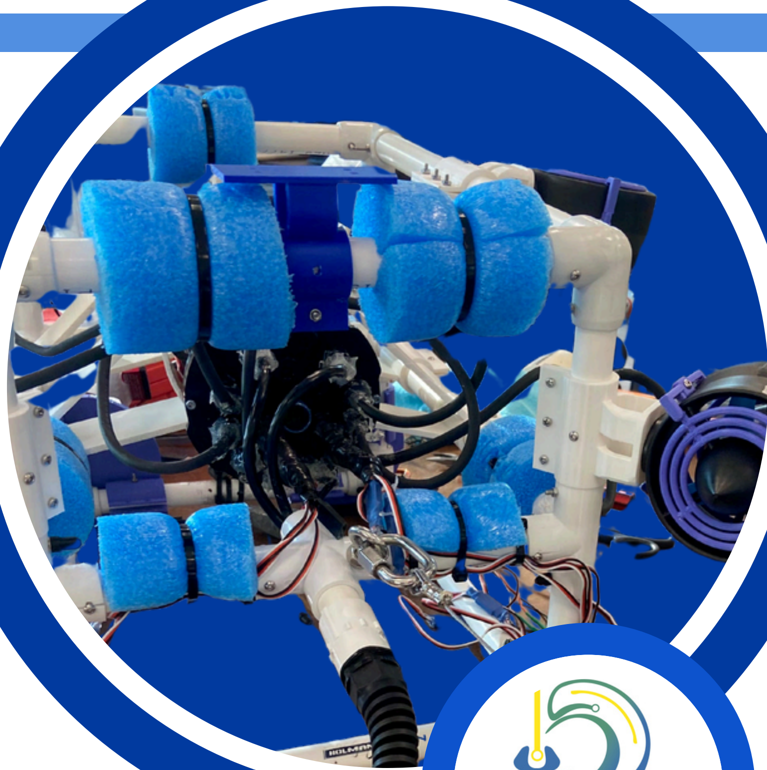
Technical Documentation

RIPTIDE



Team Members

Team Manager: Grace Lu

Head of Engineering: Kanisha Raju

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Sensor Engineer:Claire Jiang

Software Engineer: Joyce Lin

Structural Engineer: Evie Fitzgerald

Float Manager: Cissy Huang

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1. Abstract

Riptide is a first year underwater robotics company based in Melbourne, Australia. The Company is proud to be composed of 11 passionate female engineers who are driven to defy gender stereotypes in the STEM field and develop sustainable technology that addresses competition challenges which corresponds to complex real world issues.

Bluie is Riptide's most recently developed product, custom built to meet the challenges outlined in the 2025 Marine Advanced Technology Education (MATE) Request for Proposal (RFP). It is a technologically advanced underwater robot that utilises recyclable materials to maintain sustainability. As an Australian team that must travel long distances to reach the competition, Bluie is designed to be durable, compact, and easy to assemble.

This technical document details areas such as the prototyping and design development of Bluie, as well as its capabilities. Bluie features two 3D printed recyclable manipulator arms with interchangeable attachments specific to each task, modular frame design for easy assembly and swapping, as well as microcontrollers for sensor integration and to control logic.

In addition, safety has remained a top priority of Riptide, with comprehensive protocols in place to protect team members during assembly and testing, as well as design features that ensure both environmental safety and reliable operation under unpredictable underwater conditions.

Figure 1. Riptide Team Photo
***Angel Li Absent**

2. Project Management

2.1 Company Overview

Riptide is a company based in Melbourne, Australia, which engineers submersible vehicles specialised in addressing real world marine challenges impacted by climate change. The company's products assist in tasks like maintaining renewable energy structures and implementing use of advanced technologies such as vertical profiling floats to monitor marine ecosystems. The company is comprised of 11 female engineers specialising in CAD, 3D printing, manufacturing, and programming; each member is organised into six departments: enterprise, float, structural, electrical, sensor and software engineering.

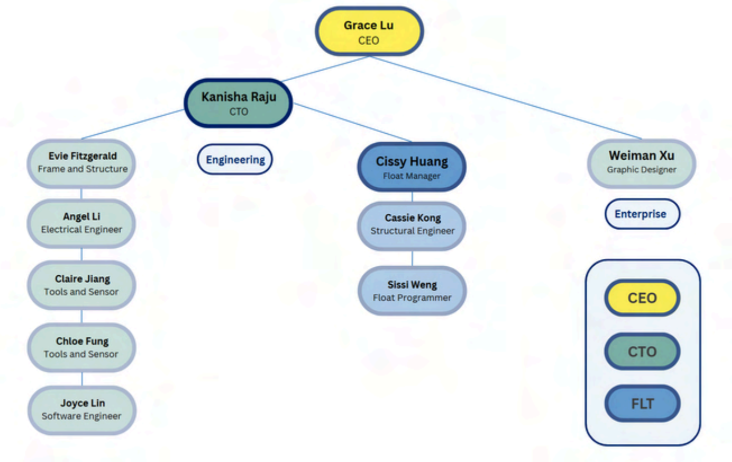

Figure 2. Riptide Company Role Chart

Riptide utilises a clear leadership hierarchy spanning the enterprise, ROV engineering, and float engineering departments.

The Chief Executive Officer (CEO) oversees the overall coordination and success of the team, as well as the enterprise components such as graphic design, branding, marketing, sponsorships, and documentation.

The Chief Technical Officer (CTO) is responsible for leading the engineering division, managing the development of the ROV and float's mechanical, electrical, and software systems. The Float Leadership Team (FLT), which manages the design, programming, and performance of the float system, operates under the CTO's guidance to ensure seamless integration and alignment with the broader engineering goals.

The leadership team coordinates progress across departments, facilitates communication, and oversees testing to ensure all systems are aligned and functioning effectively.

Every Riptide employee goes through an extensive internal training process, equipping them with adequate skills for the competition. All members of the leadership team, each with prior experience in areas such as CAD, 3D printing, and electronics, mentor team members newer to the field to build technical capability across the group. Hands-on training sessions are conducted regularly, such as building small electronics kits to practice soldering skills which involve a range of electrical components, alongside opportunities to attend external workshops in professional settings, for example, a Fusion 360 workshop held at Quantum Victoria and events like the F1 Grand Prix to further enhance skills and industry exposure.

Figure 3. Employees working on electrical kits

Throughout the development of our ROV, our team gained valuable experience in project management, including setting timelines, using Gantt charts, and assigning tasks based on each member's strengths. We also improved our collaboration and communication skills by working together to troubleshoot design and technical issues. However, as a new team, one of our biggest challenges was learning as we went. None of us had prior experience with building an ROV, so every step from designing the frame to wiring electronics was a new skill to learn. We also faced delays due to shipping times from the USA, which made it difficult to stay on schedule. But ultimately, these challenges taught us to be adaptable, to communicate clearly under pressure, and to problem solve creatively with the resources we had. Despite the setbacks, the experience helped us grow quickly as engineers and as a team.

2.2 Project Planning and Time Management

Riptide adopted a proactive and collaborative approach to project management, balancing structure with adaptability to ensure the successful development of our ROV. A formal kick off meeting, led by the CEO on 28 February, outlined our primary objectives, delegated roles, and assessed team members' availability for additional weekly workshops. This meeting also enabled the team to better understand the scope and tasks outlined in the Request for Proposal (RFP).

The project officially commenced in March 2025, with the team meeting for four hours per week during the Applied Design, Technology, and Engineering elective, in addition to weekly workshops: Wednesdays for the float team and Thursdays for ROV building. To support both long term planning and short term execution, Riptide's leadership team held weekly strategy meetings with our project management mentor, Andrew Murray, to review progress, set priorities, and resolve challenges. These sessions ensured the team remained focused and prepared for the week ahead.

Using Canva, department heads created comprehensive project schedules at the beginning of the season. The Gantt chart (Figure 4) includes department specific timelines, task objectives and overarching project deadlines. This chart served as our Project Management Tool (PMT) and was used to assign tasks, set timelines, allocate resources, monitor progress, identify roadblocks, and revise plans as needed. Buffer time was built into each stage of development to accommodate delays without compromising deadlines.
Our main channels of communication were Microsoft Teams and Outlook, which supported seamless collaboration through chat, file sharing, and updates. The Riptide Teams channel also incorporates all schedules such as the PMT and individual channels for each sub department to keep track of any documentation as well as useful resources relative to the competition. This digital communication framework ensured team wide coordination and maintained transparency across all departments.

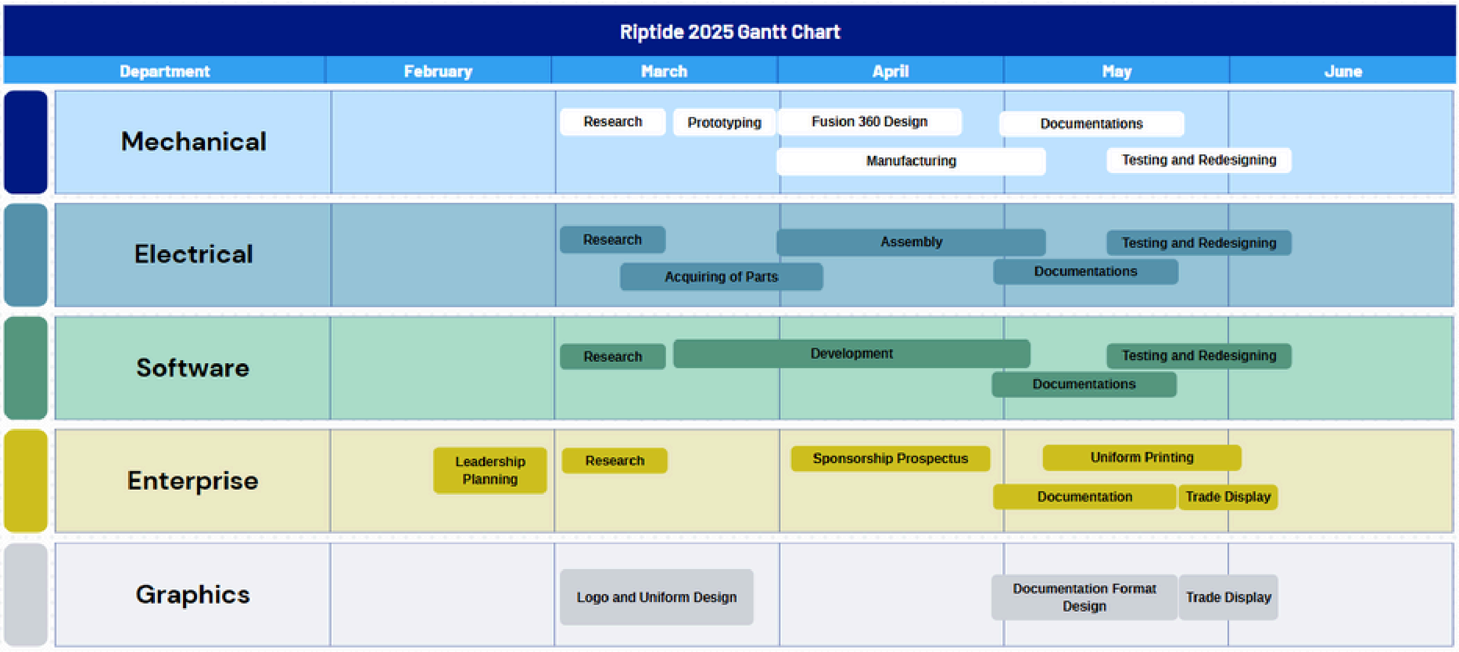

Figure 4. Riptide Gantt Chart

3. Design Rationale

3.1 Design Overview

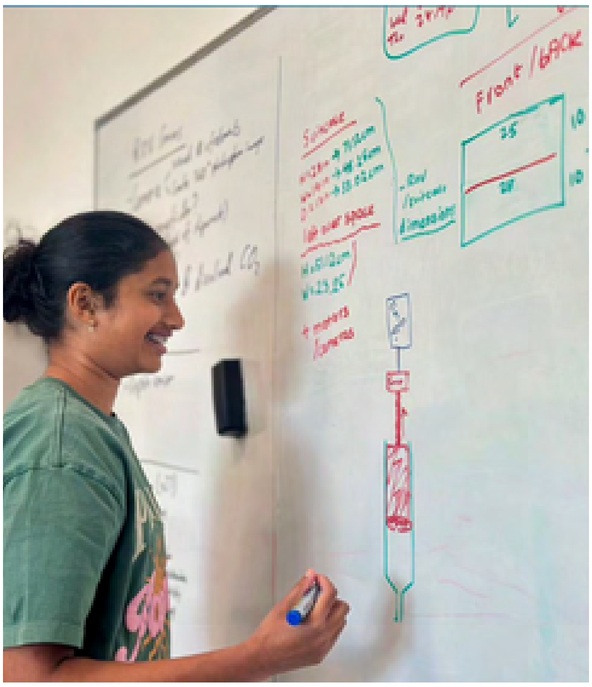

Figure 5. Team Members Researching

The key goals of our ROV design were to create a lightweight, easily portable vehicle that could successfully complete all tasks outlined in the 2025 MATE RFP . We also aimed to ensure easy access to the electronic trays and to design a functional arm capable of handling the required operations.

In the first few weeks of the design process, our team focused heavily on research, learning about ROV systems, analysing this year's mission tasks, and identifying the essential components for our build. We prioritised finding parts that were not only reliable but also cost effective. During this time, we were able to test components as they arrived and evaluate what had worked for previous teams, which helped guide our design decisions moving forward.

3.2 Build Vs Buy New Vs Used

As a first year team, Riptide did not have access to legacy equipment or components from previous builds, which meant we had to start entirely from scratch. This limitation eliminated the option of reusing or repurposing past systems, requiring us to carefully evaluate every component decision.

When faced with the choice between building a part or purchasing a premade solution, the decision was typically guided by two key factors: the complexity of the design and the reliability of the final product. If a component could be easily and effectively designed by our team, without compromising performance or durability, we opted to build it ourselves. This approach allowed for greater customisation and often reduced costs.

However, for components requiring a high degree of precision, waterproof integrity, or proven reliability, purchasing from trusted vendors was the preferred route. This balance between building and buying enabled us to optimise both functionality and efficiency while staying within our budget and time constraints.

3.3 Design Evolution

As a first year team, Riptide's design evolved rapidly over the course of just a few months, driven largely by the problems we encountered and the discoveries we made during the development process. With no prior build to reference, much of our progress relied on learning through experimentation and adapting our designs in response to real time challenges.
Each time an issue arose, whether related to mechanical performance, electrical layout, or buoyancy control, it prompted a focused evaluation of the problem. From there, our team would brainstorm possible solutions, considering factors such as reliability, cost, ease of implementation, and alignment with our overall project goals. Decisions were made collectively, balancing innovation with practicality to ensure we stayed on track with both our timeline and mission requirements.

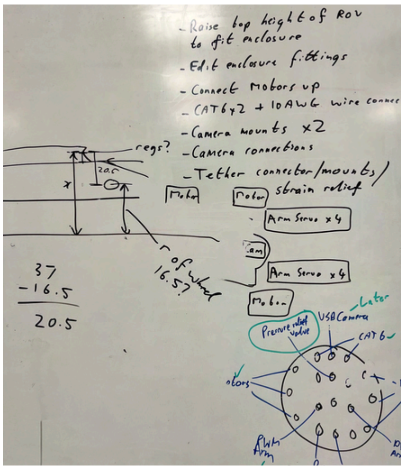

Figure 6. Riptide Design Todo List

This iterative approach not only allowed us to continuously improve the ROV's design but also helped us develop critical problem solving and collaboration skills as a team. By embracing flexibility and prioritising efficiency, we were able to turn setbacks into valuable learning experiences and refine our system into a functioning, mission-capable vehicle.

3.4 Problem Solving

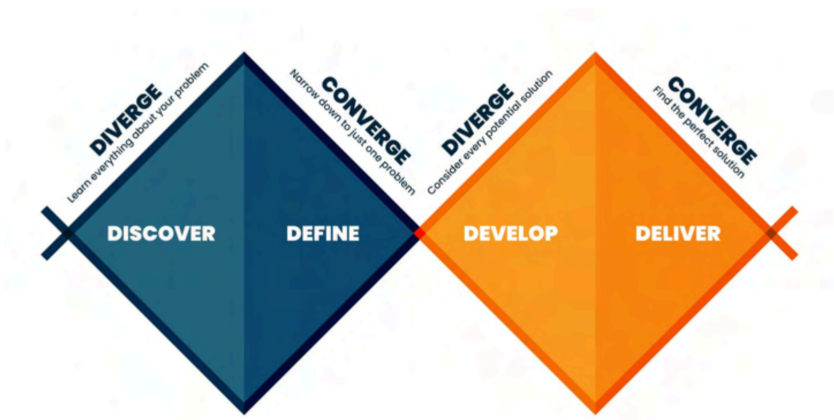

Figure 7. Double Diamond

Team Riptide employed the Double Diamond design process for the development of each component (Figure. 7). This approach began with identifying and refining the problem, followed by a divergent phase where multiple potential solutions were generated, researched, and evaluated. After thorough comparison, the most viable solution was selected for development.

Weekly team meetings were dedicated to ideation and collaborative design discussions. Initial concepts were explored through hand drawn sketches, which then progressed to physical mockups or digital modelling using CAD software. Once finalised in CAD, components were fabricated using 3D printing and subjected to functional testing. Based on performance and test results, iterative refinements were made to improve effectiveness and reliability. This cycle was repeated as necessary until the final design met all operational and performance criteria.

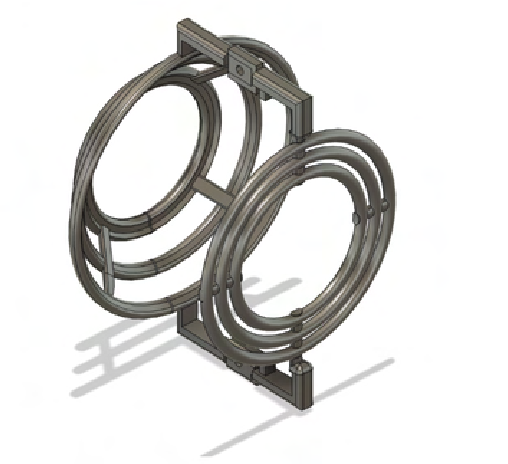

Figure 8. Motor Shield 1.0

Figure 9. Motor Shield 2.0

3.5 Innovation

The design process of our robot arms started with a ready-made CAD design.
Each of our ROV's arms features four servo-driven joints, providing multiple degrees of freedom. This design offers significantly greater flexibility and adaptability compared to the simpler gripper claws used by many other teams. Given that several mission tasks in this year's competition require precise and complex object manipulation like the anode task, this added range of motion greatly enhances the overall functionality of our system.
The development approach for the arms was both time and cost efficient. We began with a commercially available CAD design for a desktop robotic arm, which served as a strong foundation. From there, we adapted and modified the design to integrate it into the front of our ROV and to meet the specific movement and control requirements of the competition. This method allowed us to avoid the time consuming process of designing a complex manipulator from scratch, while also being more affordable than purchasing commercially available underwater robotic arms.

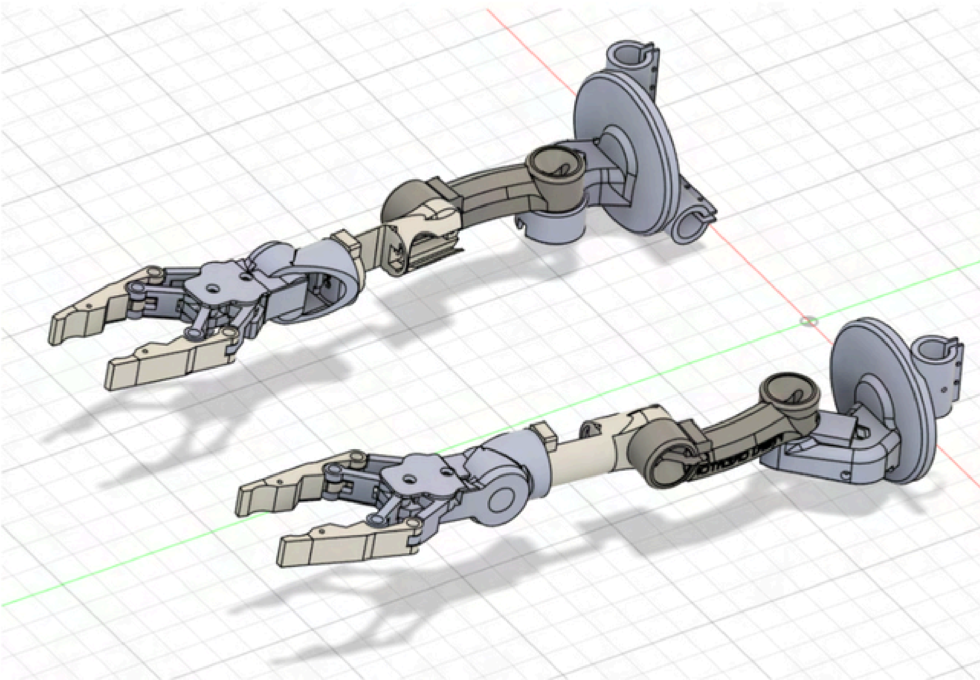

Figure 10. Robotic Arms

4. Vehicle Structure and System

4.1 Vehicle Structure

Riptide’s design philosophy focused on creating a lightweight, medium sized ROV that was environmentally conscious, structurally integral , and cost effective. The final ROV, Bluie, features a rectangular frame with dimensions of 20 x 25 x 40 cm.

The frame was constructed using recycled PVC pipes and 3D printed connectors designed using Fusion 360. Initially, basic PLA filaments were chosen because they are accessible and biodegradable. However, early testing revealed that PLA was prone to cracking when used to secure the PVC pipes. To solve this issue, the team transitioned to TPU, a more flexible and rubbery material that provided greater durability and resistance to stress under pressure.

Horizontal rails were added along the sides, front and rear of the frame, enabling various components to be secured along the central axis. This rail system also allowed the electronics housing to be mounted as close as possible to the ROV’s center, helping to align the center of buoyancy with the center of mass. This design choice significantly improved the ROV’s underwater stability, ensuring smooth and responsive movement during missions.

The use of recycled materials, precise CAD modeling, and thoughtful structural engineering resulted in a robust, stable, and environmentally conscious frame well suited for the competition and real world underwater tasks.

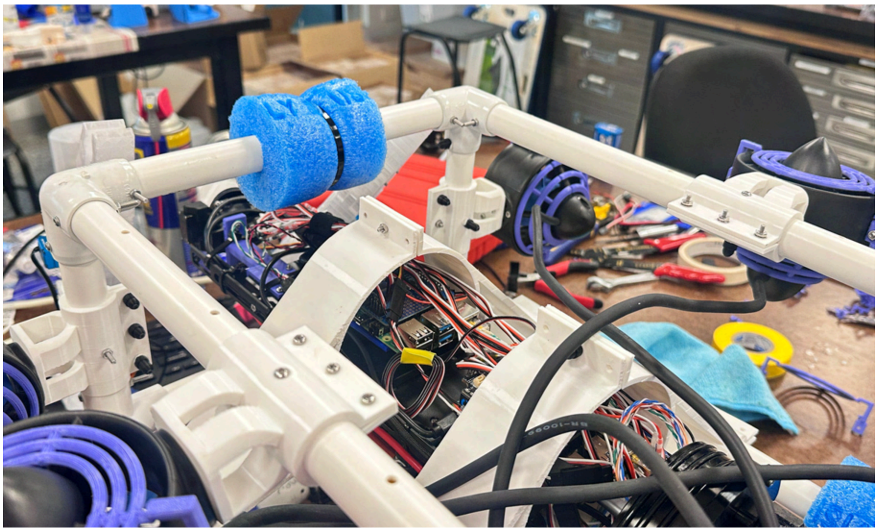

Figure 11. 3D Printed Attachments

4.2 Buoyancy Ballast

To ensure stable and efficient underwater performance, Team Riptide worked to achieve neutral buoyancy for our ROV, Bluie, through a combination of empirical testing and incremental design adjustments.

We initially attempted to balance the buoyancy of the ROV by attaching pool noodles to the tether using zip ties; these helped counteract the weight of the tether. However, during early pool tests, we discovered that the enclosure's dome trapped excess air and caused the front of the ROV to tilt upwards, pointing toward the surface of the water.

To address this imbalance, additional sections of pool noodles were secured to the back of the ROV. While this improved overall orientation, it still did not yield the results we were aiming for. Therefore, we implemented a more refined ballast system: small metal weights were attached to the underside of the front PVC frame using zip ties, providing better control over Bluie's center of mass and achieving a more consistent neutral buoyancy.

To further understand our buoyancy profile, we calculated the total buoyant force using the formula:

$B = V \times \rho \times g$

Enclosure (40 cm (length) × 10 cm (diameter) volume: $\approx 3{,}403\ cm^3$

Arm volume: $\approx 2{,}573\ cm^3$

Total displaced volume (V) $\approx 5{,}976\ cm^3 = 0.005976 m^3$

Fluid density (ρ) = $1000\ kg/m^3$ (freshwater)

Gravity (g) = $9.81\ m/s^2$

$B = 0.005976 \times 1000 \times 9.81 \approx 58.62$ N

This positive buoyant force is larger than Bluie's weight (5.5kg = 53.96N) confirming that it would float unless counterbalanced by carefully positioned ballasts.

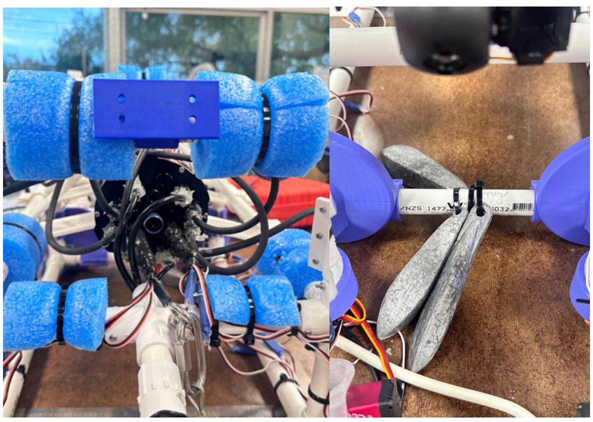

Figure 12. Buoyancy Pool Noodles and Weights

5. Electrical and Control System

5.1 Payload and Tools

Claws

Our team has purchased a basic claw model online and modified it to suit the needs of the ROV. We have utilised 3D printing to create the main frame of the claws. The claws are fitted with the servo motors that allow the claw to open and close and to also rotate. Therefore, adding more motors allows the claw to move with greater flexibility, enabling it to perform a wider range of tasks more effectively. It uses the same linear actuator as a fixed gripper, along with an additional actuator to enhance movement. We used parallel jaws as our end effector, which open and close simultaneously to grip and move objects with greater manipulation abilities such as task 2.1 where the anode has to be turned slightly to disconnect the old anode and connect the new one.

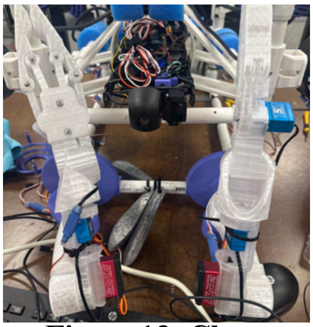

Figure 13. Claws

Basket

A detachable 3D printed basket was created to collect the jelly in Task 2.2. The basket was designed to fit onto the claws to secure the basket. It would then be carried by the ROV to move to a suitable position below the jelly. Finally, the ROV will move upwards to contain the jelly within the basket without applying any additional pressure, in order to simulate not harming any jellyfish during the sampling process in the real world.

Figure 14. Basket Bottomside

Claw attachment

A detachable 3D printed open hemisphere claw attachment was created to collect the ping pong balls in Task 2.2. Inspired by the scoop shape of ice cream scoops, we designed an open hemisphere claw attachment that can be secured on both fingers of the claw which also allows the fingers to contract to contain the ping pong balls inside the attachment. Once the claws have fully contracted, the ping pong balls will be contained within the claw attachment and the ROV will move to the surface on the side of the pool for the ping pong balls to be collected.

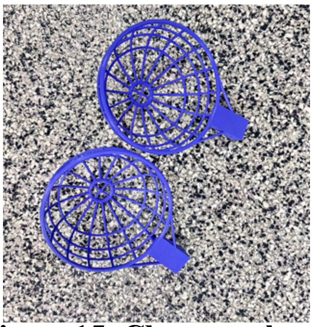

Figure 15. Claw attachment

Syringe

A syringe is attached to the ROV to collect a water sample for pH testing after it returns to the surface. The syringe used is medium sized, suitable for collecting a sufficient amount of the water sample while ensuring that the manipulator can securely grasp it to retrieve the sample.

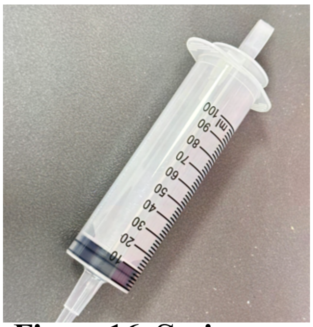

Figure 16. Syringe

Depth and Pressure Sensor

Our team has purchased a two-in-one depth and pressure sensor from Blue Robotics that can measure up to 300m water depth. It has a depth resolution of 2mm and is compatible with Raspberry Pi devices and has a preinstalled JST GH connector which connects batteries and effectively links electrical power. Being a high pressure, high resolution pressure sensor installed in a watertight container; it is connected to the Raspberry Pi 4 Model B buoyancy engine for Task 3. This sensor includes an additional temperature sensor accurate to ±4°C.

Figure 17. Depth/ Pressure Sensor

Raspberry Pi Tray

A tray was needed to be designed on Fusion in order for the Raspberry Pi to be attached to the RAILS tray. This was because the holes in the Raspberry Pi don't align with the holes in the RAILS tray. Therefore, this tray allowed the connection and security of attaching the Raspberry Pi.

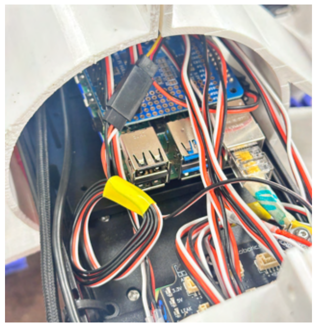

Figure 18. Raspberry Pi Tray

5.2 Photogrammetry

Cameras

We used a Low-Light HD USB Camera from Blue Robotics, which is suited to use underwater with excellent low-light performance, good colour handling, and onboard video compression.

Using a Sony IMX322/323 sensor, this camera has a large sensor (1/2.9″) and a relatively low pixel count (2MP, 1080p), meaning that the physical pixel size is large to allow maximum light sensitivity. Its wide-angle, high resolution, strong signal, high IP (Ingress Protection) rating and low distortion lens provides excellent picture quality from the ROV, as tasks such as task 1 require a clear visual for us to identify the type of shipwreck. The camera also has an onboard H.264 compression chip so that all the video compression can be done onboard. Additionally, it is attached to Blue Robotic’s Camera Tilt System. The tilting servo is the high-quality digital HS-5055MG servo with metal gears. The camera will be attached to the Blue Robotics RAILS (Really Awesome Internal Layout System), via an additional designed attachment. Eventually, the RAILS will be inserted into the watertight enclosure dome, fitted onto an end cap, safe from the outer water-filled environment.

Originally, our team considered purchasing DWE cameras due to their excellent picture quality. However, after considering the cost of the camera, we found that it was too expensive for us to purchase and chose to use our current camera as an alternative, as it still maintains a high quality of images and functionality.

360 image stitching

Our team has utilised VideoMode, a 360 image stitching software that allows us to capture the location of the ROV while creating 360 images of the environment along the journey of the ROV, to create a stitch of 360 images that will be automatically arranged into a floor plan to act as our 360 photosphere.

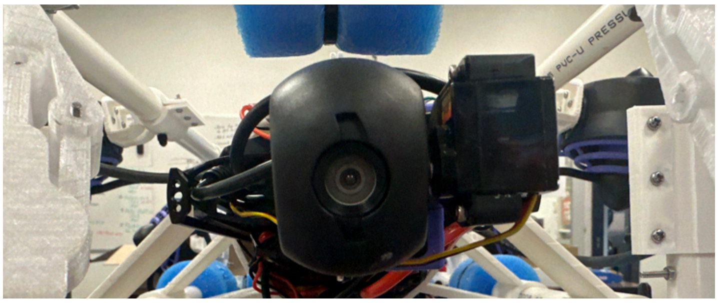

Figure 19. Low-Light HD USB Camera

5.3 Propulsion

Our ROV is equipped with six thrusters located on different sides, one on each side at the front, middle and back to steer and direct the ROV in the desired direction. A 3D printed motor cover made from biodegradable PLA tough filament designed on Fusion 360 is assembled to each motor and prevents objects from colliding with the blades of the motor and getting tangled in them, hence preventing the motors from interference that would cause them to malfunction and shut off.

It is a fully flooded brushless motor which consists of encapsulated motor windings, a stator, coated magnets and rotor. The fully flooded design of the motor enables it to be water-cooled and hence prevents it from overheating. The core motor is a three-phase brushless outrunner motor. We used a brushless electronic speed controller (ESC) to operate the motor while maintaining a relatively low energy need, as the motor can operate at 16V or over different ranges of voltages. The energy efficiency and built in self-cooling elements of the motor is one of the many reasons why we chose this motor. We believe that lowering our energy usage is essential to protecting the environment and enables us to distribute the energy evenly to different components of the ROV. These "engines" of the ROV provide propulsion for underwater navigation.

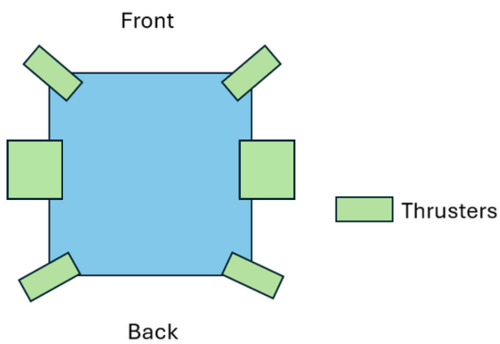

Figure 20. Thruster Placement Diagram

5.4 Submersible Connectors

Watertight enclosure

We chose to use a single watertight enclosure for our ROV's electronics. While using two enclosures would have allowed for better organisation, it would have introduced excessive buoyancy, negatively impacting the ROV's performance and balance. The chosen enclosure, purchased from Blue Robotics, was selected due to its compatibility with our thrusters, which come with built-in cable penetrators. This made Blue Robotics a logical and reliable choice for our needs.

The enclosure houses all critical electronic components, including two Raspberry Pi units, a camera, and a cable splitter. Its watertight design ensures that these non-waterproof components are fully sealed and protected from the surrounding water. Despite its high cost, the enclosure's quality is essential, any failure in waterproofing could result in electrical damage, system failure, or complete shutdown of the ROV during operation.

To maximise the limited internal space, we utilised both sides of the electronics tray, allowing for efficient organisation and secure placement of all components. This approach helped us optimise space within the enclosure while maintaining accessibility for maintenance and troubleshooting. We also chose to add a dome at the end of the enclosure, which eliminated the need to waterproof the front-facing camera separately.

Figure 21. Blue Robotics Watertight Enclosure

5.5 Control and Electrical System

Ground station

The ground station consists of two laptops, each connected to the ROV via Ethernet cables. One laptop is dedicated to visual feedback and thruster control—it receives the video feed from the front-facing camera housed in the main enclosure and allows the pilot to control the ROV's movement using an Xbox controller. The second laptop is used to control the manipulator arms. It connects to the onboard Raspberry Pi via TigerVNC, enabling remote access to the interface responsible for servo operation. This dual-laptop setup allows for efficient task delegation and smoother operation during mission execution.

Figure 22. Riptide Ground Station

Soldering:

During the soldering process, we join metal components by using a soldering iron to melt a filter metal called solder. We apply the heated solder to the connection points, ensuring both pieces are hot enough to allow the solder to flow smoothly and create a solid bond. The Raspberry Pi boards themselves did not require soldering, but the Navigator Flight Controller needed to have the channel inputs soldered onto the board in order to be used.

Raspberry Pi

For the control system, we decided to use two Raspberry Pi 4 model B to control the robotic arm and the thrusters separately as we require two separate Pi board hats for their separate functions. Both Pi Boards are connected to separate laptops through an ethernet connection. Raspberry Pi boards are the optimal choice for our ROV as they offer an extensive interface, and are compatible with a lot of types of hats for different purposes. Raspberry Pi is also optimal for coding in the Python language, which is the primary language utilized by our programmer, as well as being an easy language to learn if needed.

Adafruit Servo Hat:

We used 4 servos for each arm, making 8 in total. This gives us all the movement range required for the tasks and keeps the design simple and easy to manufacture and control. We used an Adafruit 16-channel PWM Servo Hat to connect the servos to the Pi board. This hat is specifically designed for maximum compatibility for Raspberry Pi 4 board, and has more than enough channels for servo inputs. The code to control the arms has been coded straight onto the Pi interface, and is run through a virtual environment on Raspberry Pi (set up using terminal). The code implements loops and conditions, as well as functions, for efficiency and neatness. The servos are controlled through the specific Adafruit library and keyboard inputs. The main logic is run through a While loop If, else:, and try: loops to determine which key is pressed, to then run the kit.servo[1, 2, ..., 16]. angle ±=10. This increases or decreases the servo's set angle by 10. We chose to control the servo arms in 10 degree steps after trialing with several other degrees, and decided 10 degrees was the perfect balance between efficiency and precision.

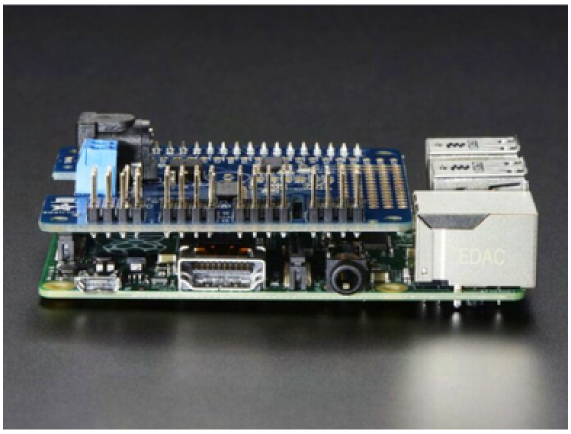

Figure 23. Adafruit Servo Hat

Blue Robotics Navigator Flight Controller:

Motor:

For our motors, we used the Blue Robotics Navigator Flight Controller for maximum compatibility with Raspberry Pi 4 model B. the board also comes with in-built accelerometers and gyroscopes for orientation, compass and leak sensors. The Navigator Flight Controller is connected to BlueOS Autopilot which provides an elaborate interface which interprets information from inputs from the channels. Autopilot also offers a livestream option to display real-time sensory input from front and rear cameras. To control the movement of the motors, we used the standard BlueOS mapping and a Xbox controller connected via USB-A to the laptop with ethernet connection to the Raspberry Pi 4 board.

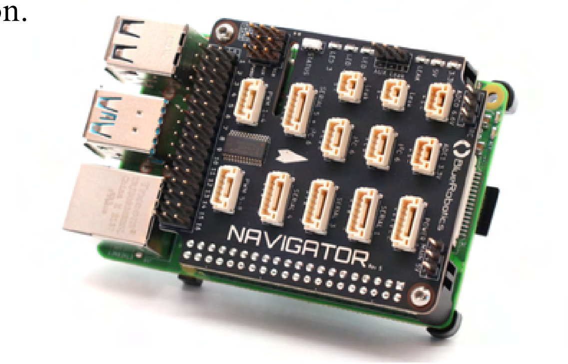

Figure 24. Blue Robotics Navigator

5.6 Tether and Strain Relief

Our tether is 20 meters long and consists of three cables: one 10 AWG power cable and two Ethernet cables for data transmission. These are enclosed in buoyant tubing to keep the tether neutrally buoyant and prevent it from dragging on the pool floor. A spiral wrap surrounds the entire tether to protect the cables and keep them organised.

The tether enters the ROV through a piece of PVC piping, which acts as a secure routing channel. This setup provides mechanical strain relief by ensuring that any tension on the tether is absorbed by the structure and not the electrical connections. This protects against disconnection or damage during operation.

Figure 23. Picture of Tether

This design prioritises durability, ease of handling, and transportability—especially for overseas travel. The buoyant tubing and spiral wrap ensure the tether stays afloat, tangle-free, and robust during missions. With reliable organisation and insulation, our pilot can transmit power and control signals to Bluie without interference.

As the only link between the surface and the ROV, the tether is one of the most vital components. Proper strain relief and cable management help ensure a stable, uninterrupted connection, which is essential for successful mission execution.

6. Testing and Troubleshooting

As a new team, one of our biggest challenges was learning how to build and optimise an ROV from the ground up. We developed a hands-on testing process that helped us identify problems early, make improvements, and build confidence in Bluie's performance underwater.

Buoyancy and Centre of Mass: We began by testing Bluie's buoyancy in a pool. Initial tests showed that Bluie was unevenly balanced, with the enclosure dome causing the front side to tilt upwards. We responded by adding pool noodle floats and later metal ballasts to adjust the centre of mass and achieve a stable, level position in the water. This trial and error method helped us understand how different materials and placements affect stability

- Subsea Enclosure Leak Tests: To ensure our electronics would stay safe underwater, we ran multiple leak tests on our Blue Robotics enclosure. We submerged the enclosure in a bucket and checked for air bubbles and water ingress over time. These tests were repeated after each adjustment or reassembly to maintain waterproofing.
- Frame Integrity and Load Tests: We performed dummy load tests by gently applying weight to Bluie's frame to simulate real world forces. This confirmed the strength of our recycled PVC frame and TPU attachment parts and gave us confidence in Bluie's durability during missions.
- Thruster and Arm Testing: All motors and moving parts were tested rigorously over several pool sessions. The arm, in particular, went through repetitive motion trials to confirm it could grip and release reliably. These repeated tests also allowed us to identify when any components needed to be reprinted, realigned, or reinforced.
- Tether Buoyancy and Management: We tested different tether setups to ensure it didn't drag or tangle underwater. By adding buoyant tubing and using spiral wrap for organisation and protection, we minimised interference from the tether and allowed smoother piloting during operation.
- Troubleshooting Process: Every test led to improvements. We maintained a running checklist of issues and used group discussions to brainstorm practical fixes. Whether it was a motor that didn't respond or a pool noodle that needed repositioning, we learned to diagnose and solve problems methodically.

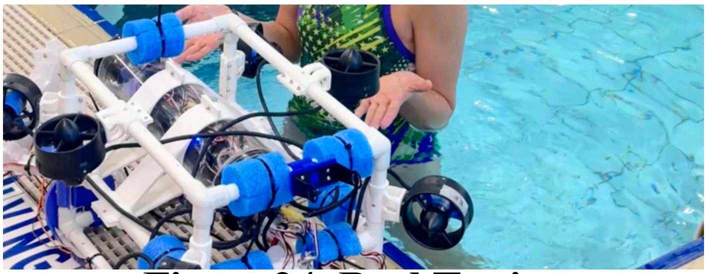
Figure 24. Pool Testing

This cycle of testing, reflecting, and refining became an essential part of our build process and taught us not just how to make an ROV work, but how to work effectively as a team to problem solve

7. Safety

At Riptide, safety is integrated into every step of our engineering and operational process, from design and testing to transport and underwater operation. We take a holistic approach that prioritises personal safety, operational protocols, underwater reliability, and environmental stewardship. Our team strictly adheres safety standards while promoting responsible use of marine technology in real world applications.

A. Safety Philosophy

Our team believes safety is a shared responsibility. All members complete safety inductions and are trained to look out for hazards not just for themselves, but for others. This includes wearing closed toed shoes in the workshop, tying back long hair, and wearing appropriate Personal Protective Equipment (PPE) such as gloves, safety goggles, and aprons. Our safety culture emphasises proactive communication, careful tool use, and regular risk assessments

B. Workshop Protocols

All ROV and float construction and preparation take place in our school STEM workshop, which must always be supervised by trained and approved mentors. These mentors guide tool usage, ensure safety standards are upheld, and directly assist with operations requiring advanced skills or equipment. Only mentors are permitted to use high risk machinery, such as the PVC pipe saw, while students operate tools like the 3D printer and heat guns under close supervision. All team members wear appropriate PPE when applicable, closed toe shoes and long hair is to be tied back at all times whilst in the workshop. Workstations are kept clean and tools returned to marked locations after use to reduce clutter and prevent accidents.

C. Pool Safety

We test our ROV and float at the Korowa pool, where safety is heightened due to the presence of water and electronics. All team members have passed a swimming competency test to ensure they are confident and capable in and around the water. This is a prerequisite for participating in any pool based testing sessions. Additionally, at least one Korowa Aquatics staff member and approved mentor supervises every session to enforce strict adherence to water safety protocols. All electronics are kept on elevated, dry platforms, and the tether is managed carefully to prevent entanglement or tripping. Non essential personnel are kept away from the water's edge during operation.

D. Underwater and ROV Operational Safety

Bluie, our ROV, and Bingo, our float, is engineered with both operator and aquatic safety in mind:

- Propeller guards protect team members during handling and marine life in real world applications.
- All electronics are waterproofed and double sealed to prevent leaks or shorts underwater.
- Tether strain relief prevents sudden pulls that could cause damage to the ROV or nearby swimmers.
- We perform a pre-dive inspection before every submersion, checking for secure connections, seal integrity, and mechanical reliability.
- The ROV is always powered off when out of the water and during transport.

E. Environmental Safety and Marine Responsibility

Riptide recognises the importance of preserving underwater ecosystems. Though our pool is a controlled environment, we have designed Bluie and Bingo with eco-conscious practices that would translate into open water use:

- We use biodegradable or recyclable materials where possible.
- Bluie's smooth frame is designed to minimise drag and avoid snagging on marine flora or fauna.
- All testing is debris free, with waste properly disposed of after each session.
- We aim to minimise energy consumption by running only essential systems during underwater missions.

This environmental awareness informs not only how we build but how we think as engineers: sustainable solutions must also be safe ones.

F. Operational Checklists

To ensure safety is consistently applied, we've developed standardised checklists for both lab work and pool sessions. These include but are not limited to:

- PPE verification
- Tool usage clearance
- ROV integrity check (seals, wiring, motor function)
- Poolside safety (dry areas for electronics, clear tether paths)

8. Accounting

Riptide employed a transparent and efficient budgeting system to ensure the project remained financially viable throughout the development of our project. The team's primary source of funding came from Korowa Anglican Girls' School, which provided both financial support and access to an extensive on campus workshop equipped with essential tools such as 3D printers which significantly reduced overall costs.

At the beginning of the season, the CEO and department heads conducted an inventory audit of the available tools and materials in the workshop. Based on the technical requirements of the MATE 2025 competition, each department submitted design proposals and purchase requests for any additional components required. These were reviewed and approved by the CEO and mentors to ensure feasibility and alignment with project priorities, and total estimation prices were documented in a budgeting list (Appendix []).

To ensure financial accountability, all purchases were recorded in a cost tracking spreadsheet (see Appendix), which logged each expense and monitored category specific spending. This system ensured the project remained within budget and allowed team members to make informed decisions about cost trade offs and resource usage.

This structured, collaborative approach to budgeting enabled Riptide to maximize the impact of its funding, foster financial literacy among team members, and ensure the successful completion of the project without exceeding available resources

9. Conclusion

Acknowledgement

Riptide would like to give our heartfelt thanks to MATE, the Marine Technology Society, and all sponsors of the 2025 competition for this incredible opportunity. We are especially grateful to Korowa Anglican Girls' School for providing the resources, space, and support that made this project possible and to the Australian Government who provided us with grant funding.

We would like to say a huge thank you to everyone who has supported us throughout this journey:

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Neil Stagg – For mentoring us on technical documentation and sharing valuable insights into the MATE competition.
Our families – For your constant encouragement, support, and belief in us throughout this journey.

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10.1 Appendix A. Safety Checklist

Pre Operation Checklist

- Work area is clear and organised
- All team members wearing safety glasses
- Pit manager is wearing gloves
- Tether is untangled and damage free
- Tether securely attached to ROV and strain relief
- All connections (Cat6, Anderson) checked and secure
- Electronics watertight enclosure sealed properly
- Vacuum test performed and passed
- Tools and hazards cleared from deck

Power Up Procedure

- Pilot's laptop powered on
- Co-pilot announces "Power On"
- Connect power supply (Anderson plug)
- Thruster test successful
- Video feed is clear and working
- Camera angle set correctly
- Arm in home position (0° and closed)

Launch Protocol

- Pit manager announces "Hands On"
- ROV lowered gently into the pool
- Visual check for bubbles or leaks
- Confirm watertight enclosure is leak free
- If safe: co-pilot announces "Launching"
- Pit manager announces "Hands Off"
- Co-pilot confirms "Ready to Fly"
- Pilot begins ROV operation

Emergency Response

- Stop all thrusters immediately if a leak is seen
- Disconnect power
- Retrieve ROV with tether
- Open electronics tube only after confirming safety
- Identify and record the source of issue
- Log incident with details and resolution

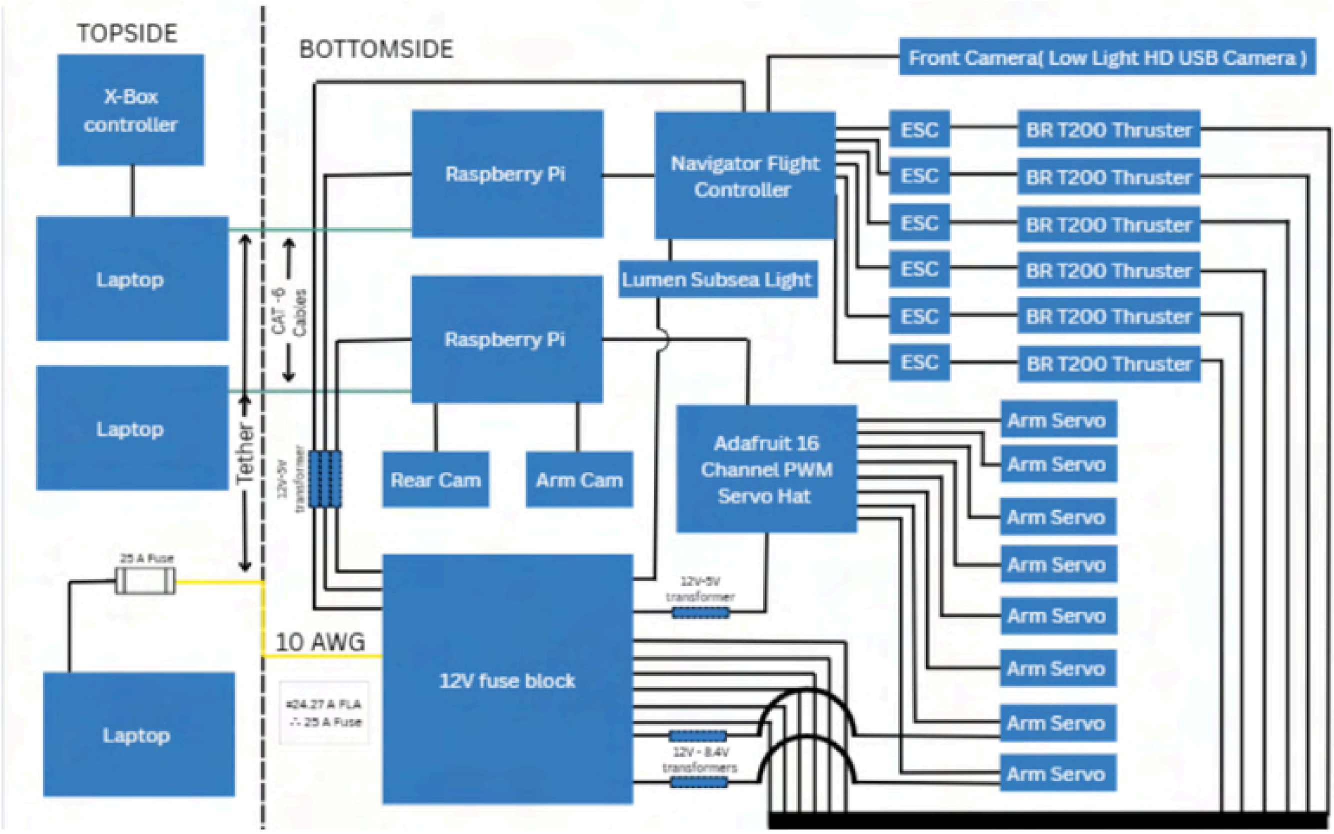
In Water Pit Stop

- Pilot announces "Pit Stop"
- Pit manager: "On the Surface, Disable"
- Co-pilot: "Thrusters Off"
- Pit manager: "Hands On," retrieves ROV
- ROV modifications completed as needed
- Pit manager: "Modifications Done"
- ROV relaunched or powered down

Post-Operation

- Power disconnected safely
- ROV removed and dried
- Visual inspection for wear or damage
- Vacuum test rerun if needed
- All tools packed and pit area cleaned
- Debrief team and log any issues

10.2 Appendix B. SID



10.3 Appendix C.
Cost and Budgeting Spreadsheet

Amounts were calculated from AUD to USD
on 19/05/2025

Income		Description		Amount
Australian Government		STEM Grant		$9,623.63
Sponsorship Funds Leftover		2024 Korowa Anglican Girls' School STEM Team		$3,849.18
Equipment		Existing equipment and material in Korowa Anglican Girls' School's STEM Workshop		$7,056.83
School Funding		Travel Funding from Korowa Anglican Girls' School		$6,415.30
Undersea ROV		Tidal tier sponsorship		$513.26
Cr Sally Davis		Personal donation		$128.32
Pizza Fundraiser		Pizza fundraiser in collaboration with Domino's		$577.42
Total Income				$28,163.94
Expenses	**Type**	**Description**	**Cost Projection**	**Budgted Value**
Mechanical	Purchase	Watertight Enclosure	$548.56	$548.56
	Purchase	Robotic Arm CAD Design File	$10.03	$10.03
	Purchase	Miscellaneous (M3 Nuts, Bolts, Screws, Carabiner)	$60.00	$60.00
	Purchase	Connection Elements (Cable Ties, Velcro Tape, Epoxy Resin)	$100.00	$100.00
Electrical	Purchase	Servo Motors	$401.29	$401.29
	Discounted	T200 Motors x6	$1,443.12	$1,298.80
	Purchase	Raspberry Pi 4 x2	$210.29	$210.29
	Donation	BR Camera	$184.57	$0.00
	Purchase	USB Camera	$72.03	$72.03
	Discounted	Navigator Control Computer	$666.25	$599.63
	Purchase	Adafruit Servo Control Hat	$25.08	$25.08
	Purchase	Electronics Tray x2	$201.93	$201.93
	Purchase	ESCs x6	$216.72	$216.72
Float	Purchase	Watertight Enclosure	$443.74	$443.74
	Purchase	Pressure Sensor	$89.39	$89.39
Enterprise	Purchase	Uniform	$530.76	$530.76
MATE Registration Fee	Purchase		$464.46	$464.46
Travel	Purchase	Accomodation	$6,845.77	$6,845.77
	Employee Expense	Flight	$10,710.63	$0.00
	Employee Expense	Food and Travel	$7,700	$0.00
Total Expenses			**$30,924.62**	**$12,118.48**