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# Chevron's Automated METOC and TURBIDITY Surveys Confirm Environmental Compliance at Wheatstone Project, Australia

### CHALLENGE
Monitor solids suspended in the water column (turbidity) during dredging and backfill operations.

### SOLUTION
Deploy unmanned surface vehicles (USVs) to simultaneously measure suspended sediment concentrations and current speed and direction in real time to differentiate and evaluate the amount of suspended sediment near operations.

### RESULTS
Ensured suitable protection of the environment on the basis of reliable, timely statistical results on the condition of the water during dredging and backfill operations.

## Turbidity monitoring for one of Australia's largest resource projects
Discovered by Chevron Australia in 2004, the Wheatstone gas resource offshore Western Australia is joint venture project being developed via an onshore liquefied natural gas (LNG) and domestic gas plant. Chevron is working closely with community and government stakeholders to ensure the project is developed in the safest and most environmentally responsible manner possible, which includes surveying and monitoring marine and land environments during construction to detect change and proactively manage activities to conserve marine habitats.

*Monitoring of the METOC and TURBIDITY USVs was conducted from Houston, Texas, USA.*

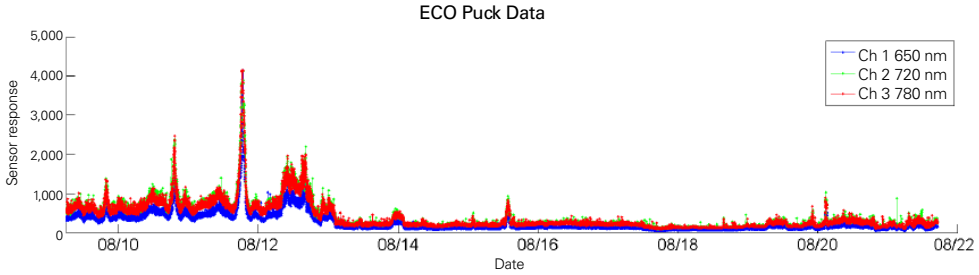
## Suspended sediment measurements
Schlumberger Robotics Services recommended using USVs to deploy instrumentation for collecting critical data about the potential presence of high suspended sediment levels in the water column. Conducting USV surveys for both meteorological and oceanographic (METOC) and TURBIDITY services would provide complementary meteorological, oceanographic, and turbidity datasets. Analysis would therefore be more efficiently and flexibly performed compared with using conventional monitoring stations deployed with moored buoys and shipborne methods.

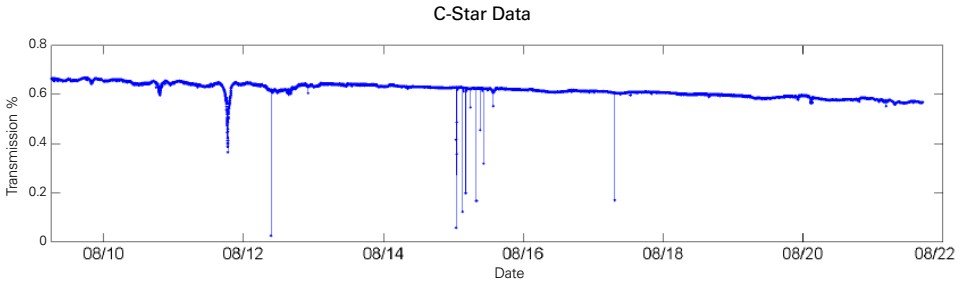
TURBIDITY services USVs are equipped with multiple sensors that measure the alteration of the light climate. The data indirectly provides a relative measure of the level of sedimentation settling on the substrate or biota through the relationship between turbidity and sedimentation rates. Particle concentration and particle size are recorded in predefined classes, with a second measurement of total suspended sediment in the water column made by using a backscatter meter for insight into particle size distribution changes. These data are combined with metocean data recorded by METOC services on a USV for such parameters as air temperature, wind speed and direction, atmospheric pressure, wave height and period, wave direction, water temperature, salinity, and dissolved oxygen.

## Documented environmental protection
Chevron was able to thoroughly document the water condition during the dredging and backfill operations through the extensive data collection using autonomous instrumented USVs. Along with the wealth of data obtained, the USVs also delivered significant cost savings in comparison with conventional monitoring methods.

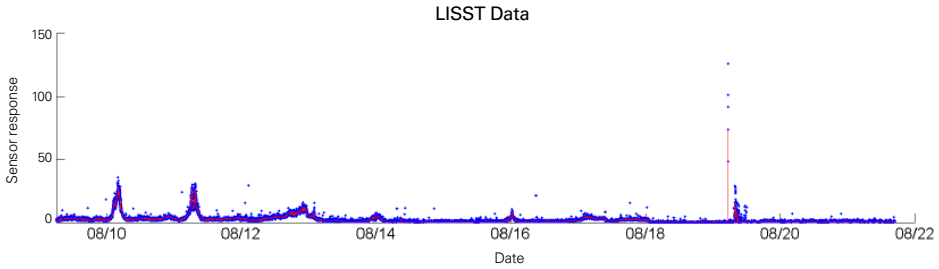
| **USV with C-Star and ECO Puck Optical Sensors** | |
|---|---|
| Number of current measurements | 2,579 |
| Number of weather measurements | 5,470 |
| Number of wave measurements | 692 |
| Number of optical measurements | >40,000 |
| Number of conductivity, temperature, and depth (CTD) measurements | 32,690 |
| Distance traveled | 686 nautical miles |
| Days in water | 56 |
| Average vehicle speed | 0.7 knots |
| Maximum vehicle speed | 2.8 knots |
| Maximum wind speed measured | 26 knots |
| Maximum current speed measured | 1.1 knots |

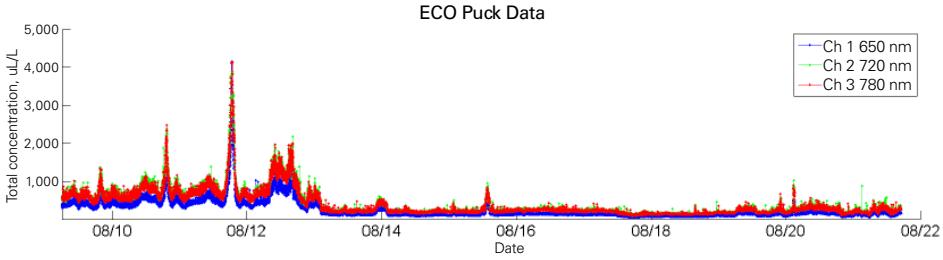
| **USV with LISST Optical Sensors** | |
|---|---|
| Number of current measurements | 1,295 |
| Number of weather measurements | 7,360 |
| Number of wave measurements | 672 |
| Number of optical measurements | 47,000 |
| Number of CTD measurements | 30,952 |
| Distance traveled | 713.6 |
| Days in water | 54 |
| Average vehicle speed, knots | 0.7 |
| Maximum vehicle speed, knots | 2.8 |
| Maximum wind speed measured, knots | 26 |
| Maximum current speed measured, knots | 1.9 |




*The TURBIDITY and METOC services instruments deployed on the USVs show evidence of suspended sediment plumes, rendered as increased backscatter and decreased transmission.*




*Clear events were sampled by both types of optical sensors on the USVs, providing an opportunity for insight through further integrated analysis.*

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