MODELLING HYDRODYNAMICS AND SEDIMENT TRANSPORT FOR A TEMPORARY JETTY STRUCTURE

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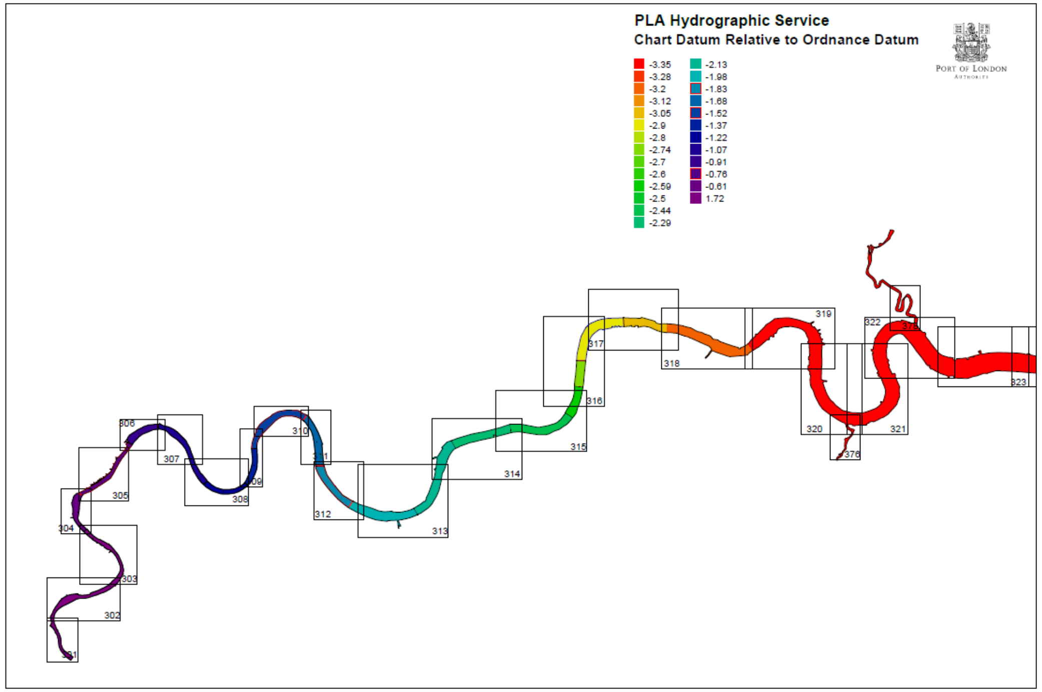
27.06.17

Introduction

- Aims:
  - To assess the hydrodynamic impact of a temporary jetty structure.
  - Determine potential scour around jetty piles.
  - Simulate the impact of dredging operations at the jetty head.

- Site description
  - ‘T’ shape jetty structure
  - 25 jetty piles
  - 1016mm diameter

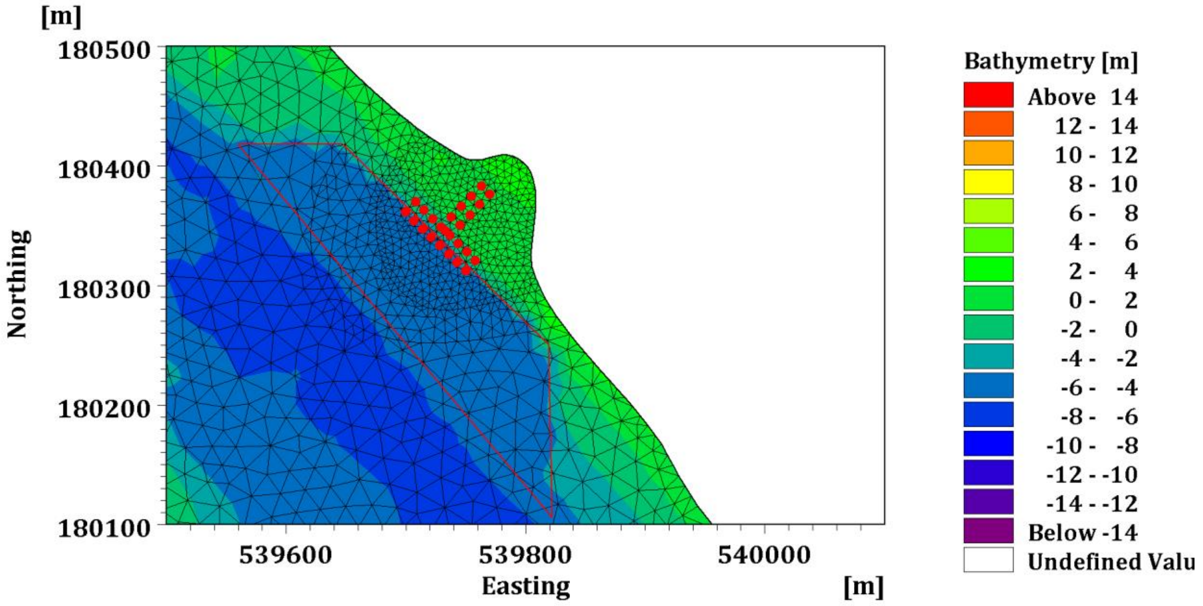


Assessment method

- Hydrodynamic modelling
  - MIKE21 FMHD model generated for study site
  - Simulate with and without the jetty structure
  - Show impact of jetty on local hydrodynamics

- Scour assessment around jetty piles
  - Velocities extracted from hydrodynamic model
  - Scour Time Evolution Predictor method of Whitehouse

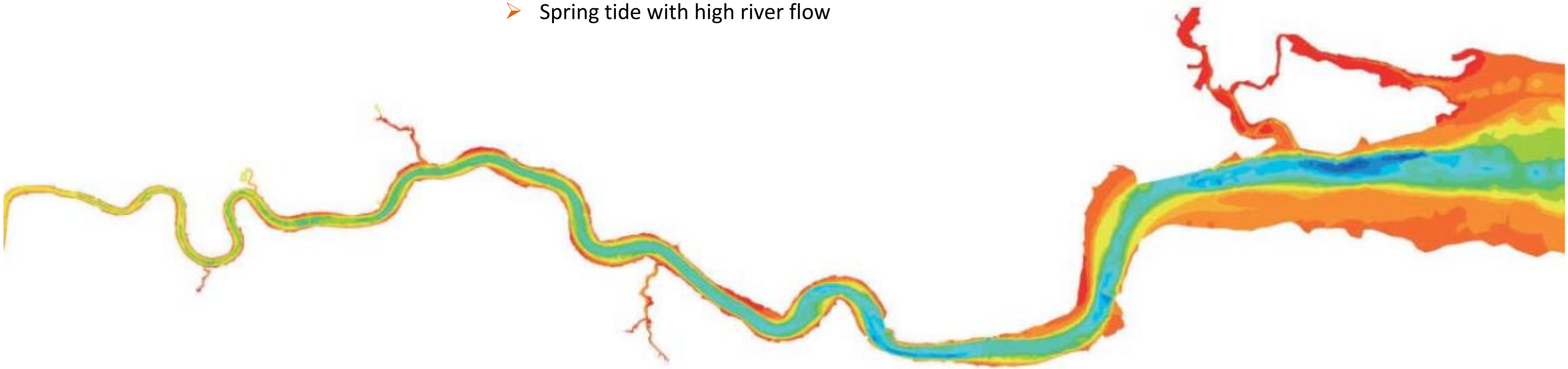
- Suspended sediment modelling
  - MIKE21 MT model coupled to MIKE21 FMHD
  - Assessment of sediment released during dredging operations



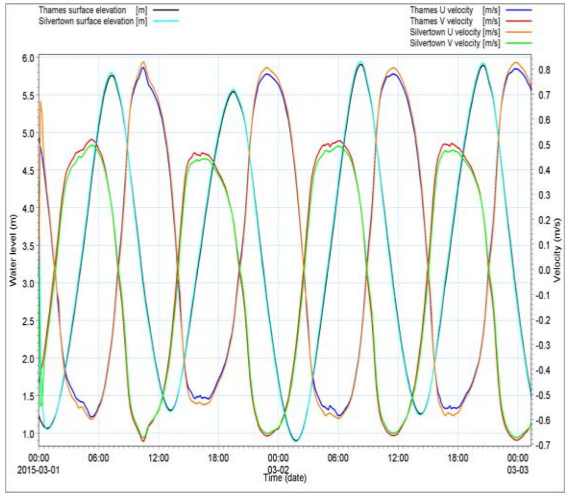
Boundary conditions

- Upstream and downstream boundaries
  - U and V velocity
  - Water level
  - Discharge

- HR Wallingford Thames Estuary TE2100 model
  - Neap tide with mean river flow
  - Neap tide with high river flow
  - Spring tide with mean river flow
  - Spring tide with high river flow

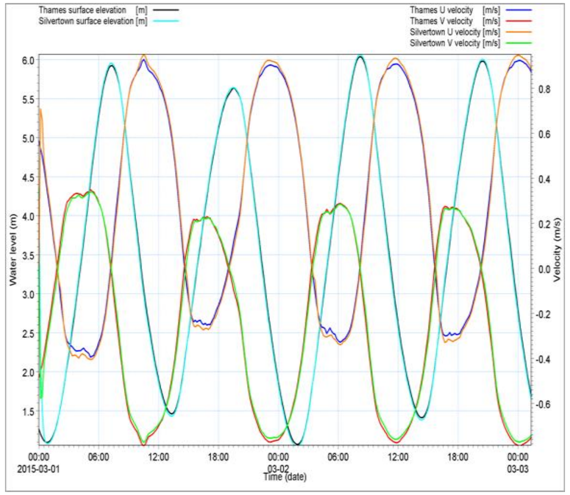


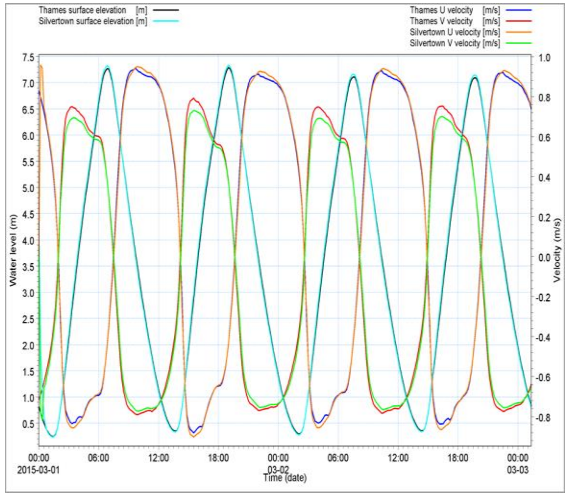
Model Calibration and Validation

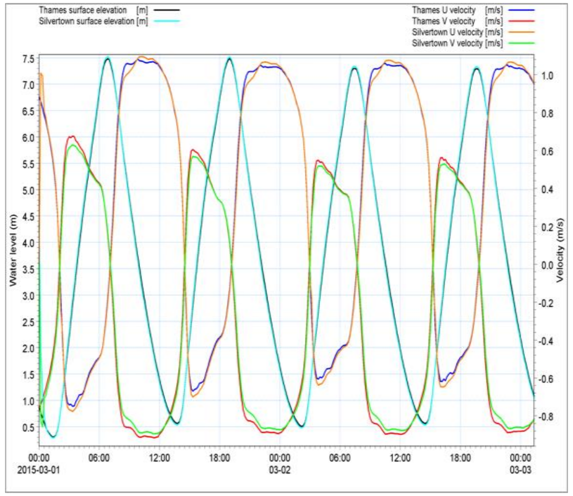


➢ Comparisons against the HR Wallingford River Thames model results at a point close to the temporary jetty (539500, 180400), using the baseline simulation without a temporary jetty structure present.

- ➢ Tidal elevation
- ➢ Current velocities







Sediment Sampling Survey

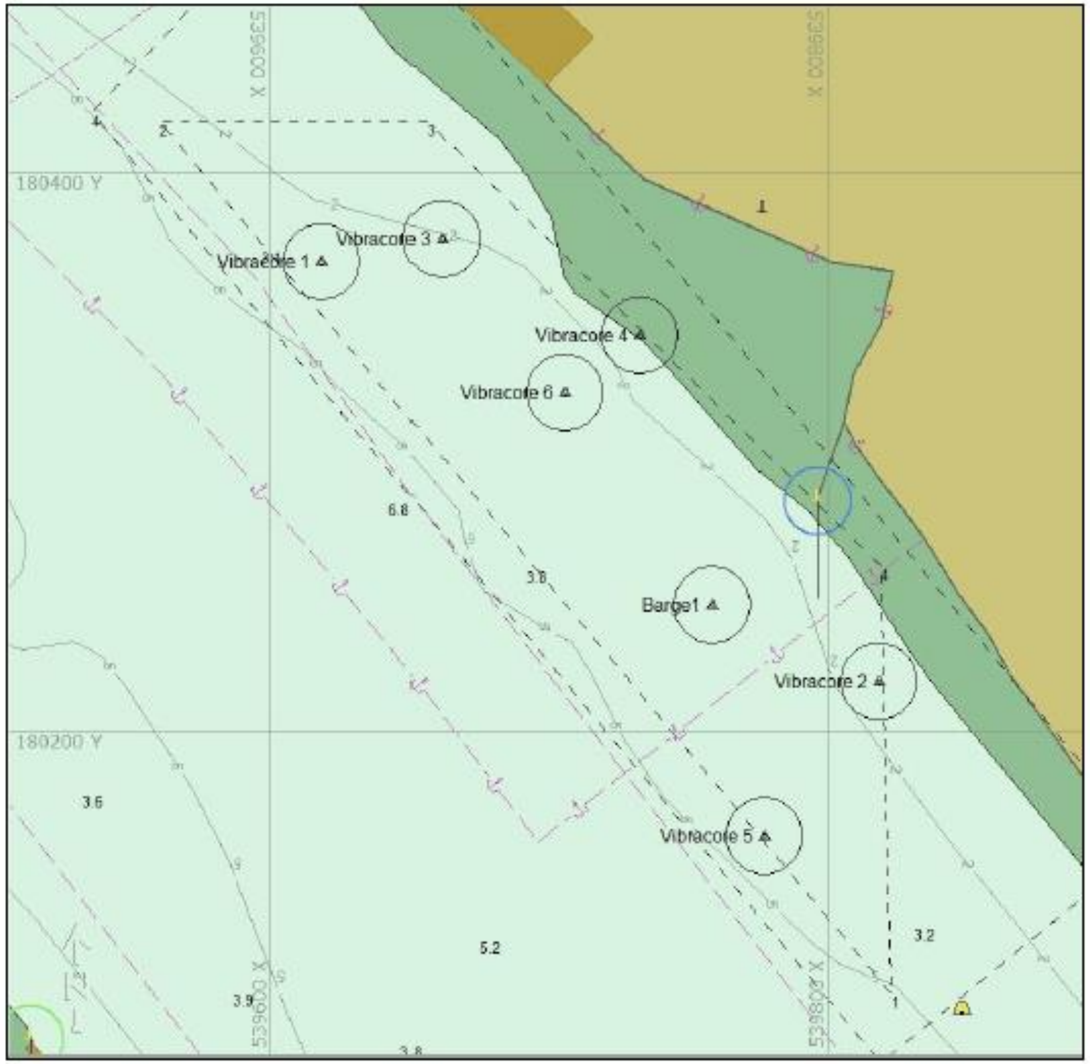
Laboratory Sample Number	Sample Description	Gravel (%)	Sand (%)	Silt/Clay (%)	Very coarse and coarse sand (%)	Medium sand (%)	Fine sand and very fine sand (%)
2016/27584	VIB 01, 0.5m	0.00	11.03	88.97	0.00	0.36	10.67
2016/27585	VIB 03, 0.5m	0.00	11.91	88.09	0.00	0.23	11.68
2016/27586	VIB 04, 0.75m	0.14	28.82	71.04	0.77	6.41	21.63
2016/27587	VIB 04, 1.5m	0.09	15.71	84.20	0.07	2.24	13.40
2016/27588	VIB 05, 1.0m	0.00	16.11	83.89	0.08	0.67	15.36
2016/27589	VIB 05, 1.8m	0.00	20.95	79.05	0.03	0.44	20.48
2016/27590	VIB 06, 0.5m	0.07	11.15	88.78	0.07	0.39	10.69

➢It was noted that sediment conditions prevented the collection of cores down to 3m depth.

➢The area was characterised as dense clay beneath a surface layer of gravelly sand.

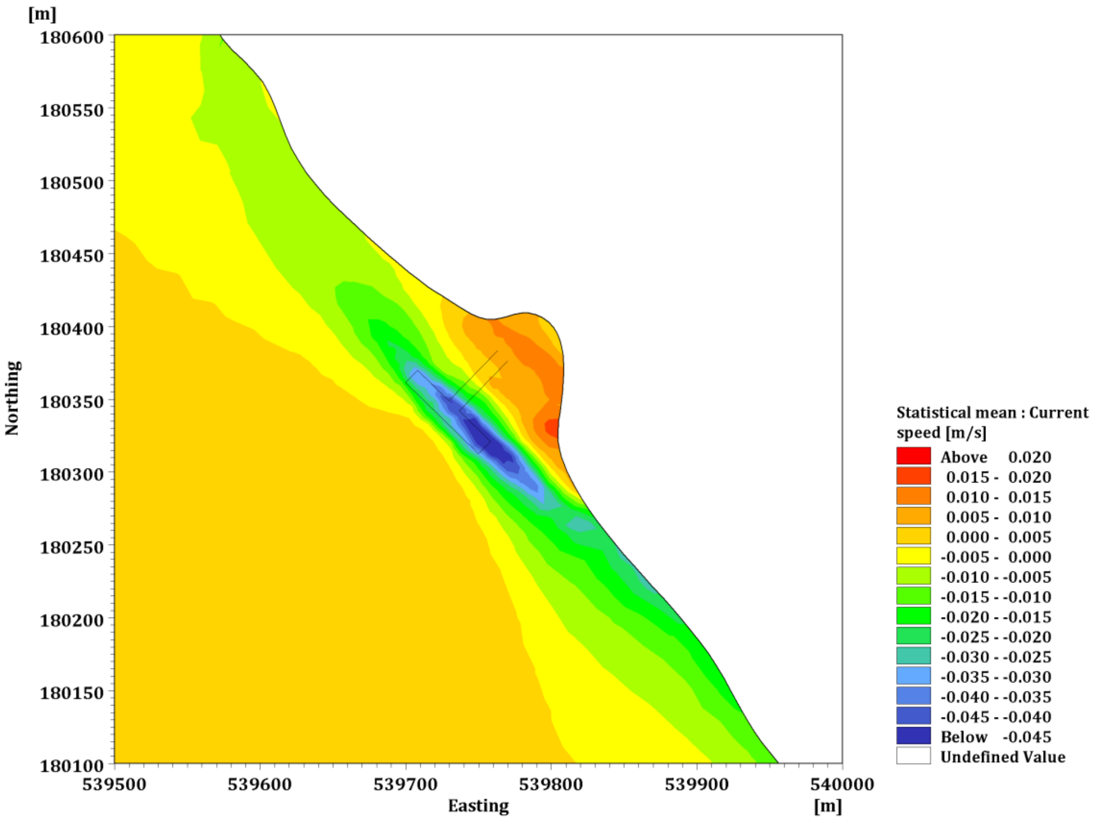
➢The clay blocked the vibracore preventing further sediment sampling at depth.

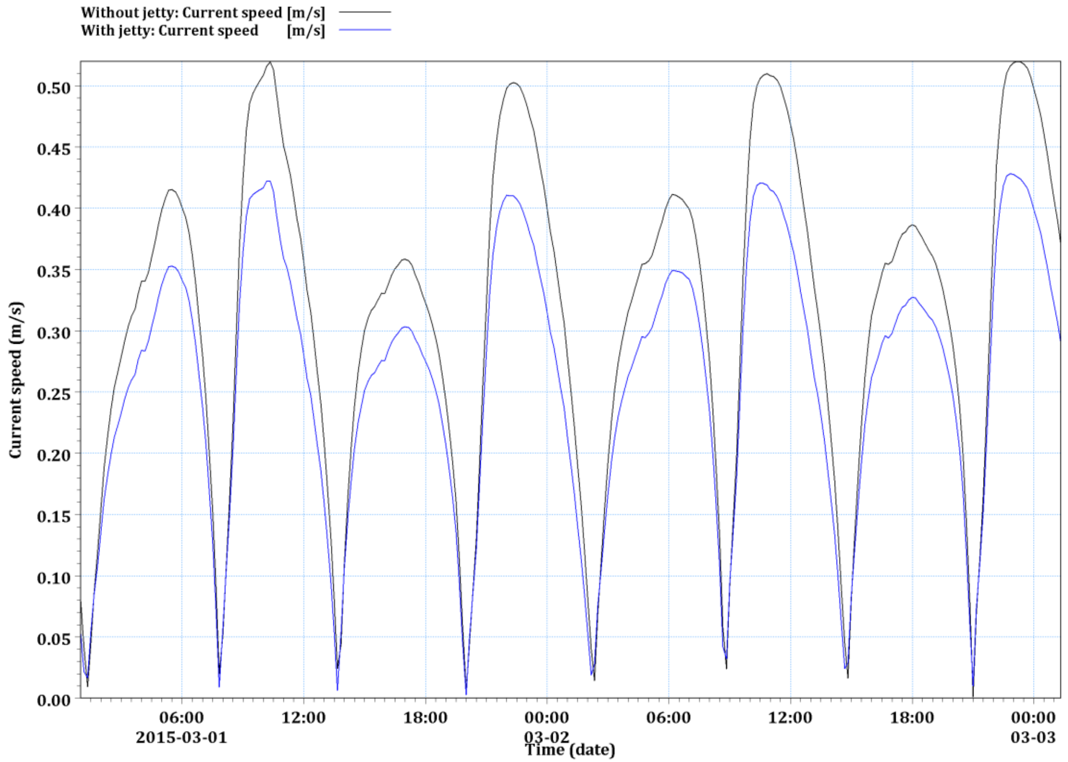
➢PSA shows 71-89% clay for all samples collected.



Jetty Impacts on Hydrodynamics

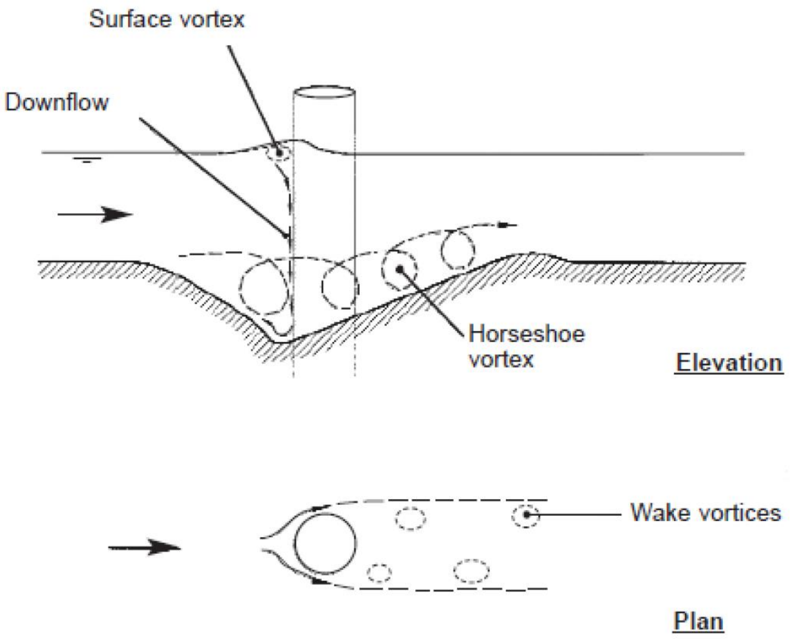
- Comparisons of simulated current speed
  - With jetty
  - Without jetty

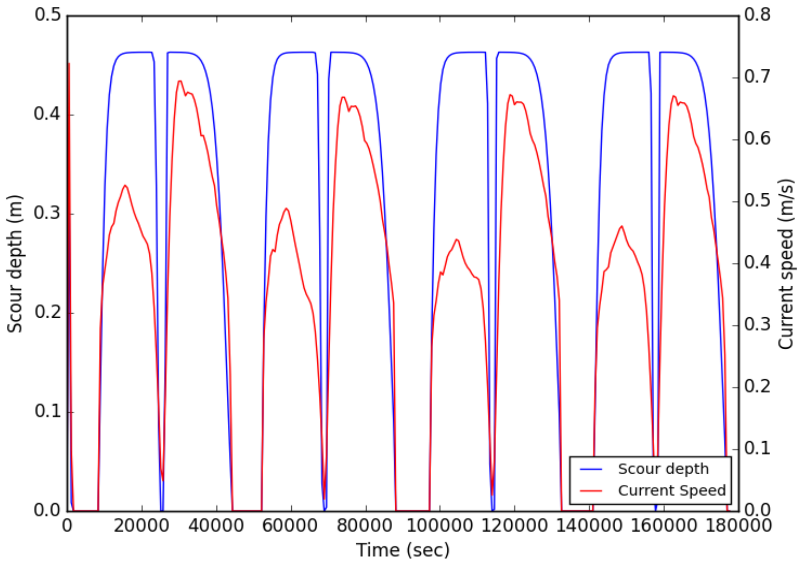




Jetty Pile Scour

- Scour depth evolution calculated using the Scour Time Evolution Predictor method of Whitehouse.
- Clay reduction factor assuming an 80% clay content.
- Lateral extent of scour calculated as a function of scour depth.



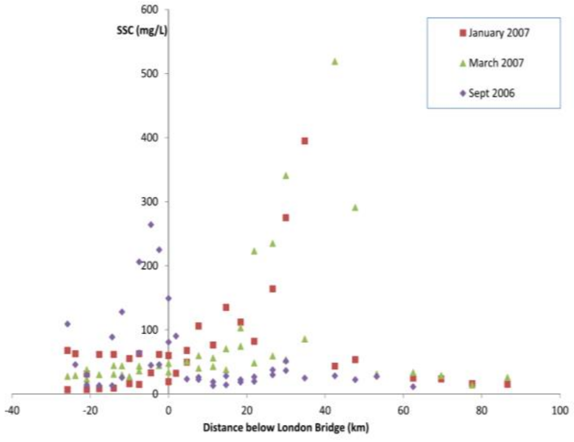


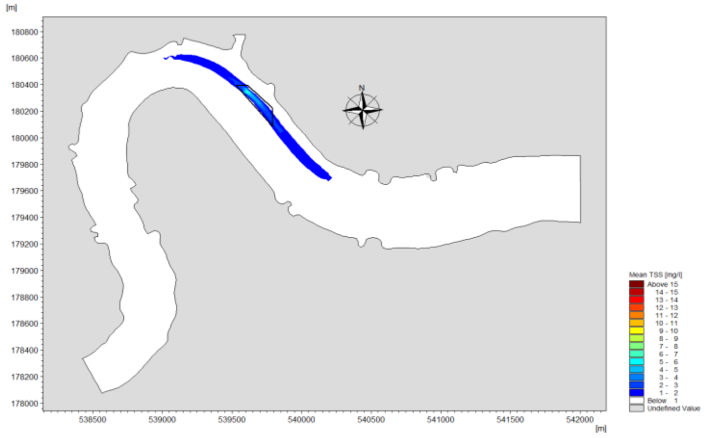
$$S(t) = S_e\left[1 - exp\left(-\frac{t}{T_s}\right)^n\right]$$

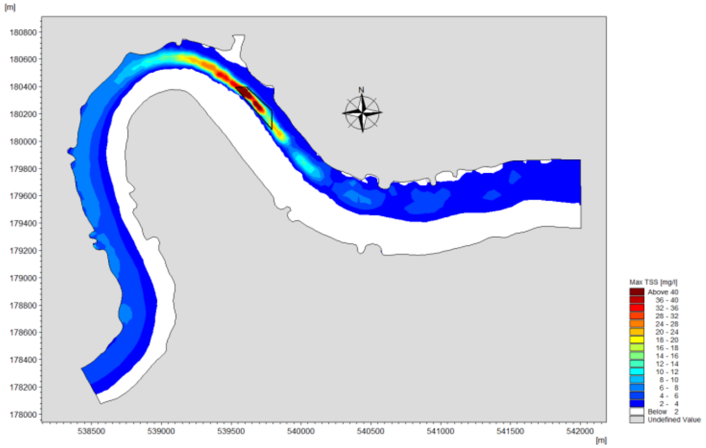
$$T^* = \frac{\left[g(s-1)d_{50}^3\right]^{1/2}}{D^2}T_s$$

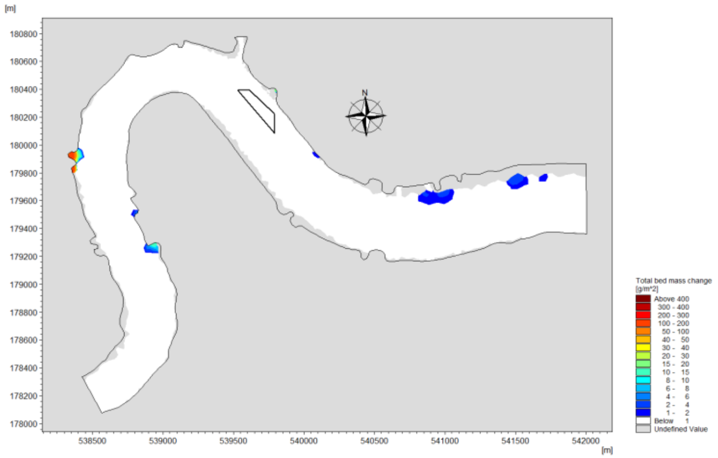
Dredge Plume Modelling

- Simulated SSC are lower than measured background levels.
- Fast current velocities advect fine sediment released during dredging operation.
- Dredging works should not create a significant impact.









Conclusions

- Low impact of jetty on hydrodynamics, any impact is very localised.

- Local sediment is characterised as consolidated clay at depth with a top layer of sandy gravel.

- Maximum scour depth and lateral extent do not pose a threat to jetty stability or impact on nearby structures.

- Simulated SSC levels from the dredging works are lower than the naturally occurring background levels.

- The dredging works would not cause an environmental impact on the local area.