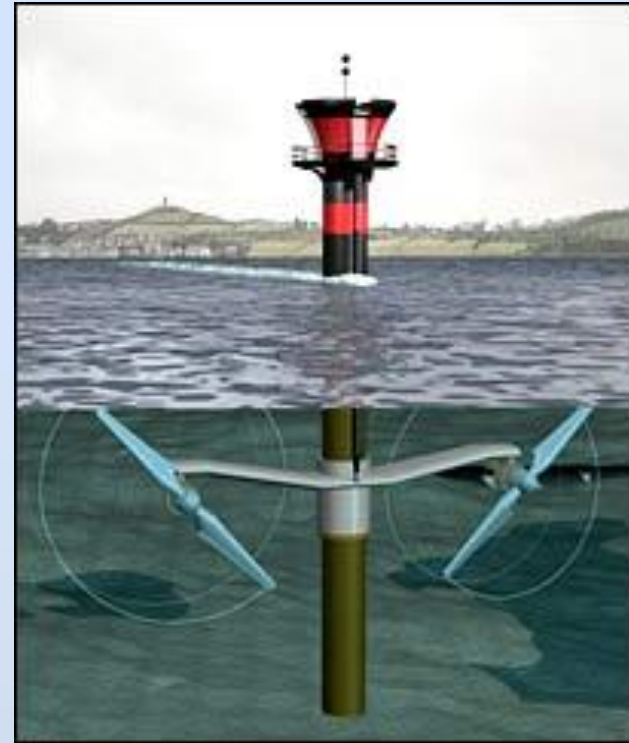


SeaGen Tidal Turbine

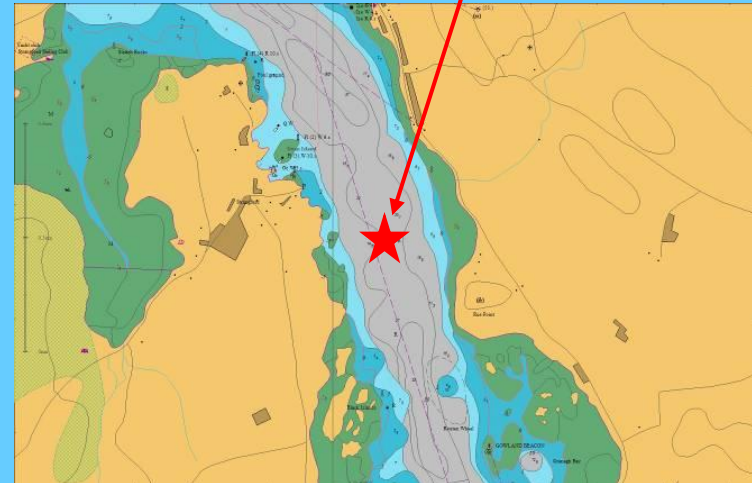
Strangford Lough, Northern Ireland

An Exercise in Adaptive Management

IEA-OES Annex IV Workshop



Location: Strangford Lough Narrows



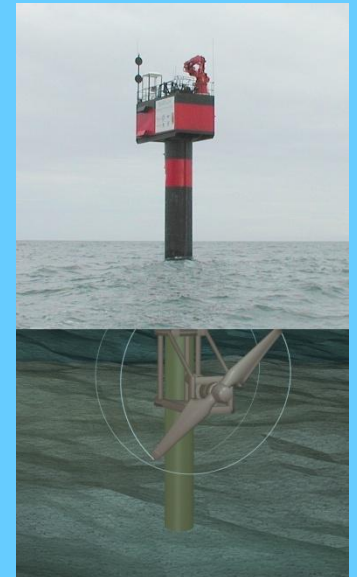
SeaGen Achievements

- Installed in April 2008
- ROCs registered tidal generator
- Achieved 1.2MW capacity in Dec 2008
- Approaching 4,000 hrs of operation
- Circa 2.5 GWh of power exported
- In August 2010 – 0.5GHW, 690 hrs, 96% availability
- Independently certified performance – DNV July 2010



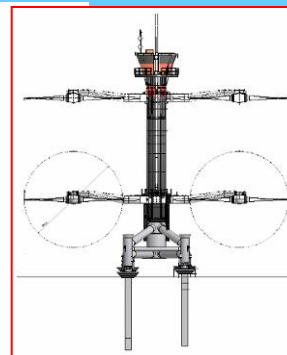
Why Strangford?

1. **Seaflow -MCT's open sea experience!**
2. **Why not EMEC?**
3. **Alternative Locations – comprehensive site selection process**



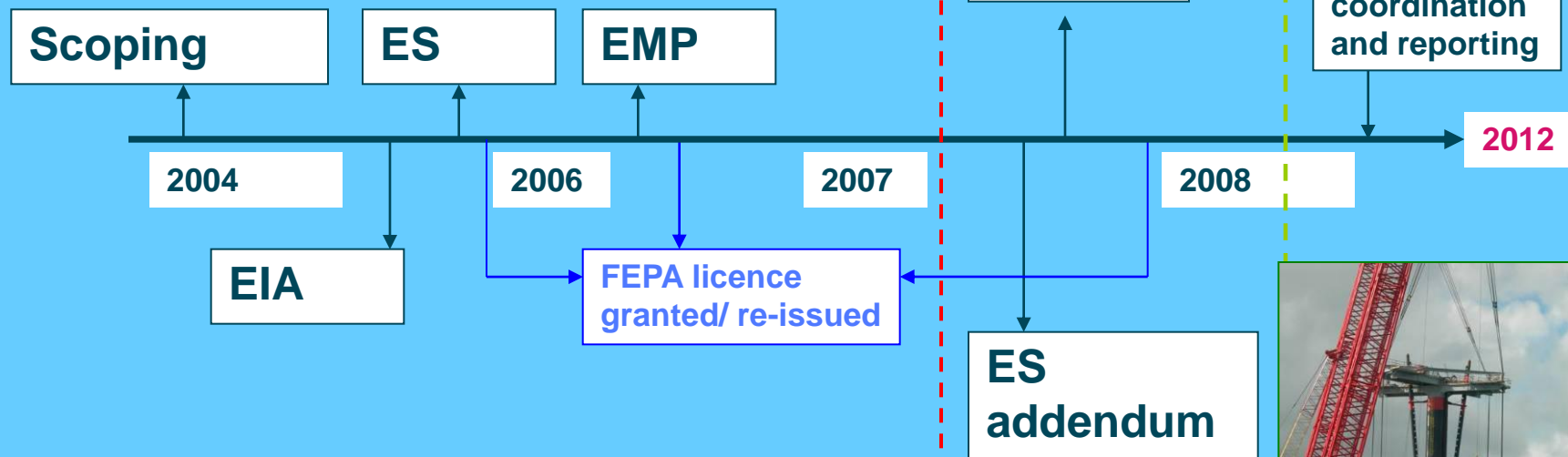
SeaGen: The journey...

- Scoping Report
- Environmental Statement (ES)
- Environmental Impact Assessment (EIA)
- Environmental Action and Safety Management Plan (EASMP)
- Environmental Monitoring Programme (EMP)



**Installation:
March 2008**

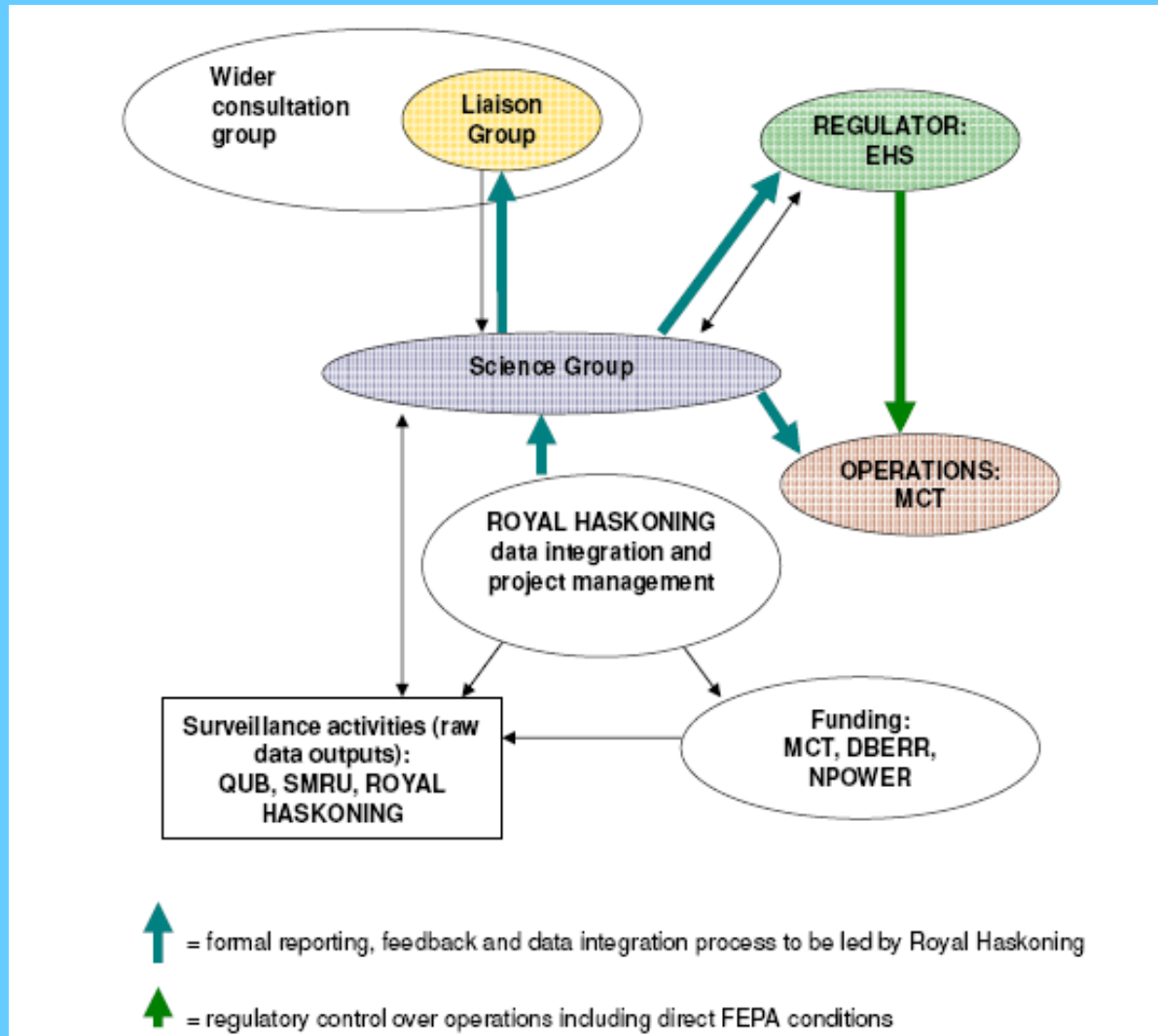
**Post-
installation
EMP
coordination
and reporting**



**Design change:
Quadropod base**



SeaGen EMP Regulation & Liaison



Environmental Monitoring Plan

1. EIA identified various levels of uncertainty surrounding potential risks to within the Strangford Lough Special Area of Conservation (SAC)

- **Common seals**
 - How does SeaGen impact the patterns of usage of the Narrows?
 - Are seals (or other large marine animals) being struck by the turbine rotors?

- **Reef (rocky and biogenic)**
 - Has the turbine significantly effect the extent, quality or composition of seabed communities?

2. Requirements to support future EIA's.



What are we doing to answer these key questions and others?



Marine mammals and sharks

Effort limited visual surveys (QUB)

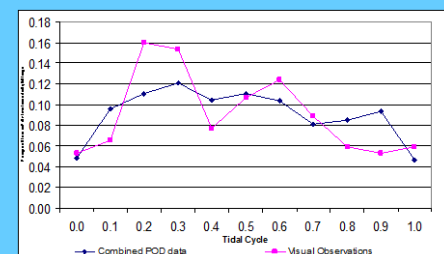
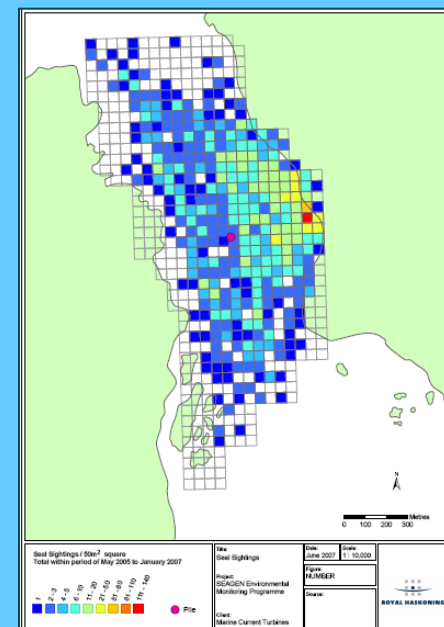
Outputs:

- 66 months of sightings data
- Statistical model to determine spatial/ temporal patterns in sightings

Passive acoustic monitoring (SMRU)

Outputs:

- 54 months of porpoise activity data
- Analysis undertaken on activity in relation to tidal state, time of day, time of year, etc.



Common seals

Aerial survey outputs - SMRU Ltd

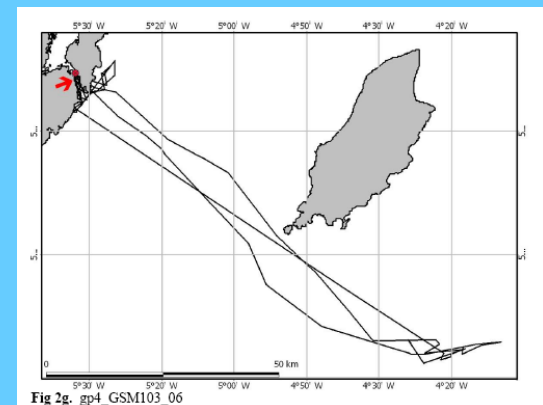
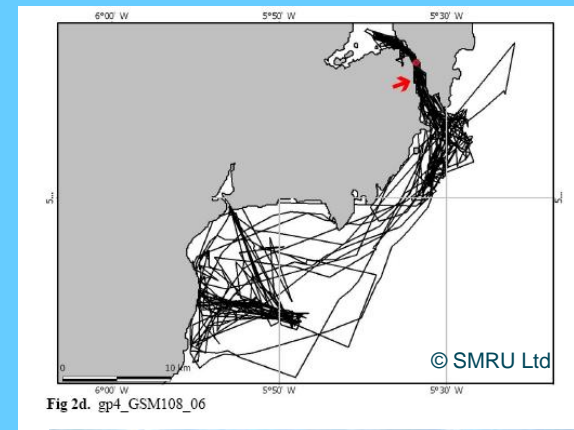
Outputs:

- Distribution of seal haul out sites
- Abundance of seals surveyed during moult (August/Sept) and breeding season (November)

GPS/GSM tracking outputs – SMRU Ltd

Outputs:

- Changes in the proportion of the regional population using Strangford Lough
- Changes in the routes taken by seals through the Narrows
- 3 Campaigns - 2006, 2008, 2010



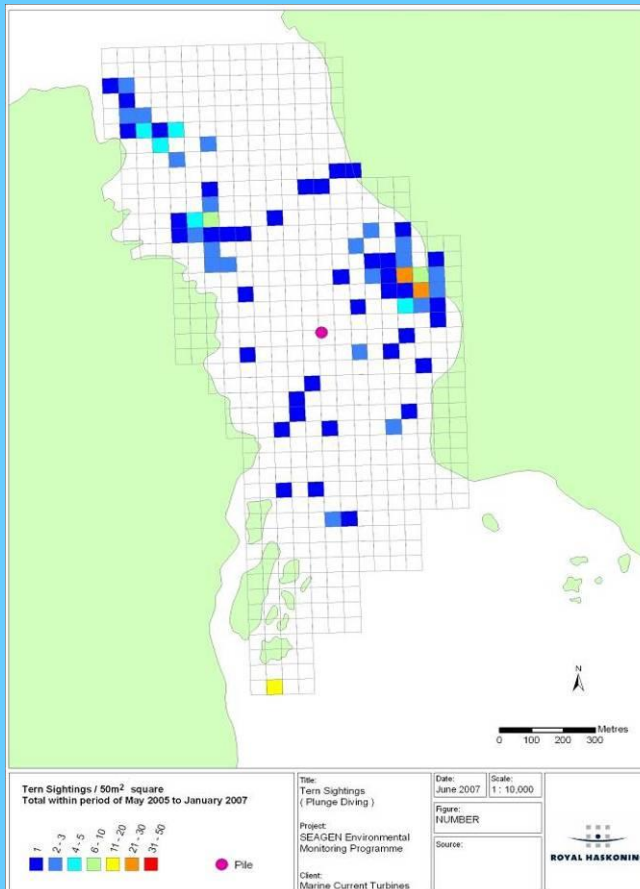


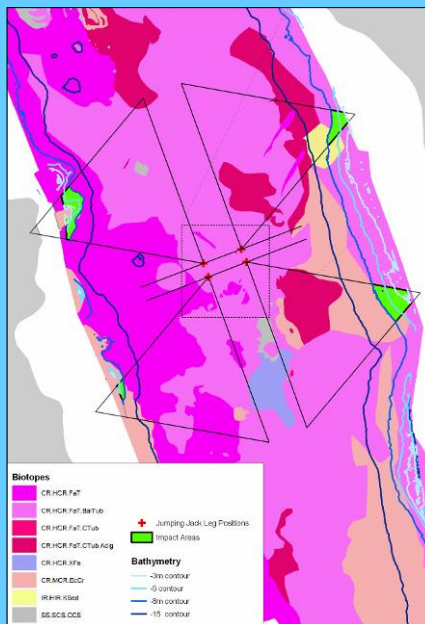
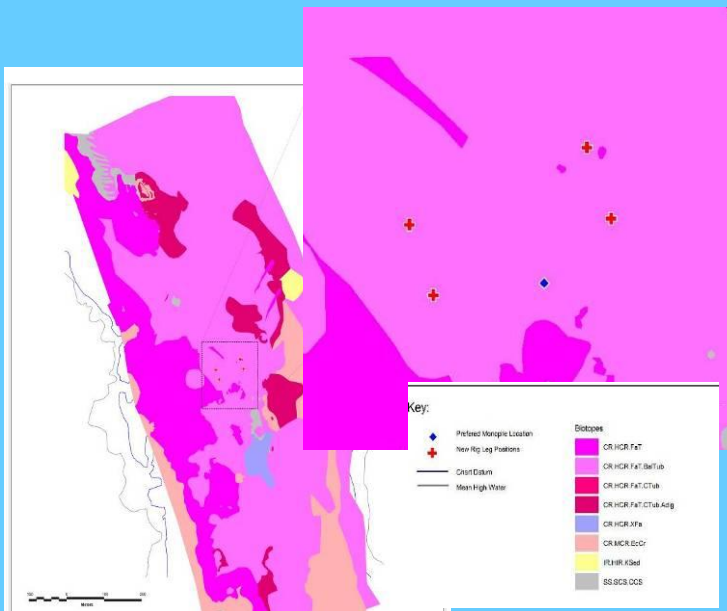
Diving birds and SPA species

Which species could theoretically interact with the turbine?

Diving species:

- Gannets
- Merganser
- Black Guillemot
- Common guillemots and razorbills
- Eider ducks
- Terns (common, sandwich and Arctic)





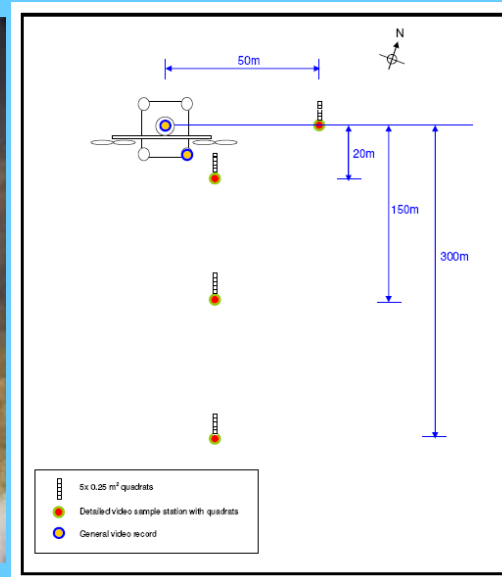
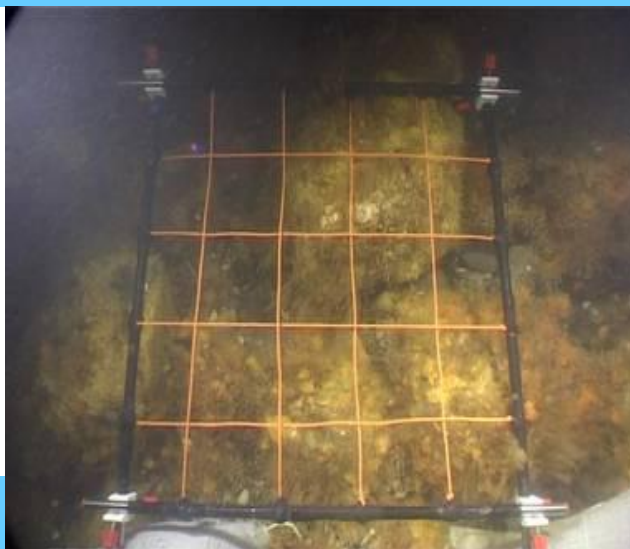
Benthic Ecology

Broad scale mapping and diver surveys

Enabled the RH team to quantify the potential footprint of the installation, operational and decommissioning phases

Benthic Monitoring

Regular diver surveys aim to detect changes in biotope presence and structure (i.e. loss of characterising species) as a result of sedimentation and/ or scouring effects SeaGen turbine.





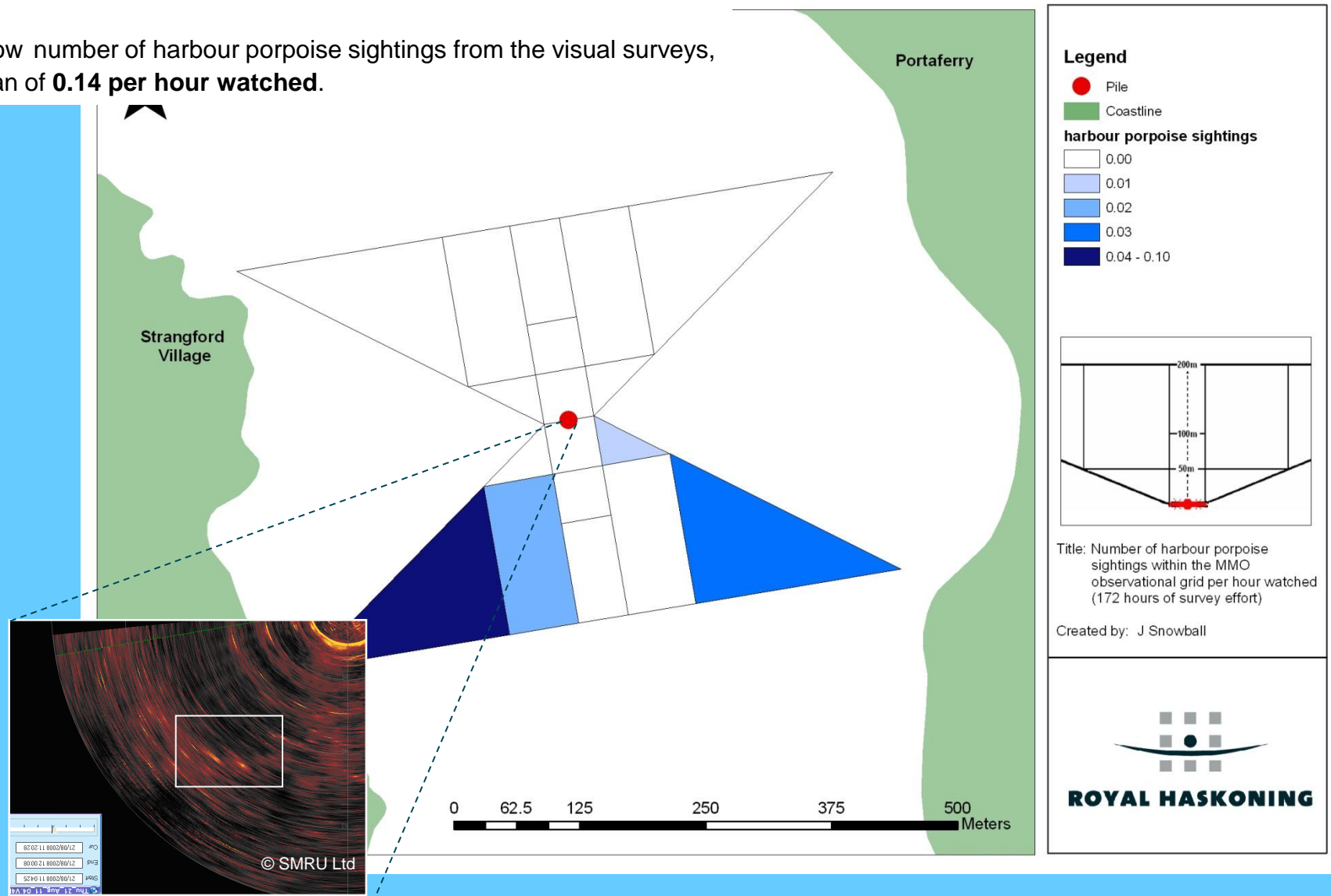
Marine Mammal Observation (Royal Haskoning team)

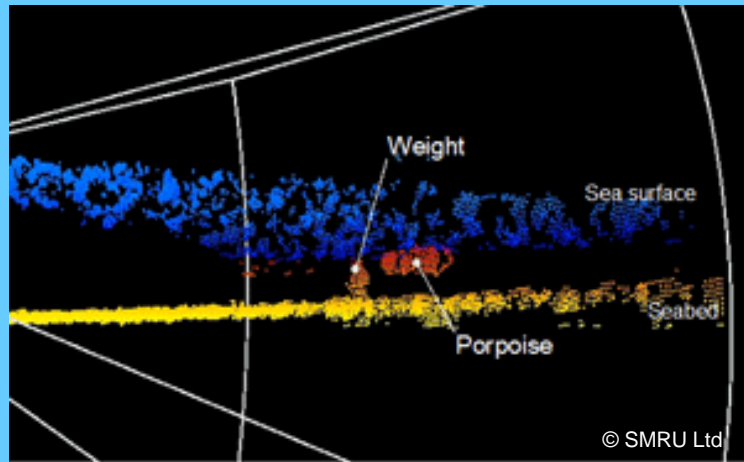
- Confirm presence of marine mammal
- Shut down as appropriate (was 200m, then 100m, then 50m, now reduced to 30m)
- Make detailed record of sightings (with focal follows of sightings within 200m)



Harbour porpoise

Typically low number of harbour porpoise sightings from the visual surveys, with a mean of **0.14 per hour watched**.



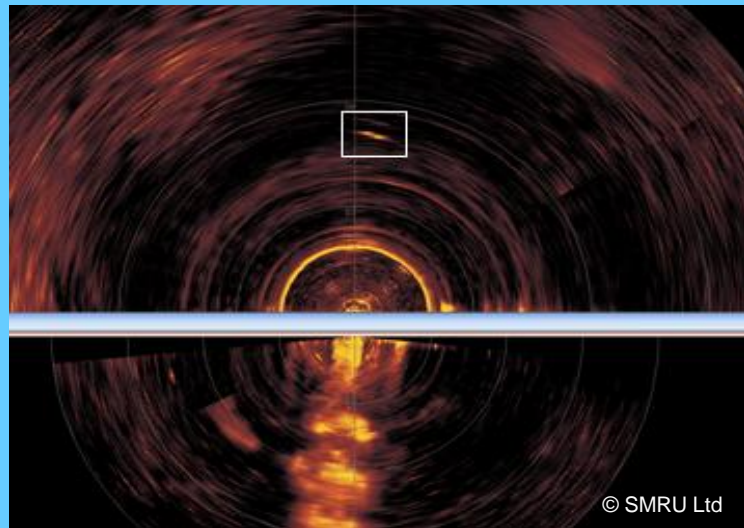


Active sonar (SMRU Ltd)

- Coordinated alongside MMO observations

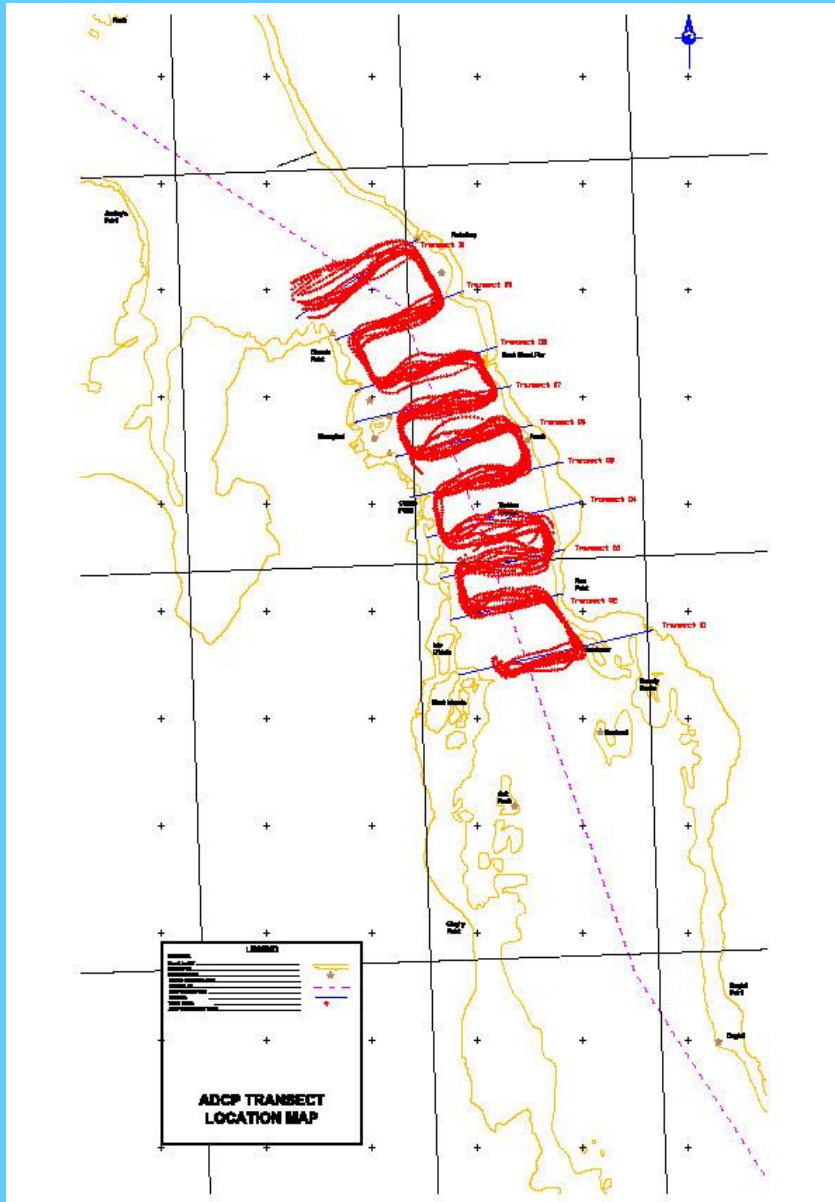
- Field trials so far successful

- Trials of enhanced system with real time sub-surface sonar imagery of seals, cetaceans and basking sharks close to the SeaGen



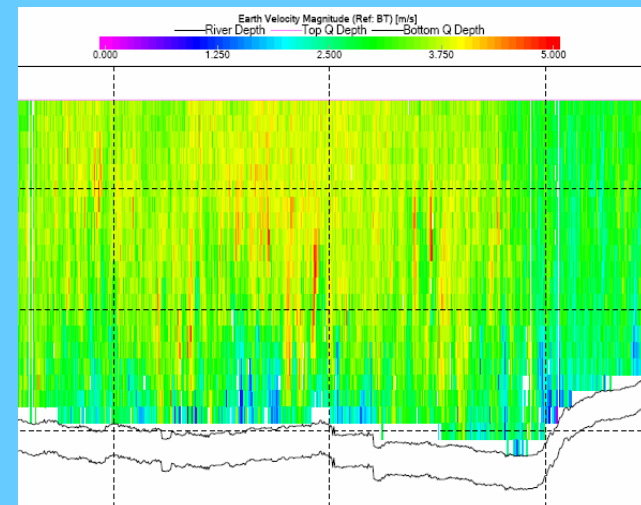
Subsea Noise Measurements

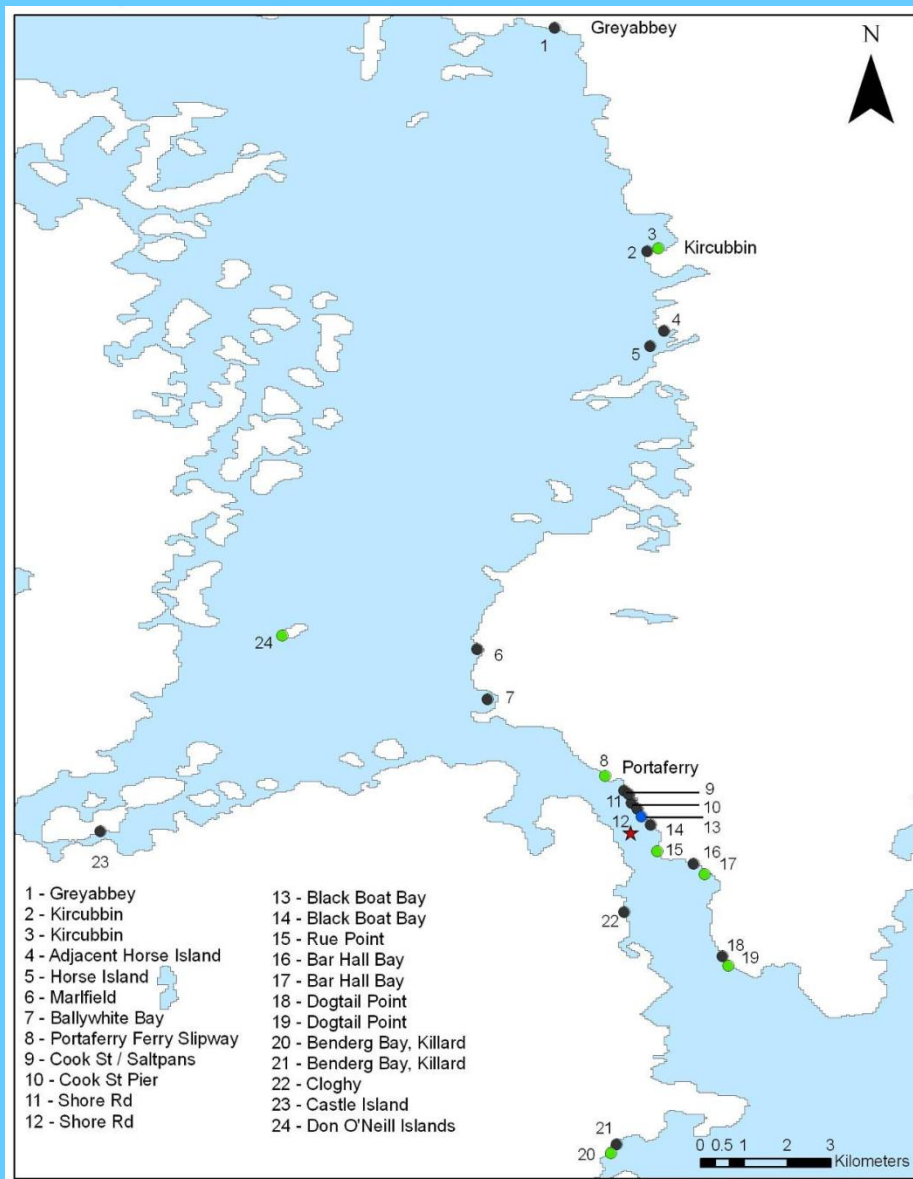
- Construction noise assessed - COWRIE
- Operational Noise
 - Background established for Strangford
 - SeaGen operational noise measured
 - Modeled/Extrapolated for arrays



Impacts on Tidal Energy – QUB

- Baseline transects up and downstream of pile installation completed and analysed
- Post installation operation transects to be completed during operational and non operational periods
- Energy variations to be determined





Seal Carcass Survey

- July to Dec 2008 24 seal carcasses recovered and autopsied (grey and common)
- Similar number in 2009
- No deaths attributed to turbine
- 2010? Media campaign

Adaptive Management Process

- The Starting point – FEPA License
- New technology – little or no background
- Heavily designated site
- Presence of protected species
- All changes in monitoring & mitigation agreed and reviewed with Science Group
- Changes MUST be evidence based

Adaptive Management Process - Status

Mitigation	Start	Now	Future
Operational Restrictions	Daylight Only	24 hrs per day since April 2010	NA
Pile Based MMO	During all operations	Removed October 2009	NA
Sonar & observer	Not accepted as mitigation, had to be calibrated against MMO sightings	24/7 manual, observed from shore	Automated or none?
Shut down distance	Was 200m	Dec 2008 – 100m April 2009 – 50m Oct 2009 – 30m	Zero? SMRU analysis of data sets
Benthic surveys	2 per year	1 per year	None
Shore based observations	Required	Ongoing	Stop Dec 2010?

SUMMARY

- Baseline data for 3 years
- 2.5 year post installation data
- No significant or adverse impacts on SAC features detected to date
- During installation porpoise activity reduced
- Summary environmental reports will be available on www.seageneration.co.uk
5,000+ registered users!