First to Field Mass Mixing In-Situ Stabilization/Solidification Remediation in Uncharted Waters of Kendall Bay

Kendall Bay, Sydney, NSW, Australia

WEDA 2023
DREDGING SUMMIT AND EXPO

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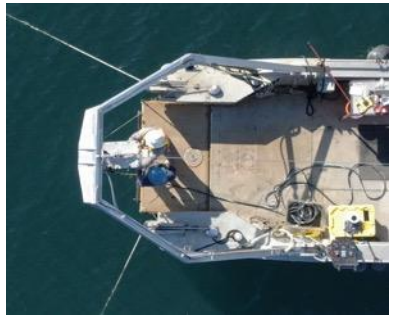


Overview



- Where is Kendall Bay?
- Why was remediation required?
- Design and Construction
- Lessons Learned

Where is Kendall Bay?



Site Background



Formerly home to the largest gasworks site in the southern hemisphere

Former Mortlake Gasworks circa 1950s

Former Mortlake Gasworks circa 1980s

Site Background



Upland remediation was completed in the 90's and former gasworks site was redeveloped

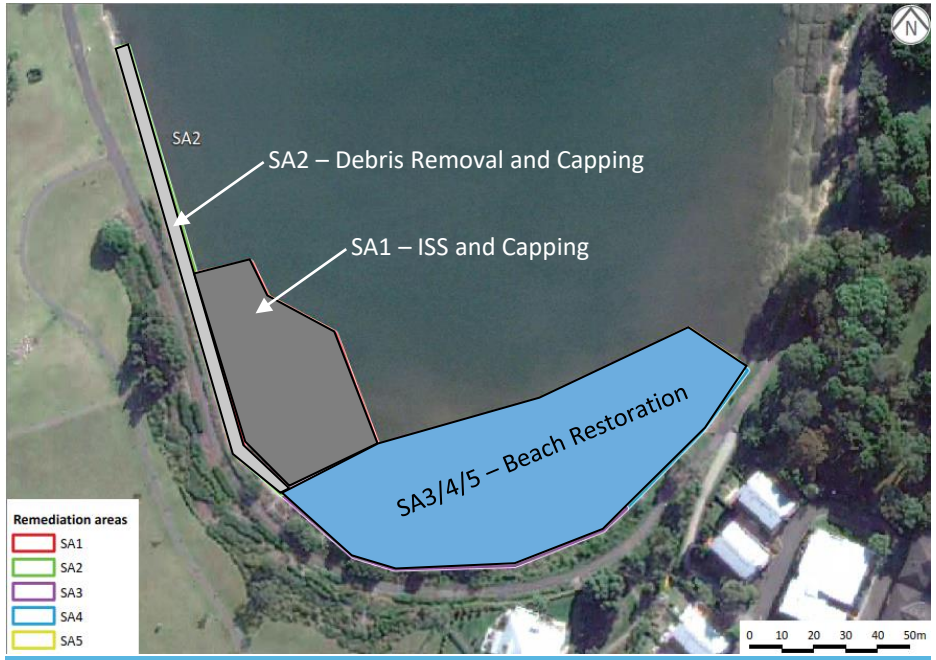
Mortlake following redevelopment early 2000's

Regulatory Process



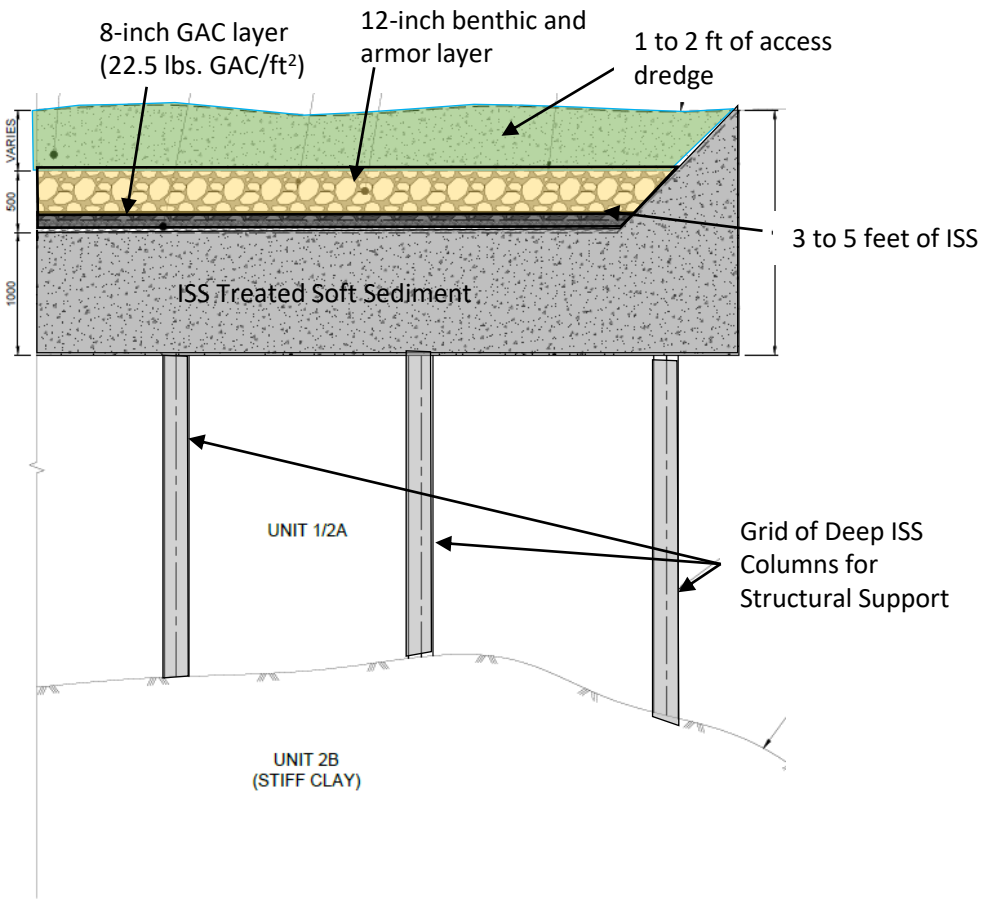
- Remediation order was released in 2007
- Site investigations and risk assessment were performed between 2007 and 2016
- RAP was released in 2018

Northern Remediation Area



Southern Remediation Area

Selected Remedy

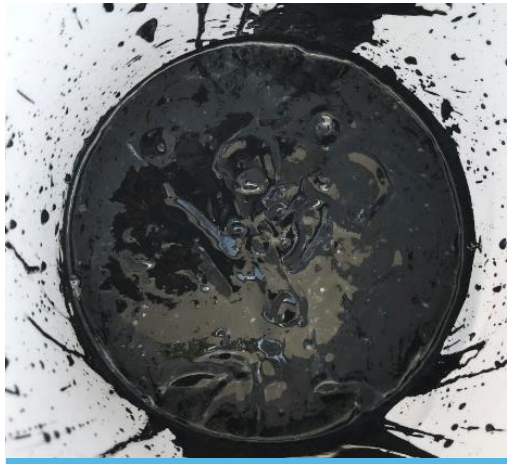


- 150 psi (1 MPa) UCS requirement for the ISS monolith
- 300 psi (2 MPa) requirement for the deep ISS columns (no basis of design)
- $1x10^{-5}$ cm/s hydraulic conductivity requirement
- More than 90% reduction in leachability for ISS (not very meaningful)
- No basis of design or performance criteria for the carbon treatment layer (22.5 lbs. of GAC/ft^2 is very costly)

ISS Treatability Study



Focused treatability study was performed to identify a mix design that would meet the performance criteria.



Sediment from Southern Remediation Area

Sediment from Northern Remediation Area

ISS Treated Sediment

- Identified cement dosage and mix design composition
- Evaluated grout modifier reagents (i.e., superplasticizers, accelerants, anti-washout additive)
- Evaluated reactive amendments (i.e., GAC/PAC, oleophilic clay, RemBind)
- Evaluated impacts of excess sea water on the mix design

ISS Pilot Study

Pilot study was performed to evaluate the means and methods, field performance, constructability and production rates

ISS Field Pilot Study at Kendall Bay (2018)

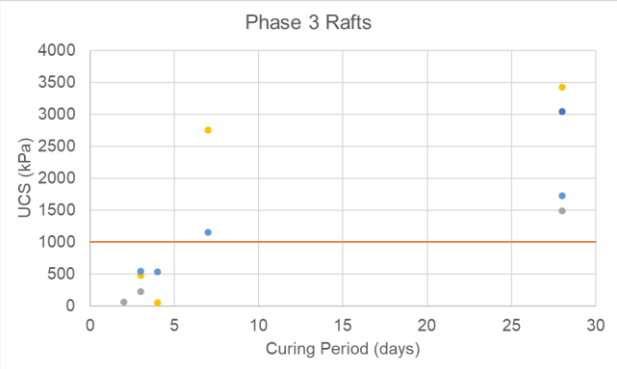
Mass mixing tool to build ISS raft

Auger mixing tool to build ISS columns

Pilot Study Results



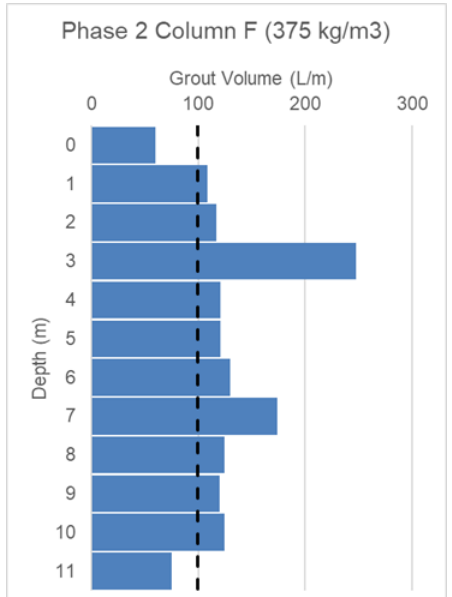
Multiple lines of evidence were used to assess field trial performance, and optimize full-scale remedy design



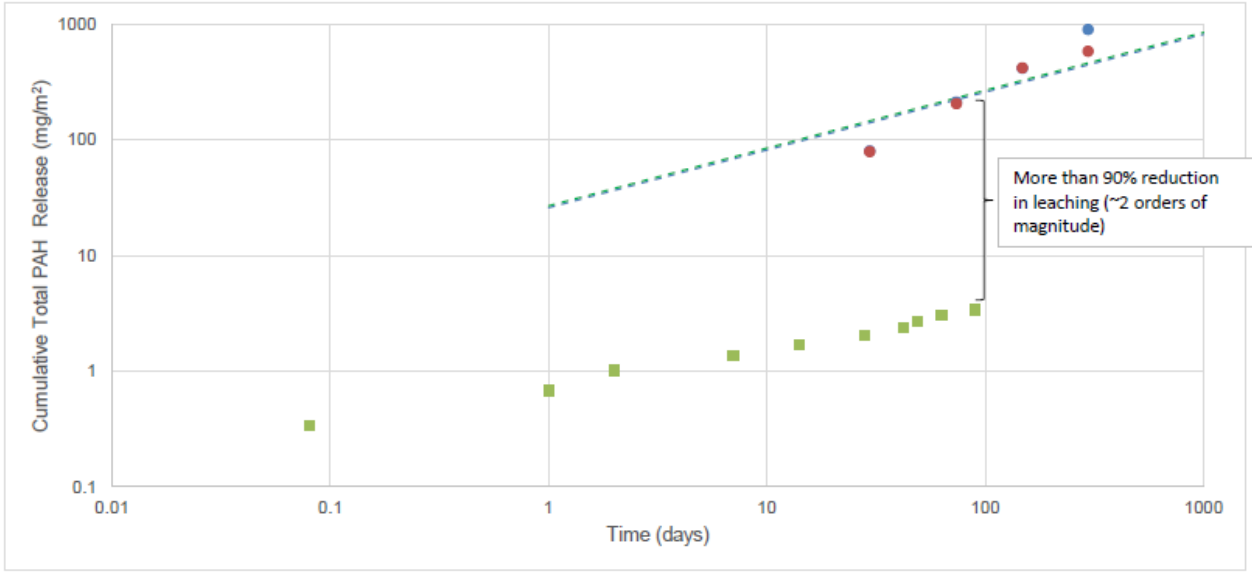
UCS results

Column ID	Temperature (C°)	pH	Moisture Content	Marsh Funnel Viscocity (sec)
E	16.7	12.5	61%	40
	17.8	12.1	38%	
F	22.8	12.3	38%	NR
G	25	11.7	NR	66
H	21.7	11.9	NR	NR

Field Screening Data



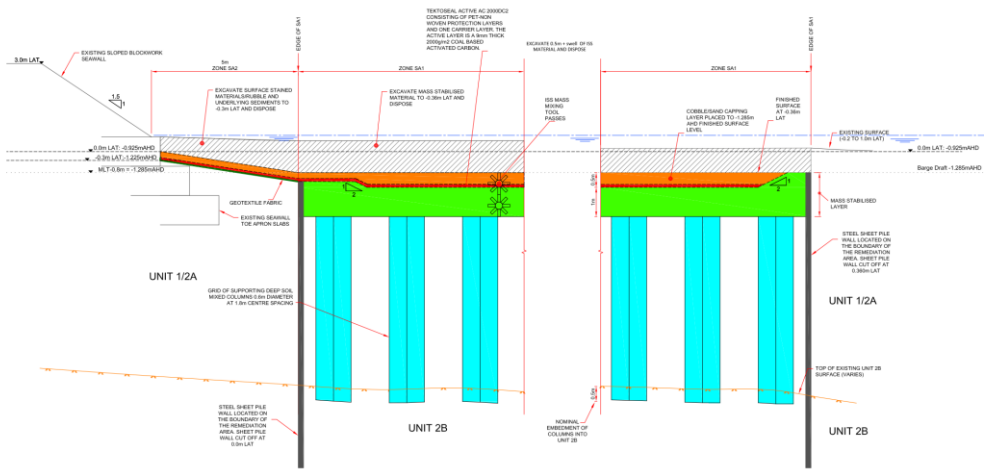
Contractor CQC Data



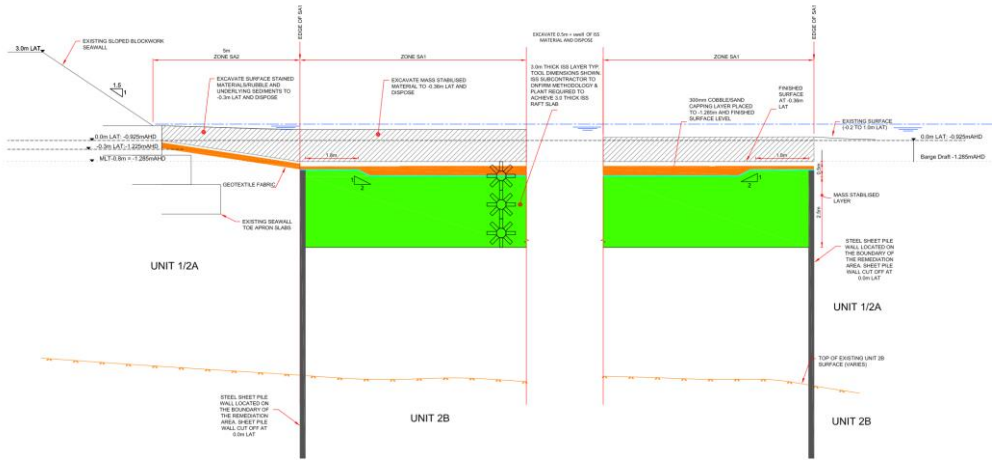
Reduction in Cumulative Mass Release Pre- and Post-ISS Treatment

Design Optimization





Original design as depicted in EPA-selected remedy



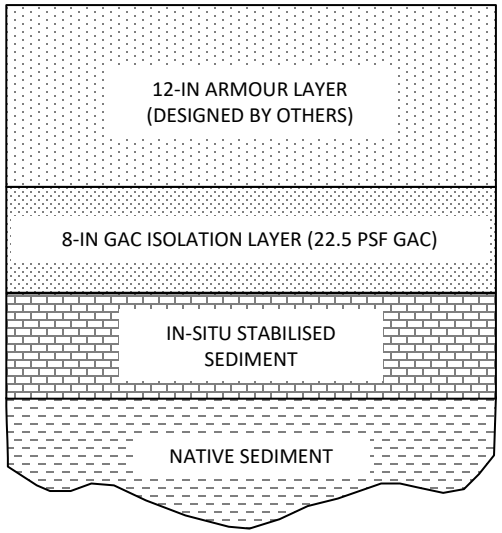
Eliminated deep ISS columns from the remedy

- A grid layout of deep ISS columns were originally planned to provide structural stability to mass mixing ISS panels
- Two different types of ISS equipment would have significantly slowed down the production rates and complicate the sequencing
- Further geotechnical evaluation concluded that deep ISS columns are not needed for stability

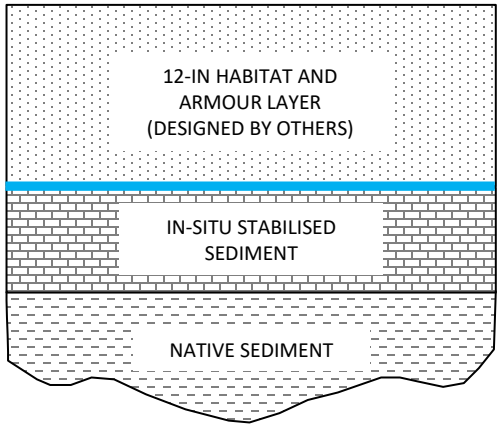
Design Optimization



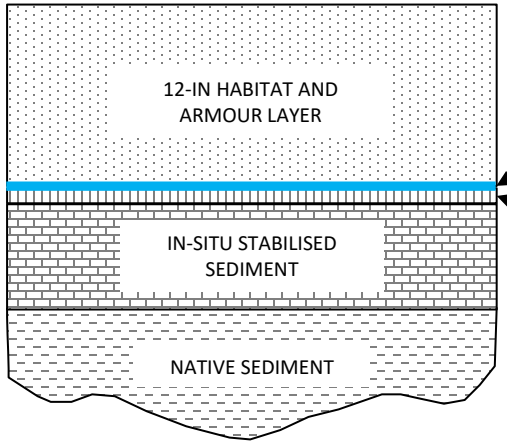
Site-specific chemical mass release data from ISS pilot study was used to refine the GAC treatment layer thickness and composition (> $3MM in cost savings)



Original Cap Design in EPA-selected Remedy (22.5 psf GAC)



Southern Area Optimized Cap Design
(Completely Eliminated GAC Requirements)



Northern Area Optimized Cap Design
(97% Reduction in GAC Requirements)

COMPLIANCE POINT

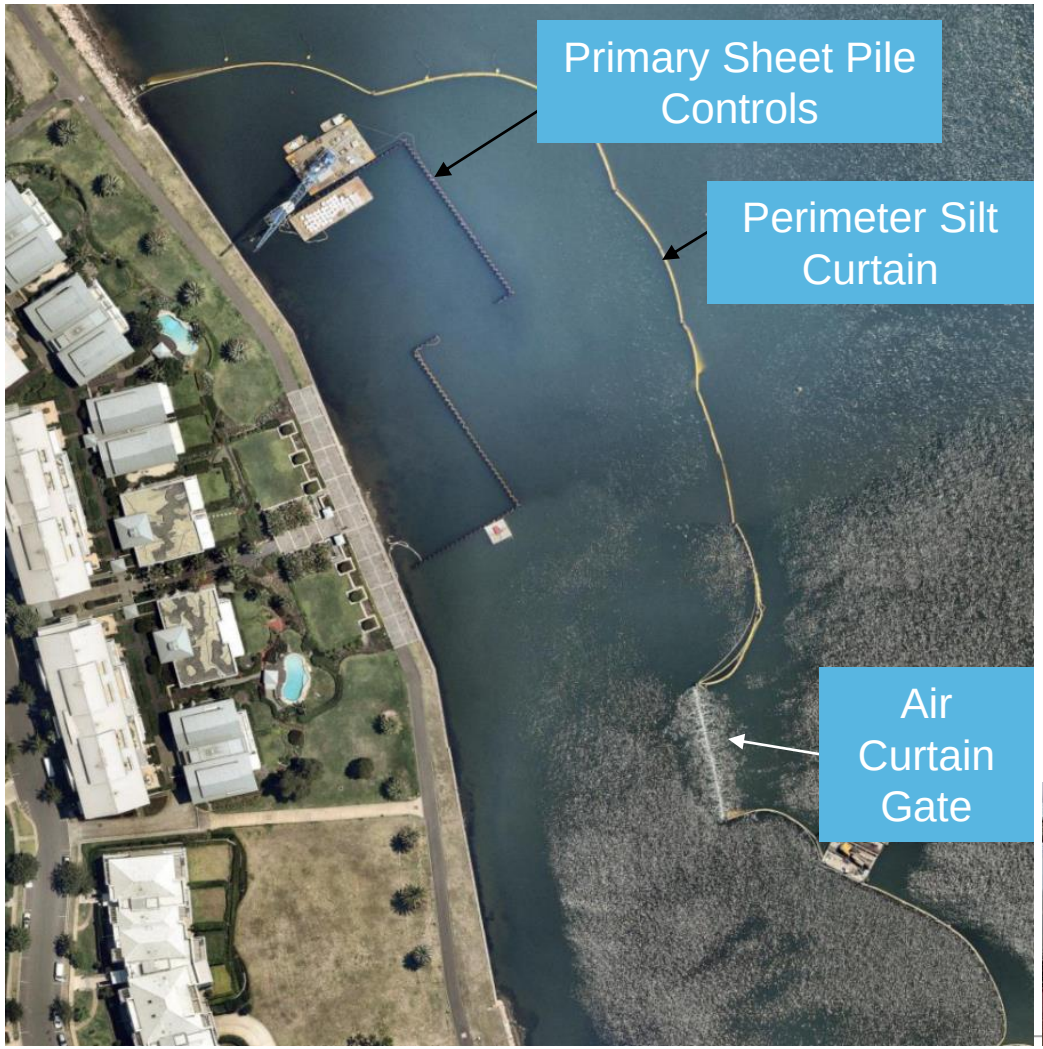
REVISED TREATMENT LAYER
(0.7 lbs. GAC/ft^2)

Approved Design Criteria

Dissolved phase concentration to be below 70 ug/L for PAHs and 700 ug/L for PHCs at treatment layer surface during at least a design life of 100 years

Environmental Controls



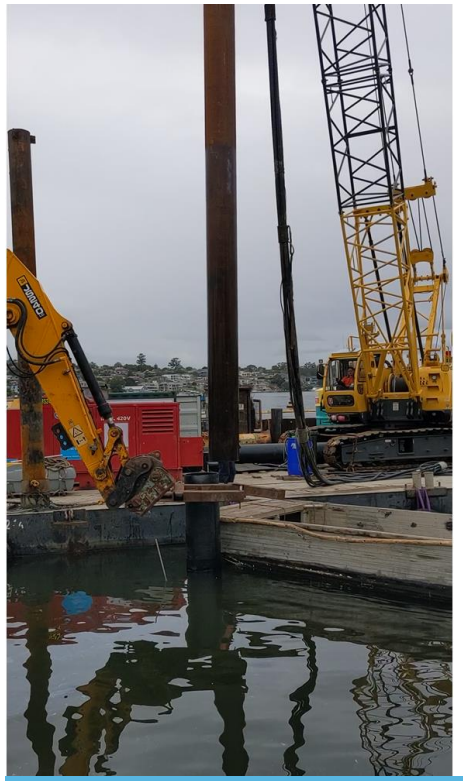


Access Dredge & Debris Removal



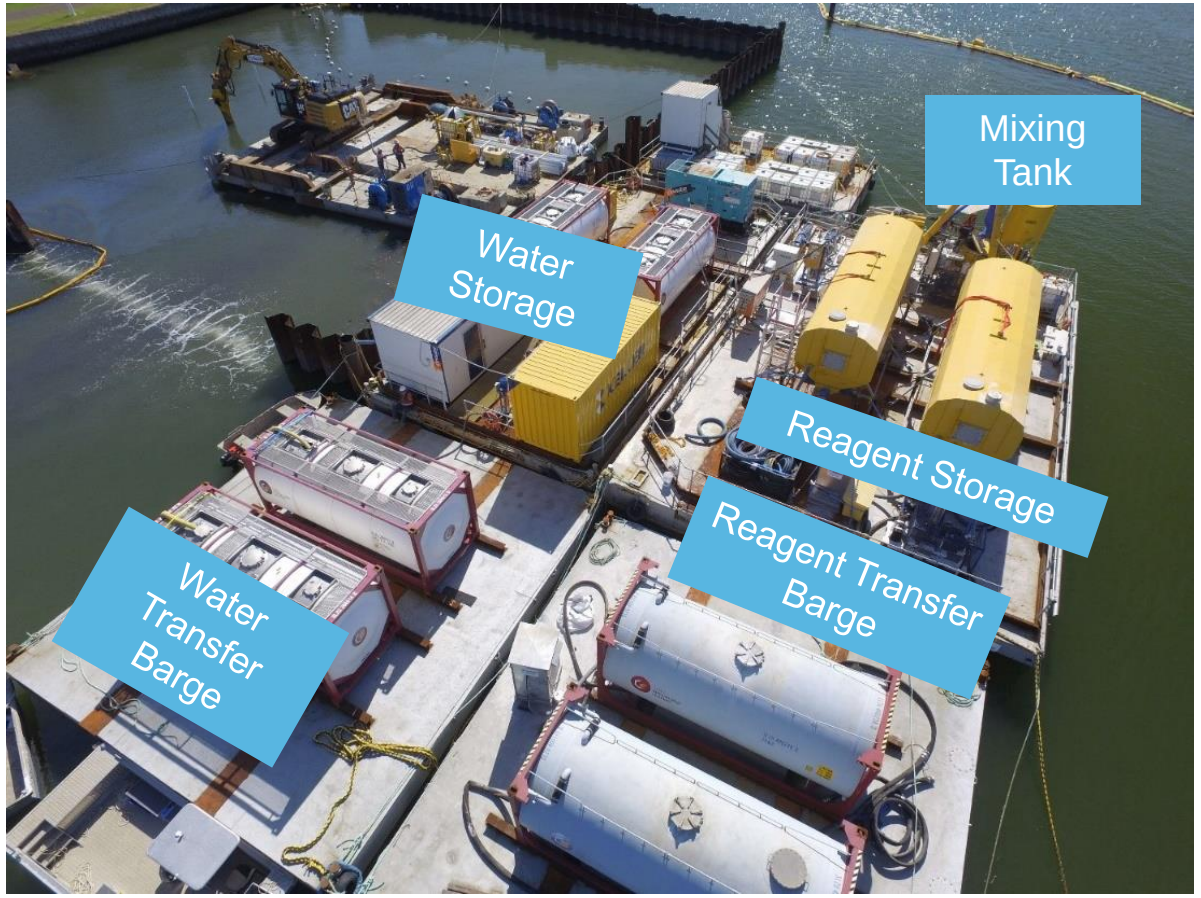
Access Dredge to Allow Barge Access to Shallow Areas

Removal of Old Piles with an Excavator



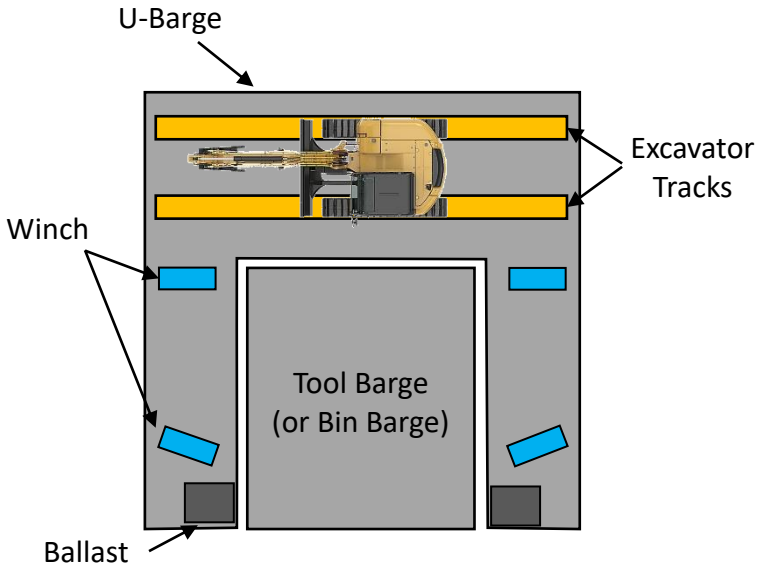
Removal of Old Piles with a Pile Driver

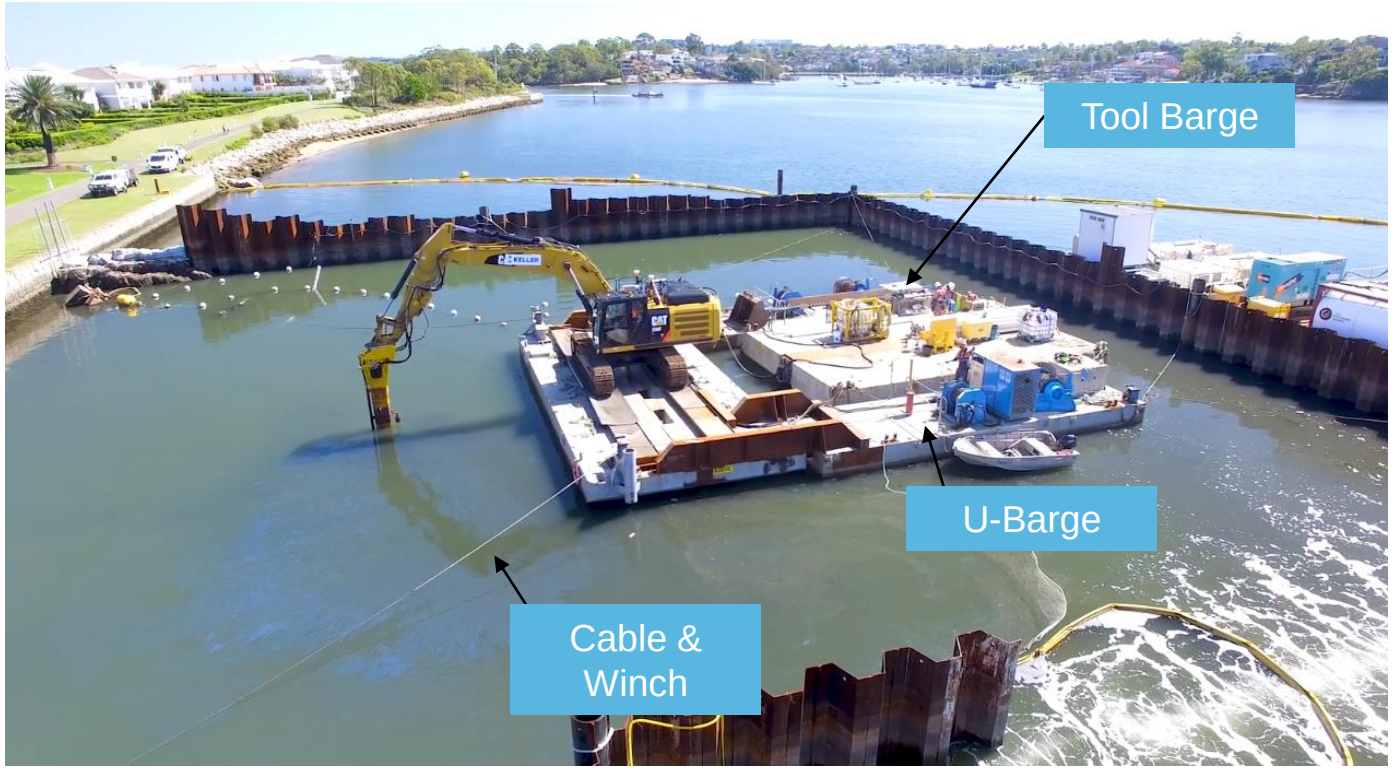
ISS Batch Plant



ISS Mixing Equipment

Average production rate ~130 CY/day
(min: 9 CY/day; max: 255 CY/day)

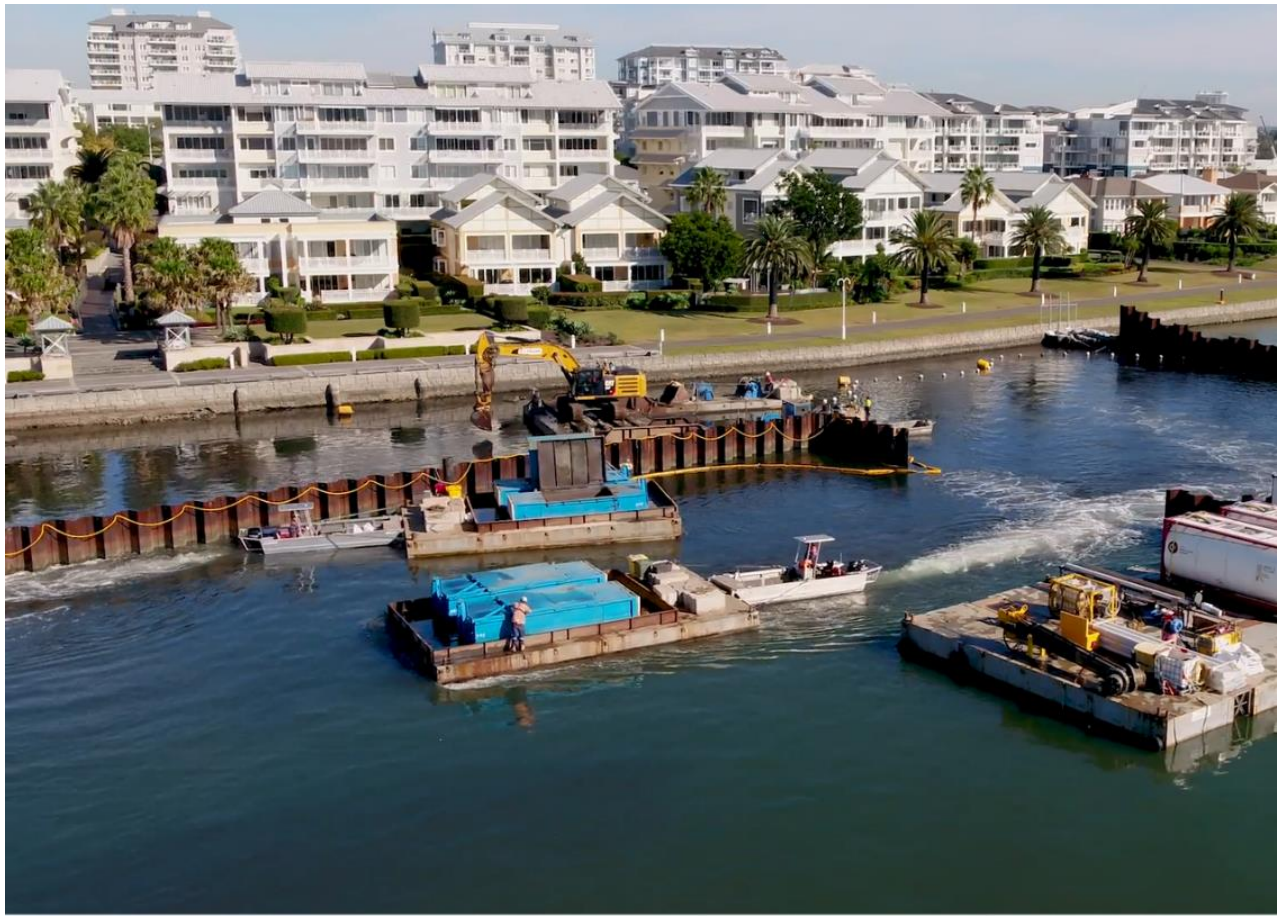




Total volume 9,500 CY

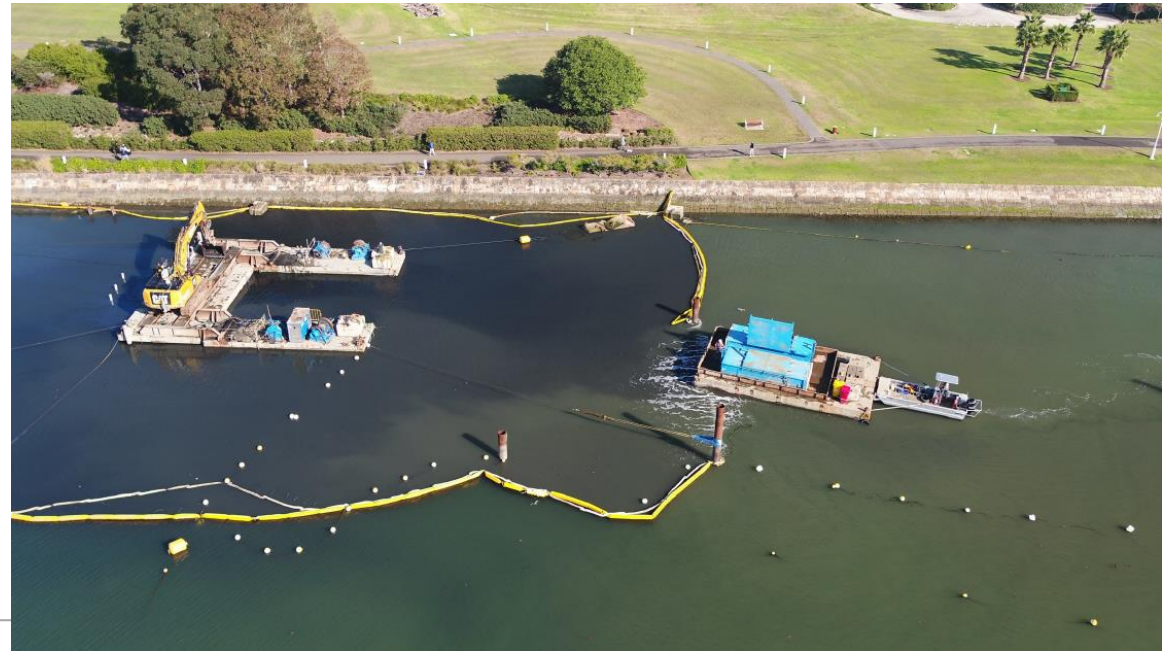
ISS Swell Management





Observed ISS swell ~40%

Swell removed every 3 to 5 days

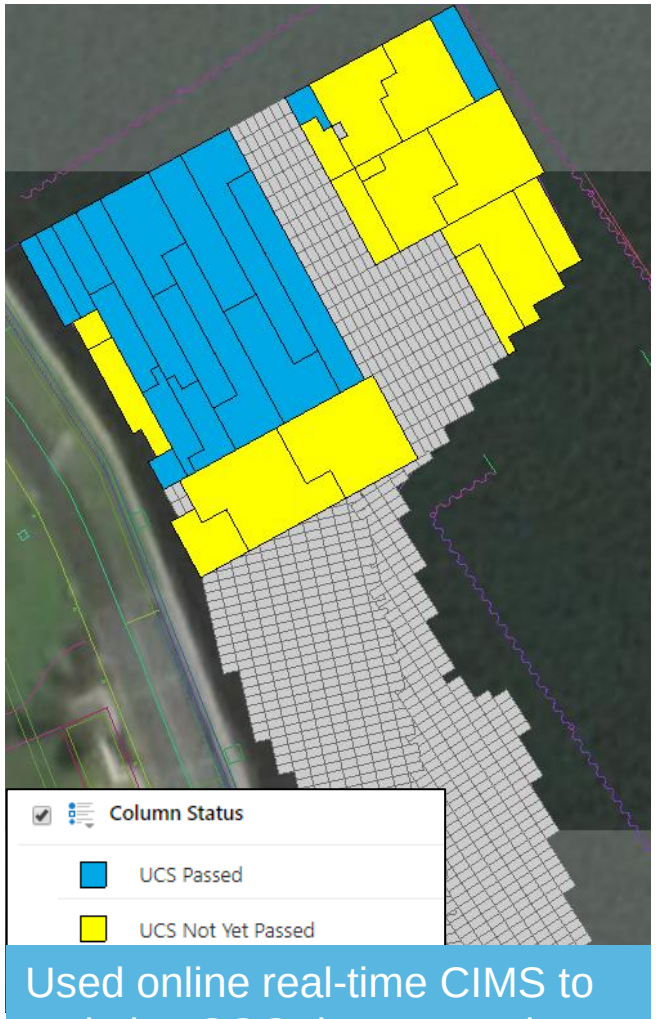


ISS CQC and Tracking



Collected cores (one core per day) of the ISS treated sediment within 24 hours of mixing (100% recovery)

Samples were processed on barge and shipped to laboratory for UCS testing within 2 to 7 days after mixing

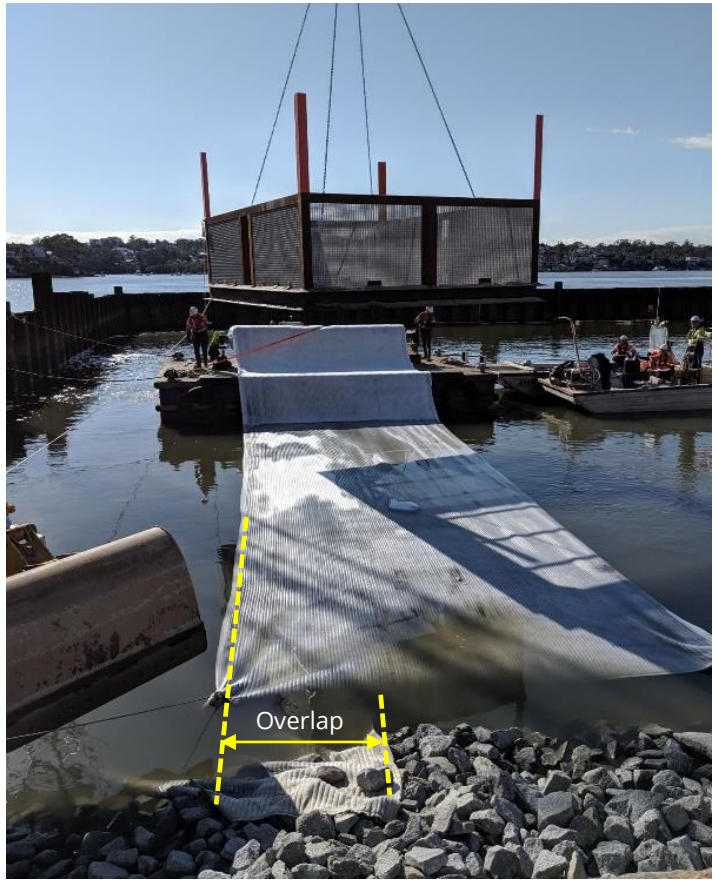


Used online real-time CIMS to optimize CQC documentation and tracking

Cap Placement (Treatment Layer)



Production rate ~1,000 m^2/day



Cap Placement (Armor Layer)

Takeaways



- ISS is a viable remediation tool for subaqueous sediments
- Don’t hesitate to “ask why” on regulator selected remedies. There could be significant cost savings while still being protective of human health and the environment
- Close collaboration between owner – design team – contractor - regulator is key to innovation and pushing boundaries of existing tools and technologies
- Design, treatability/pilot study, and full-scale construction completed in 33 months (includes a separate procurement step prior to full-scale remedy)

AIGA Australasian Land & Groundwater Association Industry Excellence Awards 2021

- Best Large Remediation Project in Australia
- Innovation that has advanced the Practice of Contaminated Site Remediation

2021 AIPM PROJECT MANAGEMENT ACHIEVEMENT AWARDS

- Project of the Year Award
- Sustainable Project of the Year Award

EDISON AWARDS WINNER 2021

Sustainable Change for Good Award

Questions