MINISTRY OF INSPIRATION

NZ AQUABOTS

KARETAO HIKO RUKU WAI

Regional and National

Aquabots Challenge Rules

2023

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Rātā Foundation

Structure of AquaBots

AquaBots is designed to give students an overall experience in the engineering process. AquaBots gives students the opportunity to demonstrate what they have learned to professionals in the field, educators, other students, and the general public.

The 2023 AquaBots Challenge will consist of 3 underwater competitions, a team presentation and technical report (for Open and National TEAMS ONLY). The challenges are a test of how well the students design, build, and operate their AquaBots. The team presentation is a test of organisational and documentation capabilities which allows the students to showcase their design and demonstrate how well they can convey their engineering ideas.

Competition Challenges & Judging

Regional competitions occur in Terms 2-4 depending on the region. National Competion occurs at the end of the November or first week of December. Nationals rotates on North Island and South Island. Top 8 teams from Regional events are invited to Nationals. Top three teams at Nationals are invited to Sea Perch International event in USA the following year. Teams must win at the National NZAquaBots competition in order to be invited to Sea Perch International competition.

I. Challenge Award Structure

1. AquaBots Obstacle Course
2. Competition – Scallop Surveying/Transect Driving
3. Competition – Algae Removal/Monitoring Biodiversity
4. National Surprise Challenge
5. Non-scoring Survey Station

II. Presentation Award Structure

Technical/Engineering Presentations
Technical Report (Open class at regionals, ALL teams at Nationals)
Factsheet
Quiz

III. Classes and Divisions

Due to the popularity of Aquabots we have a second optional class. Those teams who wish to use non-standard motors, more than 3 motors or a camera with an on deck monitor are in OPEN CLASS. These teams will follow entry qualification for the MATE competition NOT Seaperch.

Class	**Age**		
	Primary For teams with students who are only year 1 – 6	Intermediate For teams with any members who are year 7 or 8	High School For teams with any members who are in year 9 - 13
Standard Class 1	Standard Class 1 is for teams using the standard NZAB kit. Students may re-design their bot but MUST use the NZAB kit motors and		

	controller. *Teams in this category are eligible to go on to Nationals and Sea Perch Internationals.*
Standard Class 2	Standard Class 2 is for teams who have structurally changed their robots-they are not using PVC pipe. They are using alternative materials. MUST use the NZAB kit motors and controller. It is most common for teams who are in their second or third year BUT not exclusively. *Teams in this category are eligible to go on to Nationals and Sea Perch Internationals.*
Open Class	Open Class is for teams who are using NZAB 2.0 robot OR the standard NZAB kit BUT **must** have a camera with an on deck monitor. *Teams in this category are eligible to go on to Nationals and MATE Internationals.*

Panels of external judges from industry, government agencies, and all education sectors including tertiary level will evaluate each challenge.

General Rules

1. The Tether:
Throughout the competition, the robots must move only under their own power. Specifically, team members cannot pull on the tether or they will be disqualified.

2. Modifications to the Aquabot:
Robots shall consist of the parts and components contained within the equivalent of one Aquabot kit, with the following exceptions:

- Teams have a budget of $20.00 NZD to modify the Aquabot. Students are encouraged to 'think outside the box' with modification. Donated material should be assessed at what the cost would be to procure the material. The $20 NZD limit is for costs of the materials utilized on the final competition robot. Reasonable spare parts are not included in this budget. 3D printing should be represented at $0.05 per gram
- Hooks and attachments may be added/removed depending on the competition round.
- Teams may only utilize stock Aquabot motors in thrusters (Jameco P/N 232022). These are different from the NZAquaBot 2.0 robots.
- Teams may not add additional thrusters to the Aquabot. A thruster is defined as a means of propulsion, normally but not limited to a motor and propeller assembly. Teams will design for and utilize a 12-volt power source. Over charging or stacking batteries is not allowed. Team supplied batteries must not be larger than 16.5 cm long x 7.6 cm wide x 10.2 cm high and must be 12 VDC maximum with a 9-amp hour maximum rating
- Fit within a box with the dimensions of 30 x 45 x 45 cm.
- No cameras to be fitted
- 3D printed parts will be costed out at $0.05 per gram

3. Modifications to the OPEN robot
OPEN robots shall consist of the parts and components contained with the equivalent of the TriggerFish electronics kit or NZAquaBot Kit with the following exceptions:

- Maximum size of the robot 60cm x 60cm x 60cm

- Maximum weight of the robot (including motors and camera) is 15kg
- Robot materials can consist of anything

- Teams will design for and utilize a 12-volt power source. Over charging or stacking batteries is not allowed. Team supplied batteries must not be larger than 16.5 cm long x 7.6 cm wide x 10.2 cm high and must be 12 VDC maximum with a 9-amp hour maximum rating
- Controller must have an appropriate fuse
- Teams have a budget of $100 NZD to create the robot (excluding motors, controller etc)
- Pneumatics and hydraulics are permitted provided that the team follows the specifications included within the competition manual.
- Camera is required with a land based monitor included
- 3D printed parts will be costed out at $0.05 per gram

4. *Competition Day*

- Only 3 team members are allowed on the pool deck during competition (blue zone).
- No parents, whanau, coaches are allowed on the pool deck during competition (blue zone).
- Nothing other than the Aquabot/OPEN robot should be put into the pool.
- Each ROV will be inspected and qualified by a judge prior to competition.
- In the event that a robot is inadvertently interfered with during a trial or a malfunction of a robot's parts (i.e. the motor) that is beyond the design and construction put together by the team, the panel of judges will have the authority to allow the team time to fix their robot and allow them to compete later in the round. These malfunctions will be evaluated on a case-by-case basis.

5. *Safety*

Once teams enter the cordoned off competition area to trim, adjust, practice or compete, team members must not receive outside assistance, materials or communication. Teams violating this rule will be ranked below all other teams.

Safety regulations must be followed at all times. Absolutely no competitor is allowed to go into the competition pool during Aquabots Competitions. Should an Aquabots competitor or any person connected with an Aquabots team (spectator, coach, parent, etc.) go into the pool, that team's *school/organisation* will be disqualified from the competition.

6. Appeals, Challenges and Disputes

Gracious Professionalism is expected at all times. Should a protest or dispute occur during the competition it is the intent to resolve the grievance at the time it occurs, and the ruling by the Head Judge shall be final.

A team that wishes to have an issue considered shall send the student team captain and one additional student member (2) to the lead judge with the inquiry or question. The lead judge will make the decision on the issue, and this decision is final. The same issue may not be brought to the judge a second time by any member of the team.

Adults may not approach the lead judge on the pool deck regarding any perceived issues.

Teams may not question the legality of other competing robots; it is the Head Judge's role to determine if robots meet the entry and compliance requirements.

Unsportsmanlike conduct is grounds for the disqualification of a team. Team members and advisors are responsible for the conduct of all members and adults accompanying the team.

7. Materials available for open class

Teams may compete in the open class using the TriggerFish MATE package or equivalent. Teams who are competing in Open class using the Aquabots controller and motor can make use of any materials for their robot body. They must not use any different motors or more motors. If you are unsure about your design please check with the co-ordinator BEFORE the competition date. Open class requires the use of a camera with on-deck monitor.

Vehicle Performance

1. Elapsed time for each run starts when the student holding the Aquabot releases and holds his/her hands up in the air, easily visible to the timing official. Timing stops when the Aquabot touches the pool wall finish line.
2. A team member may “manage” the amount of tether cable in the water, feeding and retracting length as desired, but the tether cable must be slack at all times; the team member may not use the tether cable to assist the Aquabot’s movement in any way.
3. Provision for False Start: If a team has a “false start” defined as the Aquabot has left the wall before the start signal, 20 seconds will be added to that team’s timed score.
4. In the unlikely event of a collision with another Aquabot, a team may elect a re-run. The five-minute period does not apply to such a run.

<u>Existing robots</u>

Schools already owning an Aquabot from previous years may compete using their old ROV as long as some form of structural modification is made, for example: shape change, material change, hydraulic system, etc. This should be noted in their presentation. Cost for competition only is $20 per team.

REMEMBER! At least 2/3 of your team MUST drive your Aquabot robot. No one team member will be designated as the sole driver!

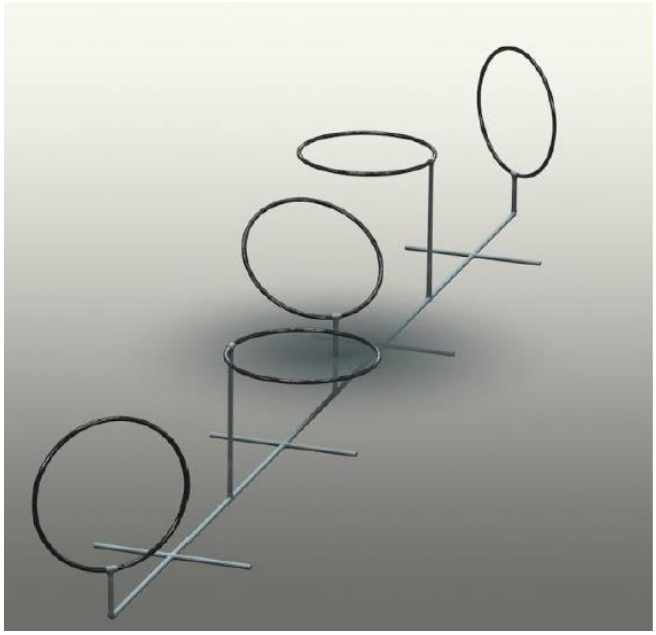
Points Awarded:

- Each competition section is scaled to be out of 100 points (except obstacle course which is timed). In the event of a tie in points, the team that took the shortest time to complete a task are awarded an additional 10 points *prior to scaling.*
- Each competition is then ranked.
- Rankings are added together across all events.
- 1st-3rd placings are awarded ribbons in Standard Class 1, Standard Class 2 for each AGE bracket: primary, intermediate, secondary.
- 1st-3rd placings are awarded ribbons across ALL Open Class regardless of age bracket.
- Regional trophy is awarded to the OVERALL winner in each age bracket, regardless of class.
- 1st-3rd Place winners in Standard Class 1 and 2 and Open Class are invited to nationals (Regions may not send more than 9 teams to Nationals)
- *Overall* 1st place team, regardless of class, from High School and Intermediate will be invited to Sea Perch Internationals. If one of these teams does not choose to go, the spot will open up in this order: 1st place primary, 2nd place intermediate, 2nd place high school.
- 1st Place team in Open class (regardless of age) are invited to compete at MATE internationals.

Nationals traditionally has a 'surprise' event that will be shown at the Saturday practice. Teams are not permitted to practice the surprise event but can fully examine it. Regional events may slightly differ in competition specifications to best reflect their tamariki.

Task 1: Obstacle Course

Description: Teams drive their Aquabots through an underwater obstacle course as quickly as possible. The course is **roughly** designed as shown.
Maximum team members on course: 3
Maximum time allotted per course: 10 minutes.



Vehicle Performance

1. Teams may make as many official runs with their Aquabot with the shortest time recorded **within a maximum time of 10 minutes**.
2. Start of run: The ROV must be surfaced, within 15 cm of the wall, and under its own power. Team members are not allowed to touch the ROV after the lane judge begins the countdown to start the run.
3. The ROV is required to pass through each of the five obstacle course hoops in order starting at the hoop closest to the pool wall.
4. The ROV must surface after clearing the hoop furthest from the pool wall. Surfacing is considered complete when any part of the ROV breaks the surface of the water.
5. The ROV must re-submerge and head back to the pool wall by passing through each of the five hoops in reverse order.
6. End of run: The run is complete when the ROV touches the pool wall *while surfaced* (any part of the ROV breaks the surface of the water). The run will be aborted if the allotted time expires even if the ROV has not completed the course
7. The gates will be approximately 2 metres apart and will be approximately 60 cm in diameter.

Task 2: Algal Removal/Replace-Monitoring Biodiversity

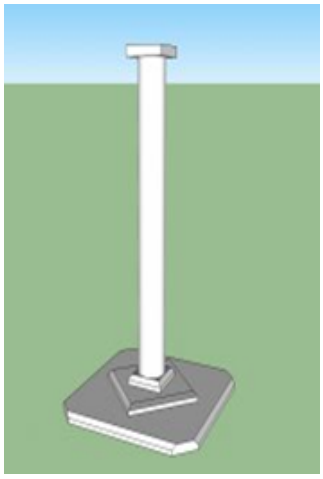
All Teams:

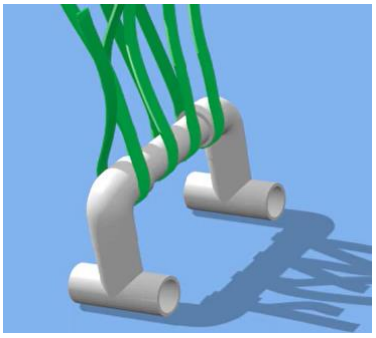
- Remove invasive algal blooms from pilings and sea bed.
- Repopulating with native algae
    - Remove and retrieve encrusting marine growth (PVC cross velcro'd on pipe) x 3
    - Remove and retrieve algal marine growth (PVC pipe raised handle) x3
    - Replace encrusting marine growth (pvc cross with velcro) X3
    - Replace marine growth (pvc pipe with raised handle)

The algal blooms are simulated by coloured pvc crosses which will be attached by Velcro to a vertical PVC pipe (either hanging or on the bottom of the pool). Some algal blooms will be designed to float upon release, some will sink upon release.

The Algal Marine Growth is simulated by a pvc pipe handle resting on the bottom of the pool inside a pvc pipe square with plastic algae attached.

Replacement pieces will be on the pool deck. ROVs must place them back on to the pipe or inside pvc square.

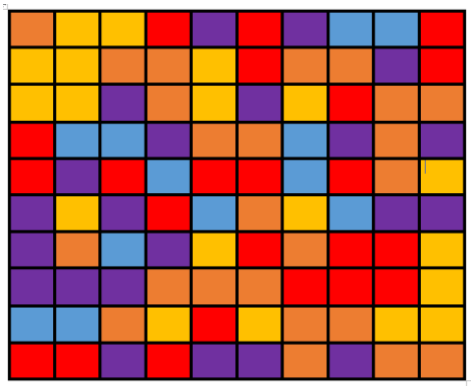




Open Only:

- Monitor the biodiversity found on the pilings by comparing it to previous year. x2
- Navigate camera over biodiversity map and compare it to map given to you on the pool deck. The grid will be 10x10 coloured squares attached to a pvc frame laying on the bottom of the pool.

The biodiversity comparison is simulated with two colour grids (A and B), each colour represents a different species. You will need to determine if there is more/less invasive species and/or more/less native species present in both A and B. *A colour key will be provided on the pool deck. This example shows 5 different species.*



Maximum team members on course: 3
Maximum time allotted per course: 10 minutes.
Vehicle Performance

Teams will make **one** official run with their ROV with the shortest time recorded **within a maximum time of 10 minutes.**
Remove Encrusting algal growth means to get it off the pipe,
Remove Algal growth means to move it at least 1 meter from its original location,
Retrieve means to bring the object to the surface for collection at the side of the pool
Navigate means that the camera is positioned above the grid (any piece) on the pool floor for a minimum of 10 seconds. The grid seen in the screen is shown to the judge.
Monitor means that the entire grid can be seen so that an accurate comparison can be made.

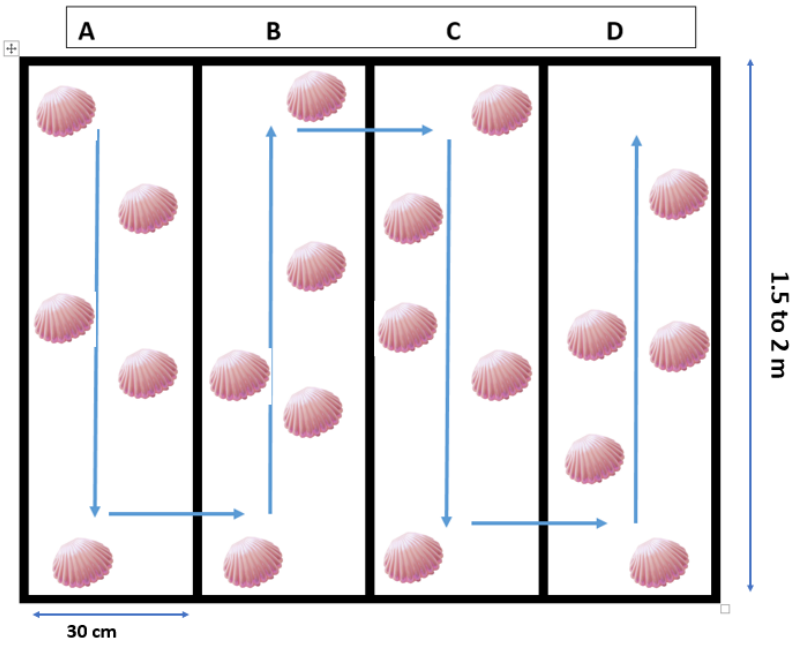
Teams can reach in to take the object from their robot. Multiple objects can be retrieved at the same time

Task 3: Scallop Collection by Transect

All Teams:

- Harvest the correct sized scallops
    - Follow the transect columns, ABCD in order
    - remove and retrieve specific sized scallops

The scallops will be simulated with plastic scallops all looking relatively the same. The correct size scallops will have a piece of metal INSIDE to weigh them down. The incorrect scallops will have rocks in them to weigh them down. Twenty scallops will be in the transect, five of which will be the correct size.



Open Class Only:

Drive ROV along transect ABCD at a height where only the edges of columns can be seen on the edge of your camera screen.

Maximum team members on course: 3
Maximum time allotted per course: 10 minutes.

Vehicle Performance

Teams will make **one** official run with their ROV with the shortest time recorded **within a maximum time of 10 minutes.**

Remove scallops means scallops are lifted a minimum of 20 cm off the bottom of the pool.

Retrieve means to bring the object to the surface for collection at the side of the pool

Transect means the ROV must transect the course in order A-B-C-D as indicated by the arrows in the diagram above.

Task 4: Quiz

Information on aquaculture in New Zealand can be found at the websites below. Quiz questions will be taken from these resources. You can visit other resources to add to your knowledge.
Surveying scallop populations with artificial intelligence | NIWA

Going easy on the scallops | NIWA

As the climate warms, Wellington's underwater forests are in trouble | Stuff.co.nz

The Kelp | New Zealand Geographic (nzgeo.com)

Kelp Blue – Blue water farming for a sustainable planet

Factsheet Potentially Toxic Algae

Description: During the course of the competition you will also be given a quiz. The quiz will be 10 questions long, a mixture of true/false, multiple choice, and short answer. These questions will come from the websites and information noted above.

Maximum time allotted for questions: 10 minutes

Quiz Notes:

1. The quiz may not be taken away from the station
2. No whanau, coaches or teachers can be at the quiz station
3. No outside resources can be used including notes, internet, cellphones, apps etc.

Task 5: Survey Station

Each member of your team will fill out a survey about their experience with the NZAB programme.

This can be done digitally or in paper form.

Task 5: Presentations

All teams must make a **7-10** minute presentation about their Aquabot experience. It is recommended that you speak for 6-7 minutes and leave 3-4 minutes for questions.

All team members present in the room **must participate** in giving the presentation. The advisor/coach may be in the room if they choose, but he/she may not participate in the presentation or interact with the team members.

Teams are advised to arrive at their designated presentation room 10-minutes prior to their scheduled start time. Teams who are more than 5-minutes late will not be allowed to present.

Poster/Digital Presentation

During the presentation, teams may use either a scientific poster (standard 'science fair' tri boards no larger than 90 x 145 cm) *or* a Digital Presentation to demonstrate their work to the judges. The poster or digital presentation should contain the following information:

- Title—Name of the Aquabot Project or Team
- Team—tell the judges about the team. Include team members, teacher/coach, and volunteers.
- Building Process and Challenges—Describe the process the team went through designing and building the Aquabot including any challenges/lessons learned the team faced during the design, construction, design priorities, and testing phases.
- Research completed on design and/or scientific principles-buoyancy, refraction, propulsion, etc.
- Modifications—describe and justify any modifications
- Cost Documentation—Receipts or other proof of additional costs incurred in building the Aquabots. This should include the itemized cost of additional items purchased or equivalent value in a simple table. Receipts should be kept in an envelope and clearly marked with team name, item and cost.
- Trials—describe the trials performed and how the Aquabot was adjusted after the trials.

Regardless of the presentation method chosen, the team should be prepared to answer the judges' questions after the presentation is completed.

Questions and Answer time is included in the 7-10 minute presentation.

Task 6: Factsheet

This prepares teams for Internationals. Teams will prepare and submit a ONE page A4 sheet which summarises their team, experience and their robot.

It MUST include:

- Team name and school/organisation
- An image of their robot
- A 100 word overview of their design
- Number of years participating in Aquabots
- 50 words for "**Our Aquabot is unique because…"**
- 50 words for **"Our biggest learning this year is…."**
- An image of their team
- Names and year levels of team members
- Names of mentors/coaches and their organisations/relationship to students

Read through the marking schedule to see where marks are allocated

Factsheets MUST be submitted 1 week prior to the competitions

Task 7: Technical Report-All teams at Nationals and OPEN teams at Regionals

Learning to write a technical report is a key skill in the engineering and science world. The technical report we are expecting will follow the outline below. Refer back to your engineering journal to help you complete it.

The **Technical Design Report** consists of seven mandatory sections and two mandatory appendices. Additional sections may be included; however, **all reports must be limited to 5 pages** (excluding References, Acknowledgements, and Appendices). Sections and appendices must appear in the order listed below. **Reports must be written in English, typed, and submitted in PDF format prior to the regional event date.**

Please refer to the Scoring Rubric for more information about how each section of the Technical Design Report will be scored.

Technical Design Report

Section 1. **Abstract (1/2 page).** A well-written abstract should concisely explain the key points or essence of your paper and quickly explain to the reader what the paper is about.

Section 2. Task Overview (1/2 page). This section should include an overview of the task(s) your robot will attempt and should discuss the characteristics and features of the tasks that affected the final design. Avoid directly quoting course descriptions or problem statements for real-world applications and instead use your own words to describe what your robot will/would do within the application.

Section 3. Design Approach (2 pages). Given the tasks described in the previous section, describe your team's strategy and approach to developing a novel robot design. Novelty may occur at various levels of the design and build process including specific components, collections of components, or even team approaches to the process. Focus attention on the creative aspects of your system and how your team conceived of, refined, and implemented these ideas. Describe your experience in making design decisions and how prospective ideas were considered among the team. Include engineering and scientific terms and concepts to demonstrate the team's understanding of the challenges of constructing and operating a robot.

Section 4. Experimental Results (1 page). This section should describe various tests accomplished in-practice and/or in simulation. What were your results? How did these tests impact your team's subsequent design(s)? Include images, charts, and figures to demonstrate your results.

Section 5. Reflection & Next Steps (1 page). Reflect on this years' experience. What did you learn? Were there aspects of the project that you particularly enjoyed or that challenged you? How do you think that your new knowledge or experience will assist you in future endeavours? Include a discussion of next steps for the team and/or the team's robot.

Section 6. Acknowledgements (no page limit) Participating in the competition involves identifying

resources and support beyond the efforts of individual team members. This support can take many forms, such as technical advice, labour, equipment, facilities, and monetary contributions. Acknowledging those who have supported your efforts is important.

Section 7. References (no page limit). As with any technical publication, original ideas and content not generated by the paper's authors should be properly cited. While there are many citation styles, the American Psychological Association (APA) style guide should be used. Use in-text citations, where appropriate.

Technical Reports MUST be submitted 1 week prior to the competition

Task 1: Obstacle Course

Organisation Name:	**Gates Cleared (outbound)**
	1 ☐
	2 ☐
Team Name:	**3** ☐
	4 ☐
	5 ☐
Diver Assist? (add 2min) ☐	**ROV Surfaced** ☐
Elapsed time (in hundredths of seconds)	**Gates Cleared (inbound)**
_____.____	**1** ☐
	2 ☐
ALL GATES CLEARED? ☐	**3** ☐
	4 ☐
	5 ☐
Scored Time (in hundredths of seconds)	
_____.____	**ROV Touched Wall** ☐

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Task 2: Algal Removal/Monitoring Biodiversity

TEAM Name: _____

SCHOOL Name: _____

Driver Name: _____Time completed: _____

TASK	POINTS POSSIBLE	POINTS AWARDED
Remove Encrusting Algae	5pts each (x3)	
Retrieve Encrusting Algae	5pts each (x3)	
Remove Marine Growth	5 pts each (x3)	
Retrieve Marine Growth	5 pts each (x3)	
Replace Native Algae on pipe	5 points each (x3)	
Replace Marine growth in square.	10 points	
Addition Points for OPEN class:		
Navigate-screen shows any piece of the grid for 10 seconds. x2	10 points	
Correctly Monitor x2	10 points	
Diver Assist	- **20 pts**	
	Total Points (145)	
	Total Points Open (185)	

Maximum team members on course: 3
Maximum time allotted per course: 10 minutes.

Vehicle Performance

Teams will make **one** official run with their Aquabot with the shortest time recorded **within a maximum time of 10 minutes.**

Remove Encrusting algal growth means to get it off the pipe

Remove Algal growth means to move it at least 1 meter from its original location,

Retrieve means to bring the object to the surface for collection at the side of the pool

Replace means to take the native marine growth and native algae back to the correct locations in the pool (on to Velcro piece on pipe or into the square)

Navigate means that the camera is positioned above the grid (any piece) on the pool floor for a minimum of 10 seconds. The grid seen in the screen is shown to the judge.

Monitor means that the entire grid can be seen so that an accurate comparison can be made.

Teams can reach into the pool up to their elbow to take the object from their robot. Multiple objects can be retrieved at the same time.

Task 3. Scallop Collection by Transect

TEAM Name: _____

SCHOOL Name: _____

Driver Name: _____Time completed: _____

TASK	POINTS POSSIBLE	POINTS AWARDED
Follow Transect ABCD exactly inside each frame	5 pts each (x4)	
Remove correct scallops	5 pts each (x5)	
Retrieve correct scallops	5 pts each (x5)	
Diver Assist	- 20 pts	
	Total Points Poss. (60)	
Additional Points for Open Class		
Screen shows proper height of transect	**5 pts each (x4)**	
	Total Open Class (80)	

Maximum team members on course: 3
Maximum time allotted per course: 10 minutes.

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Vehicle Performance

Teams will make **one** official run with their Aquabot with the shortest time recorded **within a maximum time of 10 minutes.**

- **Remove** scallops means scallops are lifted a minimum of 20 cm off the bottom of the pool.
- **Retrieve** means to bring the object to the surface for collection at the side of the pool
- **Transect** means the ROV must travel the transect in order as indicated in the diagram. ROV must not deviate outside the transect column.
- Additional Points for Open
    - Nearly only the transect column will be seen in the screen throughout the drive of the transect (idea is to keep a level and even height above pool floor)
    - Identify means that the special marking on three different scallops is shown on the screen, one at a time.

Teams can reach into the pool up to their elbow to take the object from their robot. Multiple objects can be retrieved at the same time

Task 4. Quiz

Total Points (Max 10 points)

Task 5: Presentation

Rubric Points → Design Element ↓	**Exceptional 8**	**Excellent 6**	**Good 4**	**Fair 2**	**Needs Improvement 0**
Design and Aquabot Structure	Nicely decorated. Attention to detail and aesthetically pleasing. Fits over all theme of team/poster.	Nicely decorated/painted.	Is not decorated/painted well.	Is not decorated/painted.	Looks unpleasing.
***Poster/digital*: Appearance /Organizational Flow**	Professional appearance. Exceptional use of colours, text, graphics, and flow is intuitive to observers.	Very pleasing to view, nice colours and graphics. Can follow the processes explained on board.	Pleasant to view. Section headings are clear but lacks clarity of specific flow of details	Cluttered or sloppy appearance. Gives the appearance of solid mass of text. Does not flow logically.	Unreadable or no poster.
Presenting	Professional appearance. Team speaks directly to judges. Each member equally participates. Information is clear	Balanced. Text and graphics are even. Students grasp concepts and demonstrate a solid understanding of project.	Too much text. The poster gives an overwhelming impression of text only.	Team reads from screen, little to no eye contact. Backs to judges.	Students unfamiliar with presentation.
***Presentation:* Organizational Flow**	Professional organization and flow of the presentation are well timed, easy to follow, and **highly** engaging for the listeners.	Professional organization and flow of the presentation are well timed, easy to follow, and **usually** engaging for the listeners.	Competent. Organization and flow of the presentation are mostly smooth and orderly.	Novice. Organization and flow of the presentation seem planned but are choppy.	Disjointed. There is little to no organization or flow to the presentation.
***Presentation:* Team Work**	Professional Team is cohesive throughout entire presentation. All team members speak.	Highly proficient. Team is cohesive throughout the majority of the presentation. Most team members speak.	Competent. Team is cohesive at times during the presentation. Small number of team speaks.	Novice. Team struggles with cohesiveness but is aware of the need to work together during the presentation.	Team is not cohesive during presentation. Only one member speaks.
Design Engineering concepts and explanation	Expert. Students **completely** understand the engineering, mathematical, and physical concepts behind their design and clearly explain them to the judges.	Highly Proficient. Students understand the engineering, mathematical, and physical concepts behind their design and clearly explain them to the judges.	Competent. Students understand 1 or 2 of the engineering, mathematical, and physics concepts and **can roughly** explain them.	Novice. Students can name some of the engineering, mathematical, and physics concepts but **cannot explain** them well.	No presentation
Question and Answer	Expert. Students handle questions easily, demonstrating their knowledge of concepts. **Students also inquire with thoughtful questions to the judges.**	Highly Proficient. Students handle questions well, demonstrating their knowledge of the concepts. Students also inquire with thoughtful questions to the judges.	Competent. Students handle questions with some difficulty, demonstrating a partial understanding.	Novice. Students were not able to handle or answer judge's questions.	No presentation

Task 6: Factsheet

Rubric Points → Design Element ↓	**Exceptional 8**	**Excellent 6**	**Good 4**	**Fair 2**	**Needs Improvement 0**
Factsheet Format: A4 Page All 9 items are present Delivered on time	All requirements are meet	Delivered on time, 1 – 2 requirements missing		Not delivered on time, but all requirements are met	More than 2 requirements missing or not delivered at all
Poster/digital: Appearance /Organizational Flow	Professional appearance. Exceptional use of colours, text, graphics, and flow is intuitive to observers.	Very pleasing to view, nice colours and graphics. Can follow the processes explained on board.	Pleasant to view. Section headings are clear but lacks clarity of specific flow of details	Cluttered or sloppy appearance. Gives the appearance of solid mass of text. Does not flow logically.	Unreadable or no poster.
Spelling and Grammar		No spelling/grammatical errors	Minimal spelling or grammatical errors (1-5)		Significant spelling or grammatical errors (5+)
Overview of design (100 words)	Robust discussion & analysis of design iterations. Could include the process taken to create the design, including testing and the design process	Good discussion and analysis of design iterations. Could include the process taken to create the design, including testing and the design process	Some detailed discussion of design iterations. Could include the process taken to create the design, including testing and the design process	Basic discussion of design iterations. Could include the process taken to create the design, including testing and the design process	No discussion of design iterations. Or went over the word requirement
Our robot is unique because (50 words)	Strong discussion & analysis of vehicle design novelty. Could include reference to attachment, structure or materials used	Good discussion of design novelty. Could include reference to attachment, structure or materials used	Some detailed discussion of design novelty. Could include reference to attachment, structure or materials used	Basic discussion of design novelty. Could include reference to attachment, structure or materials used	No discussion of design novelty. Or went over meet the word requirement
Biggest learning this year is (50 words)	Thoughtful design process reflection & analysis. Could cover teamwork, personal realisations, soft skills, technical skills, or strategic thinking	Good reflection and basic design process analysis. Could cover teamwork, personal realisations, soft skills, technical skills, or strategic thinking	Some detailed reflection on the design process. Could cover teamwork, personal realisations, soft skills, technical skills, or strategic thinking	Basic reflection on the design process. Could cover teamwork, personal realisations, soft skills, technical skills, or strategic thinking	No reflection on the design process. Or went over the word requirement

Task 7: Technical Report-Nationals and OPEN TEAMs ONLY

Rubric Points → Design Element ↓	**Exceptional 8**	**Excellent 6**	**Good 4**	**Fair 2**	**Needs Improvement 0**
Paper Format Page Size A4 Single Spaced Margins >0.8 Footer with team name and page # on all pages	Meets all formatting guidelines		Meets most of the formatting guidelines		Does not meet all the formatting guidelines
Abstract: Limited to ½ page			Within page limit		Exceeds page limit.
Abstract Report summarization			Includes a clear overview of the report.		Does not summarize main points of the report.
Unique Vehicle Design and/or Design Process	Robust discussions of unique design and process	Detailed discussion or unique design or process	Overview of design and/or process with some focus on unique traits		No discussion of ROV design or process
Task overview: limited to ½ page			Within page limit		Exceeds page limit.
Overview of the competition tasks	Detailed discussion of all tasks	Good overview of all tasks	Good overview of at least 2 tasks	Good overview of one of the tasks	No overview of competition tasks.
Design Approach Justification	Robust, detailed discussion of design justification		Basic discussion of how tasks impacted design.		No discussion of task influence on design.
Design Approach: Limited to 2 pages			Within page limit		Exceeds page limit.
Teams approach to engineering design process (EDP)	Robust discussion of team's strategy to EDP.	Good discussion of team's approach to EDP.		Little discussion of team approach to EDP	No overview of team approach to EDP.
Design iterations	Robust discussion & analysis of design iterations.	Good discussion and analysis of design iterations.		Basic discussion of design iterations.	No discussion of design iterations.
Conceptual drawings and/or graphics	High-quality graphics with labels that enhance text	Good graphic(s) with context within report.		Includes graphic(s) within report.	No drawings or graphics.
Final design	Robust discussion of final design features/decisions.	Good discussion of final design features/decisions		Basic discussion of final design features	No discussion of final design
Novelty of vehicle design or approach	Strong discussion & analysis of vehicle design & approach novelty.	Good discussion of design or approach novelty.		Basic discussion of design or approach novelty	No discussion of design or approach novelty.

Scientific and engineering terms	Includes 5+ terms embedded in text & enhancing the section.	Includes 5+ terms; not fully embedded or lacking context	Includes 2-4 engineering terms.	Includes 1-2 engineering terms.	Includes no engineering terms
Experimental Results: Limited to 1 page			Within page limit		Exceeds page limit.
In the field and/or simulated testing overview	Exceptional analysis of testing models utilized.	Good discussion & analysis of testing conducted.	Basic overview & discussion of testing conducted.	Testing mentioned	No discussion of testing.
Impact of testing on subsequent designs	Robust analysis of testing impact on multiple design iterations.	Good discussion & analysis of testing impact on multiple design iterations	Basic discussion of how testing impacted multiple designs.	Basic discussion of how testing impacted one design.	No discussion of testing impact on design.
Test Results	Robust test results analysis supported by graphs & charts.	Good test results analysis supported by graphs and/or charts	Basic discussion of test results.	Test results shown	No test results included.
Reflection: limited to 1 page			Within page limit		Exceeds page limit.
Reflection on the design process	Thoughtful design process reflection & analysis.	Good reflection and basic design process analysis.	Basic reflection on the design process.		No reflection on the design process
Next steps	Robust overview of future plans for vehicle and team.	Good overview of future plans for vehicle and/or team.	Basic discussion of next steps for vehicle/team		No discussion of next steps.
Acknowledgement of Support			Supporters recognized.		Support not included in report.
References follow APA format			Follows APA format.		Does not follow APA format.
Includes references to support report		4+ references that are cited in the report text.	1-3 references that are cited in the report text.		No references or citations.
Includes Budget			Submitted in approved format.		Section not included
Writing skills: Organisation		Good organization of discussion within each section.	Minimal organization with section headers.		Organization severely impacts ability to follow the report.
Writing skills: Readability		Concise and cohesive report that is easy to understand.	Report is well written and easy to follow.		Report is inconsistent and difficult to follow.
Writing skills: Spelling and Grammar		No spelling/grammatical errors	Minimal spelling or grammatical errors (1-5)		Significant spelling or grammatical errors (5+)

Compliance Checklist Aquabot

Team Name: _____

School: _____

Construction	
No loose parts that will potentially fall off during competition or handling.	☺Pass ☹Fail
Ballast attachment is secure	☺Pass ☹Fail
Propeller is properly and securely fastened to motor shaft	☺Pass ☹Fail
Safety	
No Exposed wires on controller	☺Pass ☹Fail
No Exposed live wires on Aquabot or Tether	☺Pass ☹Fail
No sharp edges	☺Pass ☹Fail
Alligator Clip covers (supplied with the kit) are installed on electrical contacts as appropriate	☺Pass ☹Fail
Operations	
Team demonstrates forward and reverse operation of each propeller to ensure they are in proper working order	☺Pass ☹Fail
Design Compliance	
No more than 3 propellers are installed	☺Pass ☹Fail
All motors are standard issue and have not been upgraded	☺Pass ☹Fail
If design modifications appear to approach the $20 allowable limit, team identifies that they have valid receipts to support the design modifications.	☺Pass ☹Fail
Aquabot fits inside the dimensions of 30x45x45 cm, including collection arm.	☺Pass ☹Fail

Compliance Checklist OPEN Class

Team Name: _____

School: _____

Construction	
No loose parts that will potentially fall off during competition or handling.	☺Pass ☹Fail
Ballast attachment is secure	☺Pass ☹Fail
Propeller is properly and securely fastened to motor shaft	☺Pass ☹Fail
Safety	
No Exposed wires on controller	☺Pass ☹Fail
No Exposed live wires on Aquabot or Tether	☺Pass ☹Fail
No sharp edges	☺Pass ☹Fail
Alligator Clip covers (supplied with the kit) are installed on electrical contacts as appropriate	☺Pass ☹Fail
Point to fuse and state the size used	☺Pass ☹Fail
Team have a 12 volt power source only	☺Pass ☹Fail
Operations	
Team demonstrates forward and reverse operation of each propeller to ensure they are in proper working order	☺Pass ☹Fail
Design Compliance	
ROV fits inside the dimensions of 60x60x60 cm, including collection arm.	☺Pass ☹Fail
ROV weight including motors and camera is no more than 15kg	☺Pass ☹Fail
Team has a camera	☺Pass ☹Fail
If design modifications appear to approach the $100 allowable limit, team identifies that they have valid receipts to support the design modifications.	☺Pass ☹Fail
Pneumatics and hydraulics meet the requirements detailed	