Survey of the Coronation Wreck's Cannon and Best Bower Anchor

FCD Project Report, 8-9 June 2019

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Introduction

The project task for the First Class Diver exam dated 8-9 June 2019 was to survey portions of the protected wreck site of HMS Coronation. There were two specific tasks:

1. As part of a continual monitoring project, survey and record the current state of the corrosion fins on the cannon at the Offshore Site
2. Survey and record the recently located large longshank anchor believed to be the “Best Bower Anchor” that was being deployed when the Coronation foundered.

This report details how the survey was performed and the results of the surveys.

History of the Coronation

Sources:

http://www.coronationwreck.org/history.html

http://www.promare.co.uk/ships/Wrecks/Wk_Coronation.html

https://www.submerged.co.uk/coronationandpenleecannons/

https://www.jssadc.org/2019-js-diving-safety-conference/

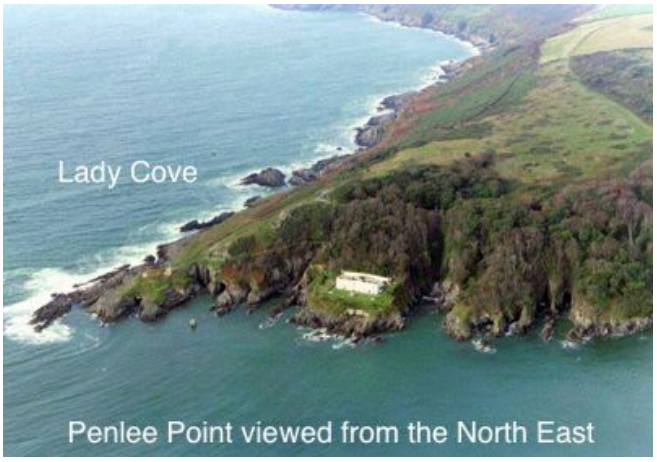
The history of the Coronation starts in 1677 when Charles II requested the reformation of the Navy, known as the Thirty Ships Programme. It was initiated by Samuel Pepys and sanctioned by an Act of Parliament, which allowed for an amount in excess of £600,000 for building one new 1st Rate ship of 1,400 tons, nine 2nd Rate ships of 1,100 tons and twenty 3rd Rate ships of 900 tons all to be completed within two years.

The keel of the Coronation was laid in 1680, the works having been suspended shortly after this date due to lack of money and building materials, were not restarted until 1684, when the rotten keel and the other timbers had to be replaced. The construction of the Coronation took place in Portsmouth and was led by master shipwright Isaac Betts. The launching took place on the 23rd May 1685 and was christened the Coronation in honour of the coronation of the catholic monarch James II. In 1688 James II was deposed by protestant king William III, who in 1689 commissioned the Coronation to service.

The Coronation was one of the nine 2nd rate ships. It boasted 3 decks with a total of 94 guns. The length of the main gun deck was 160ft 4in (48.9m), the beam was 44ft 9in (13.6m) and the tonnage was 1345 long tonnes. The Coronation should have sailed with a full ship's complement of 660 officers and men, however, due to manpower shortages it is likely that she was sailing with a smaller crew, probably managing with up to 100 men less than she needed.

In 1690, the Coronation took part in the Battle of Beachy Head as the flagship of Sir Ralph Delavall, Vice Admiral of Blue Squadron, which was heavily engaged with the French. In 1691, under the command of Captain Charles Skelton, she was part of the channel fleet patrolling the southern approaches to the English Channel under Admiral Russell. Against Russell's advice, the Admiralty kept the fleet at sea without refit. On the 1st September 1691 the Coronation was ordered to seek shelter in Torbay due to increasingly bad weather conditions. On the 3rd September 1691 high wind strengthened to a full gale blowing from SSE and the Admiral gave the order for the fleet to seek limited shelter in Plymouth Sound. Unfortunately, some of the fleets ships, including the Coronation, could not round Penlee

Point and were forced to anchor offshore. While anchoring, the Coronation started to ship water causing her to list heavily. One source believes in an attempt to save the vessel the captain ordered the crew to cut the masts to help bring the ship upright. Tragically the plan failed and the ship capsized with all crew on board. Sources vary with regard to the number of survivors but it is considered to be in the region of 17-23 crewmen.



Penlee Point viewed from the North East

The remains of the Coronation lay undiscovered until 1967 when Plymouth divers Terry Harrison, Alan Down and George Sandford found iron guns on the seabed close to Lady Cove just West of Penlee Point. This site is now known as the Inshore Site. Ten years later, in 1977, many cannon and several anchors were found 0.4M south west of Lady Cove soon followed by a pewter plate with the Skelton coat of arms engraved on it. The finding of the plate played a fundamental part in identifying the site as the Coronation. This area is known as the Offshore Site. The Coronation's bell was recovered in the same year and is now in the possession of the Coronation Group.

The sinking of the Coronation is considered the worst shipping disaster within the Plymouth area and for this reason, in 1978, the Inshore Site became one of the first wreck sites to be designated under the Protection of Wrecks Act of 1973. The Offshore Site was designated later in 1985.

In 2007 the Coronation Wreck Project Group, working with archaeologists, started to further the work of those who discovered the wreck and those who have looked after, protected and revealed some of its secrets over the years. On the 16th April 2011 the diver trail was opened to divers and as a result new artefacts are being located and mapped within the Offshore Site and beyond.

Project and Day Planning

The team split itself into the roles shown in Table 1 to expedite the planning process on the evening before the surveys. In addition to tasks around the survey project itself the team had to consider additional constraints imposed by the requirements of the First Class Diver exam

for various team members to exhibit certain roles and skills during the day, total duration and a given time for a hard stop.

Role	Who	Responsibilities
Day Manager	Gillian Bell	Assign planning teams. Coordination of information exchange between teams.
Logistics Plan		
Day plan	Nick Barter	Weather, tidal data, depth, overall day plan
Roles assignment	Mark Lovesey	Dive teams, roles & responsibilities, dive plans
Boat plans	Bart Wągrowski	Site location, passage plans, boat logistics
Project Execution		
Team member	Scott Morgan	Methods, Cannon slates and dry run
Team member	Phil Page	Methods, equipment
Team member	Chris Wilson	Methods, Anchor slates and dry run

Table 1. Planning Roles and Responsibilities

Details of the project execution including the methods used at each of the two sites, the results recorded, and an evaluation of the project with potential follow ups are included in individual sections following this Project and Day Planning section. The rest of this section provides more detail from the Logistics Plan team.

Site Location

What is thought to be the Coronation's Best Bower anchor was identified in 2018 on Elk Reef some 0.8M ESE of the Inshore Site. The Inshore Site lies at a bearing of 313°(T) from the anchor which is consistent with the theory of the Coronation Project Group that the Coronation parted from its anchor in a severe South East gale and was then blown onto the shore at Lady Cove, probably already capsized, where it broke up. A section is then thought to have drifted with the change of tide and wind to the location of the Offshore Site where it finally foundered. The cannon survey was located at this OffShore Site. This site is approximately 0.9M from the Anchor Site at a bearing of 280°(T). It is about 0.4M from the Inshore Site which lies at a bearing of 040°(T) from the Offshore Site.

Anchor Site Position: 50° 18.471N 004° 10.694W

Cannon Site Position: 50° 18.628N 004° 12.077W

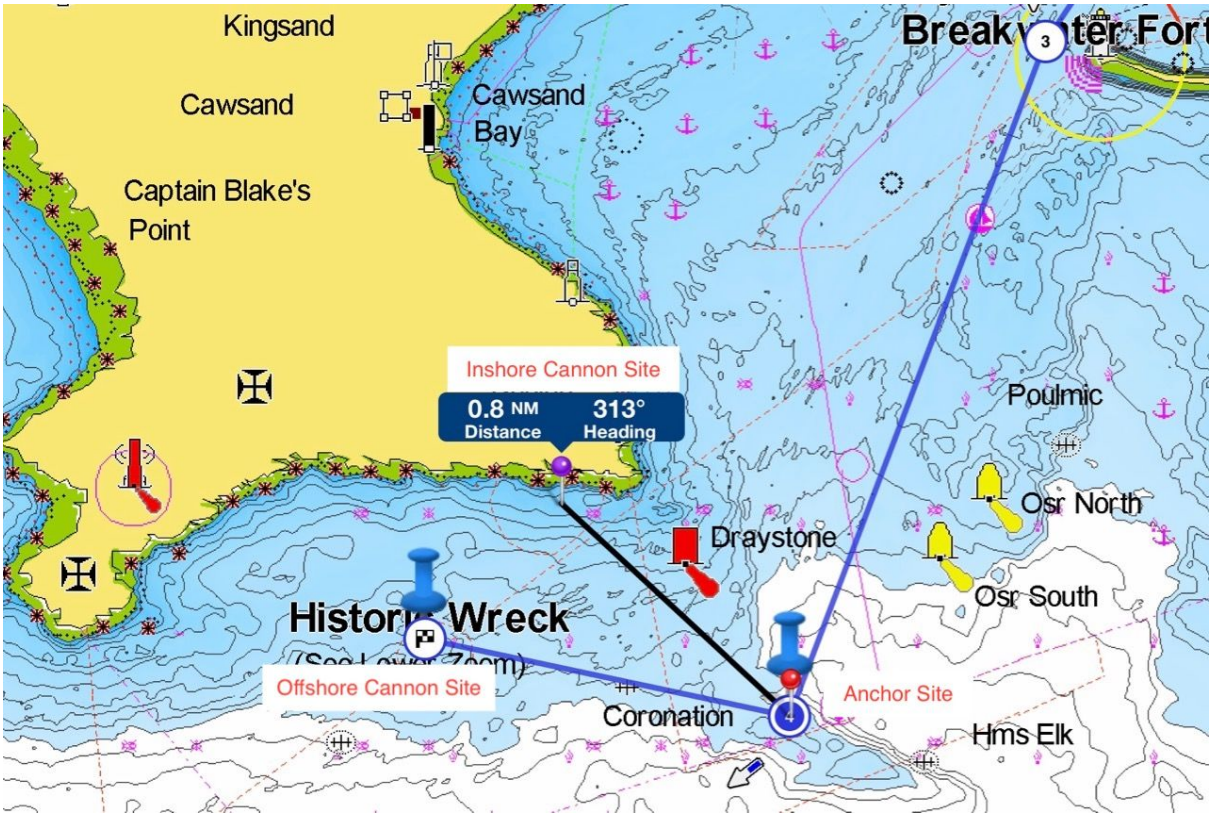


Figure 1. Position of Survey Site (Chart Source: Navionics Boating App)

Figure 2. Passage Plan (Chart Source: Navionics Boating App)

Passage Plan

The sites are only 4M from Mountbatten Pontoon which was the base for the project. Taking into account speed restriction zones until just beyond the Mountbatten pier and with a conservative speed assumption of 20kn through Plymouth Sound a conservative estimate of 16 minutes was calculated to site. The return was planned as a reciprocal, though as there were exam skills to be completed after the project it was not used. Anywhere within Plymouth Sound the return leg would be no more than 20 minutes and is easily achieved through pilotage. The written Passage Plan is shown in Appendix 3.

Day Roles & Responsibilities

Day roles and responsibilities were primarily assigned for the needs of the First Class Diver exam rather than the survey project. Of course, the day managers, dive managers and cox'n were then responsible for delivering the project diving. Table 2 below lists the roles and responsibilities. The slates used for the day are shown in Appendix 1 Dive Plans.

Role	Anchor Site	Cannon Site
Day Manager	Gillian Bell	Mark Lovesey
Clidive Yellow		
Dive Manager	Gillian Bell	Nick Barter
Assistant Dive Manager	Nick Barter	Gillian Bell
Cox'n	Phil Page	Scott Morgan
Assistant Cox'n	Scott Morgan	Phil Page
Clidive Blue		
Dive Manager	Mark Lovesey	Chris Wilson
Assistant Dive Manager	Chris Wilson	Mark Lovesey
Cox'n	Chris Wilson	Bart Wągrowski
Assistant Cox'n	Bart Wągrowski	Chris Wilson

Table 2. Day Roles and Responsibilities

Survey Teams & Dive Plan

In initial project planning it was hoped to do three dives on the Cannon Site and one dive on the Anchor Site. With day timings, calculated tidal restrictions and the need to share roles for the First Class Diver exam, the plan was changed to performing two dives on the Anchor Site and two dives on the Cannon Site. The detailed slates used on the day are in Appendix 1 Dive Plans. They include weather predictions and anticipated risk factors for dive briefings.

Candidates took the roles of dive leader. Where more than one candidate was on the same dive team they agreed together how to share the dive leading responsibility.

Anchor Site: Charted depth ~20m with ~ 4m of tidal height and flood tide ~0.5kn	
Clidive Yellow locates and shots, and recovers shot after dives are complete	
Survey Team 1 on Clidive Blue	
Chris Wilson	Candidate
Sophie Rennie	Examiner
Survey Team 2 on Clidive Yellow	
Nick Barter	Candidate
Phil Page	Candidate
Ginge Crook	Examiner
Mark Wilson	Observer
Cannon Site: Charted depth ~15m with ~4.7m of tidal height and HW slack < 0.5kn	
Clidive Blue locates and shots, and recovers shot after dives are complete	
Survey Team 3 on Clidive Yellow	
Gillian Bell	Candidate
Scott Morgan	Candidate
Wynne Evans	Examiner
Survey Team 4 on Clidive Blue	
Mark Lovesey	Candidate
Bart Wągrowski	Candidate
Mike Thomas	Examiner

Table 3. Survey Teams

Each dive team determined dive time and expected deco obligations based on dive gas and computer settings. A maximum time of 60 minutes to surface was imposed allowing plenty of time to perform project tasks. At the Cannon Site in 20m diving with nitrox 27% or 32% enabled full use of the maximum time to surface with decompression obligations <5 minutes.

Even on the deeper Anchor Site bottom times of 45 minutes were possible using 32% nitrox with a deco obligation of only 5 minutes (Bühlmann ZHL-C+GF 50/85). Gas carried was more of a limiting factor. One of the teams had a single cylinder diver and ran a dive time of 40 minutes. The other had divers on 27% nitrox and ran dive times of 50 mins.

Depths were checked by sounder once shots were in place.

Dives were planned to be as concurrent as possible with the first team on each site to signal they were on the site. The second dive team was to enter the water as soon as possible on confirmation from the first team. If a site could not be found the first team would surface immediately to enable the shot to be repositioned.

Individual team tasks are detailed in the project method sections later in the document.

Tides and Slacks

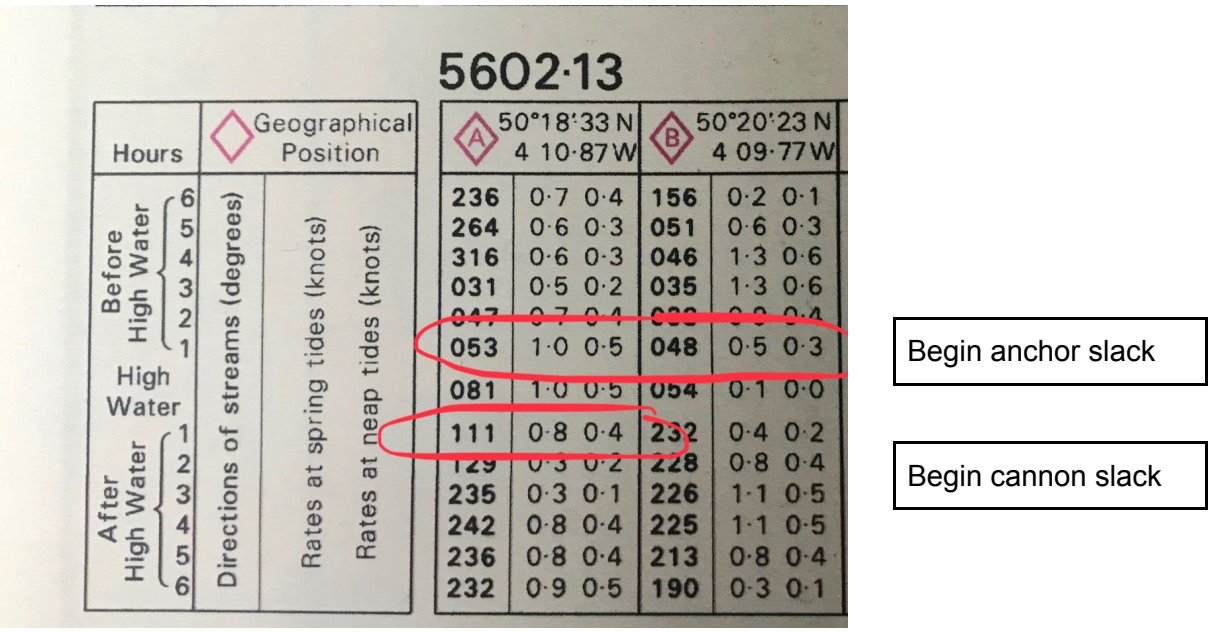
Tide times for the project dives on Sunday 9th June 2019 (BST):

HW Plymouth (Devonport) 1110H 4.7m

LW Plymouth (Devonport) 1710H 1.5m

The anchor site is located on Elk Reef about 0.3M WNW of the wreck of HMT Elk. Although geographically close to Tidal Diamond A (Admiralty Chart 5602.13) the Elk wreck to the North of Elk reef is influenced by the tidal stream in and out of Plymouth Sound via the Western entrance of the Breakwater represented by Tidal Diamond B (Admiralty Chart 6502.13). This is because of the local topography including Elk Reef. It was assumed the Anchor would also be influenced by Tidal Diamond B. From 1.5 hours before HW Plymouth Diamond B shows diveable tidal rate (<=0.5kn) on Springs and Neaps whereas Diamond A is still at its peak rate of 1.0kn on Springs and 0.5kn Neaps. As Sunday 9th was mid-way between Neaps and Springs it was determined the Anchor would be diveable from 1.5 hours before HW Plymouth with the stream rate falling during the dive. Therefore diving could commence at 0940H at the earliest at the Anchor Site.

The tidal streams at the Cannon Site are represented by Diamond A (Admiralty Chart 5602.13). It is diveable at all states at Neaps but can have stronger currents at Springs. Being mid-cycle it was determined the stream would slacken sufficiently by half an hour after HW Plymouth to a rate of 0.6kn or less and would slacken further as dives progressed. Therefore diving could commence at 1140H at the Cannon Site.



5602·13

Hours		Directions of streams (degrees)	Rates at spring tides (knots)	Rates at neap tides (knots)	A 50°18·33 N 4 10·87 W		B 50°20·23 N 4 09·77 W	
Before High Water	6	236	0·7	0·4	156	0·2	0·1
	5	264	0·6	0·3	051	0·6	0·3
	4	316	0·6	0·3	046	1·3	0·6
	3	031	0·5	0·2	035	1·3	0·6
	2	047	0·7	0·4	032	0·9	0·4
	1	053	1·0	0·5	048	0·5	0·3
High Water		081	1·0	0·5	054	0·1	0·0
After High Water	1	111	0·8	0·4	232	0·4	0·2
	2	129	0·3	0·2	228	0·8	0·4
	3	235	0·3	0·1	226	1·1	0·5
	4	242	0·8	0·4	225	1·1	0·5
	5	236	0·8	0·4	213	0·8	0·4
	6	232	0·9	0·5	190	0·3	0·1

Begin anchor slack

Begin cannon slack

Figure 3. UKHO Tidal stream data from Admiralty Chart 5602.13

Dive Platform

The project had access to two RHIBs provided by Clidive BSAC 0410. Clidive Blue is a 6.5m XS Ribs boat with a 200HP 4-stroke engine capable of carrying 8 divers in comfort. Clidive Yellow is a 7m XS Ribs boat with a 225HP 4-stroke engine capable of carrying 10 divers in comfort. Both boats are equipped with DSC VHF radios, chartplotters, depth sounders, and full safety equipment including oxygen and first aid kits. The RHIBs are powerful and capable of speeds well in excess of those used for planning even when fully laden.

Day Plan

Taking into account the project requirements and the requirements of the First Class Diver exam the day plan was created with 6 hours allowed between the day brief (0800H) and the day debrief (1400H). Key aspects of the plan are shown in Table 4. The full written plan from the day is shown in Appendix 2 Day Plan.

Time (BST)	Item
0800	Day Brief
0810	Dry Run
0840	Drysuits and final boat loading
0855	DM and Cox'n briefings
0900	Ropes Off
0915	Arrive at Anchor Site
0925	Shot in by Clidive Yellow
0930	DM Site Briefings
0945	Divers in Blue first (1), Yellow second on signal (2)
1045	Recover divers
1100	Shot recovered by Clidive Yellow
1110	Arrive Cannon Site
1120	Shot in by Clidive Blue
1125	DM Site Briefs
1140	Divers in Yellow first (3), Blue second on signal (4)
1240	Recover divers
1300	Shot recovered by Clidive Blue
1320	Arrive Mountbatten (note, expected to be later than this for other FCD skills to be performed after diving)
1400	Day de-brief
1500	Initial project presentation in classroom

Table 4. Day Plan

Anchor Measurement Method

Goal

Obtain high quality measurements of a recently located longshank anchor. This anchor is believed to be the “Best Bower” anchor that was being deployed when the Coronation foundered. It is not known exactly when the ship parted from the anchor.

Dive Logistics

Two teams of divers were deployed. Survey Team 1 were briefed to dive as soon as the shot was in and Survey Team 2 were briefed to kit up and wait for a yellow DSMB to signal that the anchor had been located.

Survey Team 1 Tasks

1. Locate anchor using circular search if required. Move shot to anchor if required.
2. Signal boat that anchor is located using a yellow self-closing DSMB with no line attached
3. Primary objective 1: Measurements of the flukes before Survey Team 2 arrives
4. Secondary objective 1: Shank circumference measurements before Survey Team 2 arrives
5. Primary objective 2: Measurements of end of the shank top enabling concurrent work with Survey Team 2 by working at different ends of the anchor. Note this was an optional requirement in the task but given two survey teams were sent to the anchor this was made a primary task for Survey Team 1.
6. Secondary objective 2: Dive in direction of inshore site 330°(T) to investigate possible debris trail

Survey Team 2 Tasks

1. Put air in shot lifting bag
2. Primary objective 1: Measurements of crown and flukes once Survey Team 1 has cleared this end of the anchor.
3. Primary objective 2: Measurements of shank circumference
4. Secondary objective 1: Measurement of spades and overall anchor length
5. Secondary objective 2: Dive in direction of inshore site 330°(T) to investigate possible debris trail

Tools

Each team were issued with the following tools and technique guidance:

- Pre-drawn slate with required measurements

- Tape measure (2 tape measures for Survey Team 2)
- Use tape to communicate “rope” signals if visibility was bad
- Yellow DSMB for signalling (Survey Team 1)
- Spare reel for circular search (Survey Team 1)

Measurements

The Coronation Project’s standard anchor measurement form was used for Survey Team 2’s measurements. Slates for the other measurements of the flukes and head of the anchor were created for Survey Team 1. Images of the slates are in Appendix 5.

Survey Team 1 Measurements

The measurement technique employed was as follows:

1. Dive leader selects measurement to undertake and indicates this on the slate to the other divers
2. Diver 2 holds end of tape at start of measurement
3. Dive leader swims to end of measurement with tape
4. Dive leader ensures tape is correctly positioned and notes measurement
5. Dive leader signals (using rope signals if necessary) to diver 2 that the measurement is finished and moves onto the next measurement

These measurements were fairly straight forward, requiring no extra processing while underwater. Survey Team 1’s detailed shank top measurements are shown in Figure 5.

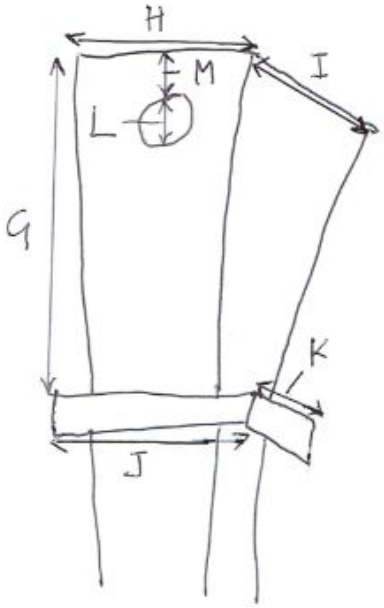


Figure 5. Team 1 Anchor Measurements

Survey Team 2 Primary Measurements

Team 2's primary measurements required more complex processes. As an illustration the measurements A1, A2, and A3 were recorded as follows:

- Dive leader indicates to Diver 3 to hold tape end where the anchor arm meets the anchor shaft to make angle A1:A2.
- Dive leader measures distance A1 to the beginning of the fluke and records it
- A2 is the same length as A1 but along the shaft of the anchor. The dive leader measures this and indicates its position on the shaft.
- Diver 2 gives the dive leader the end of the second tape to hold at this location and proceeds to measure the distance A3 back to the beginning of the fluke.
- Diver 2 returns to the dive leader and indicates the distance to record.
- Repeat for the B, C and D set of measurements.

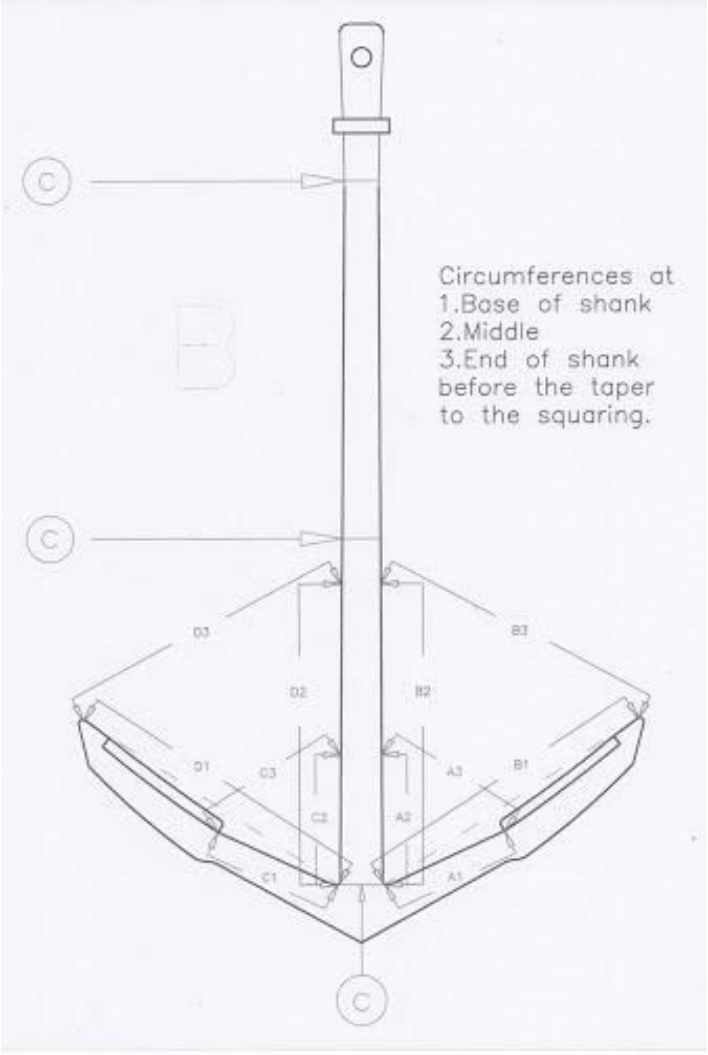


Figure 6. Standard Anchor Measurements

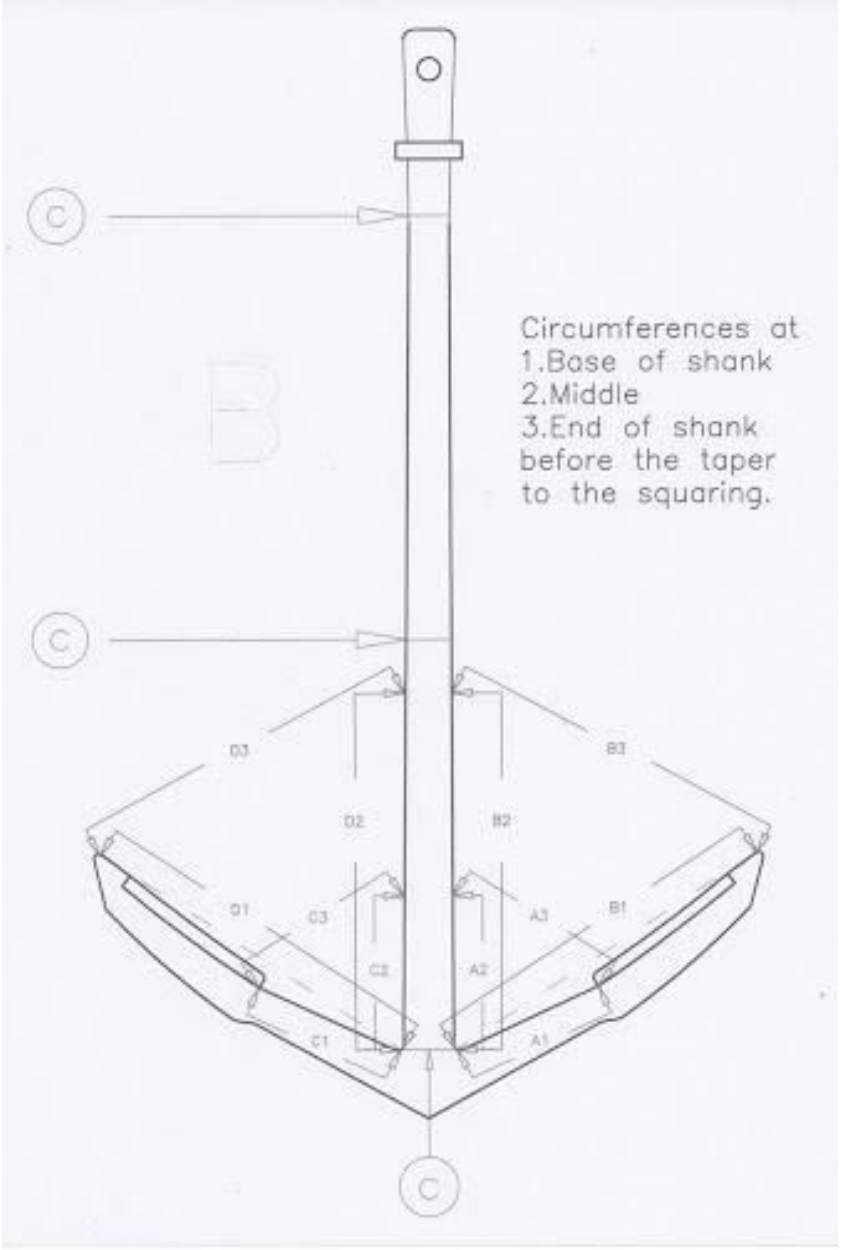
Survey Team 2's secondary measurements used the same techniques as Survey Team 1.

Anchor Measurement Results

The teams were given 2 sets of requirements for measurement of the anchor - Required and Optional. All were achieved.

Required Measurements

The Required measurements are listed on a standard template from the Coronation Wreck Project and relate primarily to the geometry of the flukes in relation to the shank:



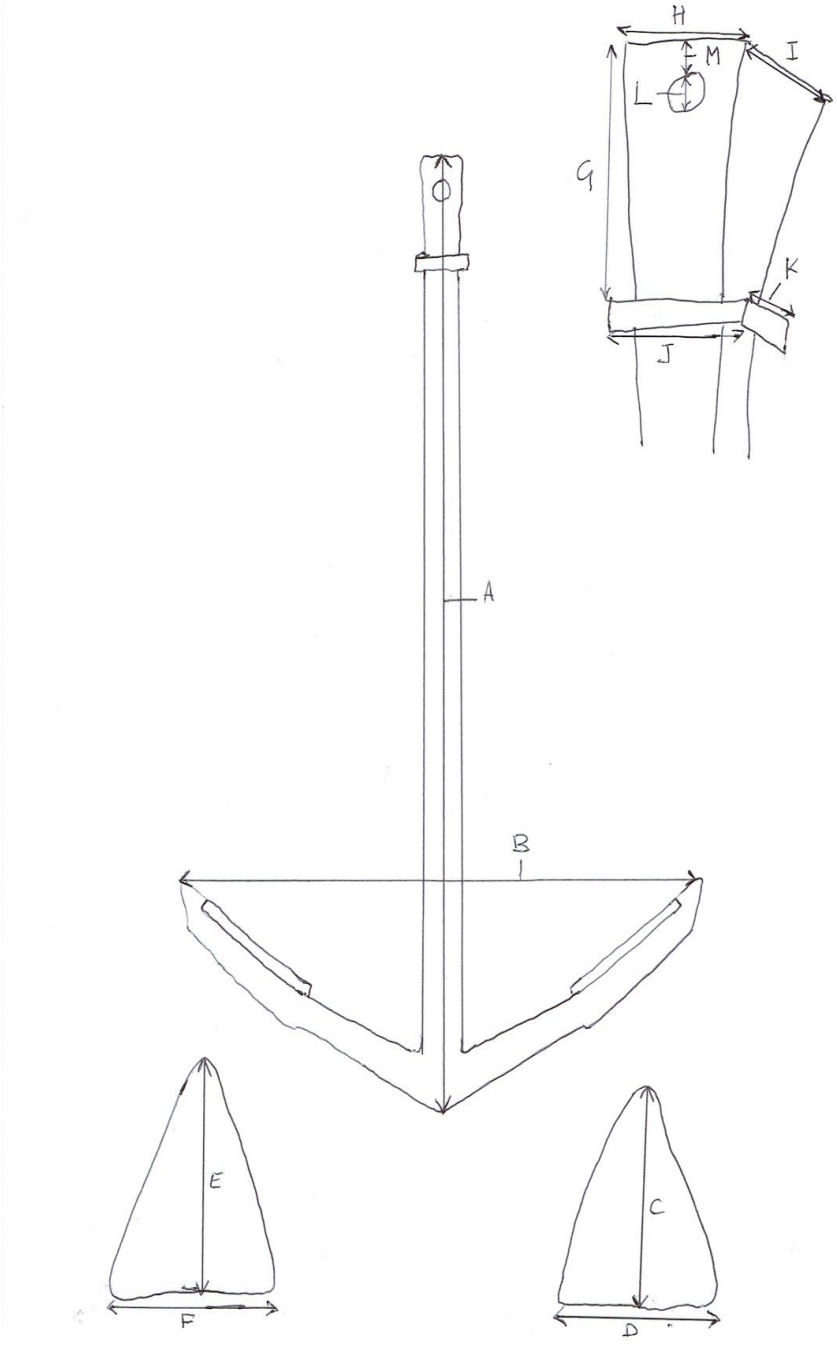
Detail	Length (cm)
A1/A2	53
A3	78
B1/B2	157
B3	167
C1/C2	72
C3	78
D1/D2	164
D3	158
C Top	66/66*
C Middle	72/70*
C Crown	86/85*

*: Teams 1 & 2 both measured the C details - 72/70 means team 1 measured 72cm and team 2 measured 70cm

Figure 7. Required Anchor Measurements

Optional Measurements

The Optional measurements are dimensions of the whole anchor, its flukes (spades) and the shank top or head of the anchor:



Index	Detail	Length (cm)
A	Total length	511
B	Fluke tip to fluke tip	294
C	Right spade length	91
D	Right spade width	77
E	Left spade length	94
F	Left spade width	74
G	Shank top length	41
H	Shank top width	21
I	Shank top height	18
J	Collar width	25
K	Collar height	25
L	Eye diameter	10
M	Eye from top	14

Figure 8. Optional Anchor Measurements

Cannon Measurement Methodology

Planned Methodology

Teams were tasked with conducting measurements on corrosion fin growth for each cannon at the offshore wreck site. These measurements were to be completed to form a basis for a non bias comparison with previous fin growth reports.

Survey Team 3 tasks:

1. Locate Station 1 with circular search if necessary
2. Move shot to Station 1 for Survey Team 4 and signal complete
3. Survey Station 3,6,8, and 10

Survey Team 4 tasks

1. Survey Station 2, 4, 7, and 9

Stations 1 and 5 were not to be surveyed as they contain anchors and not cannon. The westerly cannon at station 7 was also not to be surveyed due to its inaccessibility.

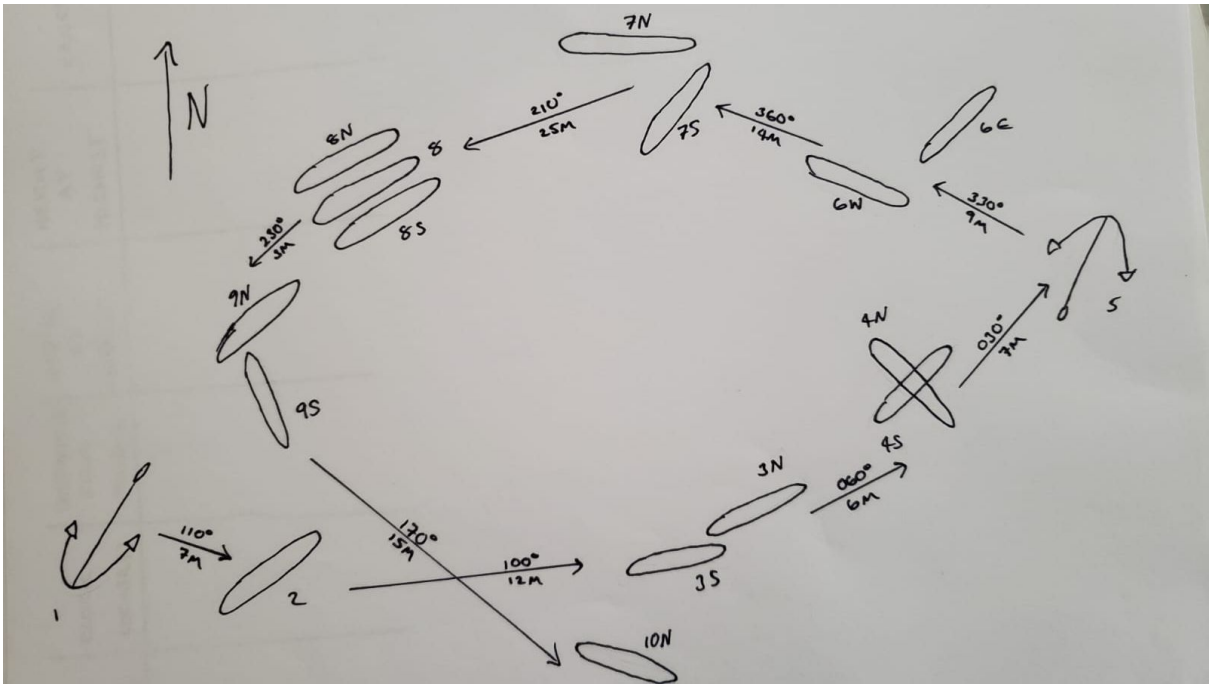


Figure 9. Outline of Offshore Site showing cannon locations (not to scale)

Both teams were provided with a tape measure and slate. One side of the slate contained a site map (Figure 9) with the other containing a measurements table (Figure 10). Once located, each cannon was to be surveyed for corrosion fins. One diver was to swim with the zero end of the tape whilst the other diver was to hold the tape and note down the measurement on the slate. The third diver was to manage time, decompression, group

safety and navigation if divers one and two became disoriented during measurements. Measurements were to be taken in centimeters and labelled as follows: Cannon number, clock location, distance from muzzle, width at widest, height at highest, length.

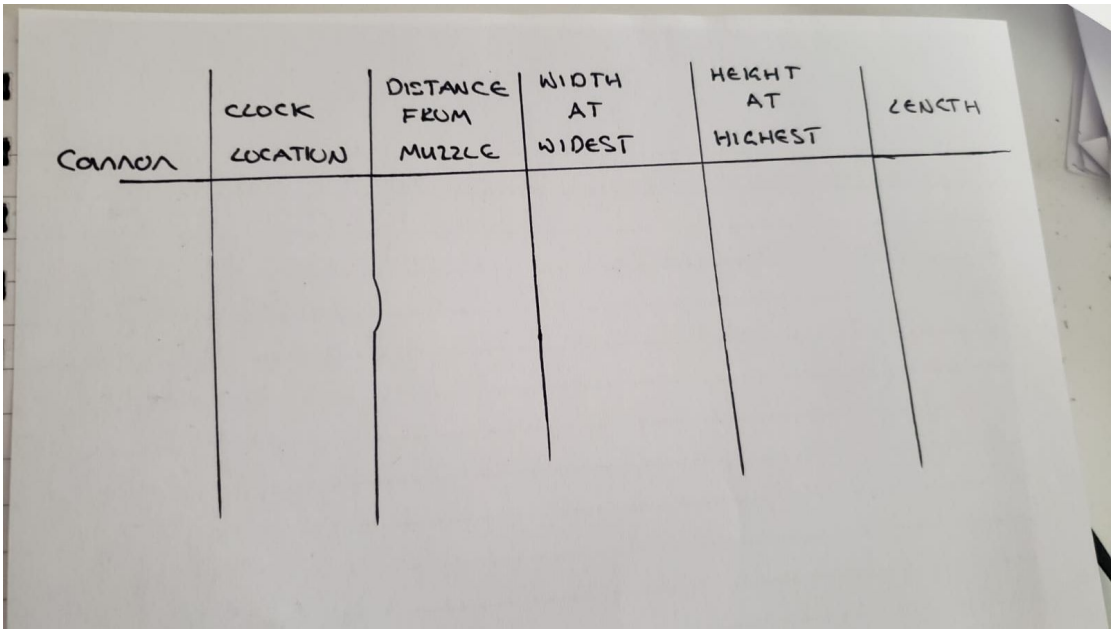


Figure 10. Required measurements of the cannon

Cannon Number refers to the number of cannon as shown on site map. These were further divided within each station using cardinal points to identify each individual cannon. An example of this is 3N and 3S as seen in Figure 9. Clock location refers to the orientation of corrosion fins found on the cannon. Surveyors were to look down the length of the cannon facing the muzzle. The highest point of the circumference of the cannon would then be marked 12 and followed from 1 through to 12 clockwise like a clock face. The approximate location of the corrosion fin would then be noted against this clock face. Distance from muzzle was used to identify where along the length of the cannon the corrosion fin was growing. The distance was measured from the muzzle to the start of the corrosion fin. This was the area where the cannon surface started to rise or change to orange in colouration. Width at widest was used to identify the measurement at widest point of the corrosion fin. This did not necessarily have to be from the base of the fin and was around the circumference of the cannon. Height at highest was to be measured from base of corrosion fin at cannon's surface to the highest point the corrosion fin grew to approximately perpendicular to the cannon's surface. Length was the total length of the corrosion fin from the closest point to muzzle to closest point to breech.

These measurements were to be collated on the slate until half of the slate was completed or the time/gas constraints were reduced to half. At which point the responsibilities would be switched within the survey team. Cannon were to be surveyed to completion before moving onto the next station. Quality data for a single cannon was prioritised over incomplete data of many cannon. Results of fin measurement were to be compiled to enable comparison with previous reports conducted to gauge corrosion fin growth.

The pictures below (credit: Nautical Archeological Society website) show how the cannon appear on the seabed and an active corrosion fin with its orange colour:

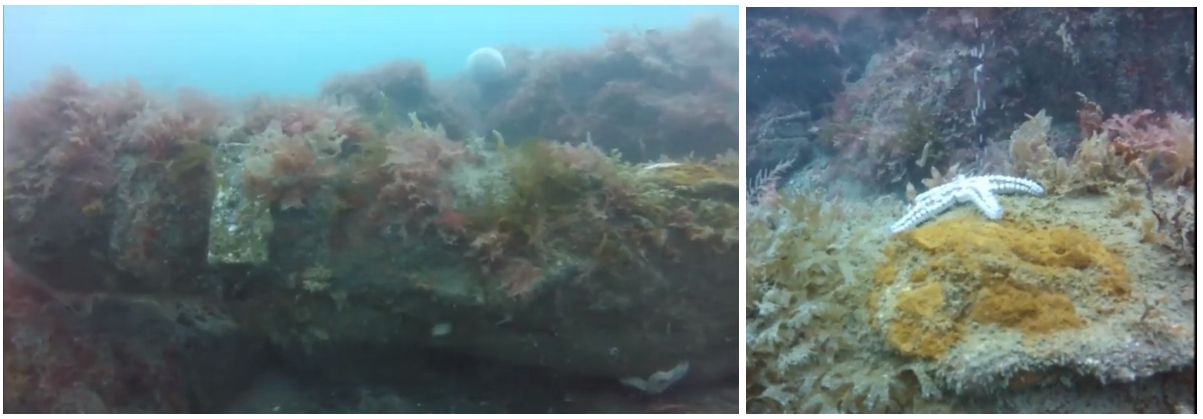


Figure 11. How the cannon look on the seabed (left), Bubbling active corrosion fin (right)

Conducted Methodological Differences

Due to time constraints both survey teams descended the shot within a very short time of one another. This caused Survey Team 3 to be unable to move the shot before Survey Team 4 arrived. Survey Team 3 proceeded with a circular search. The search concluded with the location of station 1 being located SE of the shot. From station 1 a compass was used to find cannon station 2. This cannon was surveyed.

Site orientation was more time consuming and confusing than initially planned for. Station markers were covered in barnacles meaning it wasn't possible to determine which station number they were. It was also difficult to discern one station from another as cannon from one cluster were sometimes near cannon from another cluster. Survey Team 3 chose to start surveying the stations they were closest to rather than being selective of which stations to survey. This was performed to save time and maximise data collection. Sketches were made of cannon orientations on the slate to enable the cannon stations to be identified once back on the surface. From this it was concluded that the cannon station thought to be 4, was in fact station 9. Additionally station 3 was surveyed.

Survey Team 4 moved in an Easterly direction from the bottom of the shot towards cannon Station 3 and performed a survey. From here they were unable to locate any further stations. This reduced the data they were able to collect.

Cannon Measurement Results

Survey Team 3 found a single corrosion fin was found on each cannon surveyed. No additional corrosion fins were found on any of the cannon surveyed. All of the corrosion fins found were active.

Survey Team 4 found 1 active corrosion fin on the two cannon they surveyed. They also passed cannon site 2 but didn't survey it as it wasn't allocated to them.

The table below shows the results of the cannon surveys.

Cannon	Location on clock	Distance from muzzle - cm	Width at widest point in cm	Height at highest - cm	Length - cm
2	11	255	11	7	40
9N	10	145	6	6	32
9S	8	210	12	5	20
3S	12	218	13	2	19
3N	1	229	3	1	13
4S	2	150	1	1	30
4N	1	186	4	3	39

Table 5. Results for corrosion fin measurements

Figure 12 shows the correlation between length and width of the corrosion fins.

Figure 12. Correlation of fin width and length

Figure 13 shows the correlation between length and height of the corrosion fins.

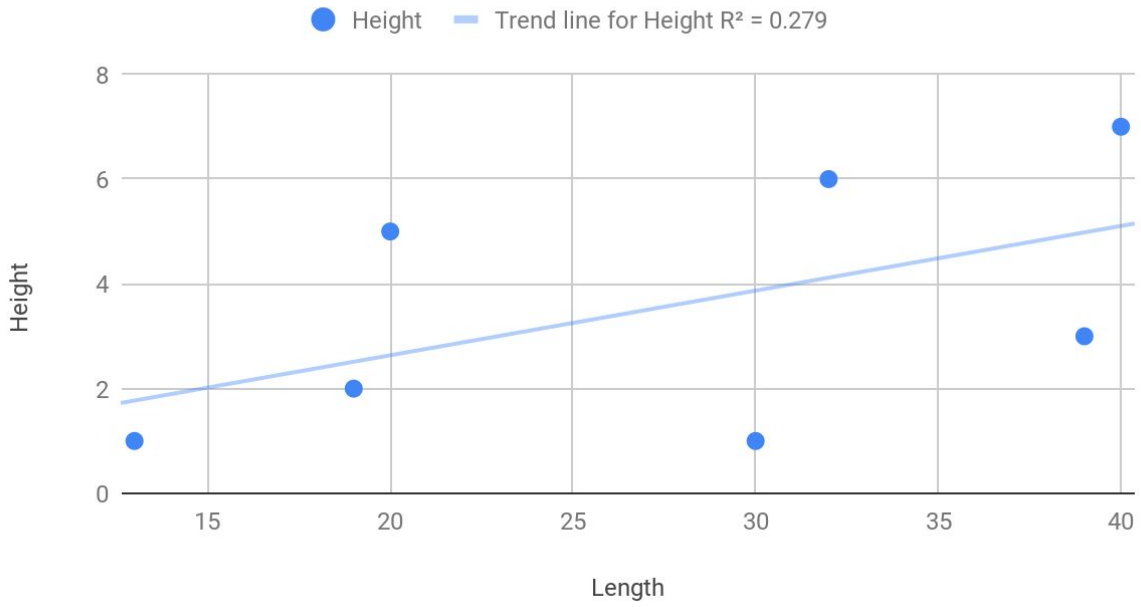


Figure 13. Correlation of height and length

There is a stronger correlation between height and length (R2=0.279) of the corrosion fins than there is between width and length (R2=0.013) of the corrosion fins.

Evaluation of Project Methods and Results

Summary evaluation of the project results:

1. 3 dives out of 4 achieved good data for the Coronation Wreck Project.
2. A full set of measurements was achieved for the Anchor Site with some dimensions duplicated for corroboration.
3. Data was collected from 7 cannon out of 17 at the Offshore Site.

Key learning points:

1. Orientation dives are a valuable tool to improve project data capture especially for divers unfamiliar with a site requiring navigation.
2. Orientation dives can also ensure the best tools for the job are selected.
3. A dry run should take into account the scale of what the divers will face in addition to the techniques and order for the performance of tasks.

Anchor Site Project Evaluation

All measurements of primary and secondary objectives were achieved. The key reasons for this success were:

- The marks provided to the project team were very accurate and the shot landed right next to the anchor. Team 1 did not have to search for the anchor or move the shot. A signal was sent quickly for Team 2 to enter the water.
- Plan times were good for tidal streams and the dive teams benefitted from very good visibility and decreasing current over the hour of diving.
- The site is finite in size (anchor length 5.1m) and so the teams could focus on taking many measurements without having to search for additional sites.
- Having 2 teams on the anchor was imbalanced in favour of the Anchor Site compared to the Cannon Site in terms of total available survey time.
- Dry runs had given the dive teams a good idea of the techniques for the tasks to be performed underwater and they were efficient in taking primary measurements enabling secondary measurements to be carried out.
- Equipment was appropriate for the project.
- Team 1 was completing its measurements when Team 2 started taking their measurements at the opposite end of the anchor.
- Dive communications and time awareness were good so the dives were adapted to maximise the data gathering.
- Team 1 finished their measurements with time to take a bearing and follow the potential debris trail towards the Inshore Site. They took the briefed bearing of 330°(T).

There were some learnings before, during and after the project:

- Team 1's initial dry run technique was awkward with the slate attached to the tape measure so this was changed during the dry run and worked successfully underwater.
- Team 2 noted that they were not sure of the expected dimensions of the anchor during the dry run and therefore were guessing as to how long the measurements would take. The anchor mock-up was not to scale and so could not be used to mimic actual movements. It would have been better to have a firm understanding of the potential size of the anchor for a ship of Coronation's size.
- An orientation dive would have helped with some of the unknowns if there had been time and for more complex future project developments such as photo-mosaic of photogrammetry this would be necessary.
- The briefed bearing toward the Inshore site for the possible debris trail appears to have been transcribed incorrectly. The bearing from the anchor to the Inshore site is 313°(T). 330°(T) would eventually take divers to the East of Penlee Point instead of the West where the Inshore Site is located. Team 1 found lots of modern debris on their 330°(T) bearing.
- Being able to take photographs of the site could have been more useful to this stage of the project than making a high level search over a potential debris trail.

Cannon Site Project Evaluation

Seven cannon were assessed out of seventeen on the site. Corrosion fins were recorded on seven cannon. Team 3 recorded one corrosion fin on each of the seven cannon they

surveyed. Useful data has been gathered for the Coronation Wreck Project. Ideally more would have been gathered.

The reasons why good data was captured are thought to be:

- One candidate in Team 3 was already familiar with the site and after a circular search to pick up the site from where the shot landed put the team on a group of cannon that could be surveyed.
- Although Team 3 were not immediately aware which cannon they were surveying they made the correct decision to measure what they were looking at noting position and orientation of the cannon so they were able to confirm which cannon they had surveyed on returning to the surface.
- Team 3 also dynamically changed their dry run techniques underwater to improve the efficiency of their data capture. They preferred one team member to write measurements while one actively measured and one held the SMB and monitored for safety aspects of the two active divers.

There were some common challenges both teams faced and other learnings taken on board by the overall project team:

- Team 4 were not familiar with the site could not orientate themselves sufficiently. An orientation dive would have been very beneficial to both teams but particularly Team 4 who had no direct experience of the site. Unlike the compact Anchor Site the Cannon Site requires movement between stations to perform a complete survey.
- Team 4 followed a bearing from their first station to their intended second station but did not find the second station. They tried to trace a reciprocal but ended up off the site. Potentially a circular search from where they initially realised they were off the site would have reconnected them with the site.
- Both teams on the cannon site appeared to have issues with their compasses possibly caused by the presence of ferrous metals.
- It was noted that the underwater Coronation Project station markers at each station were encrusted with marine growth and difficult to read which caused positional uncertainty in Team 3 even when on the site.
- Ideally a third team of divers would have been on the site to increase the number of cannon surveyed, the total available survey time imbalance that worked in favour of the Anchor Site worked against the Cannon Site.
- Measurements of the corrosion fin dimensions was not easy with the large tape measures used. A folding rule and/or callipers would probably have been easier for measuring fin height and width. Again an orientation dive if there had been time could have identified this.
- Team 3 had the longest dive to maximise the number of measurements they made. They surfaced at 63 minutes which was over the agreed time. This highlights how easy it is to become task fixated on a project dive. They realised the situation and deployed a DSMB in addition to the SMB they had dived under to indicate they were on the way back up without incident.

Overall Project Evaluation

The complete set of primary and secondary target measurements taken at the Anchor Site offset the incomplete survey of the Cannon Site. The dive planning worked well given the constraints of the day and the teams were onsite at the correct times and diving at the best times for each site. In addition to the project dives all other elements of the First Class Diver exam were able to be assessed.

It is clear had time allowed that, in addition to a third team of divers on the Cannon Site to provide sheer numbers, orientation dives would have improved the result, not just in terms of locating and identifying the cannon but also in understanding the best equipment for the survey of the corrosion fins.

An excellent online 3D virtual diver trail exists and this should be viewed by any divers wishing to gain an initial orientation of the site. It will not fully replace an orientation dive but gives a good idea of what to expect at the site. It can be found at two sites:

http://www.coronationwreck.org/tour.html

http://www.thisismast.org/projects/coronation-3d-virtual-trail.html

The one area that it is felt was really missing from the project day was the ability to take good quality photographs and video of the sites. However, this leaves room for developing the project further.

One important aspect of a project that should not be overlooked was that it was thoroughly enjoyable. All divers enjoyed contributing to the Coronation Wreck Project in both the planning and execution of the project.

Project Development and Recommendations

The site of the Coronation is generally well documented with excellent GPS coordinates and good transits provided by the licensee when an application for a diving license is successful.

On diving the cannon of the off-shore site, it was identified that the underwater marks had become encrusted by marine life, probably over the period of the winter when less activity and project work is done. Despite standing a metre proud from the seabed at each cannon station they can still be quite difficult to locate. It is suggested that the marks are cleaned at the commencement of the diving season for greater ease of transit between stations.

This could further be enhanced if a distance line is laid between each station for divers to follow. This would ensure that divers would be able to find the station merely by following the line rather than reliance on navigation which can always be challenging particularly if the visibility is poor.

Future Projects and Opportunities

The Coronation Wreck Project has teamed up with Historic England to conduct research. There could be an opportunity to engage with BSAC and bring the project to a wider audience of like minded divers. This could be achieved through a feature in BSAC magazine providing current up to date information and a link to the Coronation website to enable clubs to book onto the site via the diary, engage with the team and conduct research. Also the briefing on the Coronation that was delivered at the Joint Services Safety Conference in March 2019 could be given at the biennial BSAC Conference in October 2019 to raise awareness through those attending.

It is suggested that a list of potential project requirements is displayed on the Coronation Project website outlining tasks that the project team wish to be accomplished. This could encourage potential dive groups to understand how they can add to the project.

The Best Bower anchor site was newly discovered in 2018 and this would benefit from either a photomosaic or photogrammetry project to enhance the Coronation Project website and help divers can visualise the site prior to diving it.

Pink sea fans were found on the wreck site and divers could be requested to conduct Seasearch surveys in support of the ongoing project to gather information in the Plymouth area when they are diving the Coronation site.

The FCD team were very fortunate to have a custodian of the Coronation wreck as one of the assessors on the FCD exam. Whilst the project yielded invaluable information there is still much more to be gleaned and it is recommended that this activity is repeated by future FCD exams as both being challenging and enjoyable whilst enhancing the overall understanding of the wreck site.

Appendix 1 - Dive Plans

YELLOW

Dive planning sheet

CLIDIVE BSAC 410

Date	9 JUN 19		Day Manager	AM GILL PM MARK				Neaps/Springs	
Weather	6	9	12	15	18	Air times	Port	Times	Height
Strength	2/3	2	2/3	2/3	2		HW	11.10	4.7M
							LW	17.10	1.5M
Dir	SW	SW	SW	SW	SW	Slip times	HW		
							LW		

Hazards/Tidal streams			
0.5kn			
Contingency	50°19.768N 004°10.873W		
Coastguard FALMOUTH	VHF channels BOAT 77 LONGROOM 14	Speed limits 10 KNT SOUND	Mag variation 1°33W
Dive site 1 CORONATION		Slack 1140	Duration 4 HRS
Lat/lon ANCHOR 50°18.471N 004°10.694W CANON 50°18.628N 004°12.077W		Direction before 90°	Direction after 270°
DM/RM GILLIAN	ADM/ARM NICK	Cox'n SCOTT	Ass. Cox'n PHIL
Notes ANCHOR PAIR 1 CANON PAIR 2		Risk assessment done. 2 or 3 key risks (see RA section) VIS – SILT ENTANGLEMENT / SHARPS SEA CONDITIONS	
Pair 1 NICK, PHIL MARK, GINGE	Pair 2 GILLIAN, SCOTT WYN	Pair 3	Pair 4
Pair 5	Pair 6	Pair 7	Pair 8
Dive site 2 CORONATION		Slack 1140	Duration 4 HRS
Lat/lon 50°18.628N 004°12.077W		Direction before 90°	Direction after 270°
DM/RM NICK	ADM/ARM GILLIAN	Cox'n PHIL	Ass. Cox'n SCOTT
Notes		Risk assessment done. 2 or 3 key risks (see RA section)	
Pair 1 NICK, WYNN PHIL	Pair 2 GILLIAN, SCOTT GINGE, MARK	Pair 3	Pair 4
Pair 5	Pair 6	Pair 7	Pair 8

Figure 14. Dive planning sheet for Clidive Yellow

BLUE

Dive planning sheet

CLIDIVE BSAC 410

Date 9 JUN 19			Day Manager AM GILL PM MARK					Neaps/Springs	
Weather	6	9	12	15	18	Air times	Port	Times	Height
Strength	2-3	2	2-3	2-3	2		HW	1110	4.7 M
							LW	1710	1.5M
Dir	SW	SW	SW	SW	SW	Slip times	HW		
							LW		

Hazards/Tidal streams
0.5 kn

Contingency 50° 19.768N 004° 10.873 W

Coastguard FALMOUTH	VHF channels BOAT 77 LONGROOM 14	Speed limits 10 KNT SOUND	Mag variation 1° 33' W
Dive site 1 CORONATION		Slack 1140	Duration 4 HRS
Lat/lon ANCHOR 50°18.471N 004° 10.694 W CANON 55° 18.628N 004 12.077 W		Direction before 90°	Direction after 270°
DM/RM MARK	ADM/ARM CHRIS	Cox'n CHRIS	Ass. Cox'n BART
Notes ANCHOR 21m CANON 20M		Risk assessment done. 2 or 3 key risks (see RA section) VIZ - SILT ENTANGLEMENT/SHARPS SEA CONDITIONS	
Pair 1 CHRIS SOPHIE	Pair 2 BART, MARK MIKE	Pair 3	Pair 4
Pair 5	Pair 6	Pair 7	Pair 8
Dive site 2 CORONATION		Slack 1140	Duration 4 HRS
Lat/lon 55°18.628N 004 12.077W		Direction before 90°	Direction after 270°
DM/RM CHRIS	ADM/ARM MARK	Cox'n BART	Ass. Cox'n CHRIS
Notes		Risk assessment done. 2 or 3 key risks (see RA section)	
Pair 1 CHRIS, SOPHIE	Pair 2 MARK, MIKE BART	Pair 3	Pair 4
Pair 5	Pair 6	Pair 7	Pair 8

Figure 15. Dive planning sheet for Clidive Blue

Appendix 2 - Day Plan

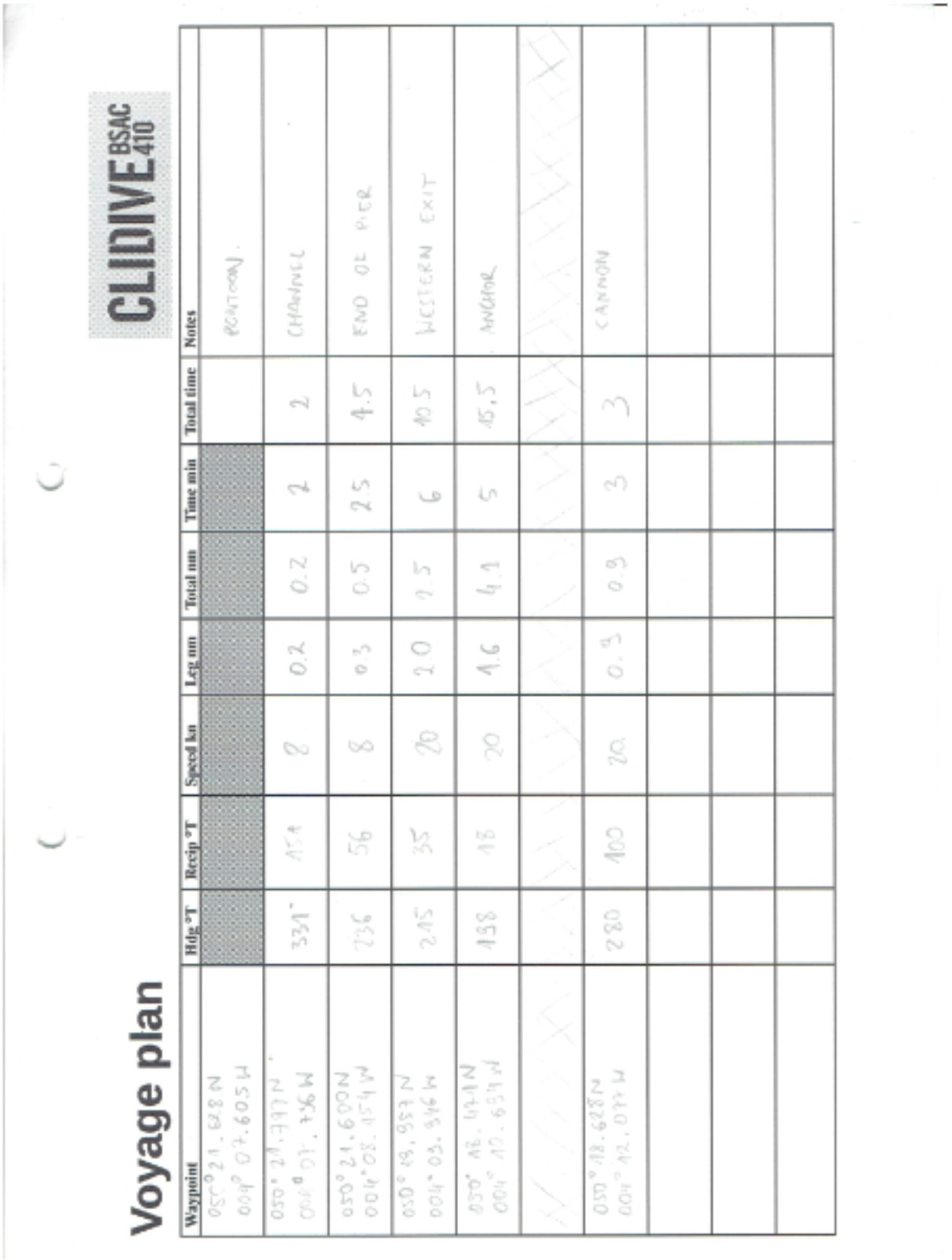
Timeline

CLIDIVE BSAC 410

Time	Thing	Notes
0700	BOAT LOADING	
0730	BREAKFAST	
0800	DAY BRIEF	
0810	DRY RUN	
0840	DRY SUITS	FINAL KIT LOADING
0855	DM+COXN	BRIEFINGS EACH BOAT
0900	ROPES OFF	
0915	ARRIVE	ANCHOR
0925	SHOT IN	YELLOW SHOTS
0930	DM BRIEF	SITE BRIEFS
0945	PAIR 1+2 IN	BOTH BOATS
1045	PAIR 1+2 OUT	
1055	HANDOVERS	BLUE DM YELLOW DM DAY MANAGER
1100	SHOT UP	YELLOW RETRIEVES
1110	ARRIVE	CANNONS
1120	SHOT IN	BLUE SHOTS
1125	DM BRIEF	SITE BRIEFS
1140	PAIR 3+4 IN	BOTH BOATS
1240	PAIR 3+4 OUT	
1300	SHOT RETRIEVED	BLUE
1320	MOVE MOUNTBATTEN	
1330	MT BATTEN	DI
1350	DEKIT	
1400	DEBRIEF	
1500	PROJ BRIEF	

Figure 16. Day plan timeline used

Appendix 3 - Passage Plan



CLIDIVE BSAC 410

Voyage plan

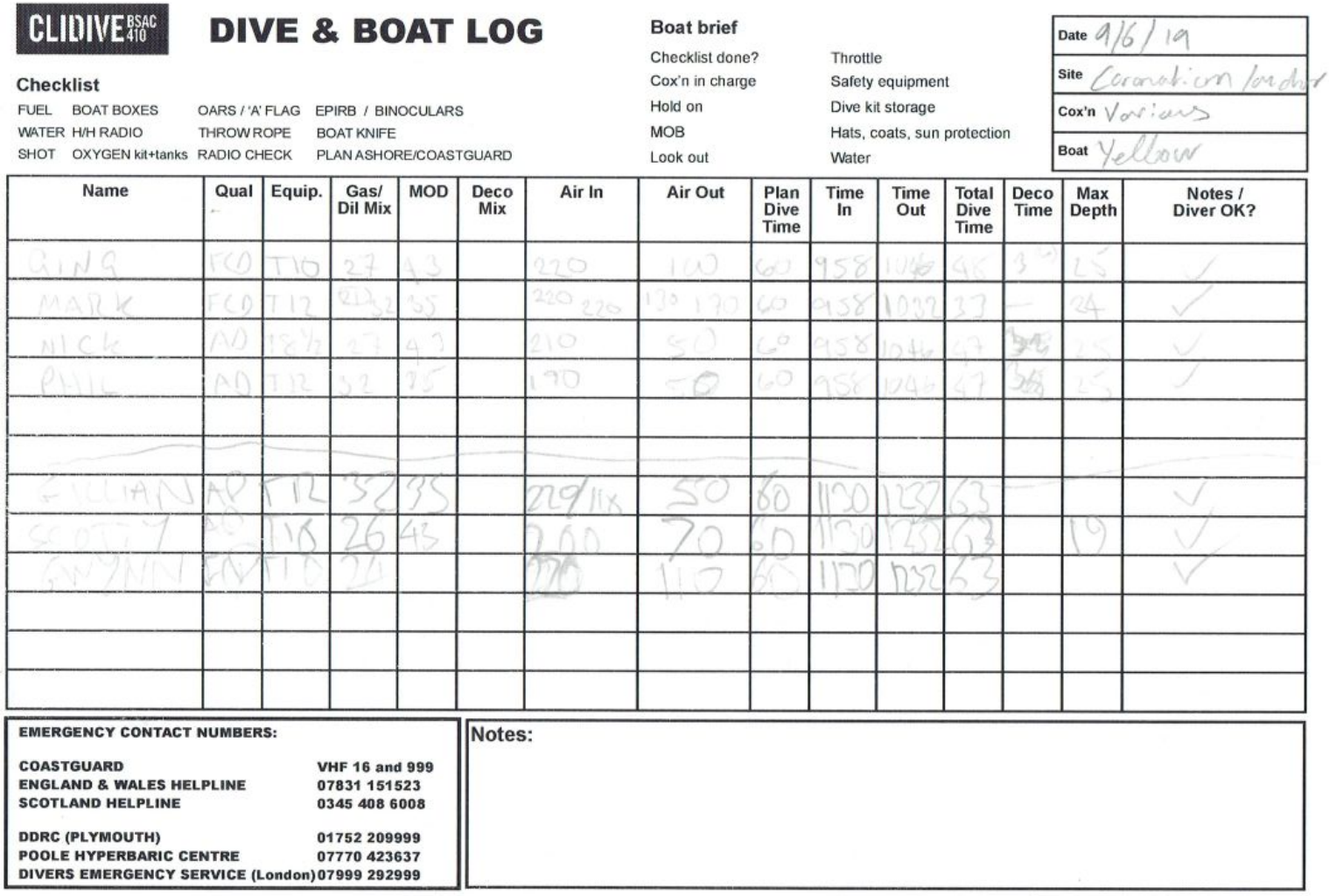
Waypoint	Hdg °T	Recip °T	Speed kn	Leg nm	Total nm	Time min	Total time	Notes
050° 21.638 N 004° 07.605 W								PONTOON
050° 21.397 N 004° 01.736 W	331°	151°	8	0.2	0.2	2	2	CHANNEL
050° 21.600 N 004° 02.154 W	236	56	8	0.3	0.5	2.5	4.5	END OF PIER
050° 49.953 N 004° 03.946 W	245	35	20	2.0	2.5	6	10.5	WESTERN EXIT
050° 48.444 N 004° 10.651 W	188	18	20	1.6	4.1	5	15.5	ANCHOR
050° 48.628 N 004° 12.022 W	280	100	20	0.3	0.3	3	3	CANNON

Figure 17. Written passage plan

Appendix 4 - Dive Logs

No.	NAMES	QUAL	CTC	CYL SIZE	AIR IN	NITROX MIX	MOD	DECO MIX	TIME DOWN	STOPS 6	STOPS 9	DIVE TIME	TOTAL TIME	MAX DEPTH	AIR OUT	SC
1	CHRIS WILSON	AO	A1	2x10	240 230	32	33	1	0410	3	1	35	39	24	120 150	1
2	SOPHIE RENNIE	RO	A1	12	200	21	21	1	0403	3	1	33	39	24	120	
3	BART WIECHOWSKI	AO	A1	2x12	230	32	33	1	1132	3	1	50	52	23	140	4
4	MIKE THOMAS	RO	A1	2x12 2x10	200 210	28	30	1	1132	3	1	49	53	20	150 150	4
5	MARK LOVESEY	AO	A1	12	230	32	33	1	1322	3	1	50	54	20	130	5

Figure 18. Dive log Clidive Blue



CLIDIVE BSAC 410

DIVE & BOAT LOG

Checklist

FUEL	BOAT BOXES	OARS / 'A' FLAG	EPIRB / BINOCULARS
WATER	H/H RADIO	THROW ROPE	BOAT KNIFE
SHOT	OXYGEN kit+tanks	RADIO CHECK	PLAN ASHORE/COASTGUARD

Boat brief

Checklist done?	Throttle
Cox'n in charge	Safety equipment
Hold on	Dive kit storage
MOB	Hats, coats, sun protection
Look out	Water

Date 9/6/19
Site Coronation Gardens
Cox'n Various
Boat Yellow

Name	Qual	Equip.	Gas/ Dil Mix	MOD	Deco Mix	Air In	Air Out	Plan Dive Time	Time In	Time Out	Total Dive Time	Deco Time	Max Depth	Notes / Diver OK?
QING	FCO	T10	27	43		220	100	60	958	1046	48	3	25	✓
MARK	FCO	T12	21 32	35		220 220	130 170	60	958	1032	37	—	24	✓
NICK	AO	T12	27	43		210	50	60	958	1046	47	3	25	✓
PHIL	AO	T12	32	35		190	70	60	958	1046	47	3	25	✓
JULIAN	AP	T12	32	35		219	50	60	1130	1232	63	—		✓
SCOTT	AO	T10	26	43		200	70	60	1130	1232	63		19	✓
GWYNNETH	AP	T12	21			220	110	60	1130	1232	63			✓

EMERGENCY CONTACT NUMBERS:

COASTGUARD	VHF 16 and 999
ENGLAND & WALES HELPLINE	07831 151523
SCOTLAND HELPLINE	0345 408 6008
DDRC (PLYMOUTH)	01752 209999
POOLE HYPERBARIC CENTRE	07770 423637
DIVERS EMERGENCY SERVICE (London)	07999 292999

Notes:

Figure 19. Dive log Clidive Yellow

Appendix 5 - Project Slates

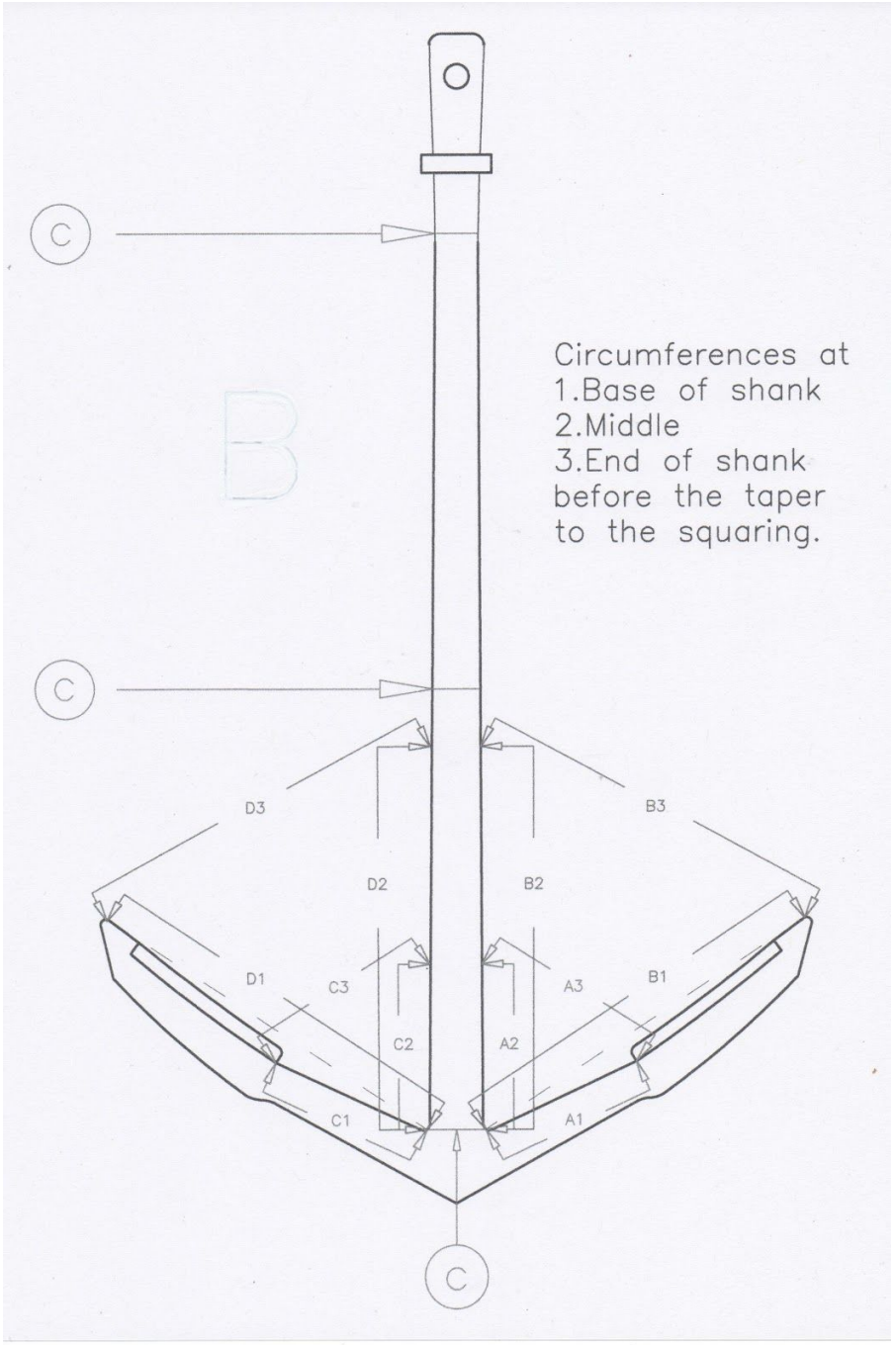


Figure 20. Standard anchor measurement template from Coronation Project Group

CORONATION ANCHOR RECORDING SHEET

Detail	Cm	Remarks
A1 / A2		
A3		
B1 / B2		
B3		
C1 / C2		
C3		
D1 / D2		
D3		
Shank Top		
Shank Middle		
Shank Crown		

Measure A1,B1,C1,D1 use this measurement for A2,B2,C2,D2 to get A3,B3,C3,D3

Figure 21. Standard recording template from Coronation Project Group

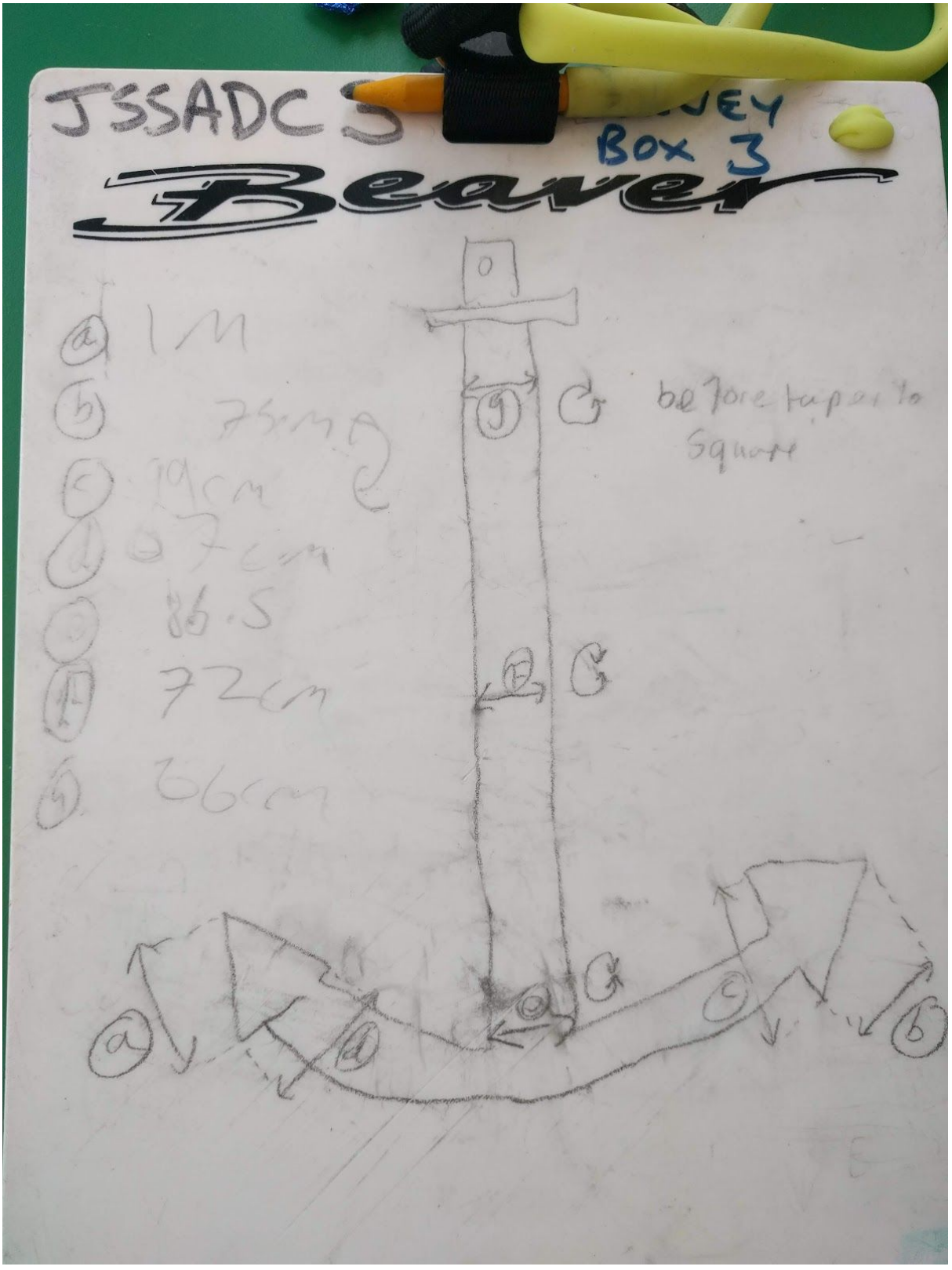


Figure 22. Survey Team 1 slate (front)

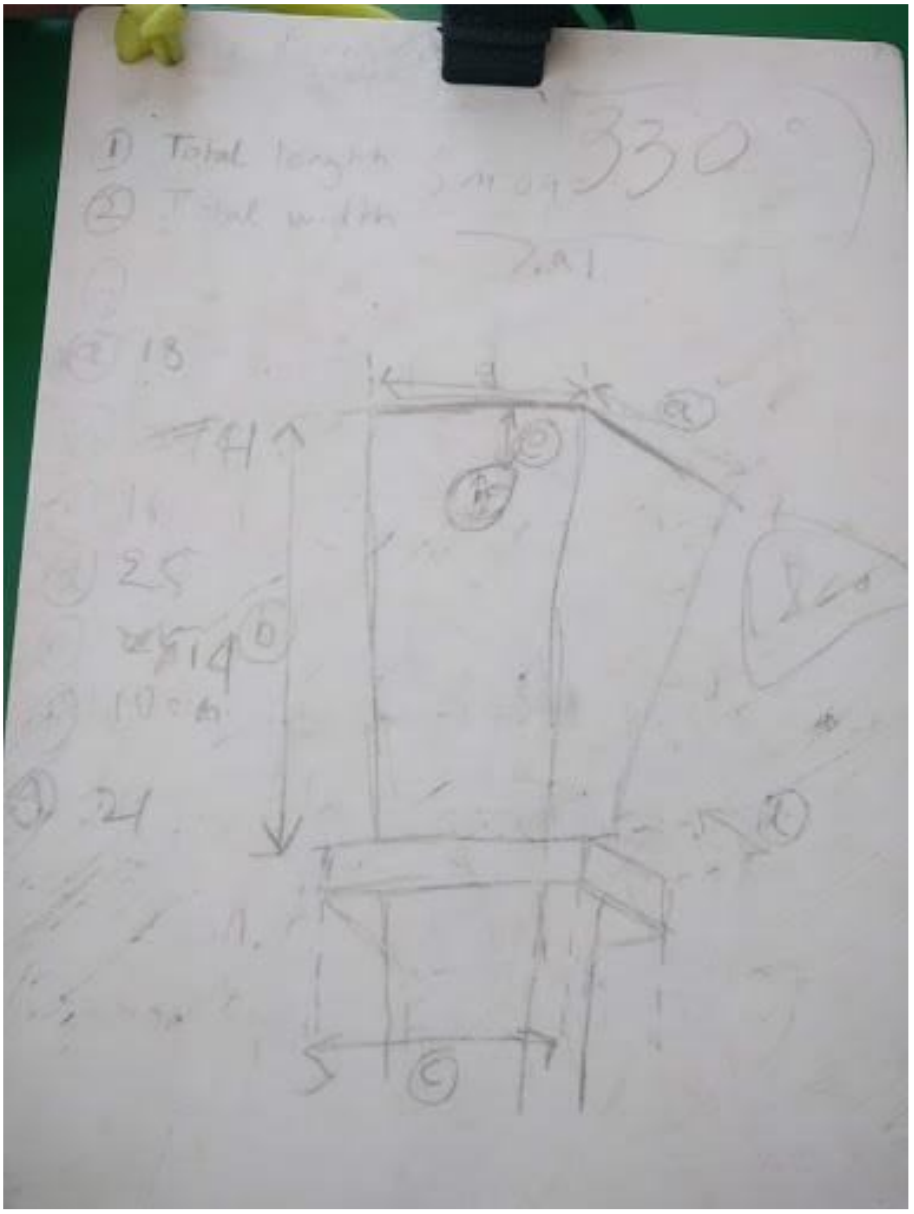


Figure 23. Survey Team 1 slate (reverse)

Note: Slates used by the cannon teams were not available for inclusion in the report.