



Coastal & Offshore Modelling Symposium

COMS2026



Determining the fate of dredge material at Dublin Port in compliance with D@S regulations

Kristopher Calder

Tetra Tech RPS



26 Feb, 2026
Cork, Ireland

Tetra Tech RPS - Coastal modelling expertise



Design

Revetments
Breakwaters
Ports
Harbours
& Other Coastal
Defences



Forecasting

Wind Climate
Wave Climate
Water Levels
Tidal Currents &
Heights



Modelling

Wave Overtopping
Hydrodynamic Models
Sediment Transport
CFD Modelling
Storm Events
Coastal Flooding
Water Quality



Assessment

Climate Change
Studies
Impact Assessments
Vulnerability
Assessments



Planning

Marine Licensing
Consenting
Coastal Management
Plans
EIARs



Analysis

Meteorcean Data
Economic Cost Benefit
Shoreline Erosion

LITPACK



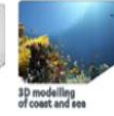
Littoral processes and coastline kinetics

MIKE 21



2D modelling of coast and sea

MIKE 3



3D modelling of coast and sea

MIKE HYDRO

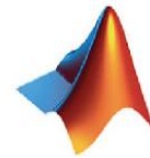
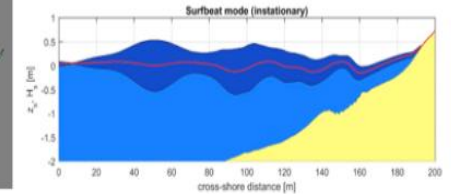
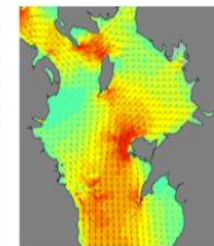
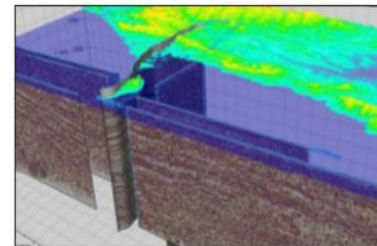
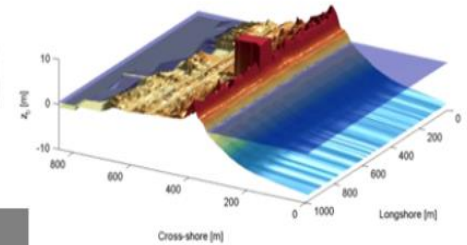


Integrated basin management

MIKE 11



Unlimited river modelling



Tetra Tech RPS - Coastal modelling expertise – Dublin Port Dredging



Design

Revetments
Breakwaters
Ports
Harbours
& Other Coastal
Defences



Forecasting

Wind Climate
Wave Climate
Water Levels
Tidal Currents &
Heights



Modelling

Wave Overtopping
Hydrodynamic Models
Sediment Transport
CFD Modelling
Storm Events
Coastal Flooding
Water Quality



Assessment

Climate Change
Studies
Impact Assessments
Vulnerability
Assessments



Planning

Marine Licensing
Consenting
Coastal Management
Plans
EIARs



Analysis

Meteorological Data
Economic Cost Benefit
Shoreline Erosion

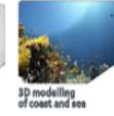
LITPACK



MIKE 21



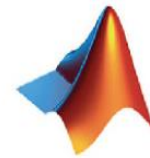
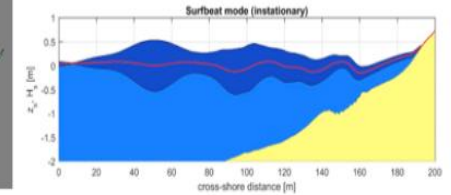
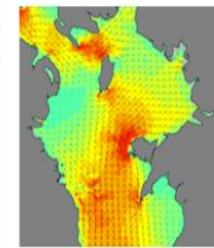
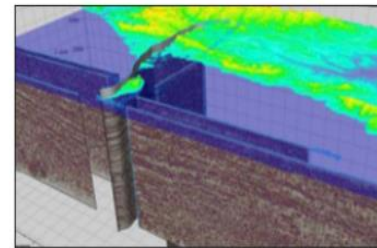
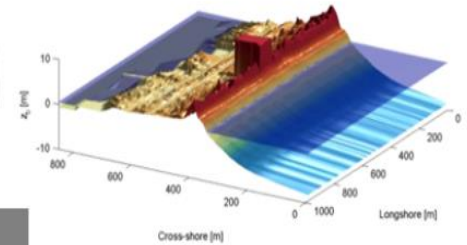
MIKE 3



MIKE HYDRO

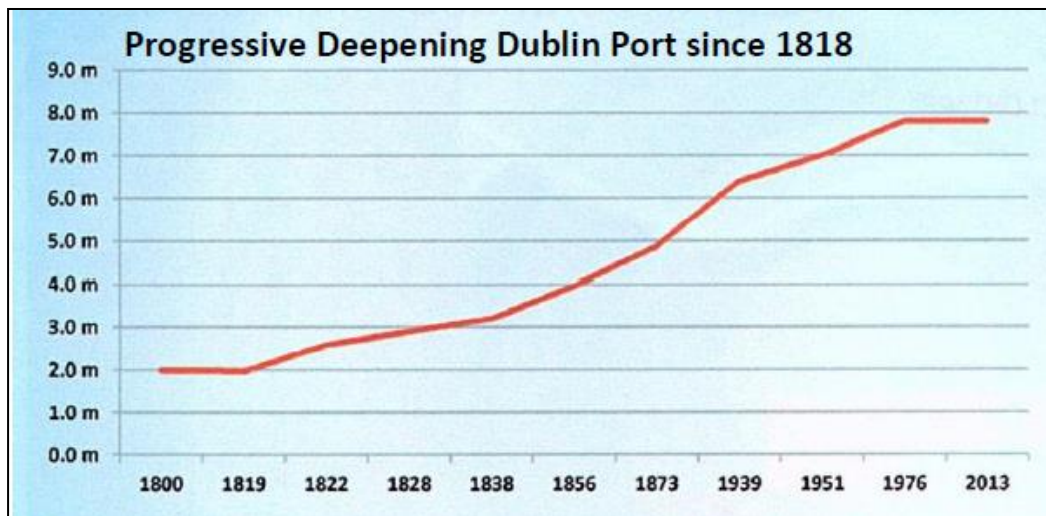


MIKE 11



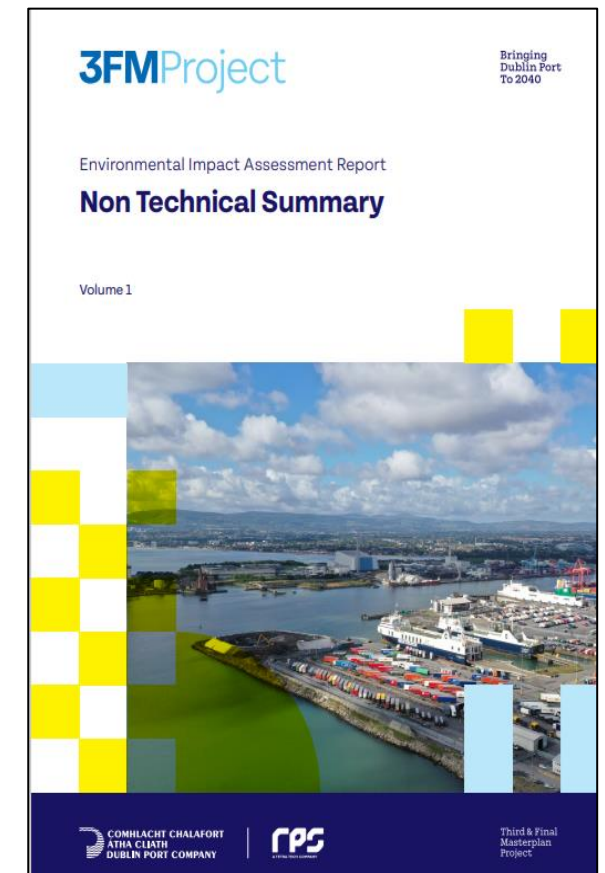
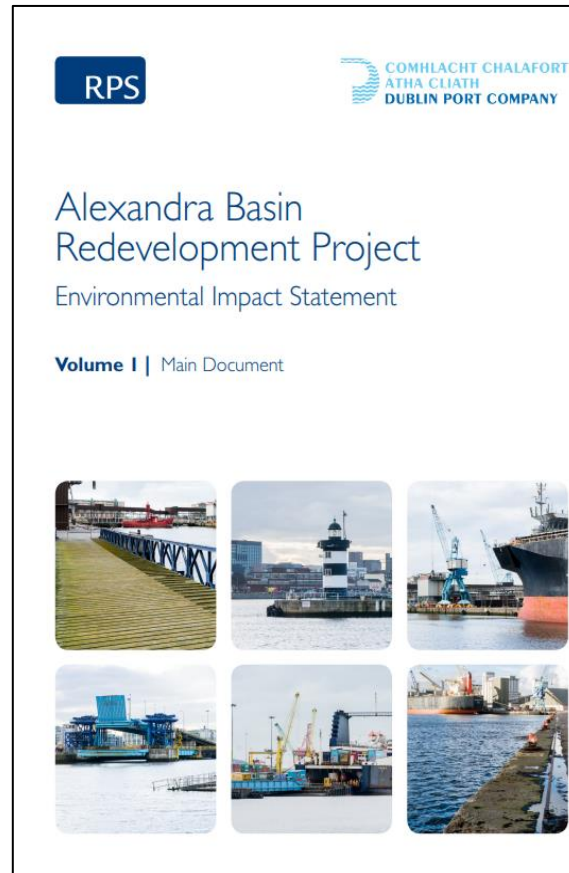
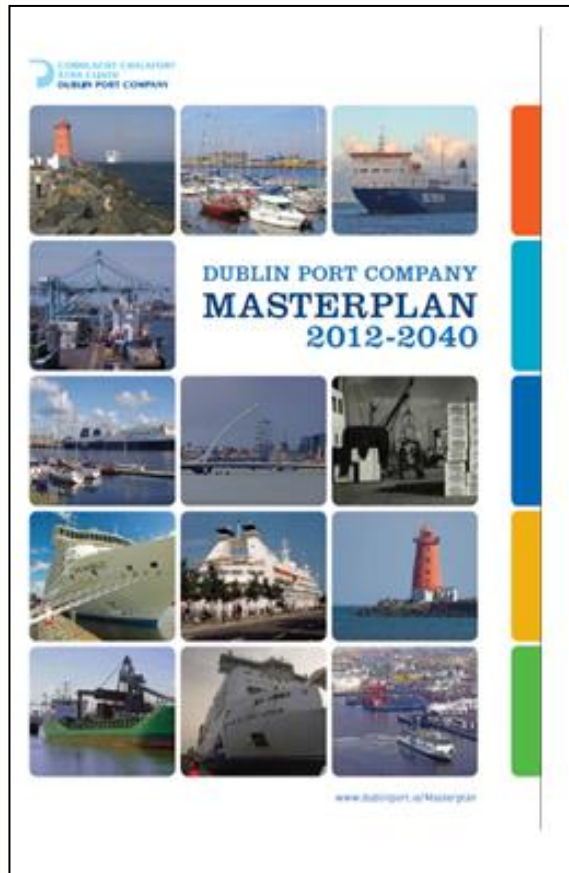
Dublin Port, Ireland's largest port:

- 8,000 Ship arrivals each year
- 38 million tonnes of cargo in 2019
- 158 cruise ship arrivals with 323,234 visitors
- Containers and freight trailers accounted for 83% of all cargo
- Ferry passenger volumes of 1,949,000



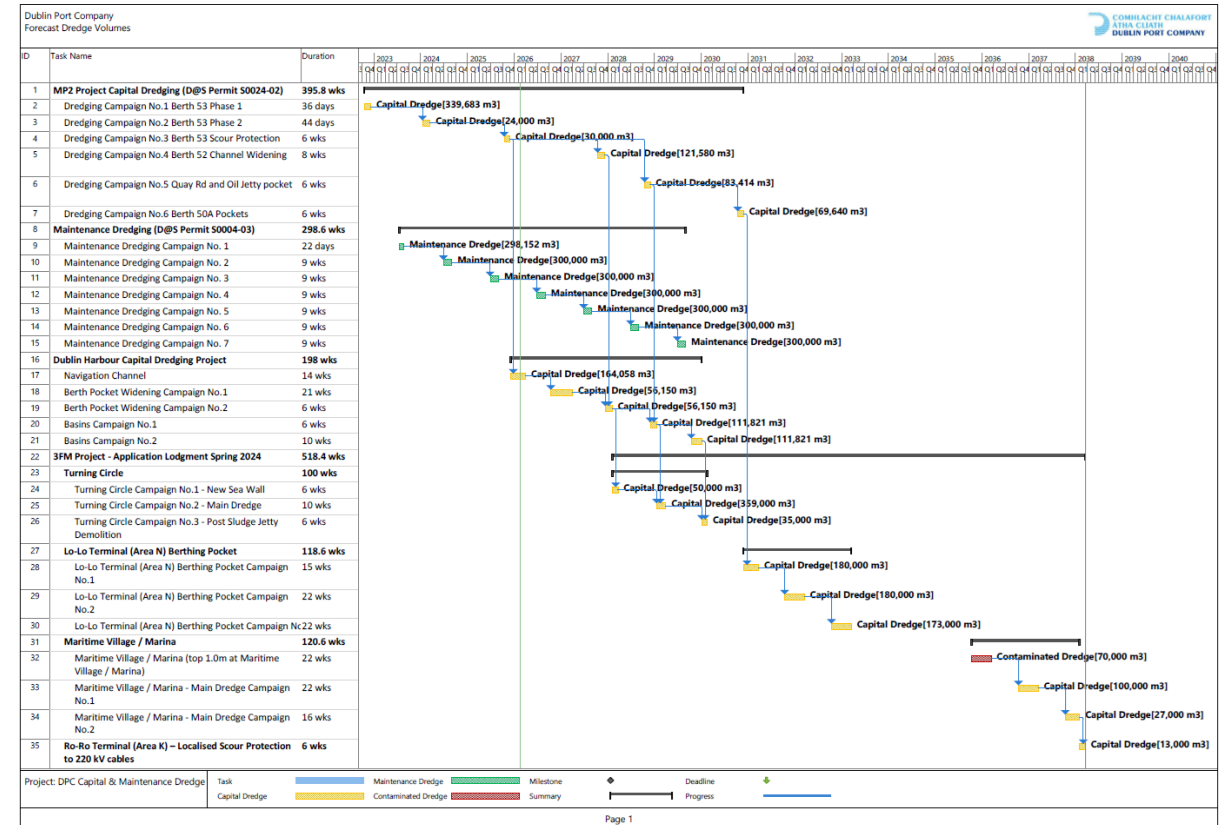
<i>Growing port volumes</i>			
1950 to 1980	3.2%	2.9m	7.3m
1980 to 2010	4.7%	7.3m	28.9m
2010 to 2040	3.3%	28.9m	77.2m

The **Masterplan 2012-2040** presents a vision for future operations at the Port and critically examined how the existing land use at Dublin Port can be optimised for merchandise trade purpose



- Extensive dredging required to facilitate the proposed ABR, MP2 and 3FM Strategic Infrastructure Projects (SIDs) as set out in **Masterplan 2012-2040**
- In combination with on-going maintenance dredging, approx. 4.5mill m³ to be dredged between 2022 - 2038

Project	Dumping at Sea Reference	Status	Maximum Dredge Volume (m ³)
Dublin Harbour Capital Dredging Project	S0033-01	Current Application	500,000 m ³
Dublin Port 2022-2029 Maintenance Dredging Programme	S0004-03	Permitted	2,400,000 m ³ (Annual Max 300,000 m ³)
MP2 Project Capital Dredging	S0024-01	Permitted	668,317 m ³
3FM Project Capital Dredging	N/A	Application expected Q3/Q4 2024	1,117,000 m ³



The Task

EPA requested further information to inform Dumping at Sea (D@S) Applications:

“...Provide details on the predicted **sediment deposition** and **sediment dispersion** from loading and dumping activities, cumulatively from the proposed activities ... and any subsequent impacts on the wider environment.

As a minimum a **modelling assessment is required** to describe the fate of sediments and the impact on the receiving environment...”

Approach

- Develop hydraulic model
- Hydrographic & sediment surveys
- Calibration and validation
- Cumulative Assessment



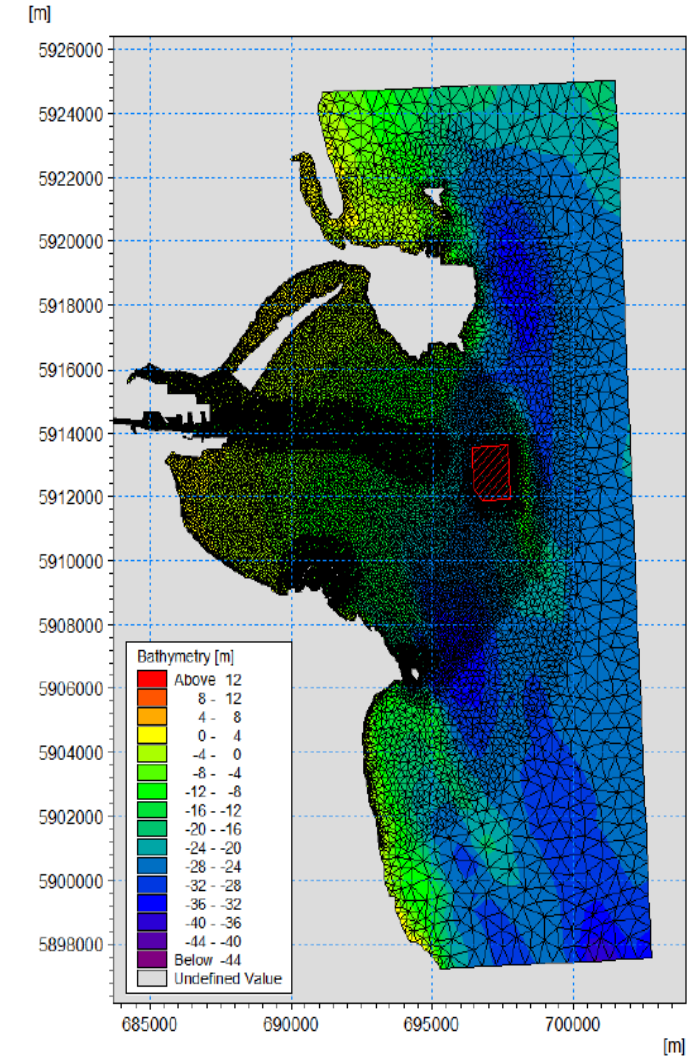
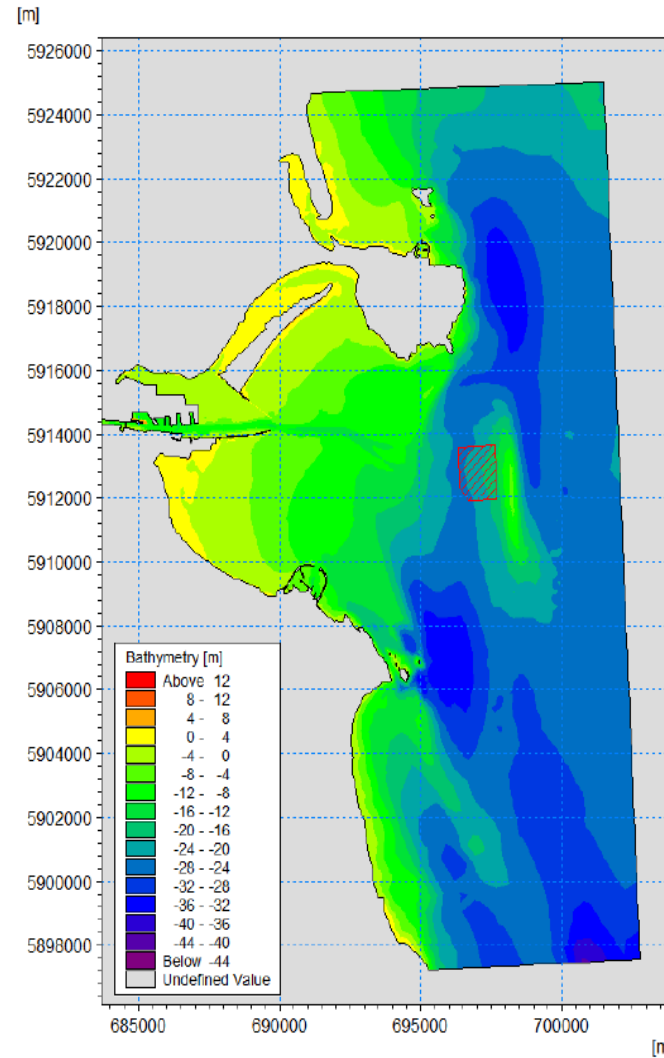
Hydrodynamic model

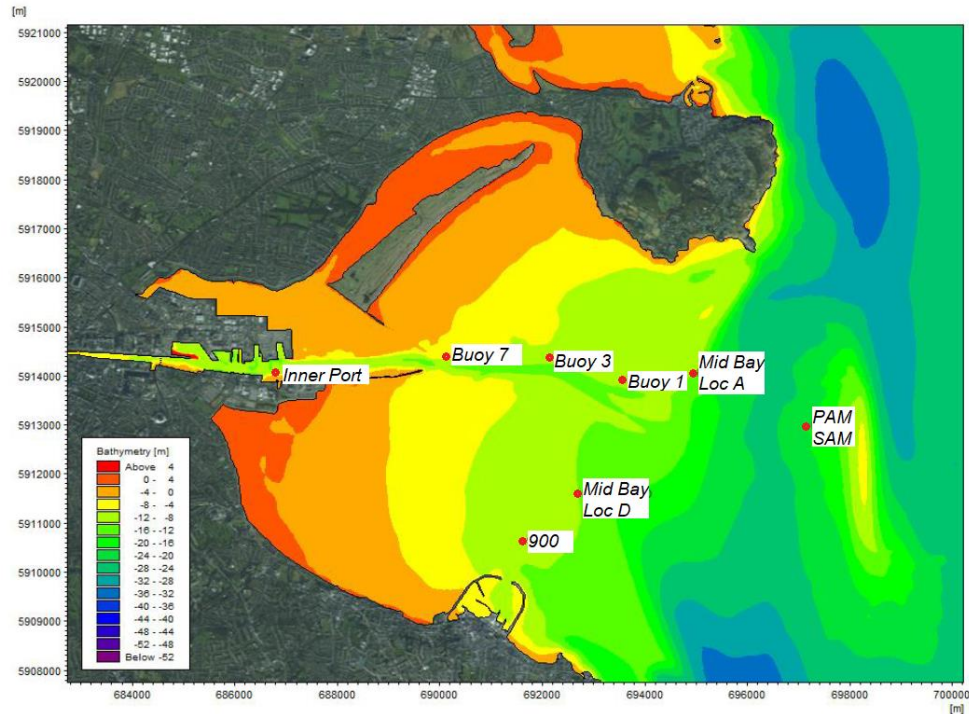
Dublin Bay model developed to support the Alexandra Basin Redevelopment project.

Model details:

- Developed using the MIKE 21 software package.
- Bathymetry defined using hydrographic surveys of Dublin Port and surrounding areas
- Tidal boundary conditions taken from RPS' Tide and Surge Forecast model was previously ran on behalf of the OPW

Mesh Resolution in key areas equivalent to 15m² triangles





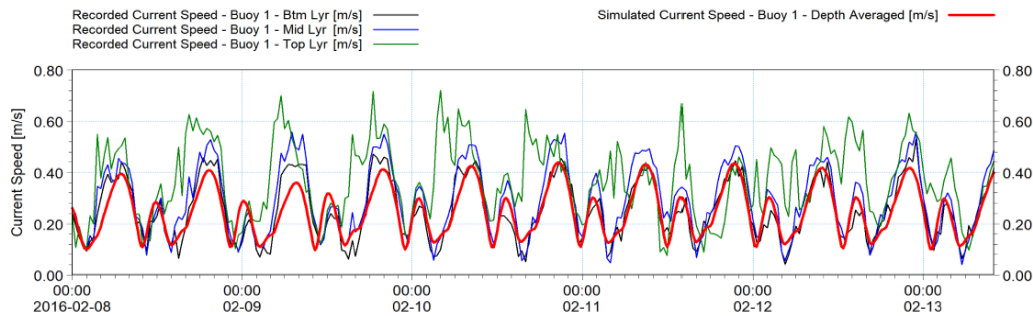
Calibration and validation of hydrodynamics

Validation process undertaken using:

- Dublin Port tide gauge information
- Current data recorded by 8 individual ADCPs between 2013 and 2019

The validation process demonstrated that the Dublin Bay model simulated the current speed, phase, range and direction to a high degree of accuracy.

Calibrated hydrodynamic model was subsequently used as a cornerstone for all sediment transport simulations



Calibration and validation of sediment transport simulations

Hydromaster surveyed 20 of the 210 dumping trips over the first Winter Capital Dredging Campaign

- TT modelled all 210 trips
- TT calibrated and validated model against all 20 surveyed trips



Hydrodynamics (MIKE HD)

The calibrated 2D model was used to simulate 6 weeks of tides in Dublin.

- 2 weeks before the dredging campaign
- 3 weeks of the dredging campaign
- 1 week after dredging campaign

Tidal boundaries taken from Tidal & Storm Surge Forecast model.

Sediment Transport (MIKE ST)

All 210 individual trips simulated:

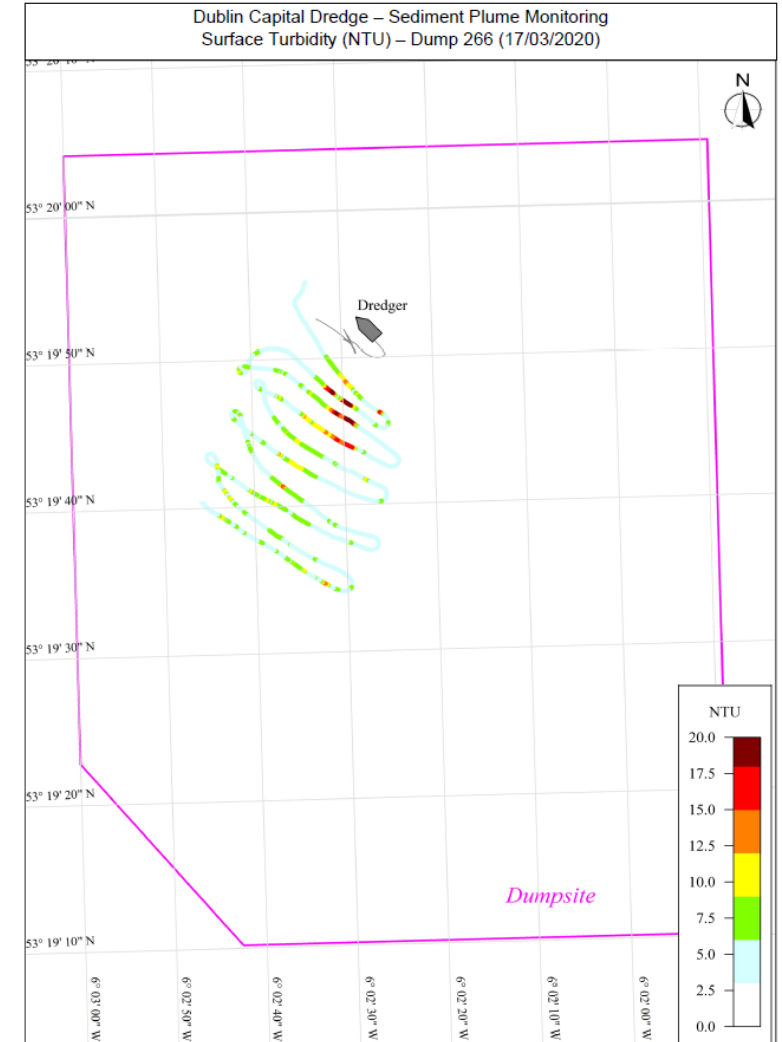
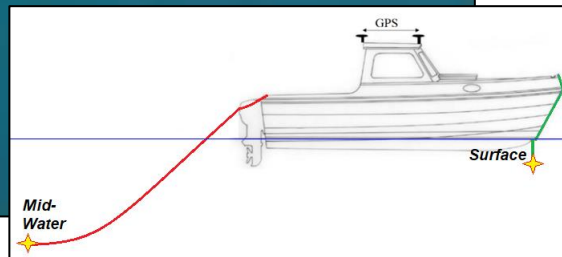
- Dumping defined as a source term
- Location & timing of source term based on Boskalis dredge logs
- Specific volume for each disposal event
- Same material composition as ABR work

Each sediment fraction given a defined fall velocity.



Measuring Turbidity

- A survey vessel equipped with two sensors followed dredger
- Tracked back and forth across sediment plume
- Measured turbidity until plume dropped below background level



Comparing modelled and recorded data

Event 231

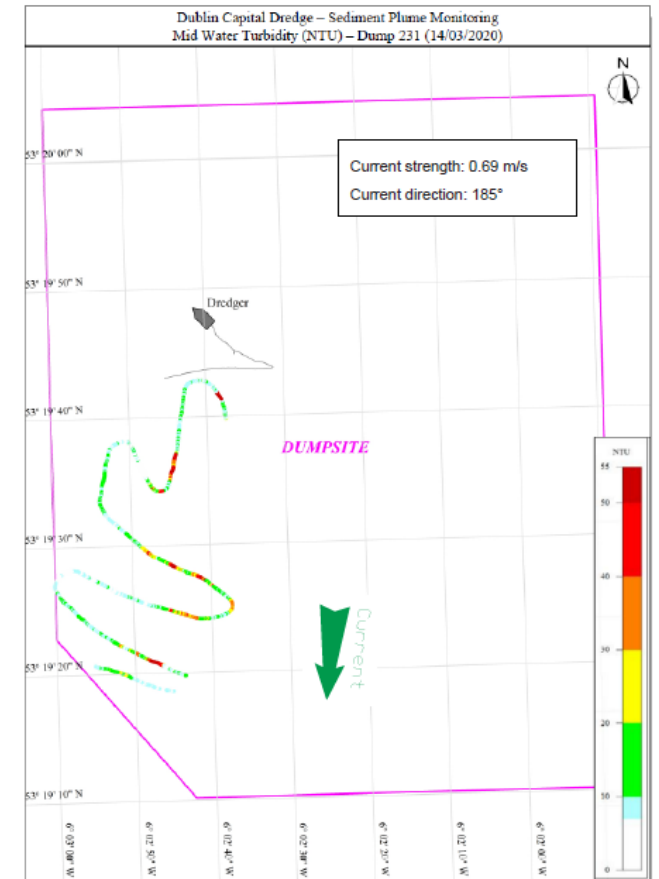
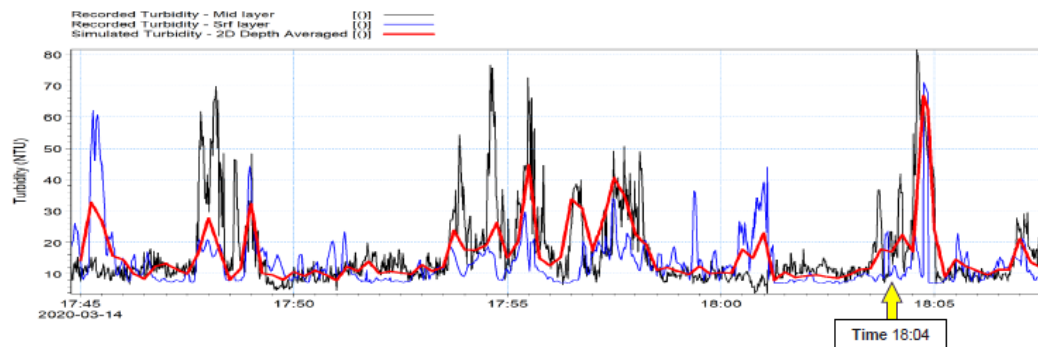
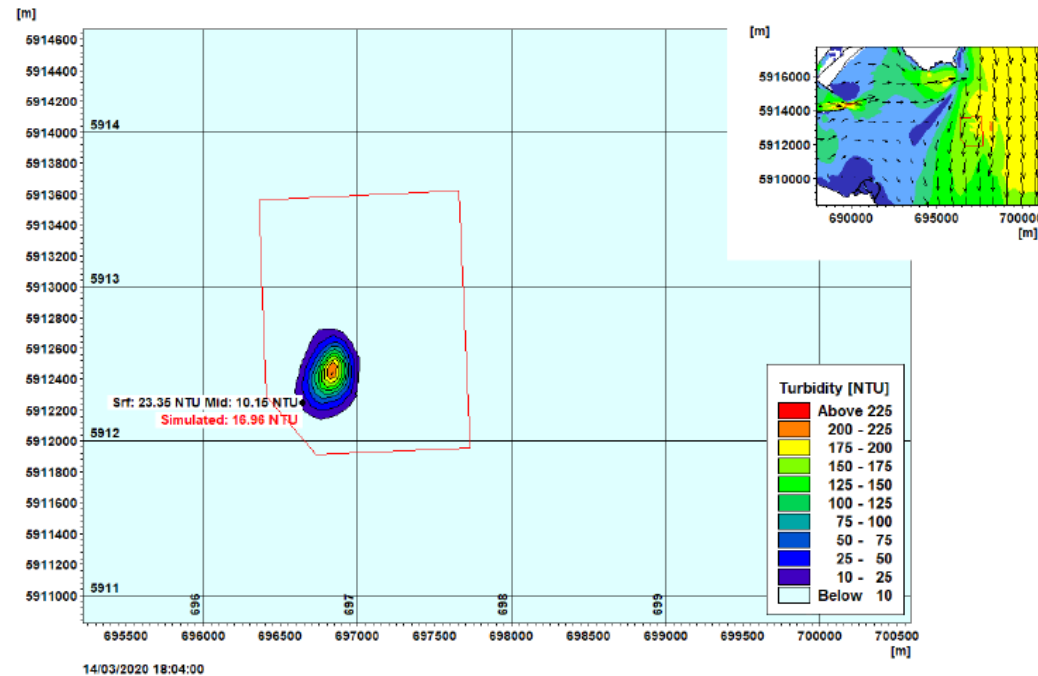
- 14/03/2020
- 1022T over 11 mins

Very good accuracy

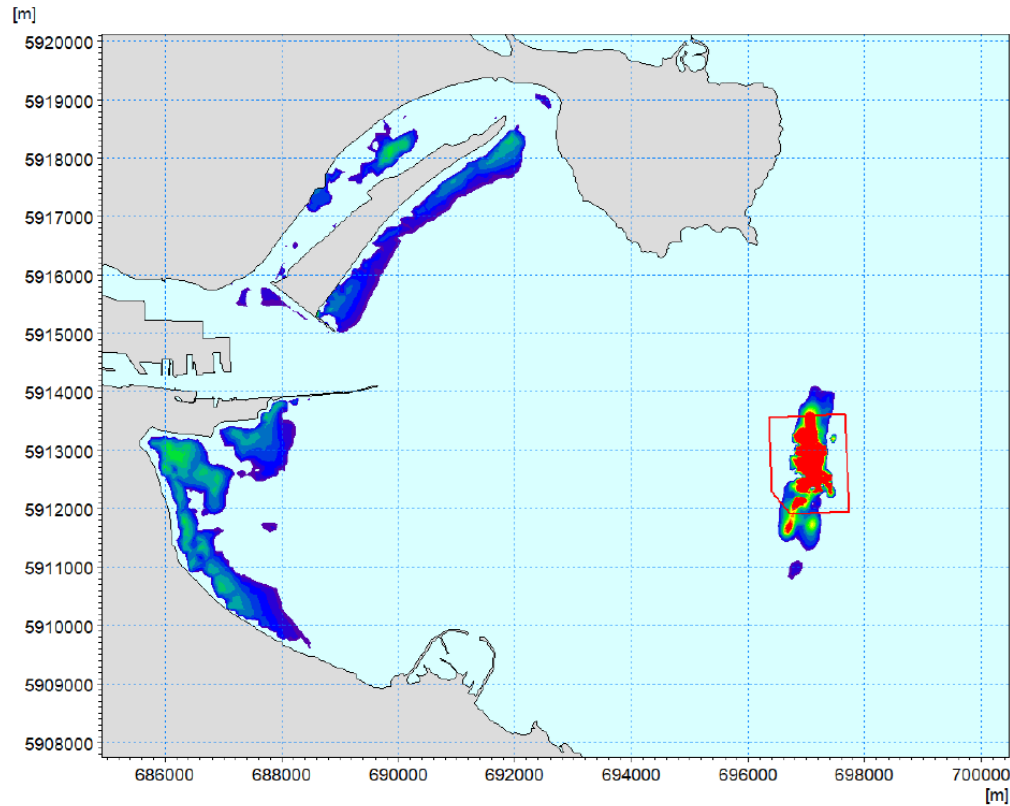
- Temporally
- Spatially

Depth averaged turbidity concentration usually falls within the envelope of values recorded at the surface and mid water column points

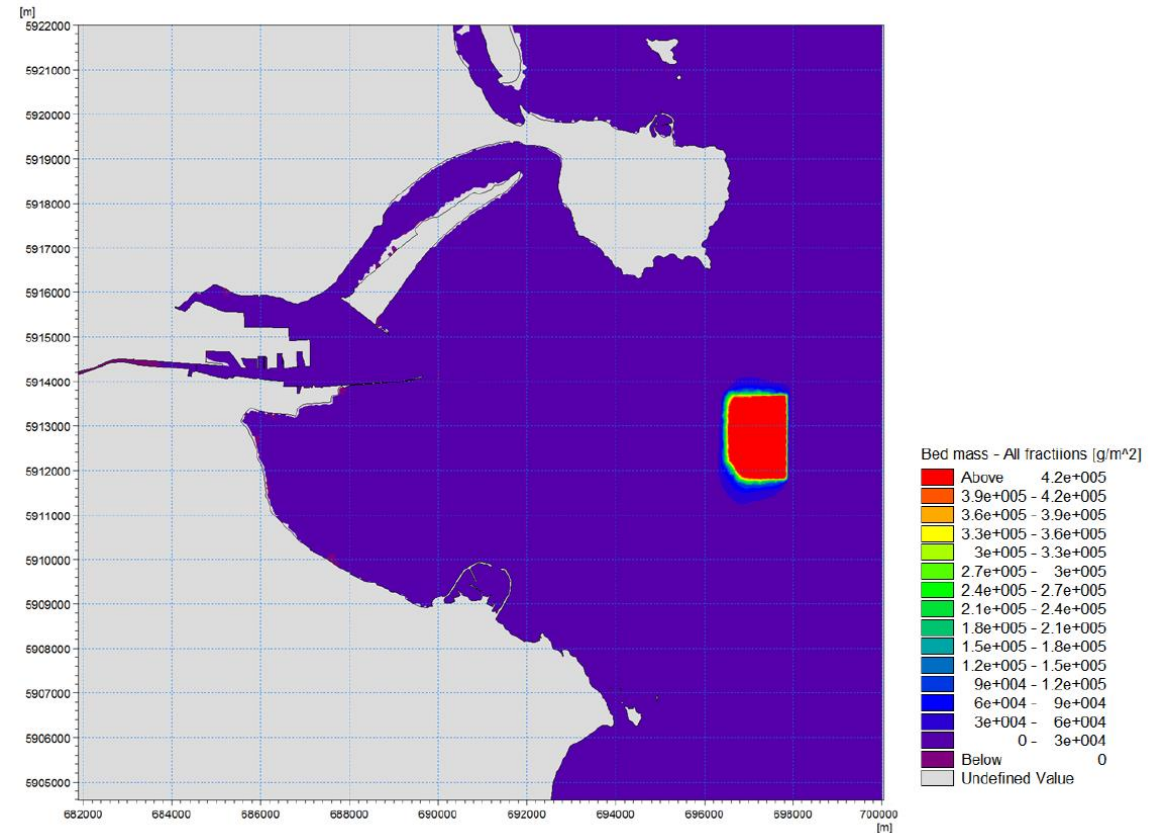
Model considered accurate and fit for purpose



Cumulative deposition plots for Silt and Sand material



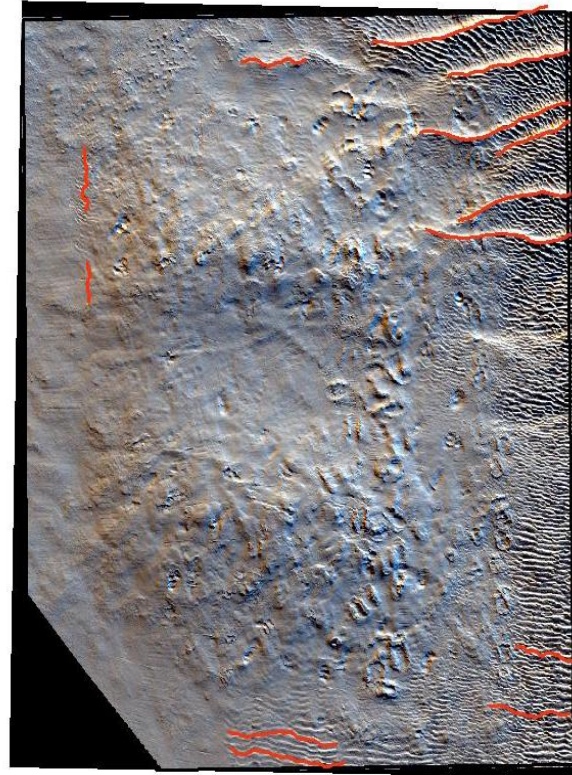
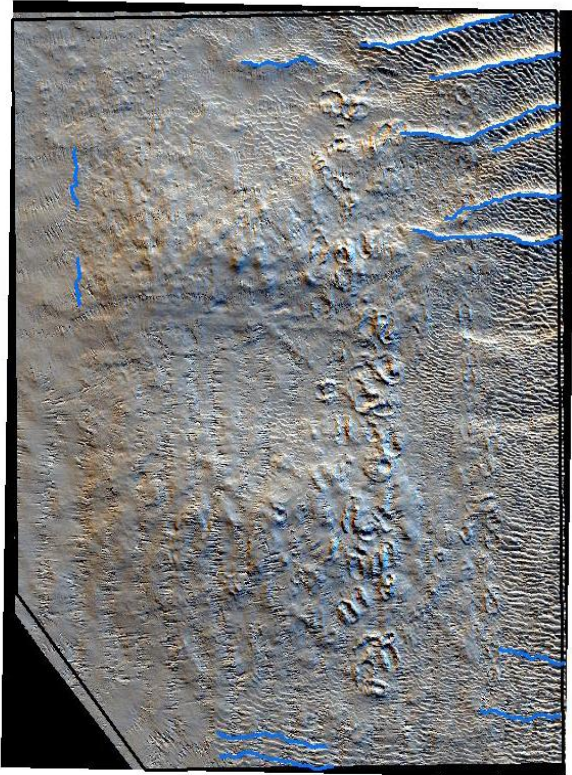
Cumulative bed thickness increase from silt deposition (all activities)



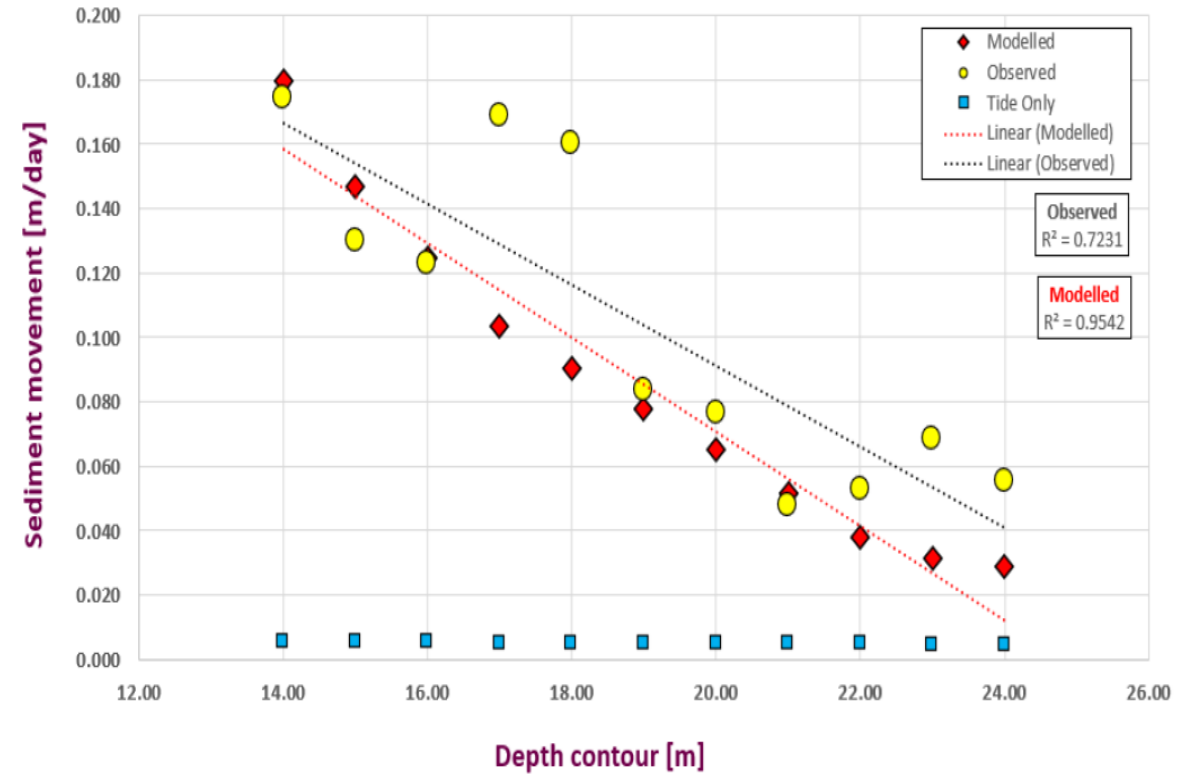
Total sand deposition after six months of continuous disposal of sand spoil material

17.07.2023

23.08.2023

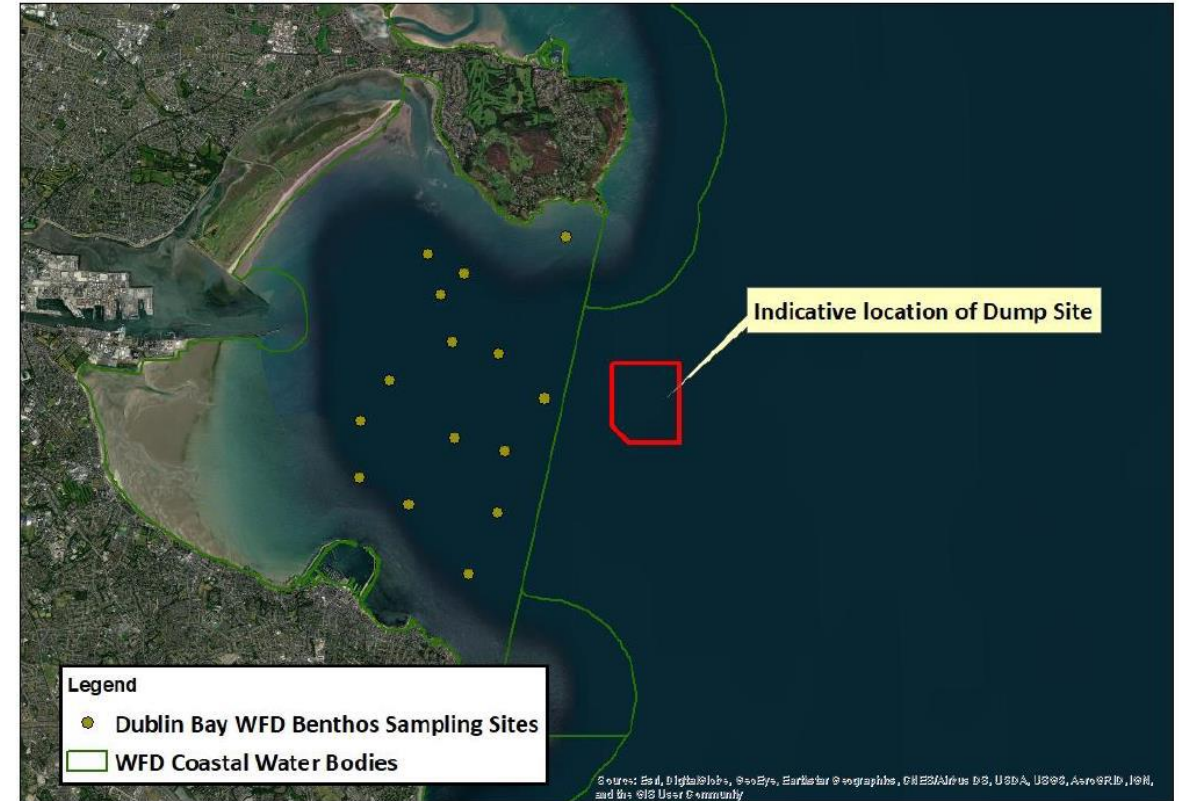


0 137.5 275 550 825 1,100 Meters



Context provided by other studies

- Since 2012, the Marine Institute, has carried out monitoring to determine macroinvertebrate ecological quality status (EQS) in around the Irish Coast to fulfil requirements of the Water Framework Directive (WFD).
- As part of this programme, sampling must be carried out within each waterbody, including Dublin Bay, at least twice within the 6-year cycle.
- Extensive sampling and monitoring throughout Dublin Bay concluded that the effects of dredging (and loading) and spoil disposal appear to be contained within dredge areas and do not appear to be impacting the wider seabed invertebrate communities in Dublin Bay.
- **MI results support TT findings that the dispersion of dredge material into Dublin Bay as a result of disposal at the dump site is extremely limited and highly unlikely to result in a large-scale deposition event in Dublin Bay.**



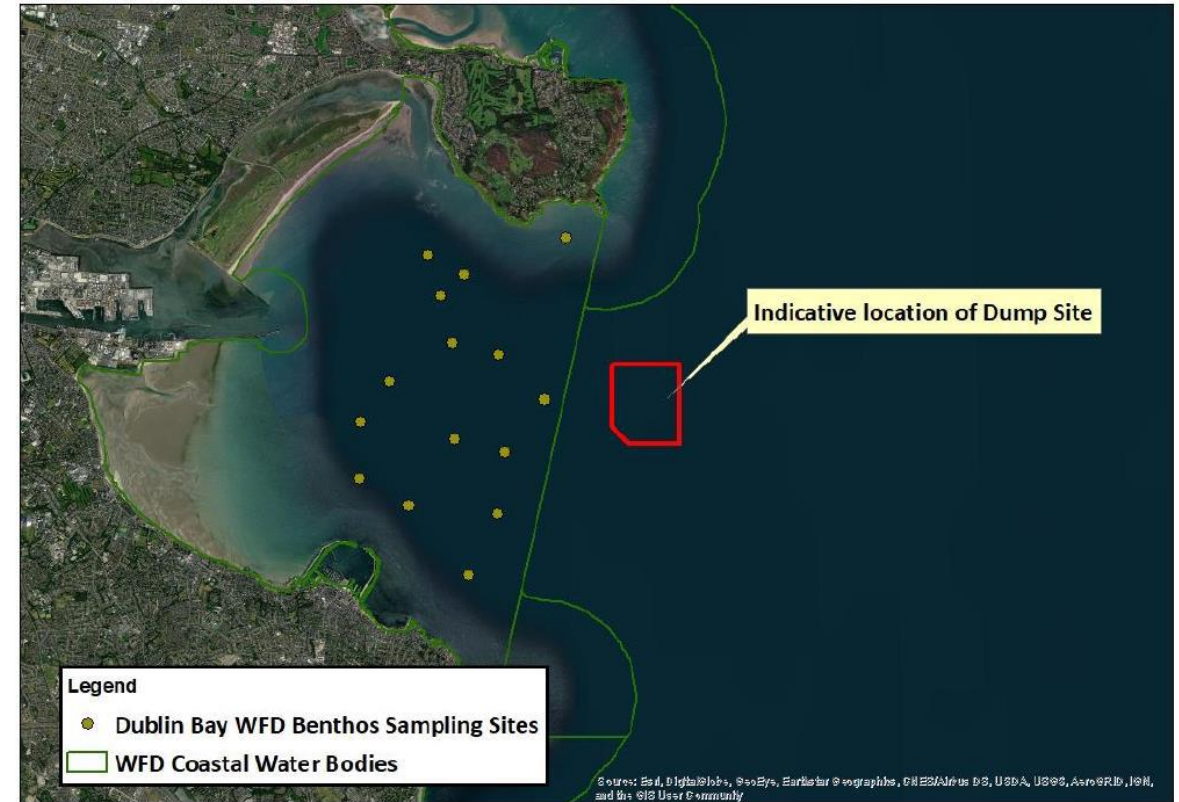
Conclusions

The cumulative sediment deposition within Dublin Bay from all four dumping at sea activities demonstrate that:

- The cumulative total deposition of **silt material** beyond the immediate vicinity of the disposal site is generally less than 0.60g/m².
- The impact of silt deposition from dumping activities is several magnitudes lower than natural sedimentation
- Even with wave action, the average rate of movement for coarser **sand material** on the dump site does not generally exceed 0.17m/day.

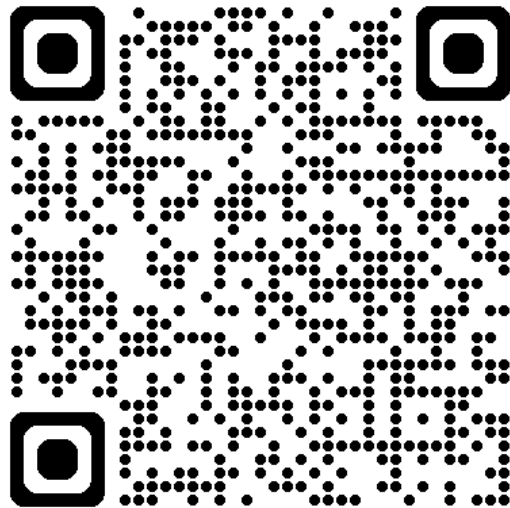
With the key mitigation measures, capital and maintenance dredging dumping activities will comply with

- The Habitats & Birds Directive
- The Water Framework Directive
- The Marine Strategy Framework Directive

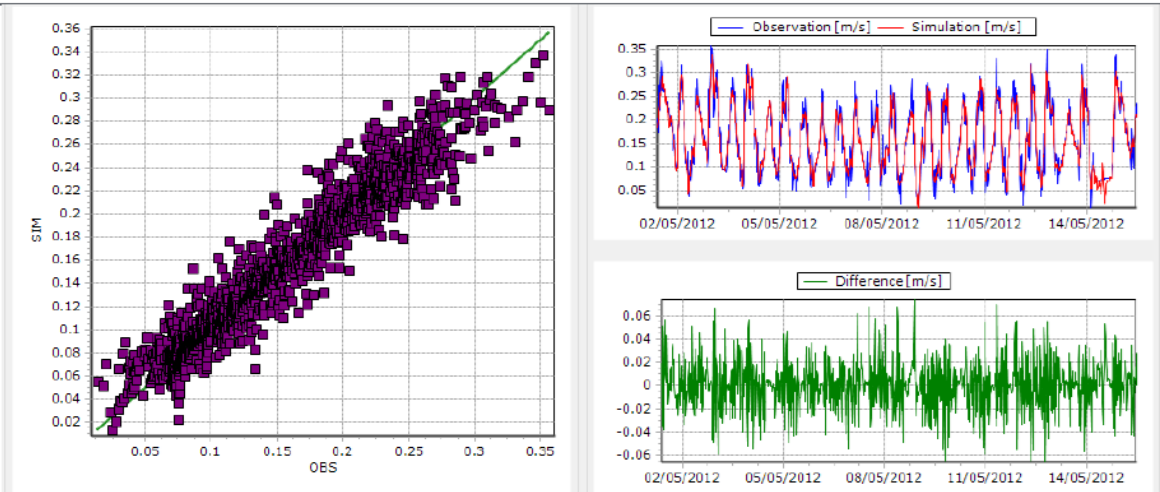


Questions?

Interested in Coastal Modelling? Scan the QR below to find out more about our team, projects and opportunities ...



HD calibration



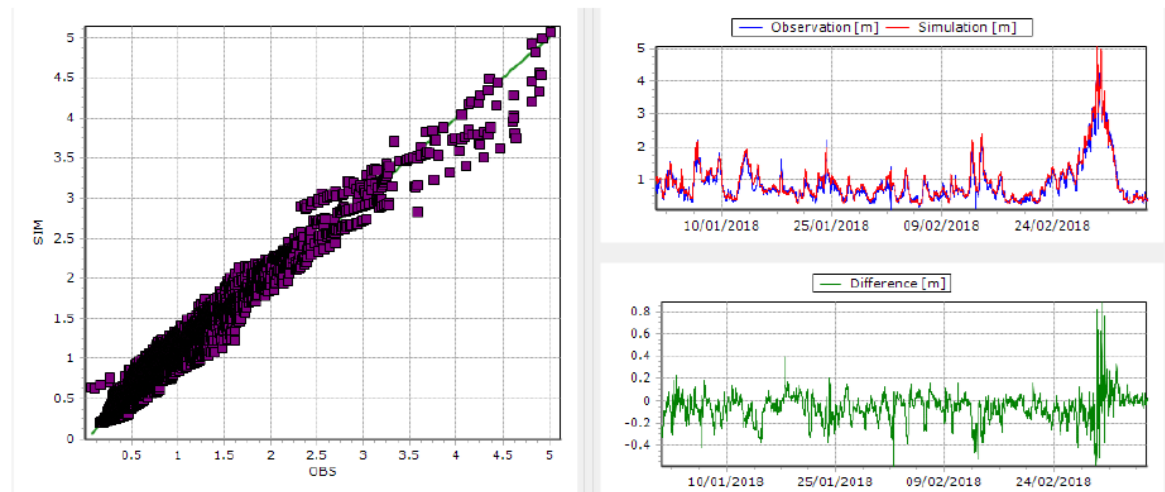
Performance Measures

Index	Value	Unit
Mean Error	0.0002	[m/s]
Mean Absolute Error	0.0148	[m/s]
Floot Mean Square Error	0.0200	[m/s]
Std. dev of Residuals	0.0200	[m/s]
Coefficient of Determination	0.9195	[-]
Coefficient of Efficiency	0.9119	[-]
Index of Agreement	0.9786	[-]

Statistics

Item Name	Observation	Simulation	Difference
Middle Velocity	Lyr3: Current speed		Difference
Item Unit	[m/s]	[m/s]	[m/s]
Minimum	0.0144	0.0134	-0.0662
Maximum	0.3566	0.3363	0.0739
Average	0.1598	0.1596	0.0002
Std. deviation	0.0704	0.0673	0.0200

Wave calibration



Performance Measures

Index	Value	Unit
Mean Error	-0.0584	[m]
Mean Absolute Error	0.0972	[m]
Root Mean Square Error	0.1341	[m]
Std. dev of Residuals	0.1207	[m]
Coefficient of Determination	0.9624	[-]
Coefficient of Efficiency	0.9531	[-]
Index of Agreement	0.9882	[-]

Statistics

Item Name	Observation	Simulation	Difference
Hs	Point 1- Sgn. Wav...		Difference
Item Unit	[m]	[m]	[m]
Minimum	0.0578	0.1932	-0.5841
Maximum	5.0157	5.0671	0.8800
Average	0.8516	0.9101	-0.0584
Std. deviation	0.6202	0.6190	0.1207