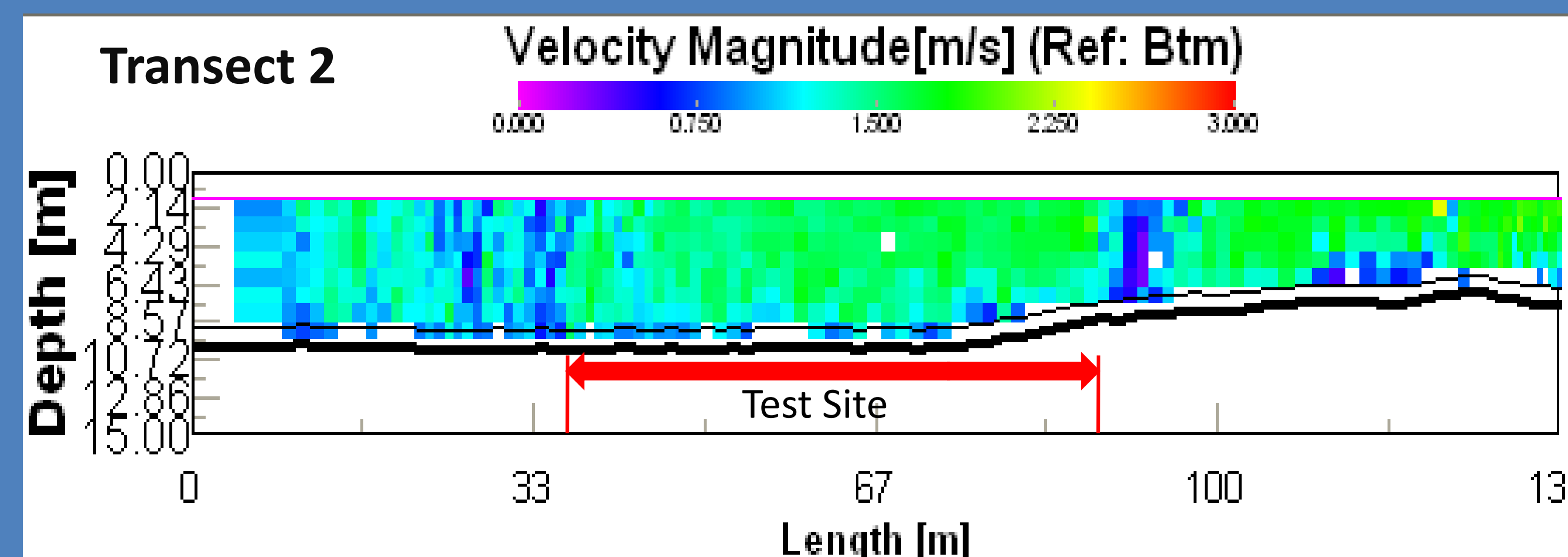
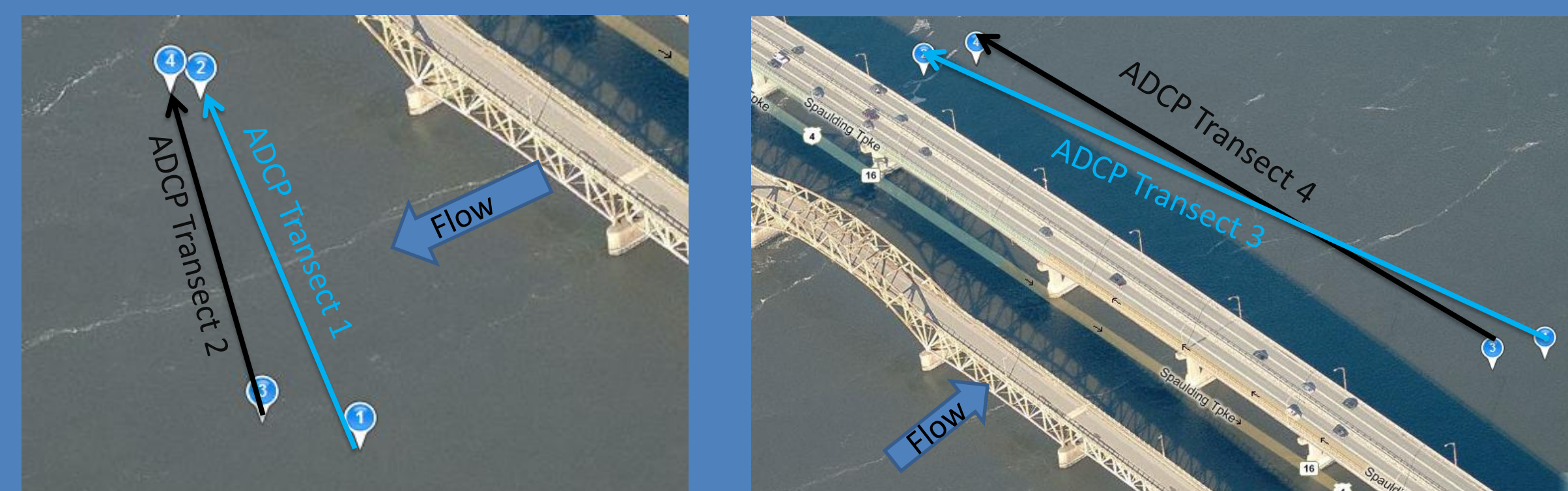


FERC Permitted Test Site



- Average peak current velocities during each tidal cycle of 4 knots (2.0 m/s)
- Maximum peak current velocities (upwards of) 5.3 knots (2.7 m/s)

Representative ADCP Transects

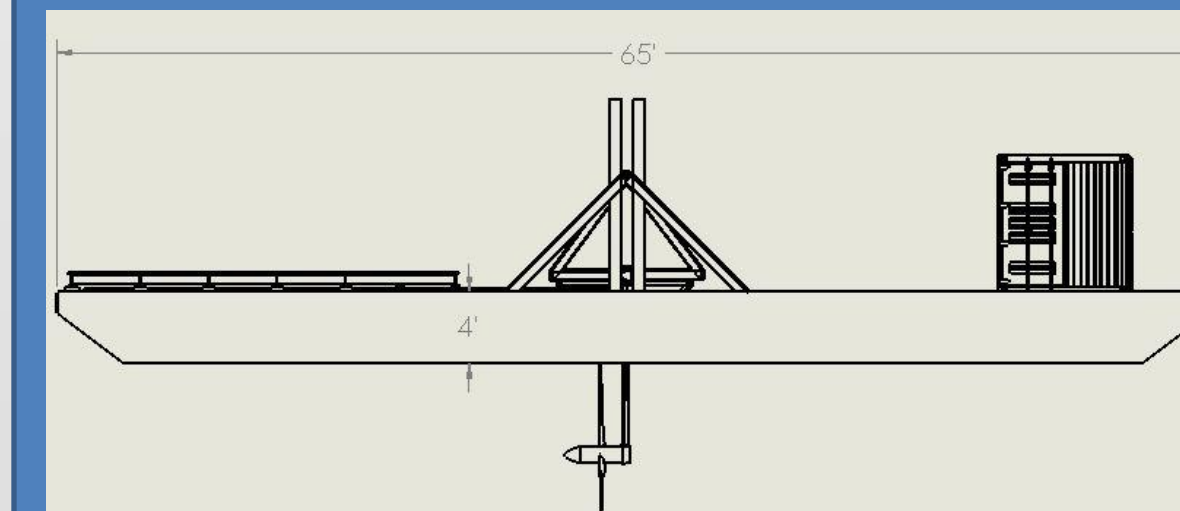


Additional velocity data exists from:

- Long term bottom mounted ADCP deployments (NOS/NOAA survey 2007)
- ADCP Transects
- Estuary numerical models (SMS/RMA2 and tidal current prediction models)

Test Platform Design

The overall design concept is that of a twin hulled deck barge with a centralized moonpool through which turbines can be deployed.



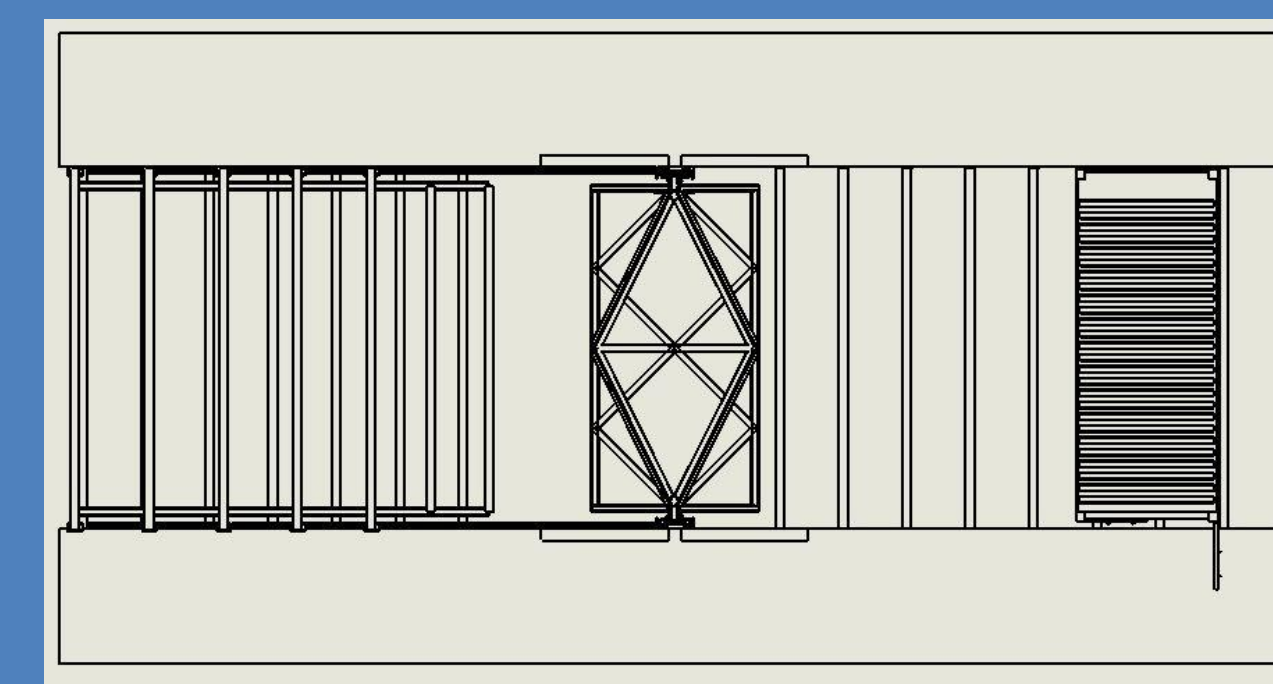
Side view (in stream axis turbine installed)

Item	Units	Value
Length	(ft)	65
Beam	(ft)	34
Draft	(ft)	1.4
Height	(ft)	16.5
Weight	(lbs)	88000
Hull Material	(N/A)	A36 Steel

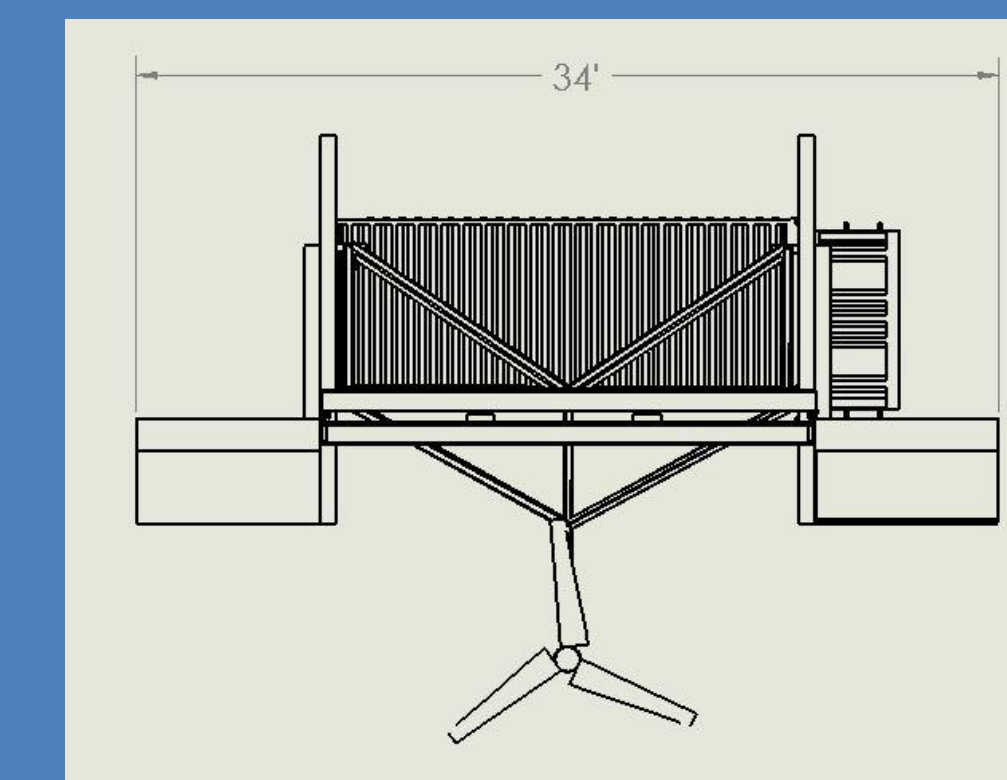
Relevant facts and dimensions

The platform employs a rigid derrick structure that supports a universal mounting system which both lifts and rotates. Relatively small turbines can be mounted and deployed without requiring the mounting system to rotate. However, the platform may at times be subjected to a height constraint due to the geometry of the bridge. For this reason, the mounting system is able to rotate 90° to accommodate larger turbines while conforming to a height limit.

A section of deck in front of the moonpool is mounted on a rail system. This deck section can slide into place over the moonpool to either mount, or dismount, a turbine. This deck section allows for turbines of any size to be easily loaded onto the test platform. From there, the platform is able to handle the alignment and mounting of a turbine without the need of a support vessel.

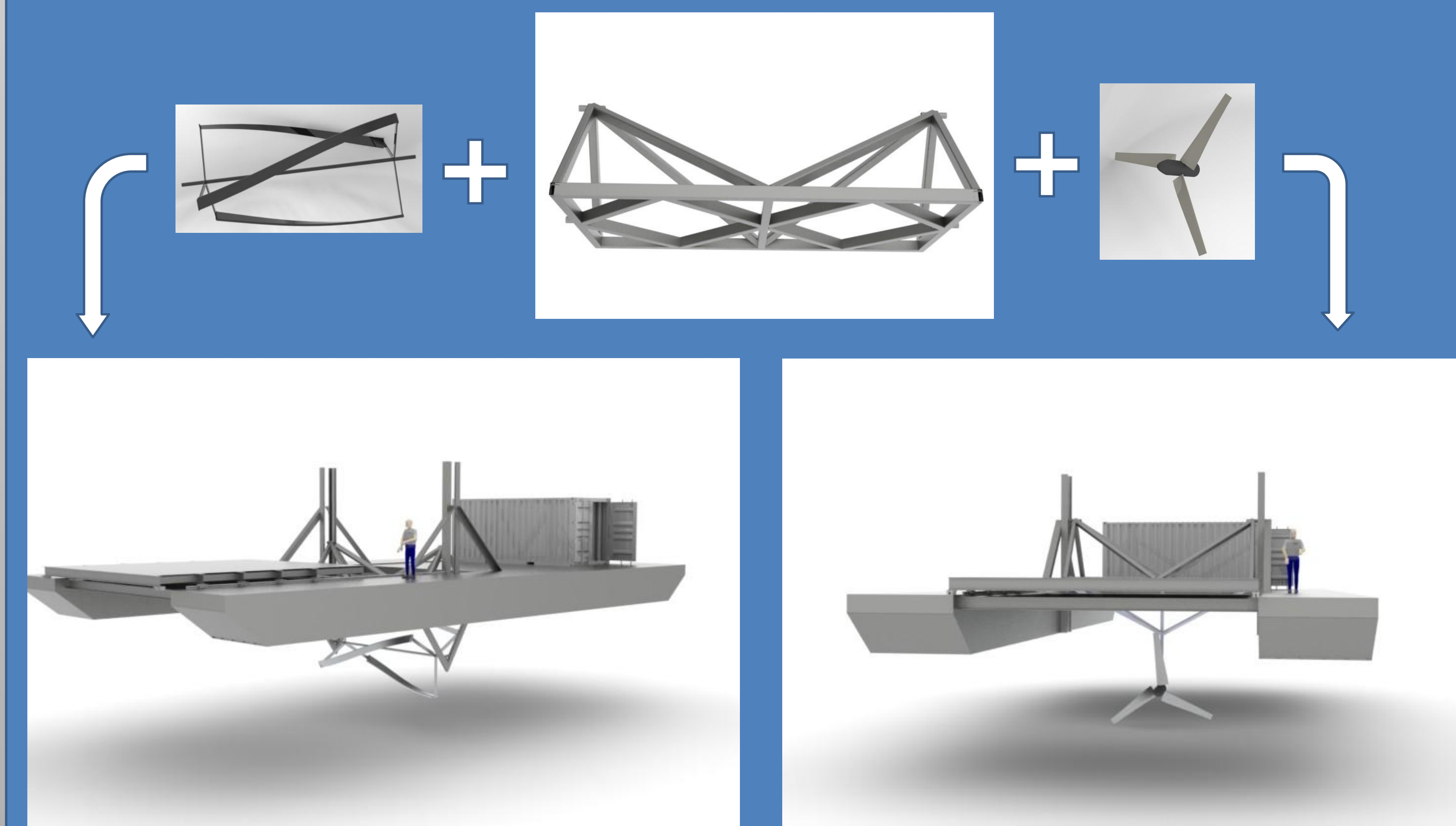


Plan view with decking removed for clarity

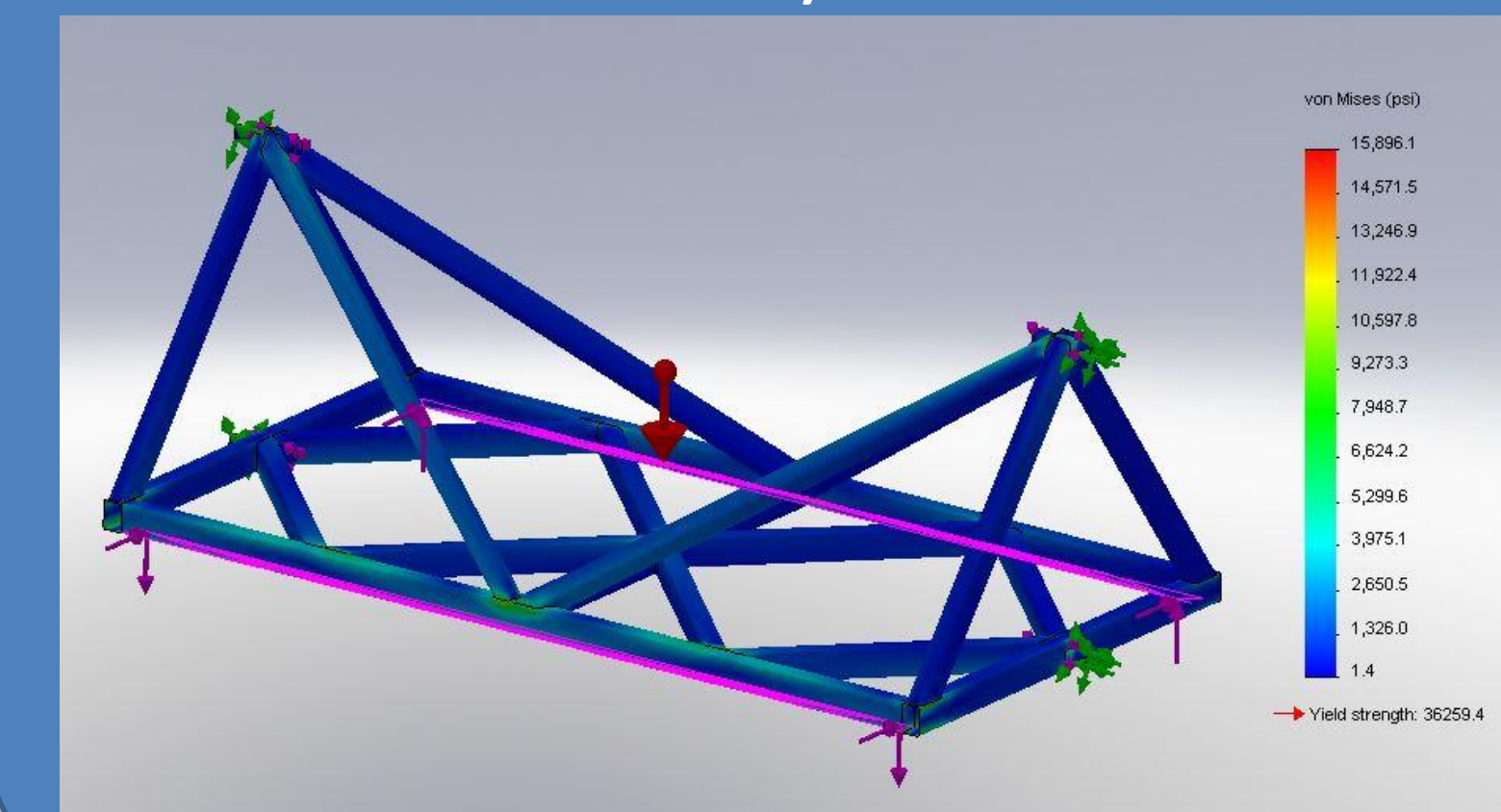


Front view (in stream axis turbine installed)

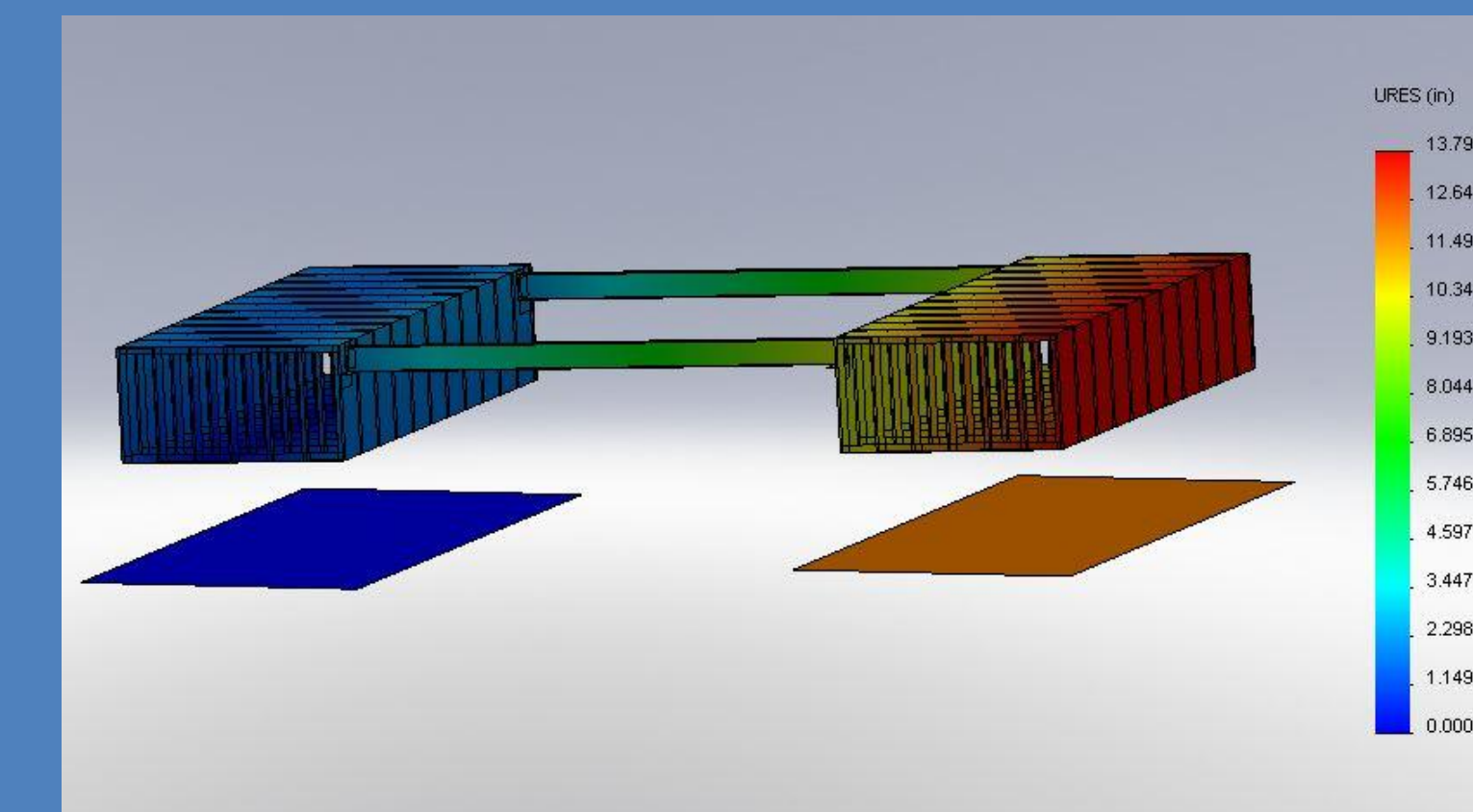
The design is based around the concept of modularity. This platform, and more specifically the mounting system (below) has been developed to provide an adaptable interface for any style of hydro-kinetic turbine.



Finite Element Analysis



Stress analysis of the mounting structure



Hull displacements from large ship wake

Design Criteria

Design decisions made with the following considerations:

Turbine Modularity



Up to 4m diameter



Up to 5m in length and 3m diameter



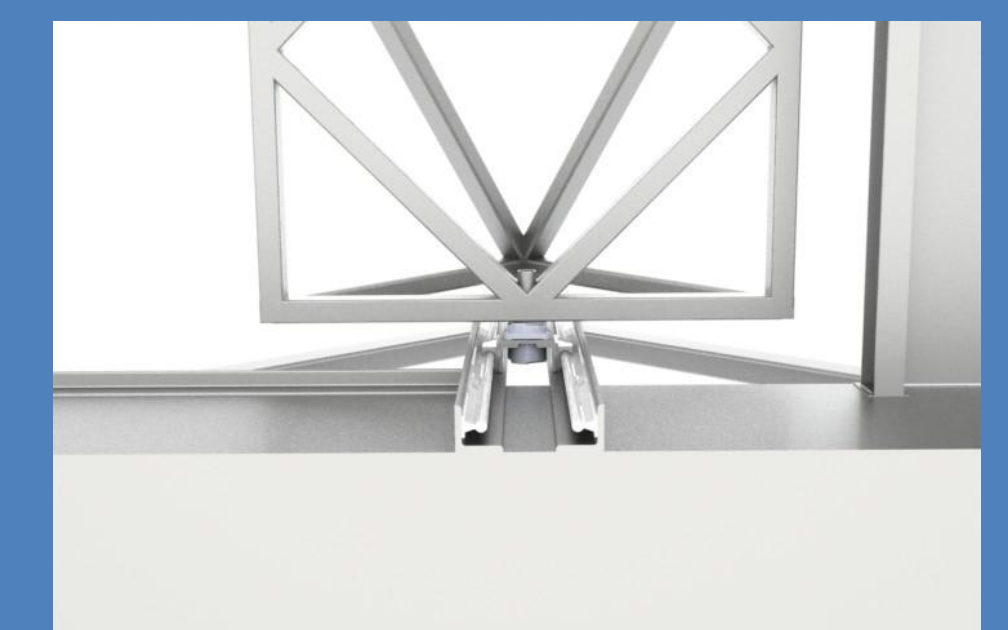
Drag limited to 7000 lbs

Stability

Under maximum expected load conditions, the tipping angle produced from turbine drag and mooring lines should not exceed 1°.

Operations

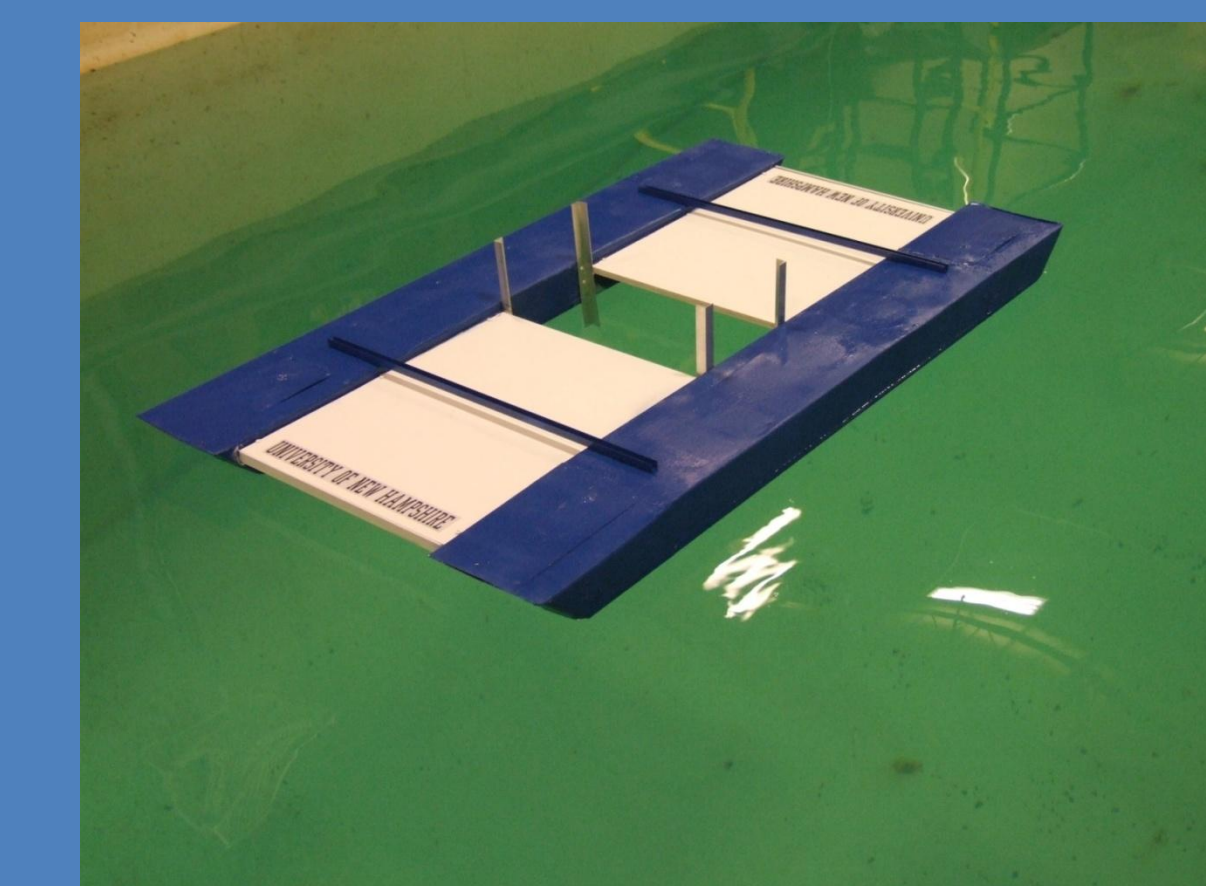
Design will expedite the deployment process and allow for proper instrumentation for performance monitoring.



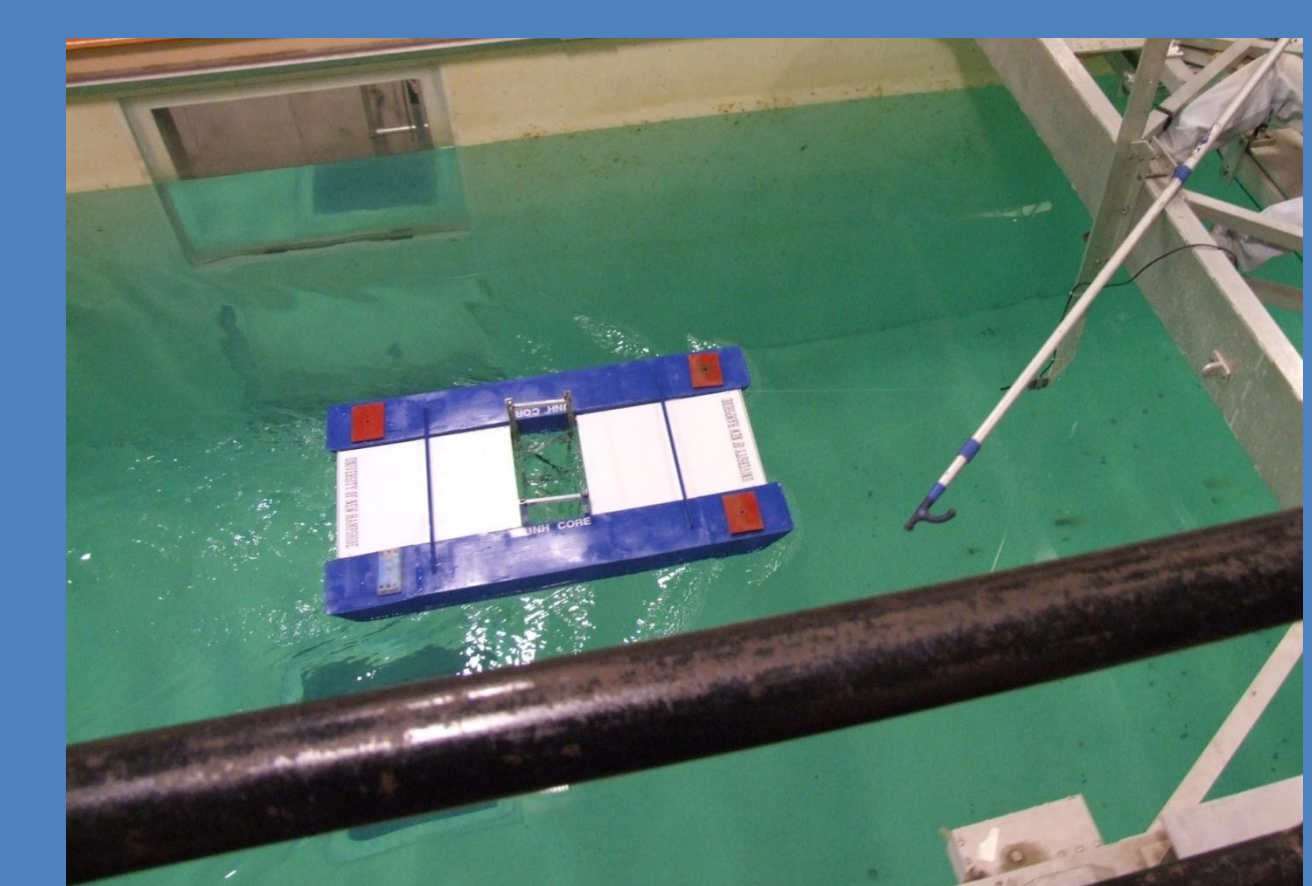
Mounting structure designed to remove turbines at any point during testing.

Physical Model Testing

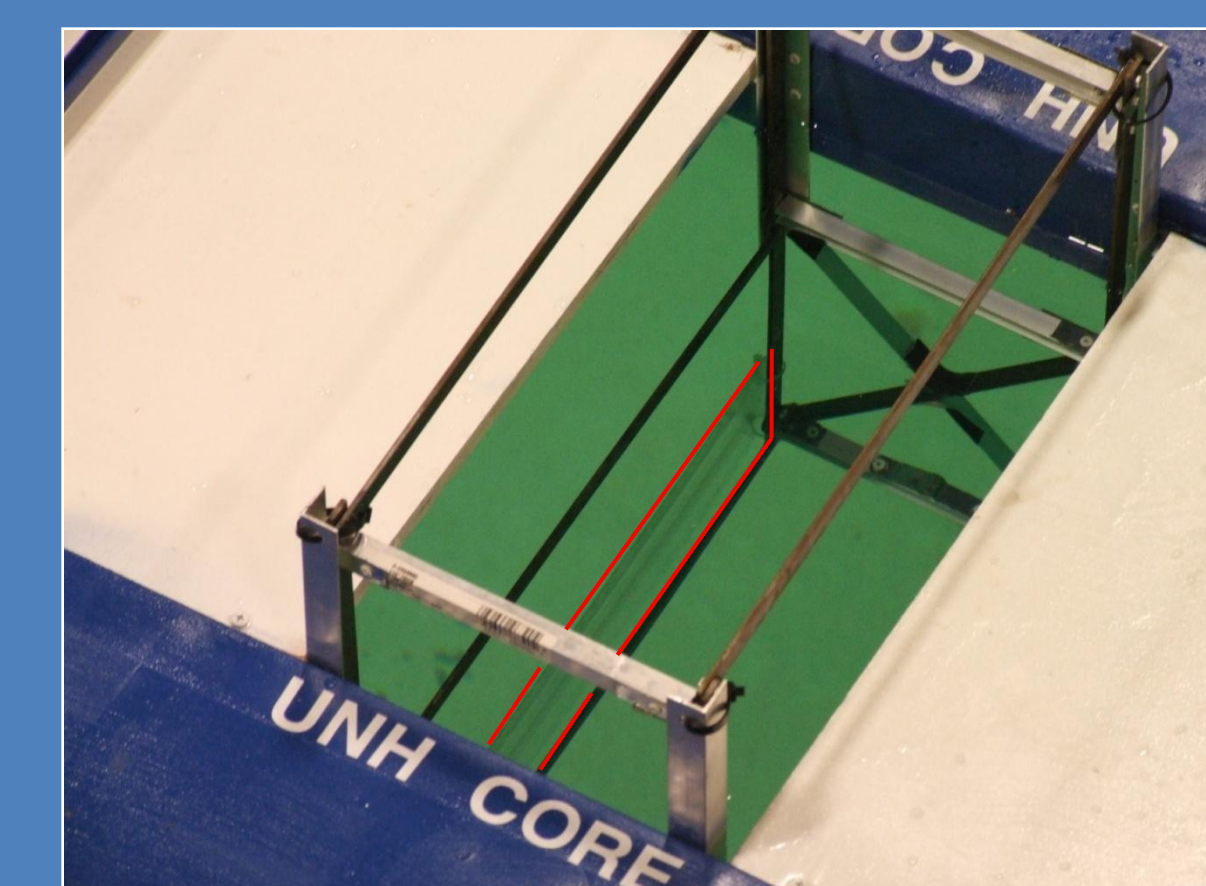
A 1:13 Froude scaled model was constructed and tested in the University of New Hampshire Tow/Wave tank. Drag forces as well as tipping angles were measured under various towing conditions. Results coincided with numerical hydro-static analysis.



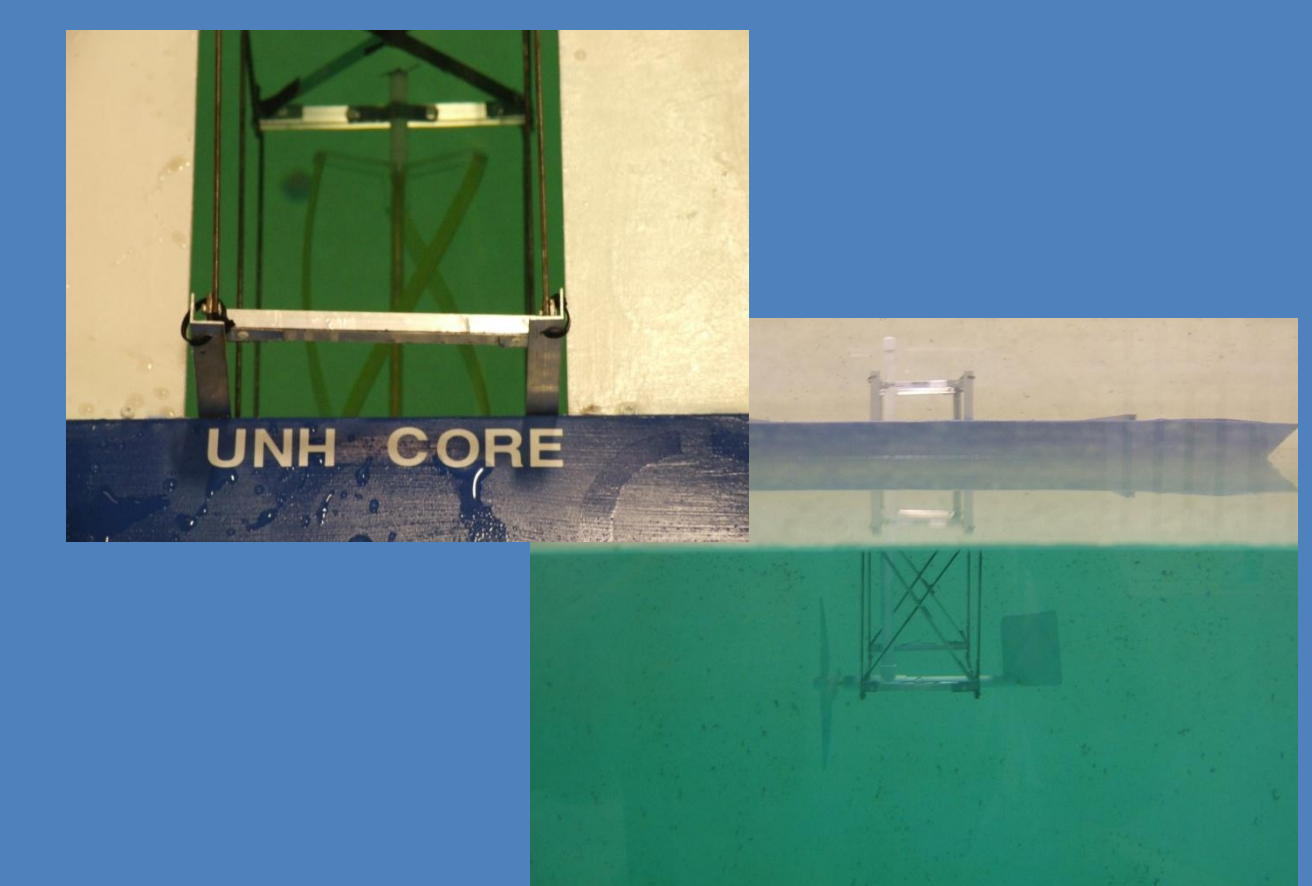
Initial float test



Towing with real time load cell force monitoring



Drag plate (highlighted) simulating highest expected drag (7000 lbs) for use in bow down measurements.



Cross-stream and in-stream axis turbines installed and tested.

Tow tests performed at model scale velocity of 0.742 m/s, this is representative of a full scale current velocity of 5.3 knots