2021 Annual Report

OceanWorks TechWorks

THE UNIVERSITY OF WESTERN AUSTRALIA

Woodside

FUTURELAB

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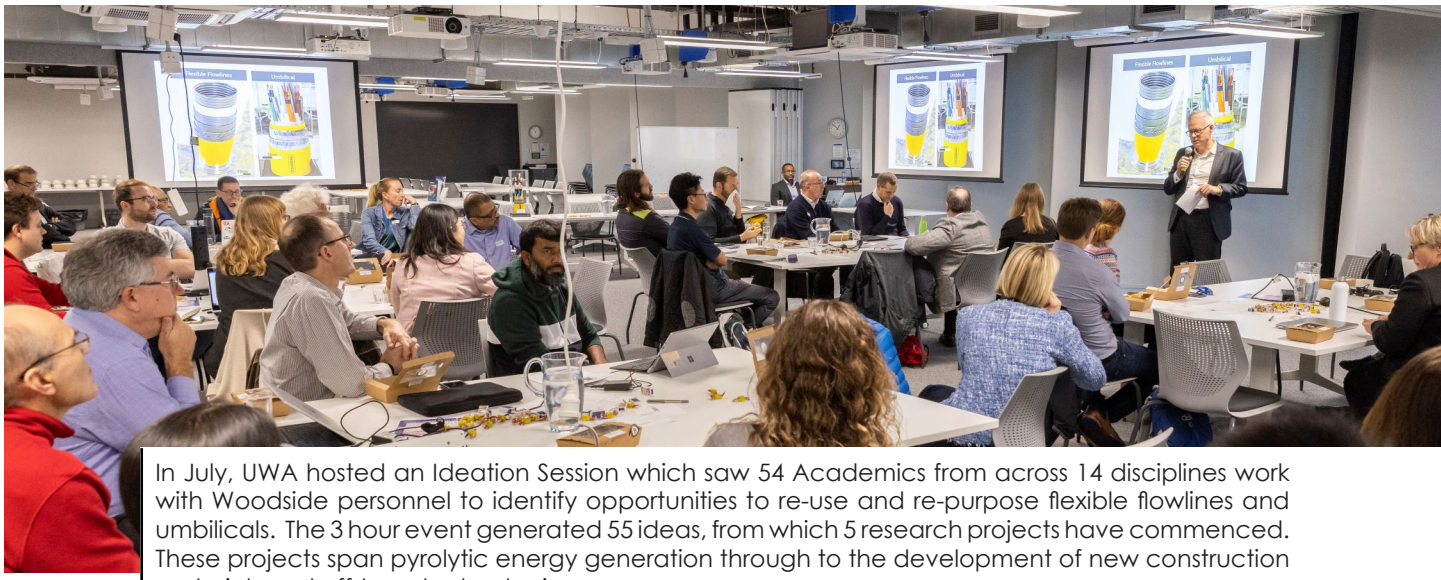
Executive Summary

Woodside FutureLab at UWA engages with a broad range of researchers who work collaboratively on the challenges faced by Woodside, and the broader energy industry, to create innovative outputs which have the potential to deliver high impact. This initiative has created a thriving ecosystem of student-researcher-industry interaction. Activities are grouped under the separate OceanWorks and TechWorks banners. These groups work together - and apart - to drive research outcomes.

OceanWorks, which commenced in 2016, exists to solve current offshore engineering problems. This initiative is supported by the far-reaching capabilities of the Oceans Institute, which brings together researchers in oceanography, ecology, engineering, resource management and governance to address key ocean challenges.

OceanWorks uses various initiatives to deliver its high impact research. These include funding for prototypes, Masters/Honours projects (RiverLab) and internships. OceanWorks hosts a collaboration space in the UWA Indian Ocean Marine Research Building (OceanWorks Lounge) and undertakes various outreach activities to inspire the next generation of offshore engineers.



In July, UWA hosted an Ideation Session which saw 54 Academics from across 14 disciplines work with Woodside personnel to identify opportunities to re-use and re-purpose flexible flowlines and umbilicals. The 3 hour event generated 55 ideas, from which 5 research projects have commenced. These projects span pyrolytic energy generation through to the development of new construction materials and offshore technologies.

The focus of TechWorks, which commenced in 2021, is technology-based solutions which make operations safer and more effective. This initiative is well supported by the School of Engineering which encompasses researchers working in the fields of Mechanical, Electrical, Electronic, Civil, Chemical, Environmental and Software Engineering.

TechWorks has created a purpose-built laboratory in the Civil and Mechanical Engineering building at UWA which may be used to test radical ideas which meet the aims of the program. An adjacent conference facility ensures Woodside remain actively engaged in the collaboration. Prototype funding is offered to drive the projects forward, where promising solutions are rapidly scaled towards implementation.

In November, Woodside funded the purchase of a new, state-of-the-art metal 3D printer. This will allow us to continue our leading-edge research into additive manufacturing, with a view of making 3D printing of critical components part of Woodside's "business as usual".

Woodside FutureLab at UWA is a bold, forward-thinking initiative which aims to add significant value to the energy industry. Perhaps one of the most important aspects of this program is the creation of relationships between Woodside subject matter experts and UWA researchers. It is these contacts which will support Woodside's current operations and help drive their efforts in the transition to New Energy.

OceanWorks

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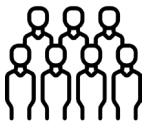
OceanWorks is a collaboration between UWA and Industry to share challenges and boost innovation in ocean engineering. We bring together high-calibre engineers, researchers and students to identify new ideas and nurture promising solutions that will shape the future of ocean industries.

OceanWorks achieves this by providing a physical space for problem-sharing and collaboration, a unique portfolio of programs to enable applied research, and a rich program of outreach and teaching activities to upskill our community.

OceanWorks successes and outcomes are reflected in our KPIs which range across Governance, Strategy, Relationship, Education and Outreach. Despite 3 mini-lockdowns due to COVID-19 during the year, OceanWorks achieved all of our KPIs.

Activity



256 Visitors / Month

17 Events / Month

57% Events Involved Industry

Strategic

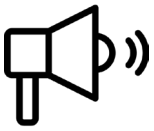
8 Prototypes Initiated

1 Challenge Session

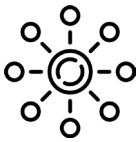
31 Research Ideas Investigated

Relationship

39 Engagement Activities



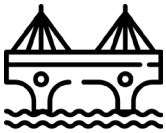
13 Promotion Events



33 Points of Contact

Education

200 Students Engaged



29 RiverLab Students

10 Internships

Outreach

3 Programs / Year

3 Community Stories

TechWorks

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TechWorks is the second FutureLab HUB at UWA and is designed to promote innovation and engagement through research, prototyping and testing activities that will drive improved production, maintenance and operations outcomes.

TechWorks achieves this by providing a dedicated, on-site Laboratory facility, as well as a professional space for Woodside personnel to collaborate and experiment with real-world production technology.

TechWorks successes and outcomes are measured by the development and understanding of the root causes of problems encountered by Woodside's operations and helping to design and implement solutions.

OceanWorks Prototypes

The OceanWorks Prototype Program nurtures ocean innovation by offering early-stage support to promising new ideas. Small Grants are available to researchers to allow projects to think big, prototype small, scale fast and innovate. In 2021, OceanWorks sponsored 8 prototype projects.

VibrioPET – Engineering a Microbial Plastic Degradation Platform

This project seeks to use synthetic biology to degrade PET (polyethylene terephthalate). Phase 1 of the Proof of Concept confirmed the effect of PETase and MHETase to degrade the PET polymer into terephtalic acid (TPA) monomers. Further research will optimize the expression of MHETase. If successful, this prototype will be expanded to engineer a metabolic pathway allowing Vibrio natriegens to feed on the resulting monomers, leading to a complete degradation of PET into organic matter.

"Through a 2021 prototype project our team had the opportunity to follow a blue-sky project with great commercialisation potential, if successful. The OceanWorks platform served as a key catalyst to link us with a valued industry partner, lifting this project to the next level."

Dr Georg Fritz

Senior Lecturer
School of Molecular Sciences

Rebecca Walters, MSc

Assessment of Flying Lead Reliability

A Bayesian statistical model was developed to better predict failure time and location of flying leads, enabling streamlined rectification works. General recommendations were also made on statistical modelling and data acquisition.

Dr Lachlan Astfalck, Department of Maths and Statistics

Plastic Characterisation using THz

This project investigated if the degradation of plastic coated pipework could be measured using Terahertz (THz) pulsed spectroscopy and imaging. THz lies between the infrared and microwave parts of the spectrum and has the unique ability to penetrate non-metallic materials like plastics to determine material properties.

Dr Vince Wallace, Department of Physics

Neutralising the Potential Energy of Belleville Springs in the Valves of Subsea Christmas Trees

This study investigated the behaviour of Belleville springs used in subsea tree valves. The study included (i) a survey of the literature on the modelling of springs; (ii) mathematical and numerical models that predict the behaviour of Belleville springs in terms of force-deflection of springs, critical stresses, and stored energy; and (iii) the use of locking substances to freeze the potential energy in deformed springs. The mathematical and numerical models proved to give excellent agreement and predicted the field data (provided by Woodside) accurately. This allowed the reliable selection of appropriate substances that can freeze the potential energy of deformed springs. High performance concrete and high strength resin proved to perform well as locking substances. However, this study proved that ordinary concrete, self-compacting concrete and low-range resin are insufficient to contain the spring of a 5" valve.

Dr Ali Karrech, Department of Civil, Environmental and Mining Engineering

Network of Floating Wind Turbines

This project investigated if mooring turbines to each other, instead of to the seabed, can increase efficiency and reduce anchoring cost. The project simulated a single turbine and an array of turbines, concluding that there is potential to reduce cost without impacting performance.

Prof Phil Watson, Oceans Graduate School

Improved Current Forecasting

A framework has been developed at UWA (via the Shell Chair in Offshore Engineering) to generate current forecasts based on Bayesian modelling approaches. This project further developed this framework for use at two Woodside buoy locations. Learnings from this work will inform whether the model should be further developed and/or rolled out to other Woodside locations.

Prof Phil Watson, Oceans Graduate School

Cementing for wells plug and abandonment

This project investigated well cementing, especially well plug and abandonment, material requirements for lasting sealing capacity, material quality verification methods, and potential additives and alternatives to the current cement system.

Dr Farhad Aslani, Department of Civil, Environmental and Mining Engineering

Well cementing data analysis

This study investigated if deep learning algorithms could be used for logging data interpretation. Results suggest good alignment with AI approaches to monitor well integrity. The model can be developed and optimized further with additional cement logging data.

Dr Farhad Aslani, Department of Civil, Environmental and Mining Engineering

32 Prototypes

Interaction of structures with the ocean environment	Novel offshore systems & sensors	Ocean monitoring, modelling & forecasting	Sustainable oceans
41%	31%	19%	9%

44	17	26	9	7
UWA Academics	Woodside Staff	Projects Complete	Expanded in TIDE	Spin-off Projects

TechWorks Prototypes

TechWorks is designed to promote innovation and engagement through research, prototying and testing activities that will drive improved production, maintenance and operations outcomes. In 2021, TechWorks sponsored 6 projects.

PixieDust (Phases 1 and 2)

The Pixie Dust program is a project that spans multiple universities and disciplinary teams that seeks to identify a single material solution (Pixie Dust) that is able to be used to produce a wide variety of parts using Additive Manufacturing (also known as 3D printing). In Phase 1, four nickel-based superalloys were assessed against criteria set out by Woodside. The project found that only one alloy had the required mechanical and critical corrosion properties. It was also found that additively manufactured parts were more susceptible to corrosion attack when compared to parts made using traditional techniques of the same material. Phase 2 of the project will now look into the chosen alloy in much finer detail to ensure parts made will withstand any intended environment with confidence as well as tackle the problem of validation.

Woodside contact: Mike Brameld, Chief Materials Engineer

Benarx WUI Top Hat Testing

The Benarx WUI Drain Plug has been designed for streamlined installation of the moisture indicators in pipe cladding. Random vibration testing was completed according to the MIL-STD-810H Method 514.8, Annex E – general minimum integrity test, at increased RMS acceleration. Wind tunnel testing was completed in the UWA Mechanical and Civil Engineering wind tunnel at maximum wind speed of 20 m/s (72 km/h). In each test, devices were mounted both vertically and horizontally. This work not only showed that the new design will significantly reduce installation time, effort, and cost, but also be durable and last on site.

Woodside contact: Rory O'Keeffe, Technology & Innovation Manager

NOVEC Fire Cabinets

Woodside's focus on safety means that costly fire extinguishing systems are used on site. These are room flooding systems, which, when activated, flood the entire room with fire suppressant. The Woodside Technology team identified an innovative solution to leverage room flooding technology in a more controlled manner. Using the same fire suppressant, Woodside is looking into releasing the agent locally inside the equipment, in this case, an electrical cabinet, in the hope that surrounding equipment will be undamaged as well as significantly reducing the cost of the system itself.

Woodside contact: Stephen Standley, Project Manager

CT Scanning of ABS Casing Devices

Understanding the cause of failures that occur with internal components of sealed devices can be difficult. X-ray micro-computed tomography (µCT) is a non-destructive imaging technique that can generate 3D images from inside objects. This approach was used to understand the extent of cracking in epoxy filled ABS housings. Imaging of ABS monitoring devices was conducted using a Versa 520 XRM (Zeiss) microCT system operating at 140kV and 10W. In all cases, cracking was limited to the ABS housing. Careful examination of all slices along the three major orthogonal axes provided no evidence of cracking within the epoxy. Given that cracking was limited to the ABS housing and not into potentially sensitive internal components, there is no risk associated with leaving existing devices currently deployed in the field which will avert downtime and allow time to reengineer new devices without these defects.

Woodside contact: Mike Brameld, Chief Materials Engineer

Pipeshoe Cold Transfer Practical Assessment

Managing LNG on-site is tricky due to the low temperatures required (~-150°C), therefore stainless steel is often used due to its resistance to becoming brittle at these temperatures. Typically, pipelines and supporting structures (pipe shoes) are made up of stainless steel. However, as stainless steel is costly, the underlying support beams are made from mild steel. Currently, there is an insulating pad between the pipe shoe and steel support structure as there is a requirement for the temperature of the mild steel to not drop below 0°C during a blow down event. However, due to the age of the plant, these insulation blocks are starting to degrade and need replacing. This project looked at whether these insulation pads are actually necessary. Ten tests were carried out using a simulated blow down event at different atmospheric conditions. A short section of pipe was filled with liquid nitrogen, which was maintained at greater than 50% capacity. Seventeen temperature sensors and 1 humidity sensor were used to measure the temperature of the pipe, shoe and support structure. The plain steel support took long times to reach 0°C even under unrealistic atmospheric conditions. In more realistic cases, 0°C was never reached. Therefore the support structure for these pipeworks can forgo the use of Permali insulation at a saving of $3 million.

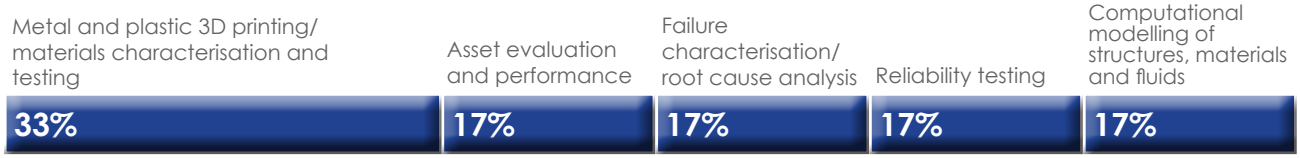
Woodside contact: Rory O'Keeffe, Technology & Innovation Manager

"Working at Techworks has given me the opportunity to see research in which industry is interested and make an actual difference to their day to day operations".

Dr Andrew Youssef

TechWorks Technical Manager

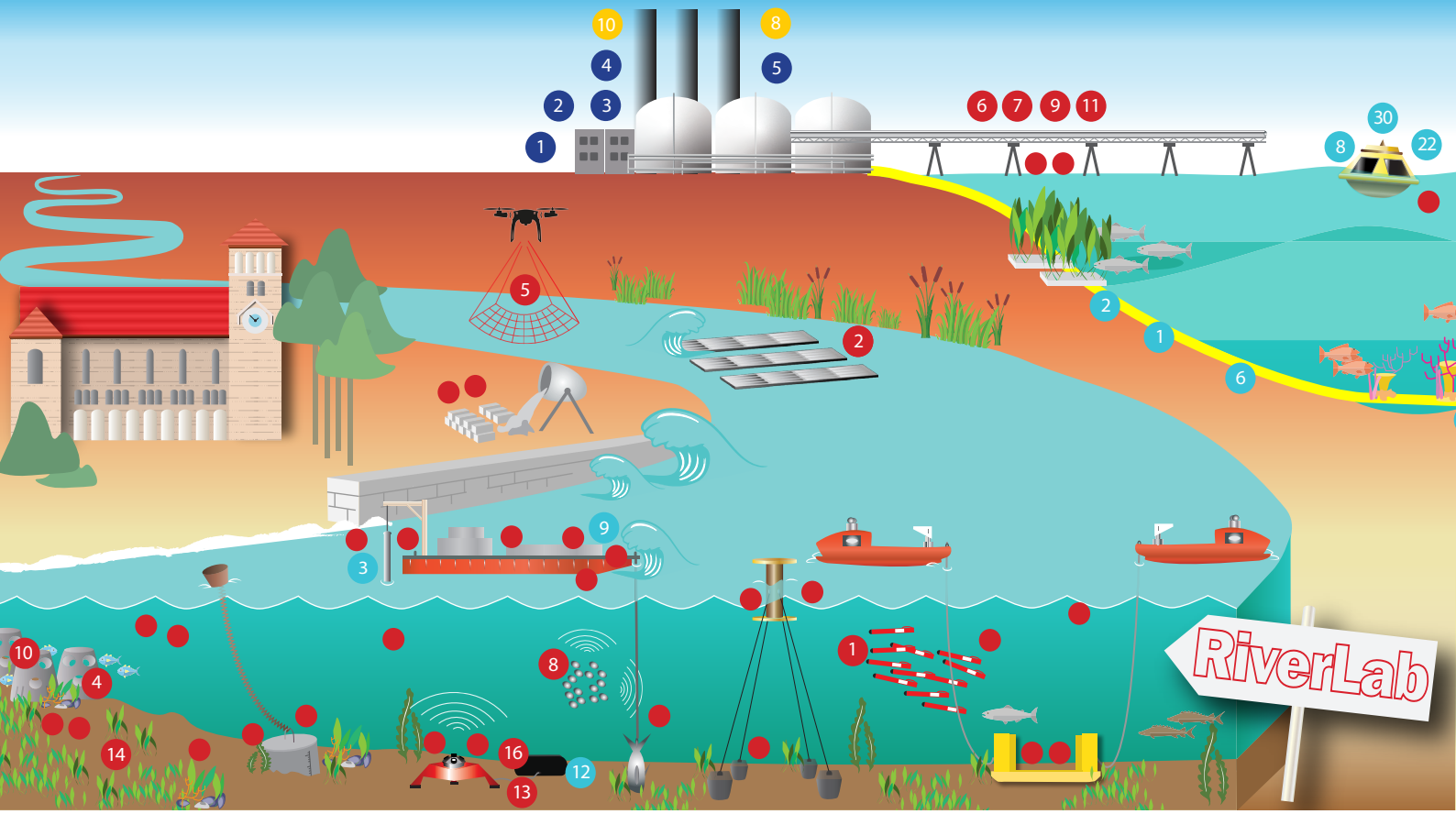
6 Prototypes



6 UWA Academics

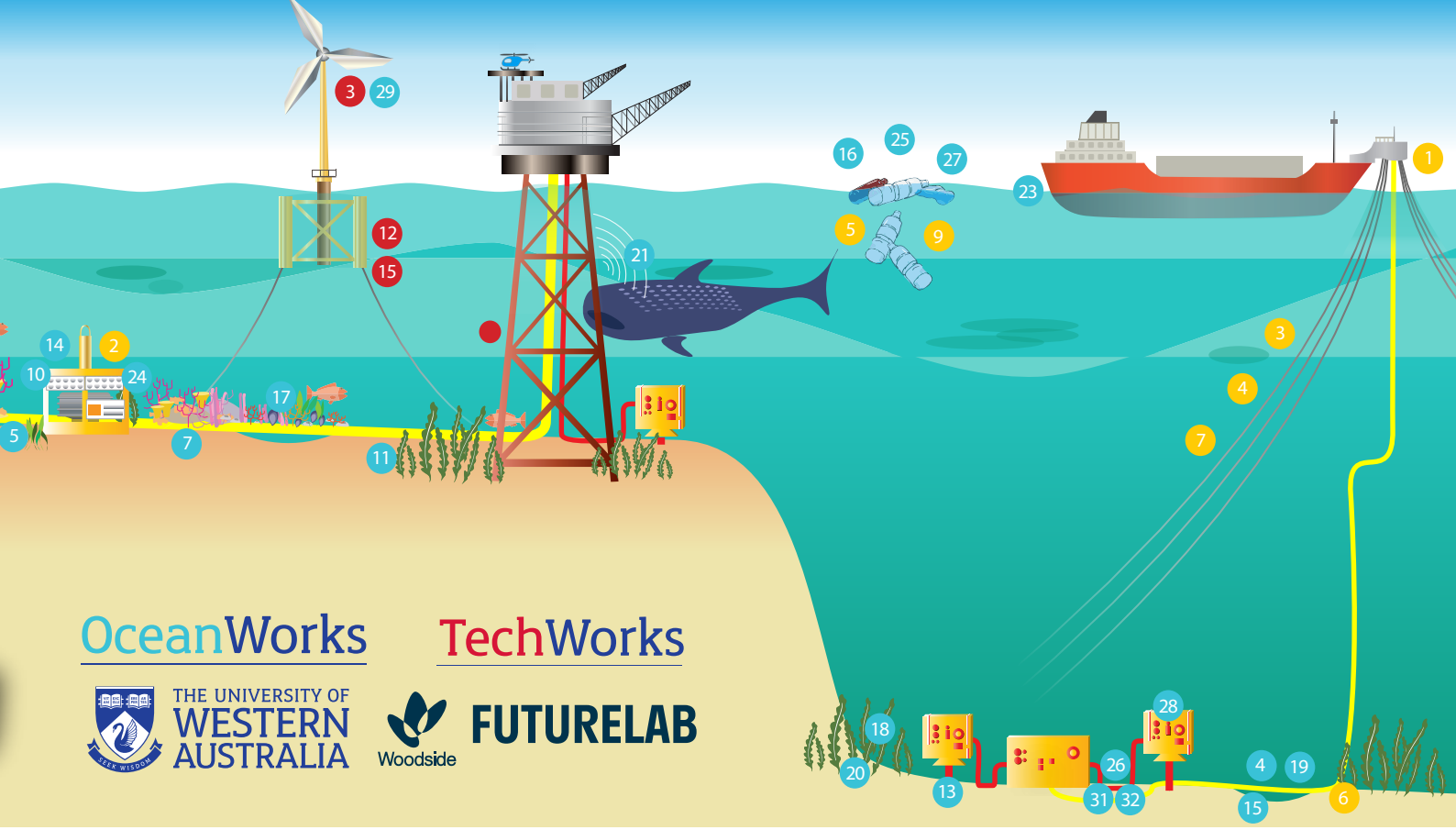
4 Woodside Staff

6 Projects Complete



OceanWorks Prototypes

1. Detecting Corrosion under Insulation
2. Performance Evaluation of Anti-Scour Frond Mats
3. Shallow Penetrometer - Measuring In-Situ Soil to Soil Friction
4. Shear Stress Amplification and Scour Around Subsea Structures
5. Elongation of Pipeline Spans Over Buckle Initiators
6. A Feasibility Study of the Detection of Pipeline Dynamics Response Using Distributed Optic Fibre Strain and Discretely Located Accelerometers
7. Robust, Automated Cameras for Biodiversity Assessments from Industrial ROVs
8. SLAM - Swell Local Adjustment via Monitoring
9. Rapid Greenwater Testing in the Wave Flume
10. Planning the Recovery of an Anti-Marine Growth Structure
11. Towards Improving Pipeline Stability Design For Solitons
12. Low Cost Under Water Data Acquisition System
13. Design Engineering for Seabed Porcupine
14. Rapid Bar Coding and DNA Sequencing Kit
15. Scouring Assessment of Compound Subsea Structures: Field Observation vs. State of the Art Practice
16. Mealworms - Taking a Bite out of Plastic Polution
17. Testing the Potential for Marine Growth to Disrupt VIV on Long Spans on Woodside Pipelines
18. Testing Waters with DNA ZOO Technology to Build Genomic Resources for Critical Marine Habitat-Forming Species of Seagrasses
19. Developing Better Design Guidance about Role of Field Joints in Initiating Pipeline Scour for Trunklines
20. Uncovering Carbon Sink Potential of Australian Kelp Forests
21. Using Acoustic Telemetry to Detect Tagged Marine Megafauna such as Whale Sharks around Oil and Gas Infrastructure
22. Machine Learning Driven Regional Wave Transformation
23. Data-Driven Real-Time Prediction of Ocean Responses
24. Characterising Marine Growth that Disables Subsea Equipment
25. VibrioPET to Degrade Plastics in the Ocean
26. Tidy Data for Effective Data Science - with Application to Flying Lead Reliability
27. THz for Platics Characterisation
28. Neutralisaion of Potential Energy in Christmas Tree Valves
29. Network of Floating Offshore Wind Turbines
30. Improved Current Forecasting
31. Cementing for Wells Plug and Abandonment
32. Well Cementing Data Analysis



RiverLab Projects

1. Using Multiple Autonomous Underwater Vehicles to Monitor the Water Temperature in the Swan River
2. Floating Solar Panel Trials in the Swan River (Phase 1)
3. Floating Wind Turbine Trials in the Swan River (Phase 1)
4. Assessing Novel Solutions for Reducing Coastal Flooding and Erosion
5. Using Drones to Remotely Measure Environmental Parameters at Sea
6. Novel Methods for Repair and Strengthening of Offshore Plate Girders
7. Novel Methods for Repair and Strengthening of Offshore Corroded Plates
8. Development and Testing of Low Cost Drifter Buoys Capable of Real-Time Position Tracking
9. Investigating the Axial Capacity of Plastic Tubular Members for use in Marine Structures
10. Mechanical Properties of Concrete for Artificial Reefs Reinforced with Steel or Recycled Plastic Fibres
11. Investigating the Load Bearing Capacity of Plastic Tubular T Joints for use in Marine Structures
12. Design and Construction of a Novel Energy Storage System
13. Using Smart Sensing to Monitor the Response of a Subsea Cable in the Swan River
14. Understanding the Impact of Seabed Vegetation on Coastal Wave Run-Up
15. Floating Wind Turbine Trials in the Swan River (Phase 2)
16. Predicting the Rate of Nutrient Transfer from Seabed Sediments to the Water Column in Swan River

Past RiverLab Projects

TechWorks Prototypes

1. PixieDust (Phases 1 and 2)
2. Benarx WUI Top Hat Testing
3. Pipeshoe Cold Transfer Practical Assessment
4. NOVEC Fire Cabinets
5. CT Scanning of ABS Casing Devices

Woodside Projects

1. Nganhurra Riser Turret Mooring
2. Anti-Marine Growth Structure
3. Modular Structural Elements using Flowlines
4. Reinforced Concrete using Recycled Plastic Fibres from Offshore Structures
5. Mobile Thermal Processing Unit
6. Torpedo Anchor using Flexible Flowlines
7. Mortarless Construction using Umbilicals
8. Magnetic Hydrogen Sensor
9. VibrioPET to Degrade PET Plastics
10. LNG Pilot Plant Freezout Tests

RiverLab Projects

Using the Swan River as a proving ground, RiverLab allows students and researchers to conduct hands-on research in collaboration with industry to gain immediate insights. In 2021, OceanWorks sponsored 16 RiverLab projects.

Using Multiple Autonomous Underwater Vehicles to Monitor the Water Temperature in the Swan River

This project tested the feasibility of using SwarmDivers (GPS-controlled AUV that can travel in groups) to measure temperature by depth in the Swan River.

Prof Chari Pattiaratchi, Oceans Graduate School

Floating Solar Panel Trials in the Swan River (Phase 1)

Mounting solar panels on a floating structure that is moored in a water body provides an innovative form of renewable energy often referred to as 'floating solar'. This project explored the efficiency of the solar panels when subjected to salt spray & wave overwash. Significant increases in efficiency were observed with overwash, which may have resulted due to cooling of the panels. Future work will utilise and improve the experimental arrangement to continue to study the effects of overtopping and panel position on the generation efficiency of floating solar.

Dr Hugh Wolgamot, Oceans Graduate School

Floating Wind Turbine Trials in the Swan River (Phase 1)

This is a seeding project for the advancement of floating wind research at UWA. It explored development of a numerical model, which simulates the aerodynamics of a small-scale horizontal axis wind turbine to predict its performance under different environmental conditions. It elucidates the effects of unsteadiness arising from turbulent wind fluctuations and from floater motions due to waves. Following onshore testing using a fixed set-up, the next step is to deploy a floating wind turbine in the river and compare its performance with an equivalent fixed wind turbine in the same location (i.e. mounted above the river). This staged approach, allows for decoupling of the unsteady effects arising from the hydrodynamics and from the aerodynamics.

Dr Jana Orszaghova, Oceans Graduate School

Using Drones to Remotely Measure Environmental Parameters at Sea

Satellite remote sensing techniques can be applied to map coastal benthic habitats and bathymetry. This project assisted in the development of a novel Splash Drone that can land on the water surface and was equipped with a bespoke measurement package to obtain in situ training and validation data for remote-sensing algorithm development. Improving the ability to measure a range of environmental variables remotely will have benefits to both industry and the broader community.

Dr Paul Branson, Oceans Graduate School

Novel Methods for Repair and Strengthening of Offshore Plate Girders

This project studied numerically and experimentally the structural load bearing capacity and failure mechanism of typical plate girders in the intact, corroded and FRP composite wrapped conditions. The test specimens included a total of six stiffened welded plate girders focusing on two different types of section, including compact and non-compact. This research indicates potential to repair corroded and/or damaged steel girders found in offshore structures in a low cost and safe way without the need for hot work permit using innovative composite repair.

Dr Mohamed Elchalakani, Department of Civil, Environmental & Mining Engineering

Novel Methods for Repair and Strengthening of Offshore Corroded Plates

Using Fibre Reinforced Polymer (FRP) patches is one of the most efficient methods for repair and strengthening of onshore structures but not being used widely yet for steel structures in the offshore/marine environment. The main focus of this project was the load bearing capacity of corroded plates (representing jetty, walkway or deck plates and steel storage tanks/vessels along the Swan River) repaired with FRP patches. The test results show that corroded plates wrapped with layers of Glass and Carbon FRPs can retain the ultimate strength equal or even greater than the intact steel plates when the corrosion is limited to half thickness of the plate or if it is presented accurately using the corrosion bubbles.

Dr Mehrdad Kimiaei, Oceans Graduate School

Assessing Novel Solutions for Reducing Coastal Flooding and Erosion

This study was unique in that it explored the full potential of Mars Assisted Reef Restoration Systems (MARRS) in terms of erosion control and flood mitigation and bridges a gap between coastal protection and rehabilitation. This experimental study, undertaken at the Coastal and Offshore Engineering Laboratory, has found that at low water depths the hybrid nature-based reef system can attenuate up to 25 percent of the incident wave height. Given the short length of the model (3.7m) this attenuation can be magnified for longer canopies.

Prof Ryan Lowe, Oceans Graduate School

"The RiverLab program has allowed me to work alongside groups like Minderoo and the Mars Foundation and attend Industry-related events which has been an amazing experience. My supervisors and staff at the Coastal & Offshore Engineering Laboratory were very supportive."

Sonia Westera

2021 RiverLab Student

RiverLab Projects - current

Mechanical Properties of Concrete for Artificial Reefs Reinforced with Steel or Recycled Plastic Fibres

Artificial reefs have been increasingly used as a method to aid marine populations in the form of protection or population regeneration. This research project is aimed at developing a suitable sea sand and sea water geopolymer concrete mix reinforced with plastic fibres, that can be used to create artificial reefs around decommissioned subsea assets. This research will investigate how the type of fibre reinforcement and curing conditions will affect the workability, mechanical properties, and durability of the concrete in marine environments. Four separate concrete mix types will be developed for testing in this project incorporating plastic and steel fibres.

Dr Mohamed Elchalakani, Department Civil, Environmental & Mining Engineering

Predicting the Rate of Nutrient Transfer from Seabed Sediments to the Water Column in the Swan River

Mass transfer across the sediment water interface (SWI) can exert a controlling influence on the water quality of aquatic ecosystems (such as the Swan River Estuary) as sediment interstitial fluid can contain high levels of dissolved nutrients, contaminants and oxygen demand. The purpose of this research project is to determine the influence of the sediment composition on mass flux from Swan River sediments. This research project will utilise a novel methodology to characterise the near-bed flow, quantify rates of hyporheic exchange, and understand the sensitivity of both to ambient flow and sediment characteristics.

Dr Marco Ghisalberti, Oceans Graduate School

Understanding the Seabed Impact of Vegetation on Coastal Wave Run-Up

Benthic ecosystems (such as seagrass meadows) are a nature-based solution for coastal protection that both reduces coastal flooding and provides ecosystem services. This project will use a physical model in the wave flume of the Coastal and Offshore Engineering Laboratory to quantify the impact of seagrass meadows on wave run-up, a key measure of the magnitude of coastal flooding. Key results will include an understanding of threshold seagrass scales and densities required to substantially impact wave run-up in coastal systems.

Dr Marco Ghisalberti, Oceans Graduate School

Design and Construction of a Novel Energy Storage System

Renewable energies are harnessed from various sources including wind, sunlight, waves, tides and geothermal heat, which lack the certainty of supply and continuity. Energy storage systems such as Vanadium flow batteries (VFB) may become invaluable to complement reneweble energy generation. VFB are suitable for large-scale applications such as farming, electricity grids, and residential/commercial buildings. However, these batteries only work in a window of temperature ranging from 5 to 40 degrees. The purpose of this project is to explore the potential of rivers in cooling VFB and ensuring their effectiveness throughout the year.

Assoc Prof Ali Karrech, Department of Civil, Environmental & Mining Engineering

Using Smart Sensing to Monitor the Response of a Subsea Cable in the Swan River

This project is investigating if vortex induced vibration (VIV) of cables and pipelines is likely in turbulent flows typical of near-seabed conditions. Conventional knowledge about VIV and existing design guidance is based primarily on laboratory studies where turbulence levels can be much lower. The project will conduct testing in the Large O-tube in the Coastal and Offshore Engineering Laboratory, to investigate VIV in flows with different levels of artificially generated free-stream turbulence.

Assoc Prof Scott Draper, Oceans Graduate School

Floating Wind Turbine Trials in the Swan River (Phase 2)

Phase 2 of our floating wind project involves 3 students designing, building and deploying a small-scale floating wind turbine in the Swan River. One student is working on hydrodynamics of the floater, one on aerodynamics of the turbine and one on electrical aspects of the turbine. This project builds on Phase 1, which acquired and characterised the turbine. This project will investigate how suitable the River is for small-scale deployments and start to train an offshore wind workforce, which Australia sorely lacks. It also complements research in the group on floating wind.

Dr Hugh Wolgamot, Oceans Graduate School

Investigating the Axial Capacity of Plastic Tubular Members for use in Marine Structures

With such magnificent properties, FRP structures are ideal for marine offshore structures, however, there is no practical FRP design guidelines/standards available to design FRP load-bearing structures. The focus of this project is to investigate the Euler buckling behaviour and ultimate axial capacity of FRP circular tubular columns under compression.

Dr Mohamed Elchalakani, Department Civil, Environmental & Mining Engineering

Investigating the Load Bearing Capacity of Plastic Tubular T Joints for use in Marine Structures

Tubular joints are one of the most important components in structural integrity of marine structures. The main focus of this project is to investigate the load-bearing capacity of FRP tubular T joints under compression. The results of this project can be used for engineering and fabrication of safe, cheap and long lasting jetties and walkways with minimum annual maintenance costs along the Swan river or coast lines of WA. In total, 12 specimens will be fabricated utilizing different brace diameters and thicknesses.

Dr Mehrdad Kimiaei, Oceans Graduate School

Development and Testing of Low Cost Drifter Buoys Capable of Real-Time Position Tracking

This project aims to provide a solution to high frequency measurement of local currents in ocean environments, by adopting LoRa ('Long Range') IOT technology as a means of transmitting real time, fine scale updates of GPS position. To achieve this, current drifter concepts are being adapted to accommodate drogues – needed to measure current at the target depth – and fitted with ESP32 microcontrollers to support a range of sensors (including GPS and IMU). By deploying multiple drifters at one time, and using an innovative mesh network, the area being studied is expanded – by allowing individual units to 'talk' to each other, transferring positional data between each other to a master unit. Trials are being conducted in the Swan River, with further testing by the student team in early 2022 at an offshore location.

Prof Phil Watson, Oceans Graduate School

"The RiverLab program has been a fantastic experience. With the monetary support of the program, we were able to explore new technologies that would have previously not been possible. The project itself has been extremely insightful of the entire research process. From conceptualisation and design, to the real world testing and application. Due to the support of this program this project has remained on schedule and been very enjoyable."

Roarke Holland

2021/22 RiverLab Student

65 Projects

Interaction of structures with the ocean environment	Novel offshore systems & sensors	Ocean monitoring, modelling & forecasting	Sustainable oceans
32%	31%	22%	15%

38	11	116	56	8
UWA Academics	Woodside Staff	Masters Students	Projects Complete	Spin-off Projects

2021/22 Summer Internships

The OceanWorks Internship program brings high achieving students to UWA to work on a 10-week OceanWorks research project. In addition, we provide a program of activities for all intern students across the Oceans Graduate School who are funded from a variety of industry partners. In 2021, OceanWorks sponsored 8 Internships.

Development of Long Range Ocean Drifters

This project consisted of the design and testing of an ad hoc mesh network combined with pre-existing ocean drifters technology. A mesh network allows for a drifter's transmission range to be greatly increased as servant units can act as a relay and forward positional data to a master device. It also provides many new use cases for drifters, such as search and rescue operations or tracking food intake cycles of reef systems.

Roarke Holland

Seasonal Sediment Transport Movement along the Geraldton Coastline

This project analysed the shoreline movement along Geraldton's coast to gain a deeper understanding of the geomorphic dynamics along the coastline. Results from the project have identified several beaches that have been flagged as coastal erosion hotspots.

Bianca Veth

Marine Renewable Energy, Albany

This internship was carried out at UWA's Marine Energy Research Australia's headquarters in Albany. Multi-year wind data from different locations around King George Sound, Albany were analysed to uncover the statistics and seasonal variation of wind speed and direction in the sound. The analysis provided valuable information for the design and planned deployment of the M4 wave energy demonstrator as part of the Blue Economy CRC project.

Dave Dong

Physical Modelling in Coastal and Offshore Engineering

This internship provided technical assistance for the design and testing of 3 separate Industry projects in the Coastal & Offshore Engineering Laboratory at Shenton Park. These included testing the stability of a rock berm over a pipeline and cable; the output from a wave energy converter device under varying sea conditions; and the most efficient configuration of an artificial reef structure under varying sea conditions.

Dan O'Donnell

Wave Modelling in Cockburn Sound

This project developed a neste phase-average wave model to understand if metocean data (eg wave, wind, tide) could still be used to calibrate a reasonable wave model. This is the first step in developing a wave model specific for each region of the Perth coast.

Chao Tang

Predicting Riser Fatigue using Surface-Level Vessel Motion

This project concerns the fatigue modelling of the Water Intake Riser (WIR) for a Floating Liquified Natural Gas (FLNG) facility located in Western Australia. Accurate estimation of fatigue damage to the WIR bundle is critical to reliable production. The goal of this project is to investigate whether the fatigue life of the WIR bundle can be accurately estimated using only surface-level motion data collected aboard the FLNG vessel. Traditonally, fatigue life is estimated from a time series of the WIR bundle's motions using sensors. But these sensors are costly and require regular replacement.

Rongnan (Andrew) Yang

Nature Based Coastal Defence

This project focused on quantifying how coral reef restoration approaches can attenuate wave energy and reduce coastal flooding and erosion. Using scaled models of 3D printed corals subjected to a range of wave conditions, the forces of corals and wave attenuation were measured at model scale in the Coastal and Offshore Engineering wave flume.

Tim Green

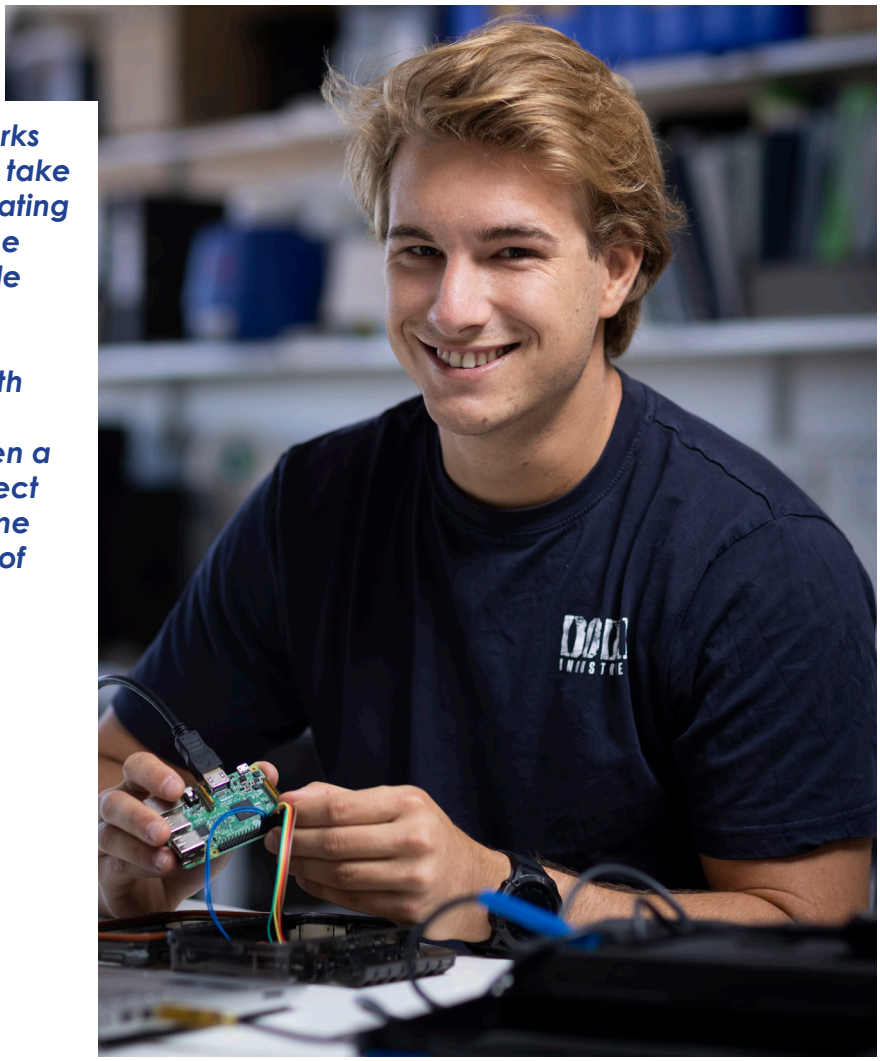
Boat Wake Effects in the Lower Swan River

This project was undertaken in collaboration with the Department of Transport and the Department of Biodiversity, Conservation & Attractions and aimed to measure the size of boat generated waves in the lower Swan River to inform the potential effects on surrounding fauna and infrastructure. Ultimately the project will help to define appropriate boat speed limits in different parts of the river.

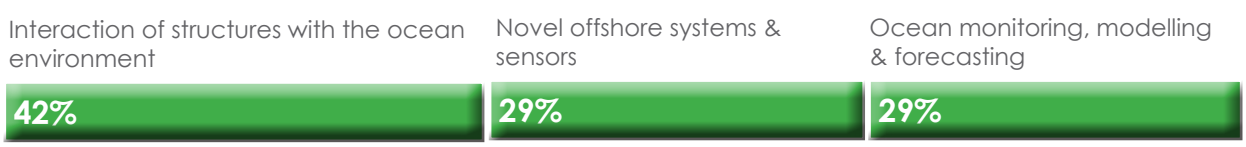
Tom Couve

"My internship at OceanWorks gave me the opportunity to take the lead on a project evaluating boat generated waves in the Swan River. I was responsible for deploying instruments in the river and analysing the data while collaborating with the industry stakeholders involved. Overall, it has been a fantastic well-rounded project experience which helped me discover a different aspect of hydrodynamics."

Tom Couve
2021/22 Intern



28 Internships



Outreach

OceanWorks recognises that diversity and communication are vital ingredients for innovative engineering. A number of targeted programs have been created to address the need for greater gender diversity in engineering. These activities target students in primary and secondary school, as well as university students and professional engineers.

In 2021, OceanWorks sponsored 3 programs:

1. Future Engineers Program
2. Emerging Engineers Competition
3. Women of IOMRC Network

Future Engineers Program

This is a week-long school holiday STEM program for High School girls in Years 8 - 12 designed to educate young girls about where our energy comes from and explore the opportunities to pursue a STEM career in the subsea and ocean based industries. OceanWorks and UWA Girls in Engineering were pleased to host the final day of activities at UWA, as well as the final presentation event in the Indian Ocean Marine Research Centre with industry sponsors Subsea Energy Australia, WISE Professional Network, BHP and Engineers Australia.

"This course has shown me that within engineering there are so many different fields and has given me the opportunity to speak to women in engineering with a wide range of careers. It has helped me in choosing what type of engineer I would like to become".

Riya Singh

Student, All Saints' College

Emerging Engineers

The Emerging Engineers Competition is an outreach program supported by OceanWorks and UWA Girls in Engineering aiming to engage young women in the future challenges facing ocean engineers. With an emphasis on problem-solving, project-based work, and communication skills, the Emerging Engineers Competition offers primary and secondary students a chance to work on a real problem from ocean industries.

This year's competition invited the students to design solutions that would mitigate microplastics in our urban waterways. Due to the connectivity between urban waterways and our oceans, the accumulation of microplastics in our rivers and streams directly impacts the level of polution in the ocean.

In 2021, 15 teams participated in the competition, with 7 teams making it through to the finals.

The winning Santa Maria team (l-r): Sienna Pitt, Isabela Fernandes, Chelsea Smith, Ava Scafetta and Lilianna Renton

"The UWA Emerging Engineers Competition provided an ideal platform to expose our STEngineers to a community issue, to think innovatively, to evaluate and redesign and to develop a prototype to solve a significant problem. We are very proud of our students".

Jennifer Oaten

Principal, Santa Maria College

"FutureLab is Woodside's innovation flagship. It's all about fostering new ways of working with our external innovation partners, whether in research collaborations or using the power of the crowd to identify and accelerate novel solutions.

Our relationship with UWA is one of the foundations of FutureLab. It's a partnership that has successfully delivered a wide range of research activities supporting technical challenges across the business. Oceanworks has been a standout in offering both an agile and adaptive prototyping programme and a much-used collaboration space. So it was particularly exciting in 2021 to witness the start of the next phase of this partnership with the launch of Techworks."

Dr Shaun Sadler
FutureLab Manager, Woodside

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