A.D.M.A.T.

UNDERWATER SURVEY DIVER COURSE (v8)

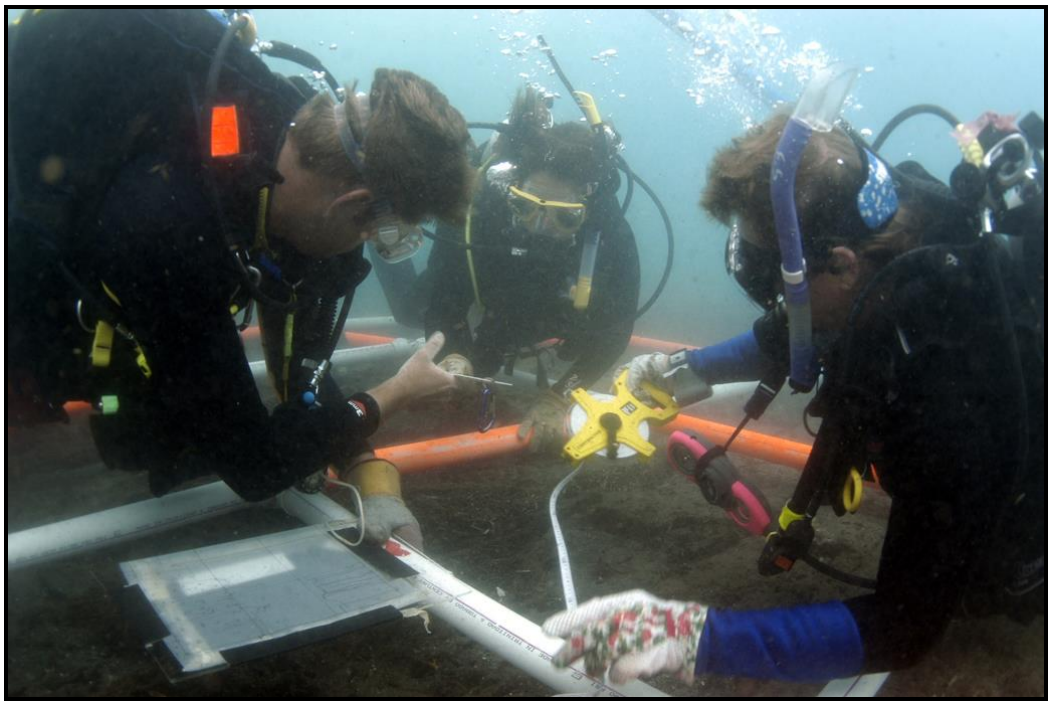

Illustration 1: Survey and excavation work on the ***White House Bay Wreck***, St. Kitts.
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By

Dr. Simon Q. Spooner, BSc, PhD, MRICS, MIFA.

Anglo - Danish Maritime Archaeological Team

A Non-Profit Educational Organisation, Assisting Students To Participate In Maritime Archaeological Field Work
Protecting the Caribbean's Underwater Cultural Heritage

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ADMAT - FRANCE
Association pour la promotion de l'archéologie subaquatique de terrain

ADMAT USA
Dedicated To Protecting Historic Shipwrecks

1.0 Introduction

By Dr. Simon Q. Spooner, Co-Founder - ADMAT

Illustration 2: Simon Q. Spooner (© ADMAT)

It gives me great pleasure, in introducing you to this Underwater Survey Diver course, the only one of its kind. It is an approved P.A.D.I. Speciality Course and is part of the coveted **ADMAT Archaeological Diver Award.**

The aim of this course is to give the student a through understanding of the complexities of underwater surveying, enabling them to achieve success in basic survey work. It is not designed to make the student a master of this subject, as that takes many years.

As a by product of taking this course, you will be learning the basics which will enable you to take part in underwater surveying on one of the ADMAT archaeological projects, which are planed over the next few years. You may even be fortunate to undertake this course on one of our projects, which has distinct advantages. ADMAT is conducting full archaeological surveys of a number of historic sites. Some of these are and have been in the Dominican Republic, St. Kitts, Florida and other sites worldwide. By learning the skills in this course and conducting plenty of practice on one of our projects, you will be able to take part in the exciting part of measuring and recording the priceless historic information. This information is available from the remains of the surviving ships construction, on the lower hull assembly, which is present on most of our sites.

I know that together we can save these important archaeological sites for future generations to enjoy. In the process, we are helping to preserve and protect the underwater cultural heritage of the old European Empires.

I look forward to taking part in one of our exciting projects with you!

Yours faithfully

Simon Q. Spooner

Dr. Simon Q. Spooner, BSc, MRICS, PhD, MIFA.
President & Principal Investigator of ADMAT, ADMAT-FRANCE and ADMAT USA

2.0 Information on: Anglo ~ Danish Maritime Archaeological Team

The Anglo~Danish Maritime Archaeological Team (ADMAT), is a non-profit educational archaeological organisation, which was created in 2001. Having spent a number of years conducting archaeological projects in the Dominican Republic, the founders Simon Spooner and Christine Nielsen, were aware of the problems facing maritime archaeology as well as some of the potential answers.

ADMAT comprises of a small staff, maritime archaeologists, scientists, volunteers and students. They all have an interest in maritime archaeological work. These dedicated members are all joined by the same desire, to do something to protect the cultural underwater heritage, before it is lost forever. They want to take an active part in recording, surveying, preserving and protecting shipwrecks from the old European Empires. ADMAT works to preserve Underwater Cultural Heritage (UCH), preventing where possible historic shipwrecks from being destroyed and saving the historic data, artefacts and research; as well as promoting practical maritime archaeological education. ADMAT is a non-profit educational organisation based in Hampton Court, England, with subdivisions: ADMAT USA a non-profit ***Section 501(c)(3) Charity*** based in Ohio and ADMAT-FRANCE, a non profit organisation, (*association Loi 1901*) based at the Institut de Paléontologie Humaine, Muséum National d'Histoire Naturelle in Paris.

ADMAT assists the preservation of UCH, by surveying and documenting the exposed shipwrecks uncovered by hurricanes, looters, or treasure hunters. If no action is taken to preserve these wrecks, then they are either destroyed by the weather, or looters, or treasure hunter; and the information they contain, their artefacts and history will be destroyed and lost forever. We aim to provide education to the Caribbean Nations on how to protect their UCH as well as education on maritime archaeology to students.

ADMAT has successfully carried out maritime archaeological projects in St. Kitts for their Government on ***The White House Bay Wreck,*** (1782), for the National Oceanic Atmospheric Administration (NOAA) in the Florida Keys National Marine Sanctuary ***The Button Wreck*** (1760s); and for the Oficina Nacional De Patrimonio Cultural Subacuático (ONPCS) in the Dominican Republic ***The Tile Wreck*** (1720s), the ***Faience Wreck*** (1760s), ***Le Casimir*** (1829) and other sites. Maritime Archaeological field schools are conducted giving students practical "hands on" educational experience, as the team helps to protect the Underwater Cultural Heritage.

The Team from ADMAT identified the French shipwrecks ***Le Casimir*** and ***Le Dragon*** the French warship. ADMAT is advising the French Government on the protection of its sovereign warships in the Dominican Republic and has been key in returning the shipwreck ***Le Dragon*** back to French ownership. ADMAT attended the 2009 March UNESCO convention and spoke from the floor as an NGO on the issues of protection UCH in the Caribbean.

2.1 Problems with Maritime Archaeology

Problem 1

With archaeological work, especially in maritime areas (shipwrecks) it is almost impossible for student archaeologists and divers to take part in archaeological shipwreck surveys and excavations. The reasons for this are:
a) There are few archaeological projects being conducted.
b) Some universities only do field work for their own students or for students of the same nationality.

Problem 2

Due to lack of finance, there are few Universities offering maritime archaeological courses in the first place. Those that do only offer limited fieldwork experience of a few weeks, which does not provide much training in the field. When the student qualifies he or she finds a further problem, being that prospective employers require large amounts of experience for which the students lack. They can't get the experience with out the job and hence a vicious circle.

Problem 3
Large amounts of information are being lost daily on numerous shipwreck sites across the world. These wreck sites, which are important time capsules, are being destroyed by looting, treasure hunters, wave action and lack of analysis by trained archaeological teams. In the Caribbean the governments are aiming to do things right in accordance with the UNESCO and ICOMOS Charter on the preservation of underwater heritage, but they lack the funds to pay for archaeological groups to advise them and to conduct surveys and archaeology. If archaeology were undertaken, it would protect their national culture.

2.2 The Solution

The Main Aims of ADMAT are to:

1) The main aim is to organise and undertake maritime archaeological projects via field schools. This will enable archaeological work to be undertaken where it would not otherwise be done, and to enable archaeological students to take part in maritime archaeological surveys and excavations. Members of ADMAT represent numerous countries including England, France, Denmark, Mexico, USA, Sweden, Canada, Italy, China and the Dominican Republic. ADMAT will organise and conduct archaeological maritime surveys at cost basis for students, where sponsorship is not available.

2) Where large projects are fully funded by external organisations (i.e., not funded by the participants), to provide educational scholarships to enable outstanding students to participate for longer time periods on excavations, which due to lack of finance, they would be unable to do so.

3) To conduct maritime archaeology in the Caribbean and the Florida Keys on behalf of governments and where applicable in co-operation with archaeological institutions and

organisations of the same nationality as the targeted shipwreck e.g. The French organisations when working on the French Perfume wreck (***Le Casimir***).

4) With the agreement of the hosts country, to provide archaeological displays and educational matter, in the hosts countries museums.

5) To provide conservation expertise to Caribbean countries and to provide conservation programs to enable (where applicable under the UNESCO agreements) artefacts recovered, to be conserved then placed on display in national museums.

6) With the host countries agreement, to provide study collections of artefacts on loan from the host country to other national museums and major universities. This will increase the awareness of information and can provide a major boost for tourism.

7) All archaeological work will be published and will be available to all.

8) It is anticipated that numerous organisations will wish to take part in ADMAT's archaeological work. Some of the universities and organisations consulted are in the past:

Musée de l'Homme (Museum of Man), Paris (France).
National Center for Shipwreck Research, Ltd, (USA).
University of Bristol (UK).
Musee National De Ceramique. (National Ceramic Museum),Paris (France).
Musee National de la Marine. (National Maritime Museum), Paris, (France).
ERIMAT, Fondation Internationale D'archéologie sous-marine, Paris (France)
Londinium Military Dive Club (UK).
NOAA (USA).
Florida Keys National Marine Sanctuary (USA).
Oficina Nacional de Patrimonio Cultural Subacuático (USA).
St. Christopher Heritage Society, St. Kitts.
Muséum National D'Histoire Naturelle, Paris (France)

9) Increase awareness of underwater archaeology by live Internet productions and lectures, which will be accessible to schools.

10) To conduct with other parties, educational documentary television programs.

11) To provide research opportunities for students and academics.

12) To provide advice to countries in the Caribbean, advising them as to how they can manage and protect their national underwater cultural heritage.

13) To promote the increase in international co-operation for the protection of maritime shipwreck sites.

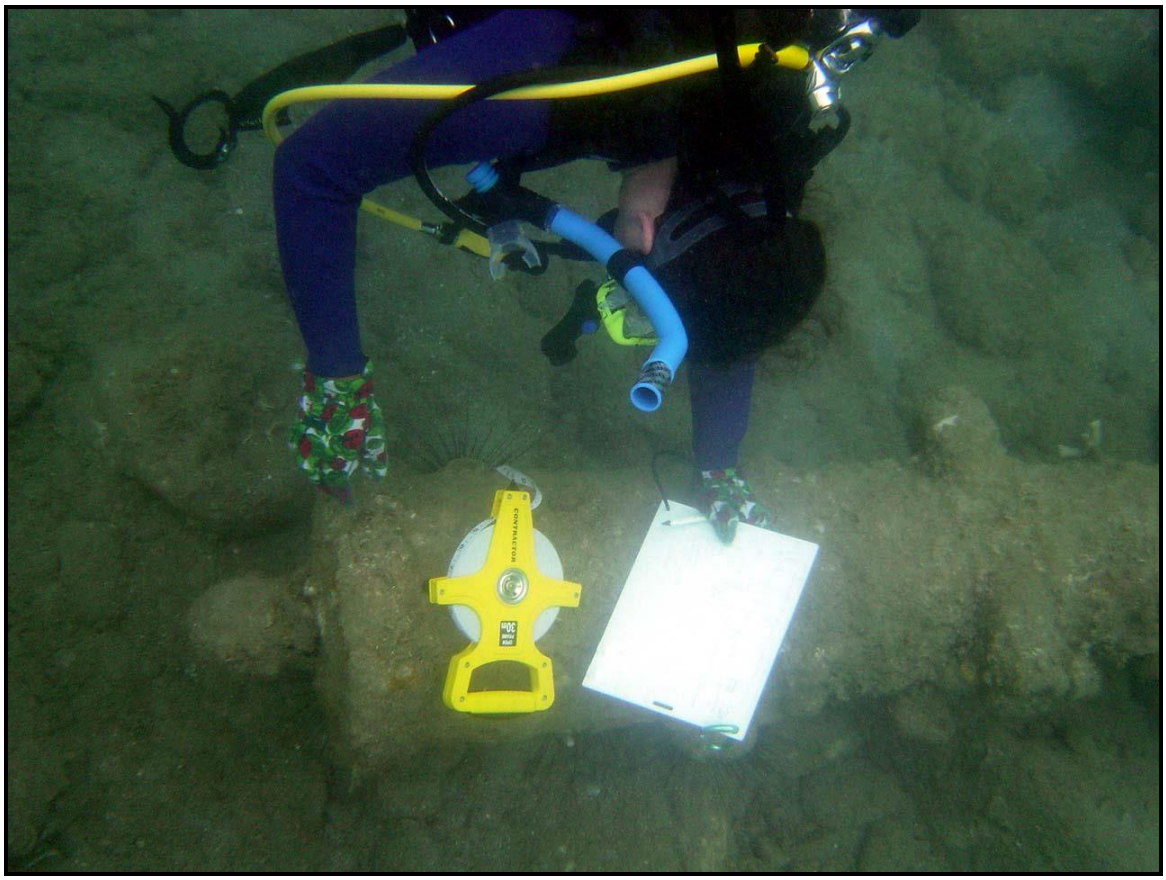

Illustration 3: Student Louis Côté surveying iron cannons on the ***White House Bay Wreck***, St. Kitts (© ADMAT Archives).

UNDERWATER SURVEY DIVER

3.0 Course Overview

The purpose of the Underwater Survey Diver course is to familiarize the divers with the basic understanding and practical working knowledge of underwater surveying. The course should contain a minimum of 2 hour of classroom lecture, 2 hours of on land practice and 4-10 sheltered good visibility open water / pool dives, conducting three types of skills. This is followed by at least 4 hours of draftsmanship. The goals of this course are to:

1) Develop the student's practical and working knowledge of the basic surveying techniques.

2) Enable students to practice the three main types of surveying on dry land.

3) Enable students to safely conduct three simple surveys underwater over a number of separate dives.

4) Enable students to draw scale plans from the data they found during their surveys.

5) Enable students to understand how to use basic compass levels and survey equipment.

4.0 Academic Topics

The following is an actual presentation outline. Directions to, or comments for the instructor are enclosed in [brackets].

4.1 Introductions, Course Overview & Welcome.

1.Course Objectives.

The objectives of the course are:

a. To develop a practical and working knowledge underwater surveying techniques and skills.

b. To understand how to maintain and use surveying equipment.

c. How to erect underwater ground lines, base lines and grids taking into account the depth, topography and currents.

d. Practical experience of setting up a Base Line on land and underwater, with measured reference tags and using this as a reference for surveying the target area.

e. Practical experience of deploying and using a Point Line Survey System on land and underwater.

f. Practical experience of deploying and using a Survey Grid System on land and underwater.

g. Developing the necessary skills to transfer all the data collected from the underwater survey to scaled drawings.

2.Course overview.

a. Classroom presentations. [Academic information may also be given on boats or the shore. If classroom presentations are used to teach academic information, give the times, dates and locations.] There will be---(number) classroom presentations during the course.

b. Dives. There will be four to ten dives (optional survey dive over the site. However in certain circumstances, pool dives will count, as the option is to practice in good visibility (keeping things simple at first)).

i) The first dive will be using the Point Line Survey System.

ii) The second dive will use the Base Line Survey System.

iii) The third dive will be erecting the Survey Grid System.

iv) The fourth and subsequent dives will be surveying on the grid. Each dive is designed to maximize your fun and enjoyment, while you are professionally supervised by your Instructor (and certified assistants).

Note: If the course is conducted on an actual archaeological site, then the order above may well change and the three methods may well be incorporated into the same dives.

3.Certification.

a. Upon successful completion of the course, the Underwater Survey Diver certification is awarded.

b. Certification recognizes that you:

- Have been trained to understand and be able to perform underwater surveys.
- Be able to dive on a target area and conduct three types of survey methods.
- Be able to transfer the data obtained from the underwater survey, into scaled plans.

4.Class Requirements.

a. Cost of the course

b. Equipment needs.

c. Materials needed for the course.

d. Attendance requirements.

5.Administration.

a. Complete paperwork - Enrolment, course application form.

4.2 Reasons for Conducting Underwater Surveys

By the end of this session, you will be able to:
State 3 common reasons for conducting underwater surveys.

1.Detailed Underwater Maps.

a. Underwater map, sketches and plans of reefs, shipwrecks and dive sites are a result of effective underwater surveys. These aid divers in navigation and make a dive more exciting if divers know what to expect and where to go.

b. To be used for training dive sites, eg Stoney Cove in the U.K or the Shipwreck Trail, Florida Keys National Marine Sanctuary.

2.Marine Archaeology.

Marine archaeologists use underwater surveying techniques to great effect. Each shipwreck or historic target is carefully surveyed and the data accurately recorded for information and also for future generations. As the divers /archaeologists survey and excavate (depending on the archaeological protocol for the site: Non-intrusive & Intrusive) the site, each artefact is recorded. The location or each artefact is carefully recorded and measured. This ensures that the surveyors can produce a scaled diagram or even a scaled model from the data.

3.Marine Conservation.

a. Conservation divers when assessing the marine life on the reefs need to have accurate underwater maps of the topography and dimensions of the reefs. In addition, detailed maps can show which marine life is concentrated where and at what depth. This can be used to check the growth of the reef and as to whether the reef is healthy or not. Coral Cay Conservation is a classic example of what can be achieved.

b. This information can assist governments in the creation and preservation of marine parks, conservation areas and can assist mariculture projects.

4.3 Ground Lines, Shot Lines & Ropes in General

By the end of this section you will be able to:

State how to maintain and deploy shot lines, and reference points.
State how to use pulley systems.
State how to deploy ground lines, base lines and grids.
State how to use Delayed Surface Marker Buoys and reels.
State the effects of tides and currents on the above

1.Shot Lines.

a. Fixing a Datum.

When diving in any open-water site, it is necessary to provide a fixed focus point for both the divers and the boat cover. One means of providing this focus is by the use of a fixed line with a buoy at the surface and shot weight at the seabed.

b. Differential G.P.S. (D.G.P.S.)

A fixed Datum is particularly essential for underwater surveying as there has to be a surface reference point. At the surface the reference point location should have a G.P.S. or D.G.P.S. fixing. This enables the “whole picture” to be plotted accurately on a chart and scale drawings. The target area may need multiple fixed datum’s at key locations.

c. Shot Weights.

i) It is important that the correct shot weight is used. It needs to be of adequate size (30 kilograms) to ensure that it cannot be dragged by the tide or wind action. Note if a

large buoy is used, it will create greater drag by the wind, which can drag the buoy away. Also divers can drag the shot weight if they pull on the line as they descend.

ii) Divers should never pull themselves down the shot. If they need to do so, this means that they have not mastered their buoyancy.

iii) Shot weights can be purpose made iron weights or can be made at home. The best ones are buckets or containers filled with concrete with an eye inserted so that the shackle can connect to it. There are two additional points to mention when you think of how you are going to make them.

1) You must be able to carry them, and lift them up from the seabed without causing backaches. Two points here. The thickness of the rope is important. The thicker the better for your hands, 1/2inch diameter is good thin twine will cut into your hands like a garrotte! The last diver ascends the line for the final time, he should connect a small lifting bag initially inflated to the shot weight. When the shot line is lifted the air expands in the bag, which increases the buoyancy and sends the shot weight to the surface as you pull the line.

2) Concrete can flake and chip. As with any large heavy object, it can make large dents in your boat, divers or their kit. Therefore it is a good idea to leave the mould on, eg the bucket or container. This will protect the weight and the boat.

d. Shot Lines.

It is not only important to use a line of suitable thickness, but it is also important to ensure that you do not have slack line in the water once the shot line has been deployed. This can be done by accurate depth measurement, usually from pre-dive planning, confirmed by an echo sounder when on site, Remember to allow or an tidal changes during the dive, but avoid the temptation to add a few meters more for luck.

e. Buoys.

Adequate surface buoyancy is essential to support the shot line and weight, if the occasional embarrassment and expense of lost shot lines is to be avoided. Some key points are listed below:

i) Shape and Colour.
High visibility colours are essential for buoys. Florescent colours are best. If you have large swells or you are going to be operating some distance from the datum marker, then it is useful to attach a flag buoy to the buoy. The flag buoy is like a Man Over Board marker 6 feet high with a flag on the top and a float with a weight below it to keep it upright. If you use a M.O.B. buoy, please remember to change the flag, which is usually a distress flag!

ii) “Rope Pulley of The Lazy Shot System.”
In some coastal areas there is a large range in the tides. In the Caribbean, Mediterranean, the range may only be one or two meters. On the other hand in the U. K. the range can be 3 to 6 meters! Whilst this may not affect diving, as

diving only occurs in slack water it will effect the height of the water and if the shot line is taught at full tide it might pull the buoy under at high tide or lift the shot weight.

This must be avoided at all costs. So by using a simple “rope and pulley” system it is possible to construct a shot line that will always provides taught line allowing for the range of tides. This is like a normal shot line, except that

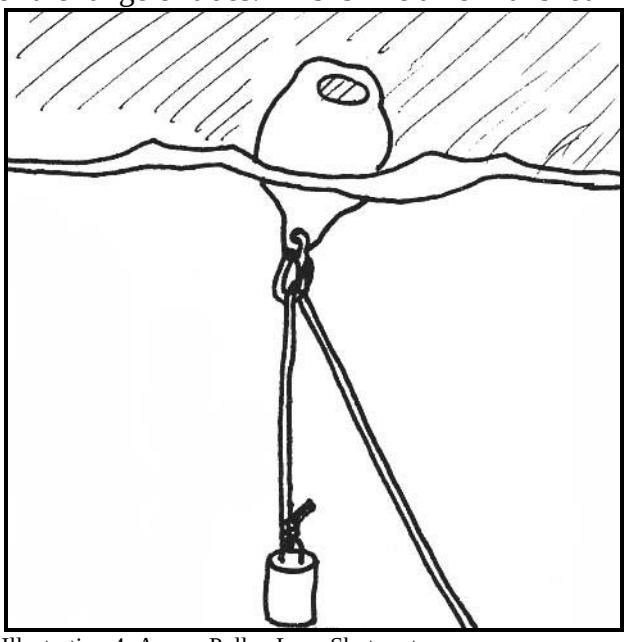

Illustration 4: A rope Pulley Lazy Shot system.

the line is not attached to the buoy. Instead, it passes through a metal ring which is attached to the buoy, and carries on back down to a second weight usually about 10 kilograms. It is important to deploy the shot line with care to prevent entanglement, and practice like usual makes perfect. Once deployed it will automatically adjust for the changes in the tide and ensue that the buoy is taught, - “ lazy shot” system as you do not have to do anything.

iii) Tidal Flow.

In some locations the tidal action may be strong and may pull the buoy under due to the drag effect of the rope. This only occurs at depth where there is strong tidal movements, the solution is to use No: ii) above.

2.Ground Lines.

a. Purpose.

On a survey site ground tines are very important. They are used to establish a fixed straight line from two points. The lines usually have some form of measurement attached to them whether it is colour or tags. A number of ground lines can also be used for navigation, to and from a particular survey area.

If a quick survey is being done over a small area during one dive, then SMB lines can be used. For larger surveys or ones, which may take time, ropes should be anchored or pegged in place.

b. Types.

It is recommended that any ground line used should be of the non floating variety, preferably braided containing a lead core. Floating bottom lines are a distinct hazard especially in the low visibility.

Another type of suitable ground line is “Glow Line” This is a plastic type of washing line with a nylon woven inner core. Whilst it is naturally buoyant and needs weights to keep it in place, it has the advantage of being like a fibre optic, which absorbs the ambient light and shines all on the line. At night or in low visibility it can easily be illuminated creating a glowing line.

SMB lines whilst they are good for ease of deployment and can be used for temporary lines, they are not strong enough or long durations underwater and if pulled tight can be easily cut or snagged.

c. Deployment.

The ground line should be stored in a reel for simple deployment. The topography of the survey sight is important. Ground lines should be taught and level. If the survey is for only one dive then it is acceptable to lay the line on the seabed, provided it is straight and no kinks in it. If the line is to be used for a longer duration, then it should be pegged into the seabed. If the topography is not flat then it may be necessary to fix the line above the bottom on poles so that it is about 1 meter /3.3 feet off the bottom. Ranging rods can be used for this purpose.

3. Base Lines.

a. What are they?

Base lines are used as a linear common reference point for the survey. They may be any length up to 30 meters. Usually they are made of white “Schedule 40” PVC of 1,1/2 inch diameter or for long-term surveys 2 inch. These pipes usually come in 20 foot lengths and can easily be connected together. The pipe should be sprayed fluorescent orange for one meter lengths, every other meter.

b. Deployment.

Once the divers are in location the pipe should be lowered to them. Once all the equipment is with the divers the pipe is put together. Each section should be pegged to the sea floor.

4. Grids.

a. What are they?

Grids are an extension of the base line. A grid maybe a series of base lines running parallel with intersections and may take the appearance of a chessboard. Each of the

squares is fitted together like scaffolding poles. The PVC pipe (schedule 40) can be fitted together with cross pieces. Each length of pipe is sprayed every other meter. They are used for visualisation, measuring and are flexible enough to take the weight of the divers and the dredges. This is very important as it enables the divers to lying on the grid, therefore being off the actual wreck.

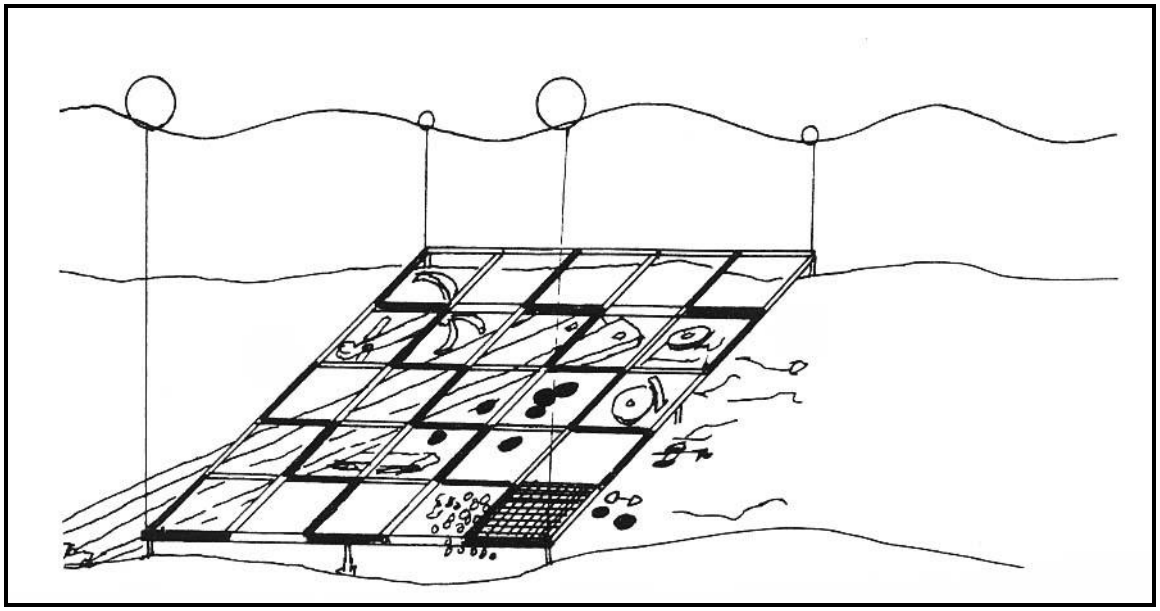

Illustration 5: Base Line fitted together, to form a 5 m grid (© ADMAT Archives).

Illustration 6: Students start planning how they are going to built the grid for the ***White House Bay Wreck*** in St. Kitts (© ADMAT Archives).

Illustration 7: The first meter long sections are cut and fixed together (© ADMAT Archives).

Illustration 8: Teamwork is essential (© ADMAT Archives).

Illustration 9: Marking, removing, painting and reinserting the orange sections (© ADMAT Archives).

Illustration 10: Painting the alphanumeric numbers on the cross pieces which will identify the individual squares (© ADMAT Archives).

Illustration 11: Launching the first 5 metre square grid section (© ADMAT Archives).

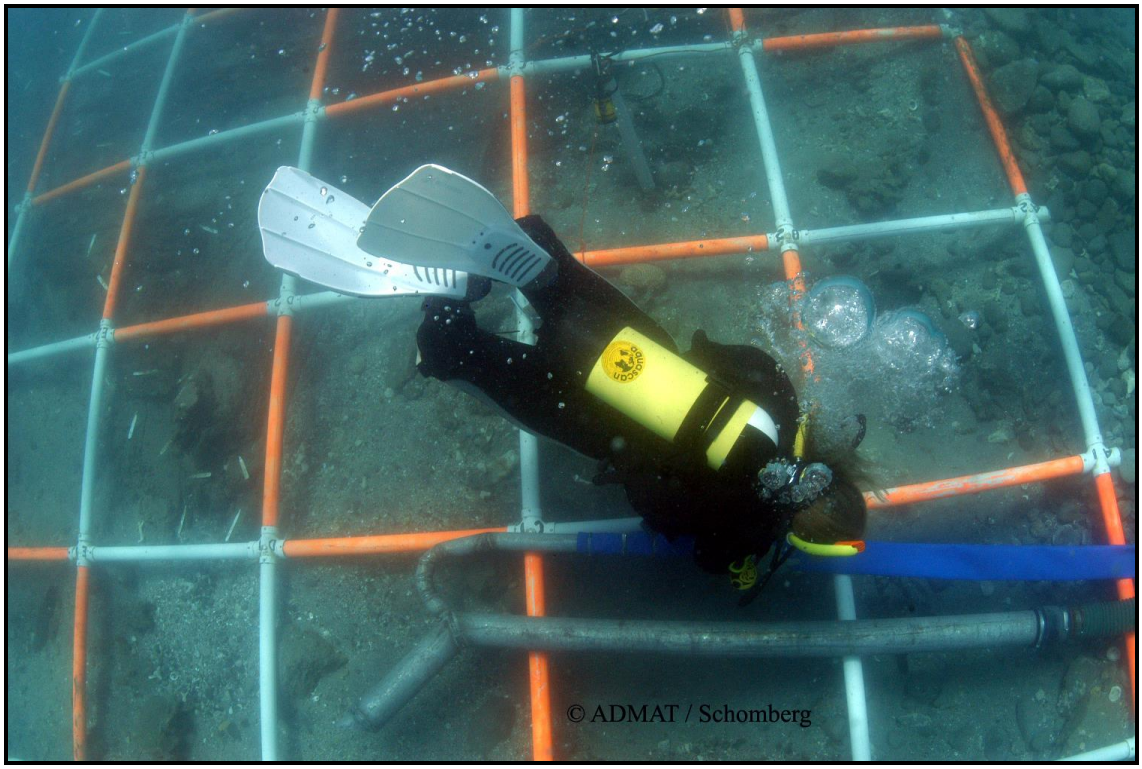

Illustration 12: Work begins on the ***White House Bay Wreck*** (© ADMAT Archives).

Illustration 13: Showing the construction of the ***Le Casimir Wreck*** grid 1, being constructed in the Dominican Republic (© ADMAT Archives).

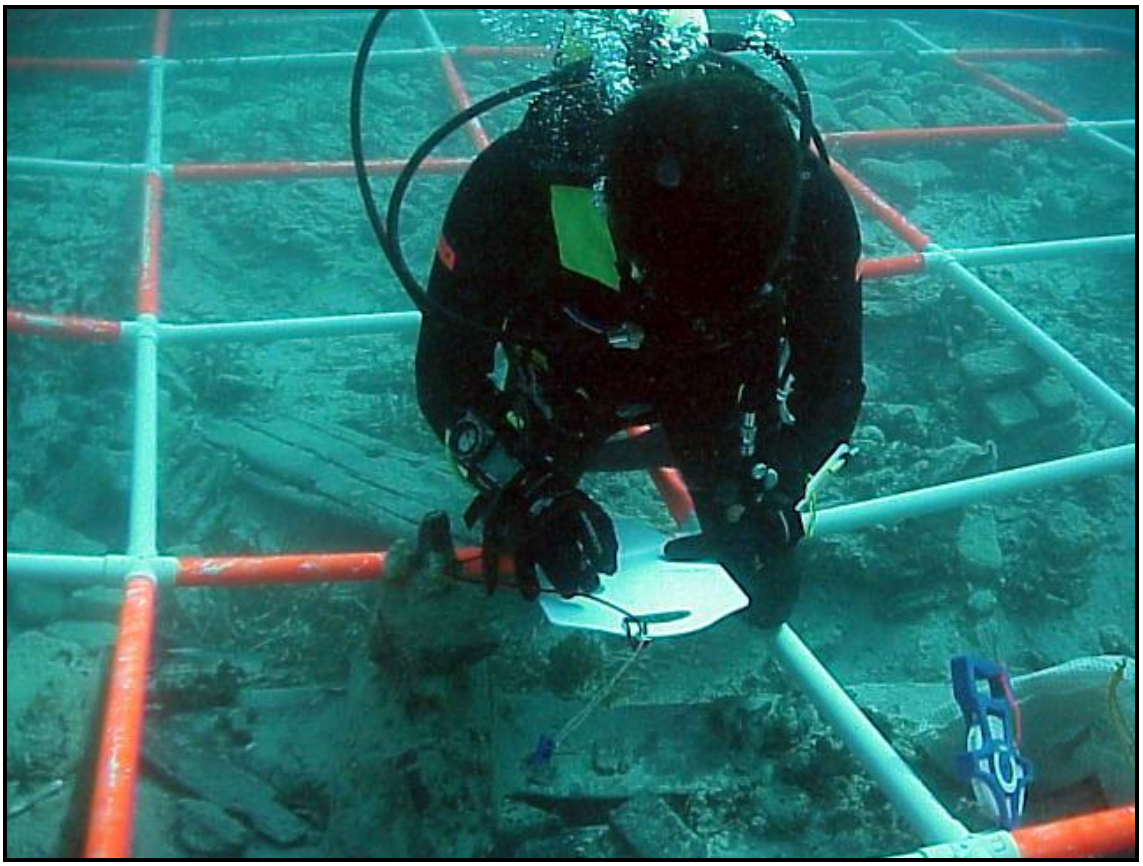

Illustration 14: Archaeologist James Taylor, surveying the ***Le Casimir Wreck*** (© ADMAT Archives).

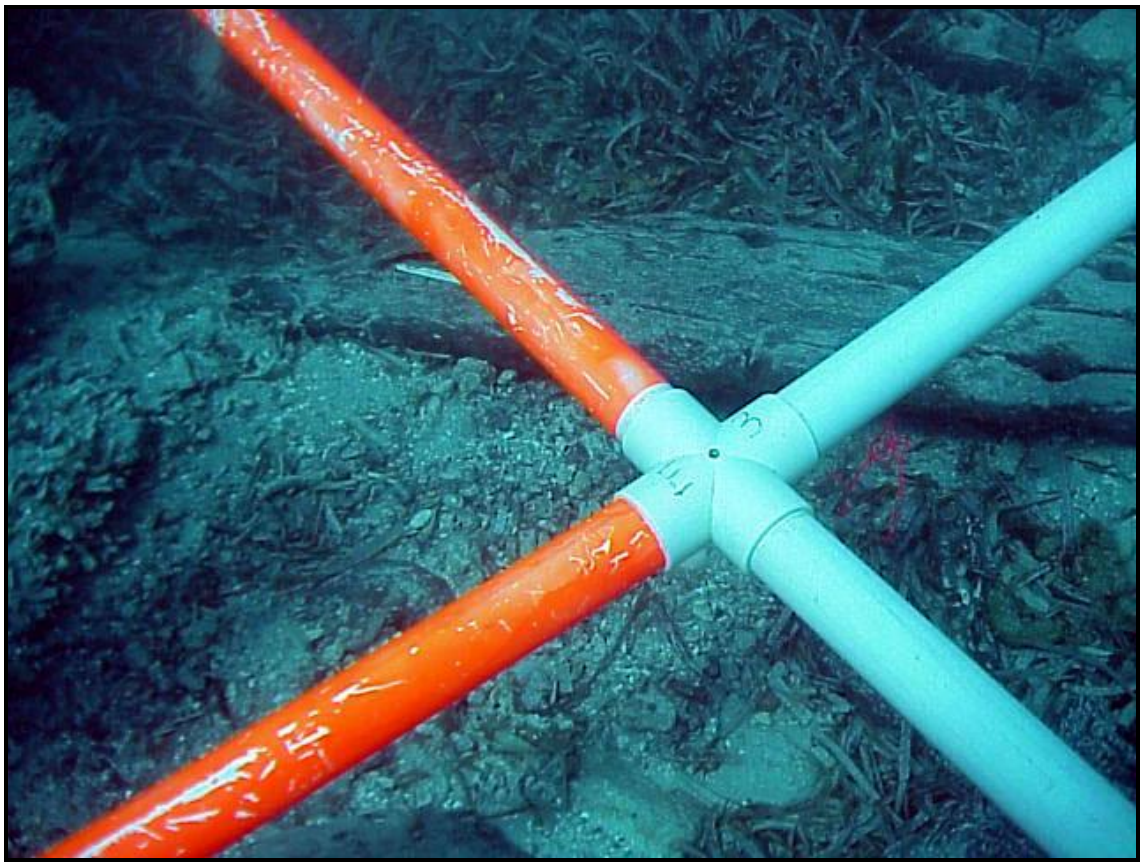

Illustration 15: The all important cross pieces – ***Le Casimir Wreck*** Grid (pre Hurricane Design)
(© ADMAT Archives)

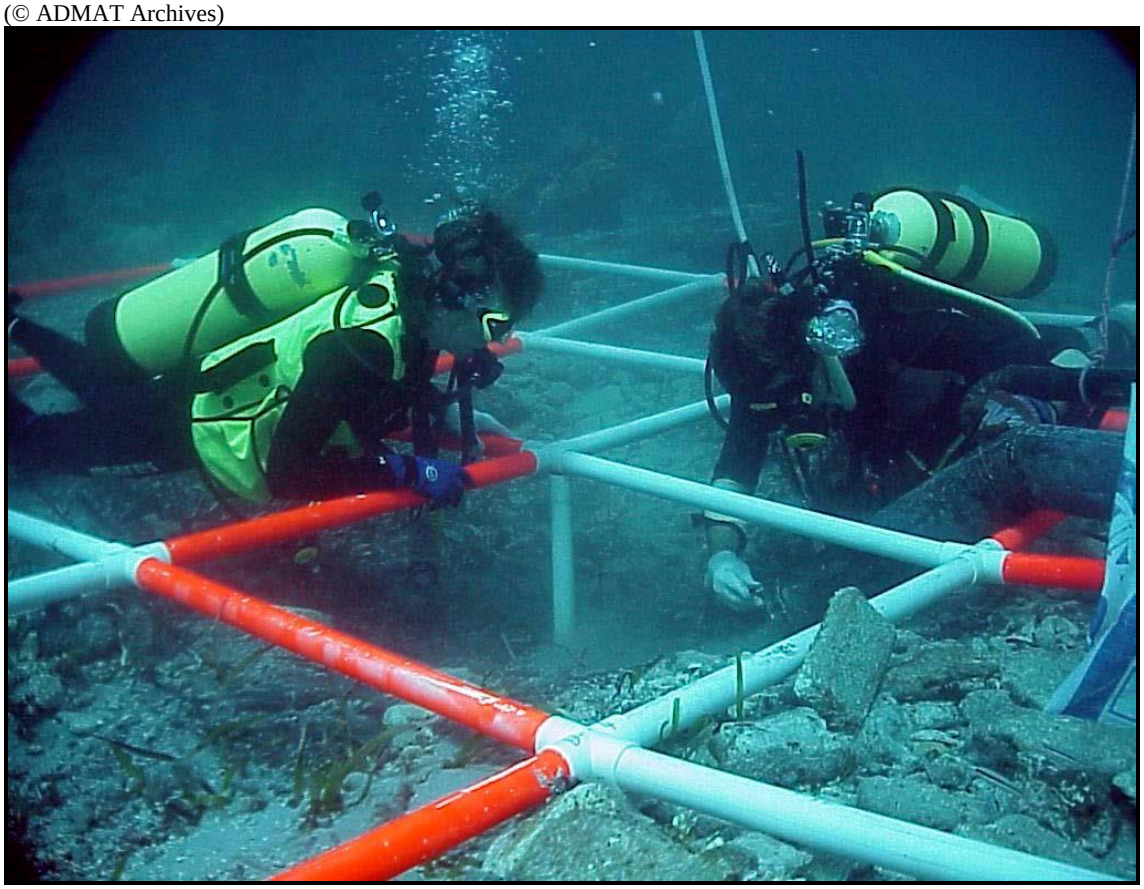

Illustration 16: The Excavation Director and archaeologist Rebecca Hardy using the grid for support during the excavation of the ***Le Casimir Wreck*** in 2000 (© ADMAT Archives)

b. Topography.

The topography of the survey site is very important. The grid must be level. If the area is on a slope or on a coral reef, then the grid will have to be deployed on stilts firmly fixed to the bed. As the seabed rises and falls the grid can create additional " floors' like a wire frame building. For surveys on the side of a reef this is the most efficient method although it is very time consuming to construct. This would only be done on a serious survey, which would take weeks such as an archaeological excavation of a shipwreck.

5. Delayed Surface Marker Buoys.

DSMB are buoys, which are shaped like a tube with one open end. They are inflated at depth by placing the octopus regulator under the open end and pressing the purge button. The tube fills up with air and rises up to the surface unwinding a reel as it does so. They require practice on how to use them, and care must be taken when winding them up so that no knots are formed.

4.4 Survey Equipment

By the end of this session you will be able to:
Know how to use and look after various types of equipment.

1. Underwater Measuring Tapes.

Underwater tape measure is an important piece of equipment and needs to be looked after. The tape will stretch if it is pulled too tight and the winding system needs to be greased with silicone. At the end of each dive, the tape should be washed dried and then wound in slowly using a piece of cloth to ensure there is no sand or grit in the tape and no knots or twists. The plate should be unscrewed and heavy grease inserted in the winding mechanism to ensure rust does not start.

2. Metric and not Imperial.

Underwater surveyors and archaeologists use Metric measurements rather than Imperial. This makes calculations much easier to do and scale diagrams simple.

3. Ridged Measuring Rods.

These meter long wooden or plastic surveying rods are ridged and can be folded into smaller sections. They are very useful for small areas but have two drawbacks, being that some tend to float, and that the sliding hinges need careful maintenance and greased.

4. Survey Chains (Günter's).

   These are usually in lengths of 20 to 50 meters long. They have the advantage of being accurate because they cannot stretch and they are always negative buoyant. However they can be difficult to deploy underwater and if they do tangle up. Also because they are normally made of steel they do have a tendency to rust unless they are very carefully cleaned after each dive and greased.

5. Underwater Lasers.

   These expensive underwater lasers are very accurate but are prohibited expensive and are only used for very expensive projects in clear water. They have the disadvantage that if there is a large amount of sedimentation in suspension in the water, the laser beam might be defused or refracted, giving inaccurate measurements.

6. Pegs.

   Pegs are used to anchor the ground lines and base lines. They should be greased with oil based heavy grease on top of the paint. This will help to prevent rusting if the paint flakes off. A rubber mallet is best to hammer them into the seabed. Note: **Please do not hammer pegs into the coral or fish!**

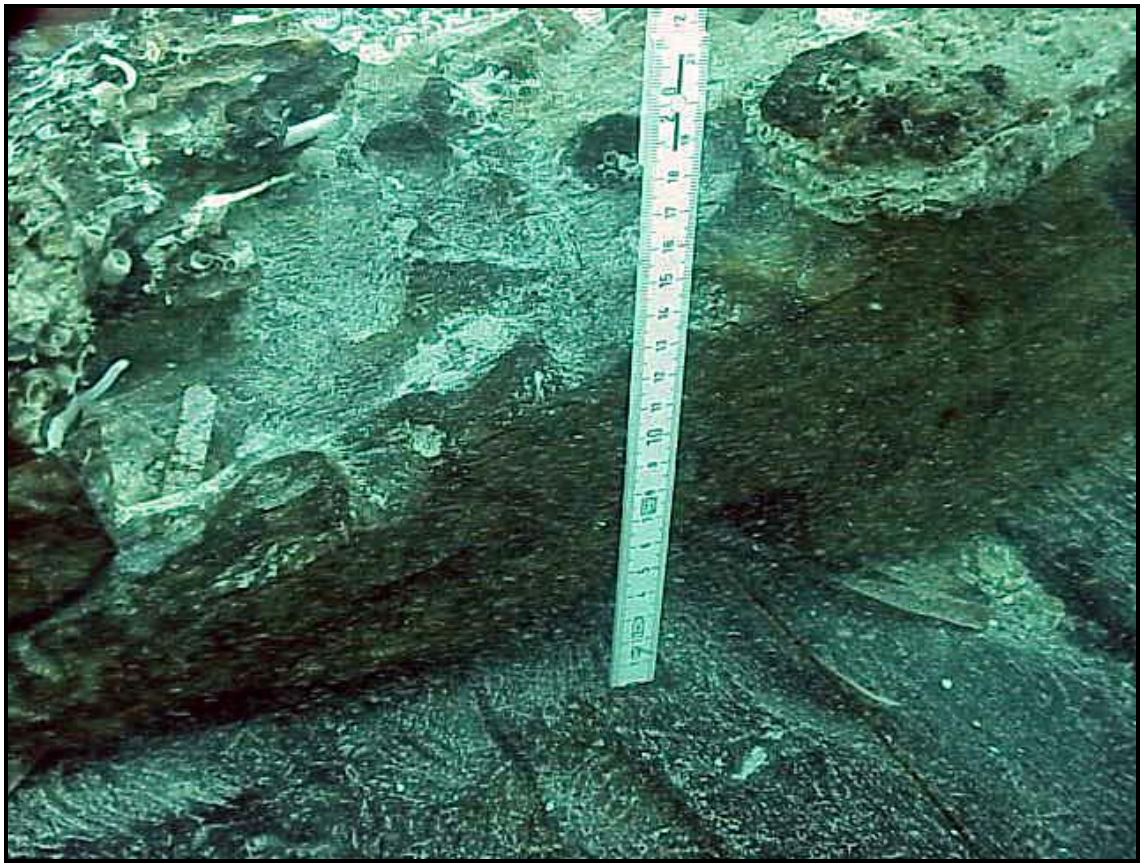

Illustration 17: Ridged plastic measuring rod, (collapsible) being used to measure a floor and a limber hole, on the ***Le Casimir Wreck***. (© ADMAT Archives)

7. Bearing Level Board.
These surveying pieces of equipment need to be carefully sited to ensure that they do not harm the coral life if they are deployed on the reef. Concrete blocks should be used to ensure it remains upright and secure. When cleaning the unit use soapy water on the Plexiglas or Perspex to prevent scratching of the unit. The bubble levels need to be centralised.

8. Concrete blocks with floats.

The concrete blocks can be used as markers to identify various objects or used as weights on ground lines. It is a good idea to spray the blocks and paint numbers on them for reference points. If a small float is attached to it on a short length of line 1 meter, it will ensure that the block can be easily spotted even if the bock has been covered by sand.

9. Underwater Clipboard and Pen.

You will need something to write on underwater, and a clipboard is idea, without the metal clasp, as rubber bands can be used. Waterproof paper (Mylar, Tyvac) should be used with pencils, preferably the propelling type, anchored on string to the board. The board should be negatively buoyant. A prepared survey sheet is a good idea with questions already on it for the diver to complete.

10. Compass

Very useful for noting the alignment of timbers or other artefacts. It is essential that the north direction is noted, for the plan.

11. Meter Survey Squares and Tracing Squares.

One-meter square frame with two layers of string, (one on the top and the second on the bottom) in scaled grids are very useful for small survey areas. Plumb lines can be used with the two layers of string to ensure an accurate measurement is given. By placing a one meter square ridged sheet of Perspex on the frame it is possible to trace the objects accurately. This can be used on the grid system.

4.5 Survey Techniques

By the end of this section you will be able to:
Know different methods of surveying an area

1. General Points.

a. Whilst it is difficult to teach all the different survey skills and techniques, the following three methods will ensure that a site can be

accurately surveyed. The skills will be developed after practice, and students should not be frustrated if they take longer than they originally envisioned or they make mistakes at first. Also teamwork will help, especially in the grid survey.

b. It is advisable to have an orientation dive prior to the actual survey. This enables the students to calculate the best location for the Base Line and the best position for the Bearing Level Board. Time must be taken on ensuring the measurements are accurate as they can be, and the measurements clearly written down on the underwater slate, to avoid confusion later.

c. Each time a measurement is taken, the depth should be noted.

REMEMBER IT IS ALWAYS GOOD SURVEYING PRACTICE TO TAKE MORE MEASUREMENTS THAN YOU THINK YOU NEED. FOR THREE DIMENSIONAL SURVEYS TAKE THE DEPTH READING EVERY TIME YOU TAKE A MEASUREMENT OR THE TOPOGRAPHY OR TARGET CHANGES.

d. Always check your measurements as you write them down. If you get a measurement wrong it is very annoying to have to go back and re-do the measurement.

2. Drawing Sketches.

In surveying an area sketches can be a very useful tool. By drawing a sketch you are giving an overview, which can include useful information on the nature of the seabed, marine life and wreck site. Major features such as boulders, outcrops, gullies and sand patches can give a good illustration of the topography. This information can be simplified later by using symbols and annotations to produce a plan.

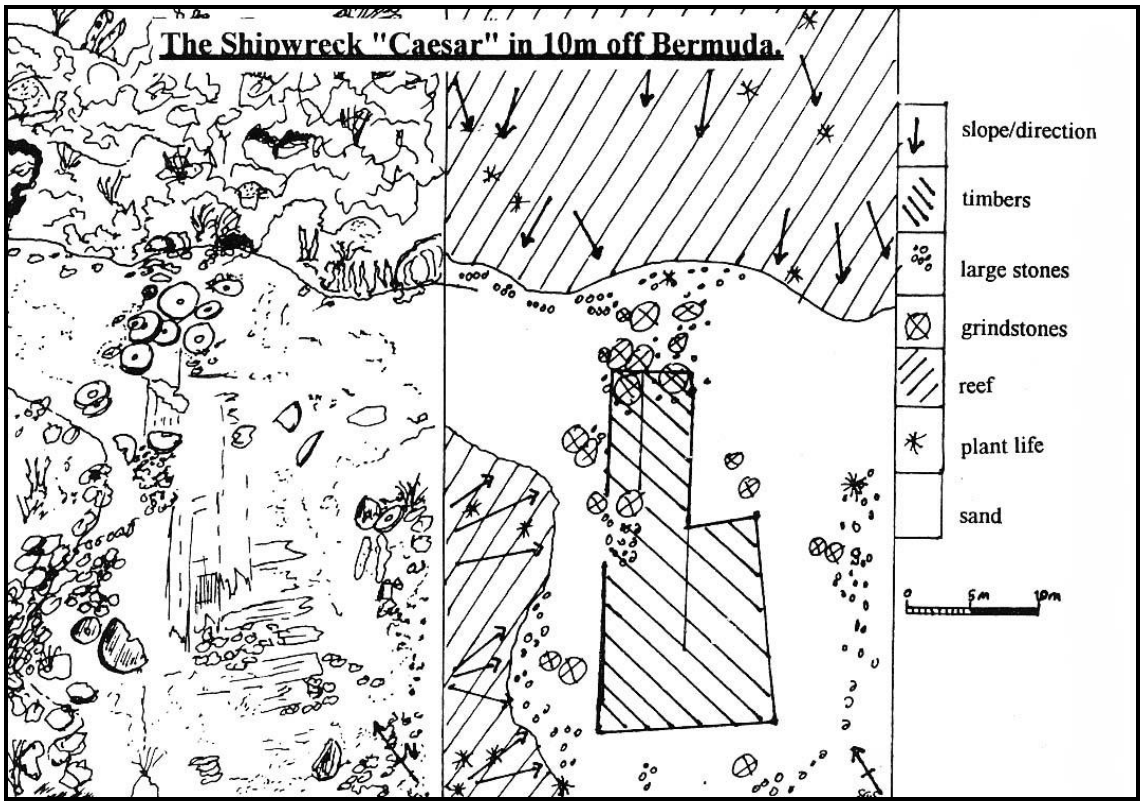

Illustration 18:Visual underwater sketch showing the artefact locations and a symbol sketch diagram of the same thing.

3. Photography and Video.

In this course, we unfortunately do not have time to go into detail on how to survey an area using Video or Photo mosaics.

Photography is one of the most useful tools that a surveyor can use. The photographs give an instant picture of what the survey site looks like at a given date. Photomontages and Photo mosaics can be crucial to a successful survey. Underwater viability will seldom be good enough to take a whole photograph of a wreck site. Also the lens would distort the accuracy of the photograph. So by "flying the camera" and overlapping the photographs and joining the prints together, a photo mosaic can be formed.

Video footage can provide invaluable record. Complex areas where photographs will not give a three dimensional impression can be easily recorded by using video.

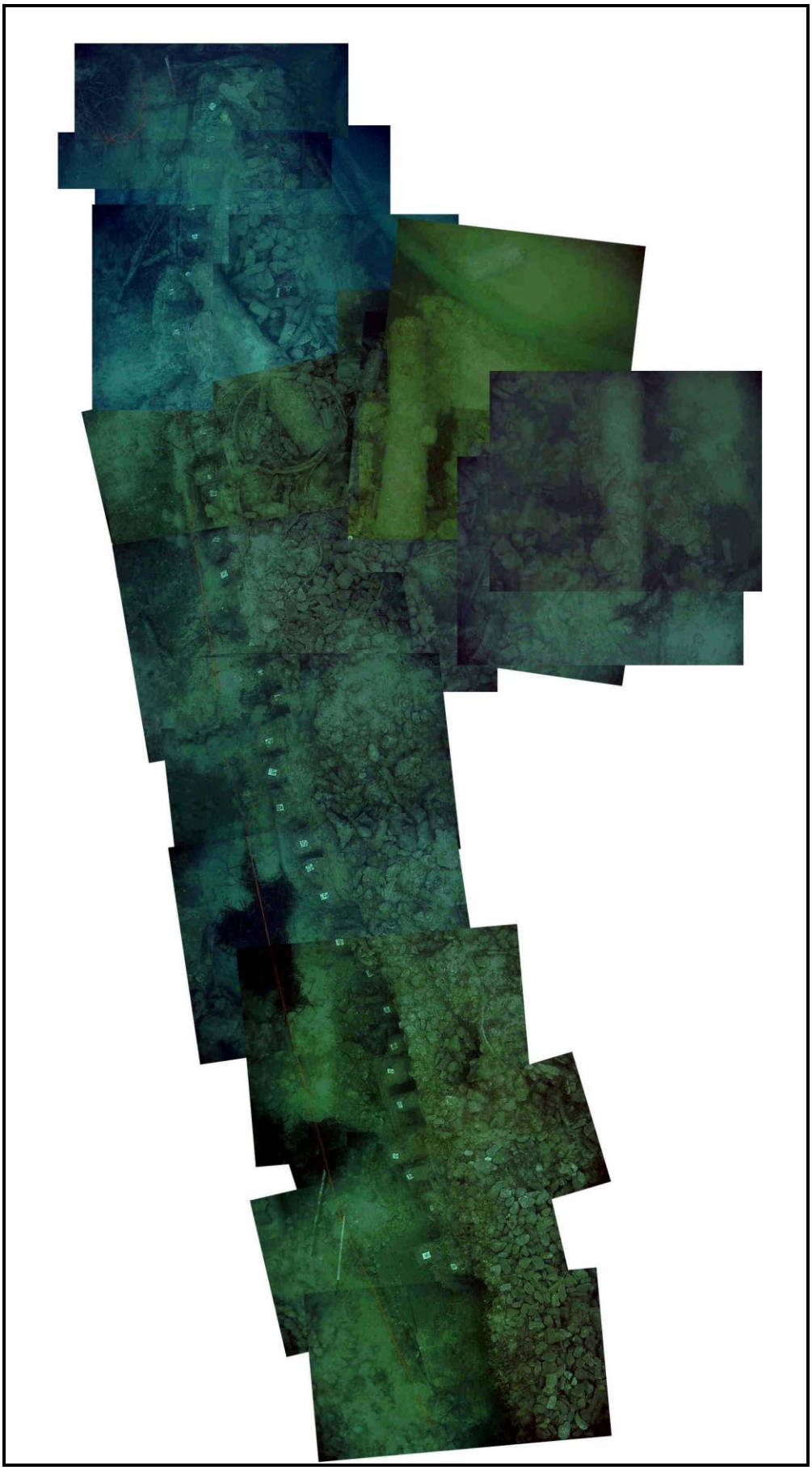

Illustration 19: The ***Le Dragon Wreck***, Dominican Republic (© ADMAT Archives).

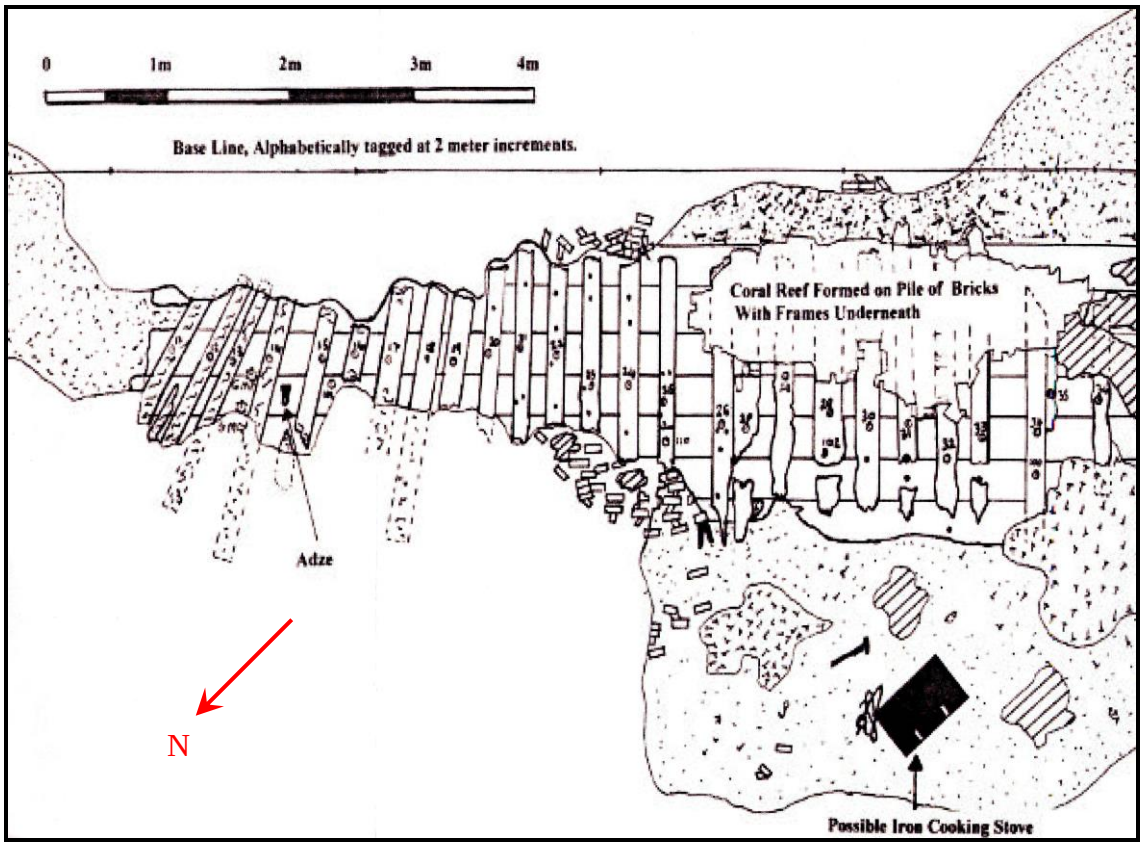

Illustration 20: Stern section, North or Seaward section of the ***Musket Ball Wreck*** in the Dominican Republic (© ADMAT Archives).

Illustration 21: Stern section, North or Seaward section of the ***Musket Ball Wreck***, midway through excavation (© Lt. Bill Baxley USN).

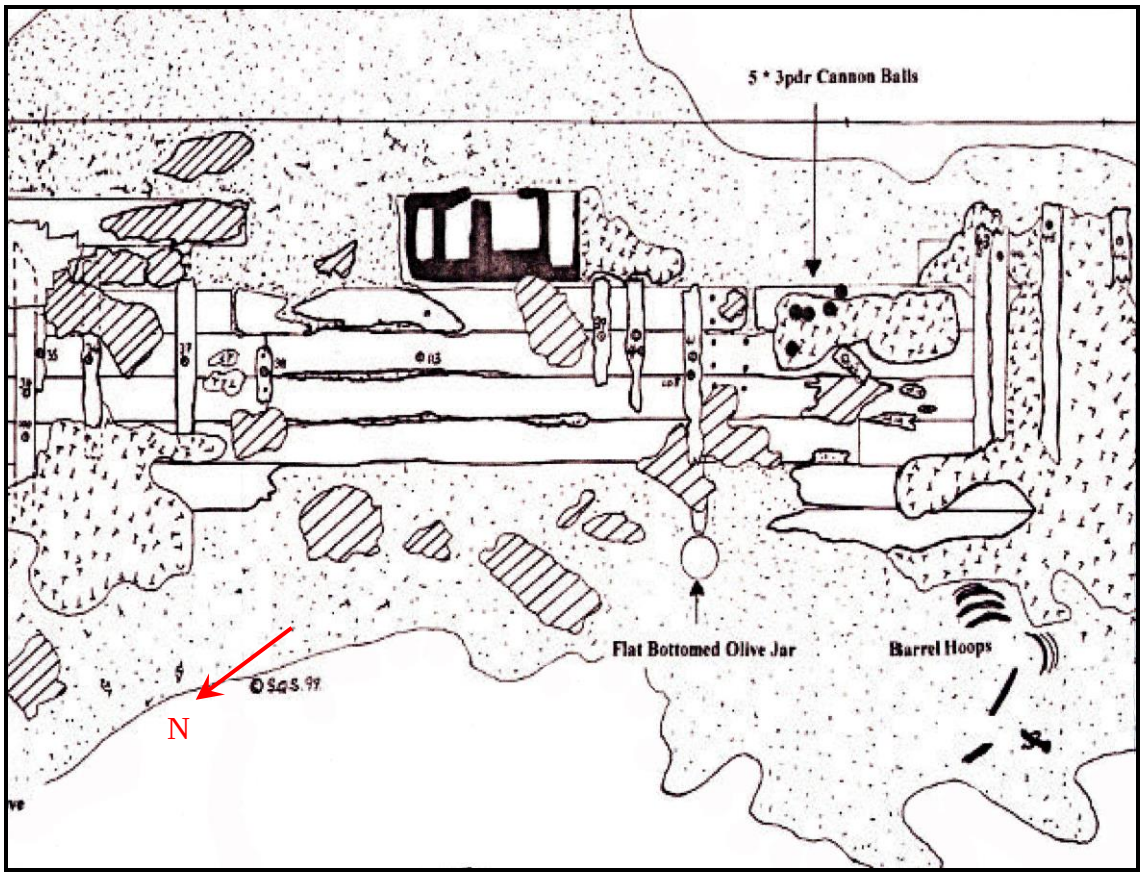

Illustration 22:Amidships section of the ***Musket Ball Wreck***. Note Bow is missing (© ADMAT Archives).

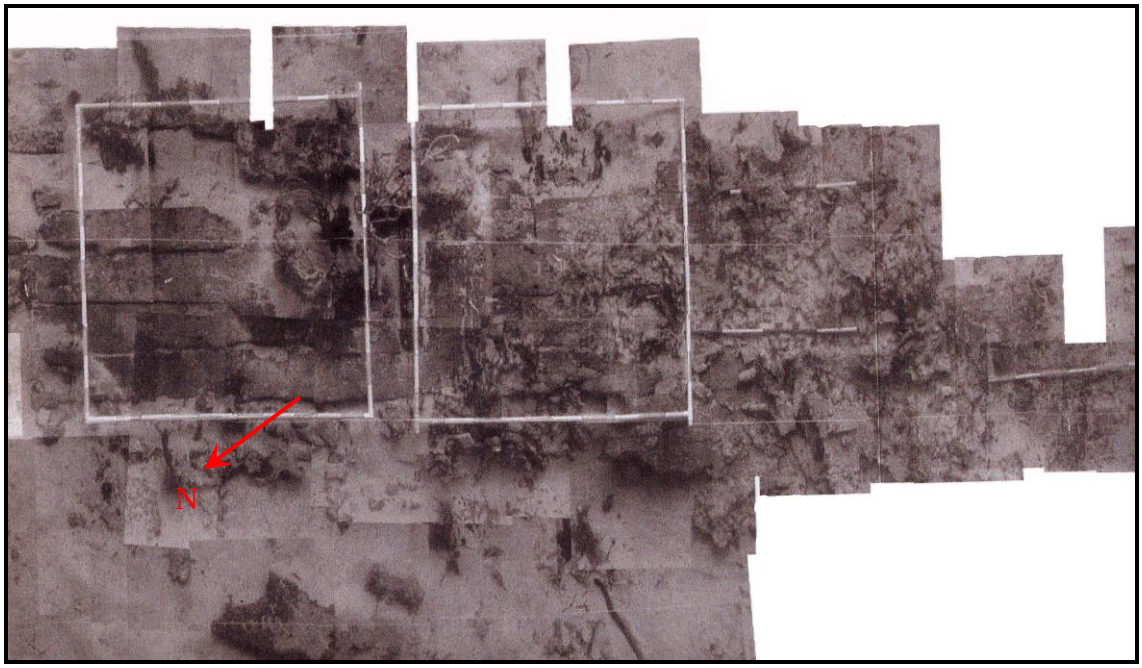

Illustration 23: Amidships section of the ***Musket Ball Wreck*** (© Lt. Bill Baxley USN).

THE *WHITE HOUSE BAY WRECK* IN WHITE HOUSE BAY, ST. KITTS
Phase 1 of ADMAT's St. Kitts Maritime Archaeological Project
Believed to be built 1740-1760's and wrecked 1780's
Surveyed by ADMAT in April 2003

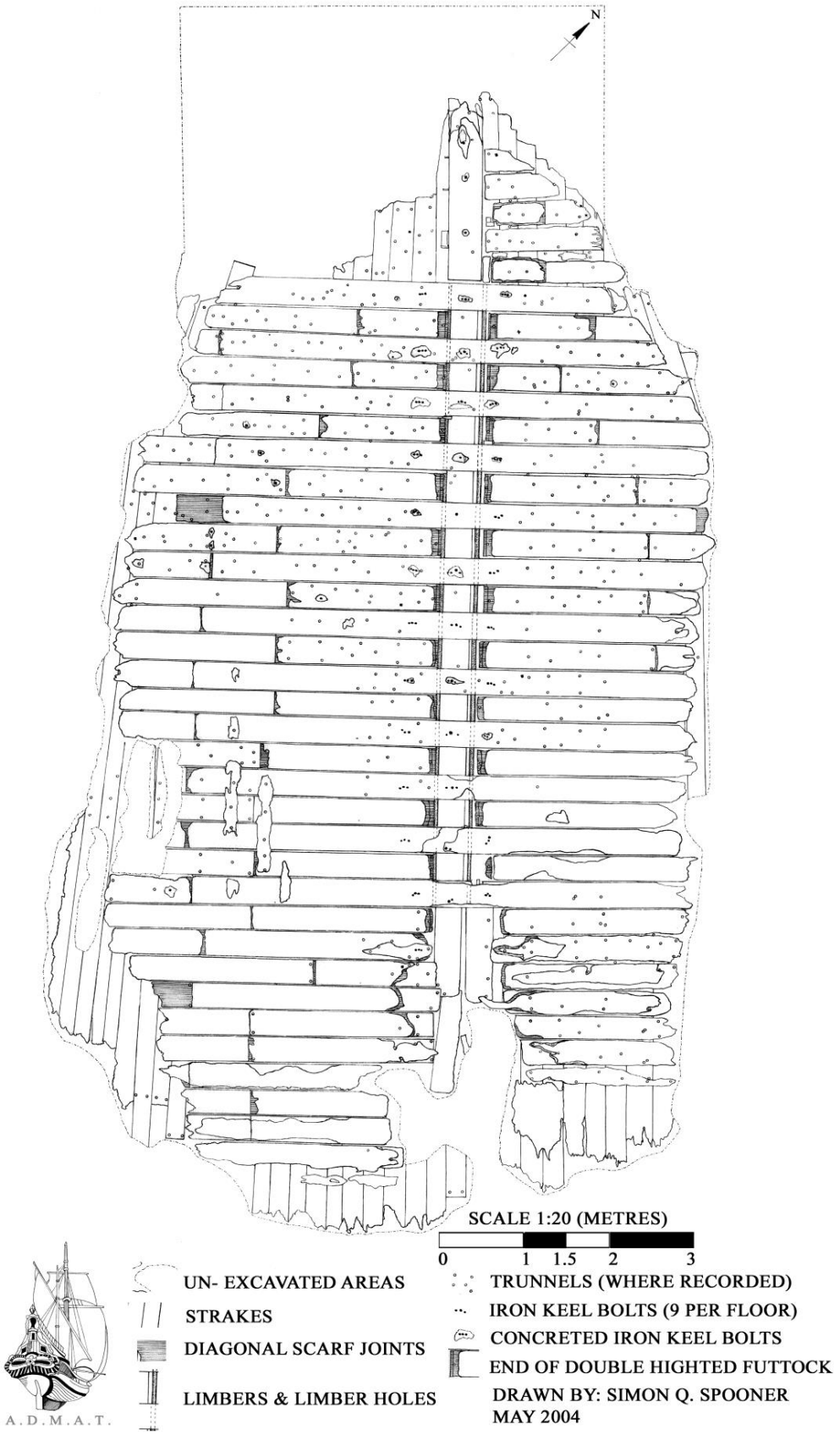

Illustration 24: A scale drawing of the remains of the ***White House Bay Wreck***, St. Kitts (© ADMAT Archives).

The three survey methods this course will teach are as follows:

1. Point Line Survey System.

a Introduction.

This method is the simplest to use and will provide accurate survey of the site. This is best used when time is short or the area has large objects to survey such as patch reefs or large wrecks

b. How to use this method.

i) First establish a fixed datum with a shot line and buoy. It is best to place this datum close to the objects or in the middle. Once the datum has been established then an accurate D G P S or G PS reading should be made on the surface.

ii) Erect the Bearing Level Board (BLB) next to the shot line. Ensure that the board is flat and that it is secure.

iii) Sight the first target through the "Gun Sights" on the Bearing Level Board and note the bearing.

iv) Clip the end of the tape measure to the hook on the stand of the BLB and swim out to the first target unwinding the tape measure. When you arrive at the target, ensure the tape is taught and level. Take the measurement.

v) Deploy a marker, noting it's number and then retrieve the tape. Swim back to the marker and measure the target.

vi) Ensure you have the length, height, and several measurements of the width if it varies. Every time you take a measurement, take a bearing to your next reference area before you swim out to it with the tape.

vii) Draw a simple sketch of the target as you go, placing all the measurements depths and bearings on it.

vii) When you get to the end of the target, take a bearing back to either the marker or if the BLB is visible, to it. If necessary you can then take a measurement from the end of the target back to the BLB.

viii) Return to the BLB and sight up the next target and so on. If applicable take measurements from one target to another, from marker to marker.

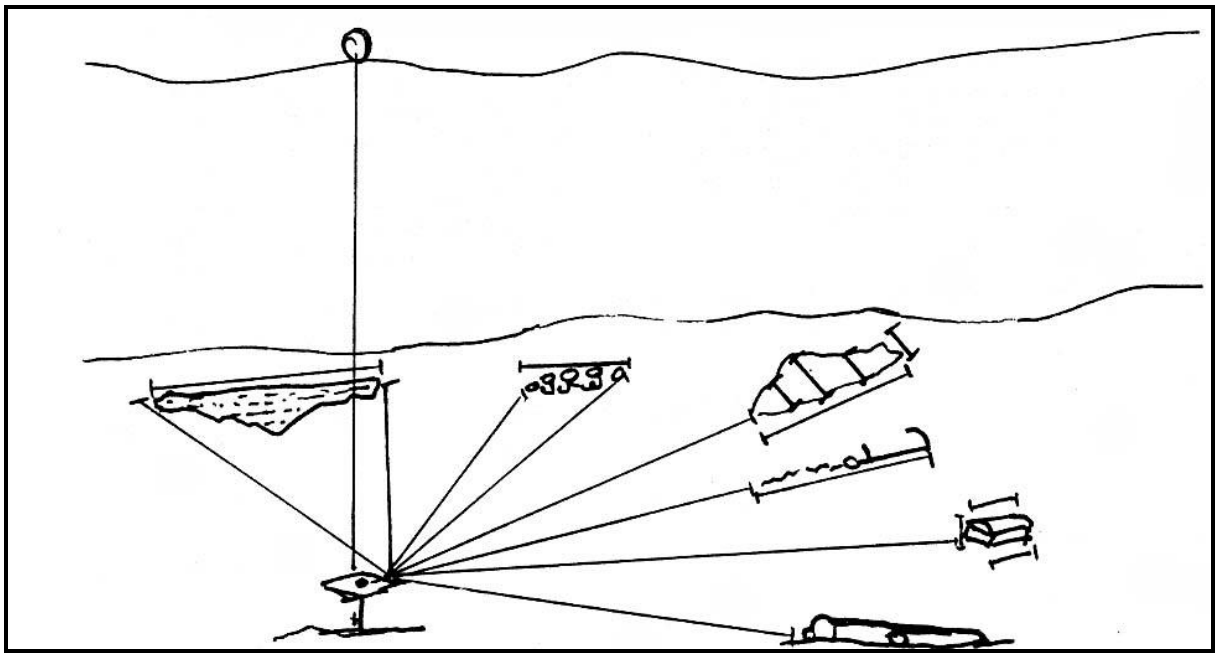

Illustration 25: Point line Survey System (© ADMAT Archives).

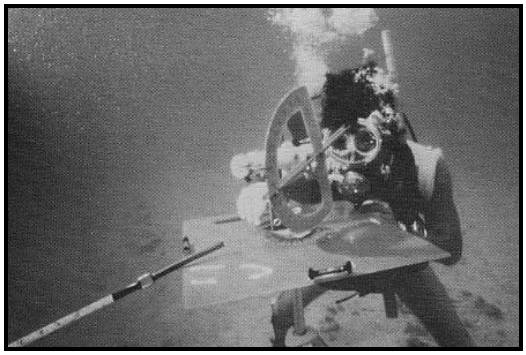

Illustration 27: Underwater Transit designed to provide location data for construction of three dimensional perspective plans (© Dr. Duncan Mathewson III)

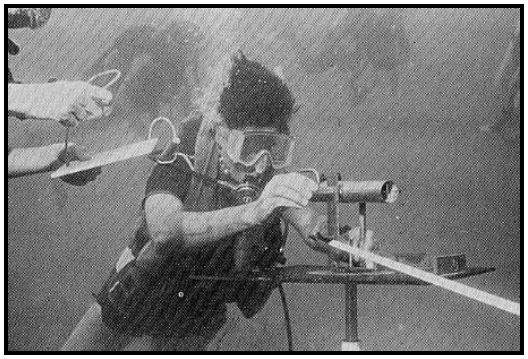

Illustration 26: Kew West workshop participants use an underwater transit (© Larry J. Wilson 1985)

2. Base Line Survey System.

a. Introduction.

This method is particularly suited for large areas such as historic shipwrecks where the students will find numerous targets, which have to be accurately measured and surveyed. This method uses a central fixed line made of pipes, which is colour graded every meter. By using triangulation on each target an accurate survey can be made. The same principles that were taught in No:1 apply. Remember always take three distance measurements and bearings to maintain 100% accuracy.

b. How to use this method.

i) First establish a fixed datum with a shot line and buoy. It is best to place this datum close to the objects or in the middle. Once the datum

has been established then an accurate DGPS or GPS reading should be made on the surface.

ii) Deploy the base line and ensure it is secured firmly, and that it is in a straight line.

iii) At the farthest end, deploy a SMB and secure. On the surface this buoy should be replaced with a shot line and buoy which will act as a second fixed datum. When this has been established then an accurate DGPS or GPS reading should be made on the surface.

iv) At one end start swimming along, when you spot a target note the measurement on the base line and fix the tape to it. Swim out to the target unwinding the tape. Deploy a marker measure as per No: iii. When finished, measure the distance back to the base line and record this as well as the measurement on the base line.

v) This method only works if you take bearings and measurements from the base line about 30 degrees from the line and back, to form a triangle and not going 90 degrees out to the target. Remember you must have at least two distance measurements and bearings from the base line to the target point. For large objects you might have two or three target points apart from both ends.

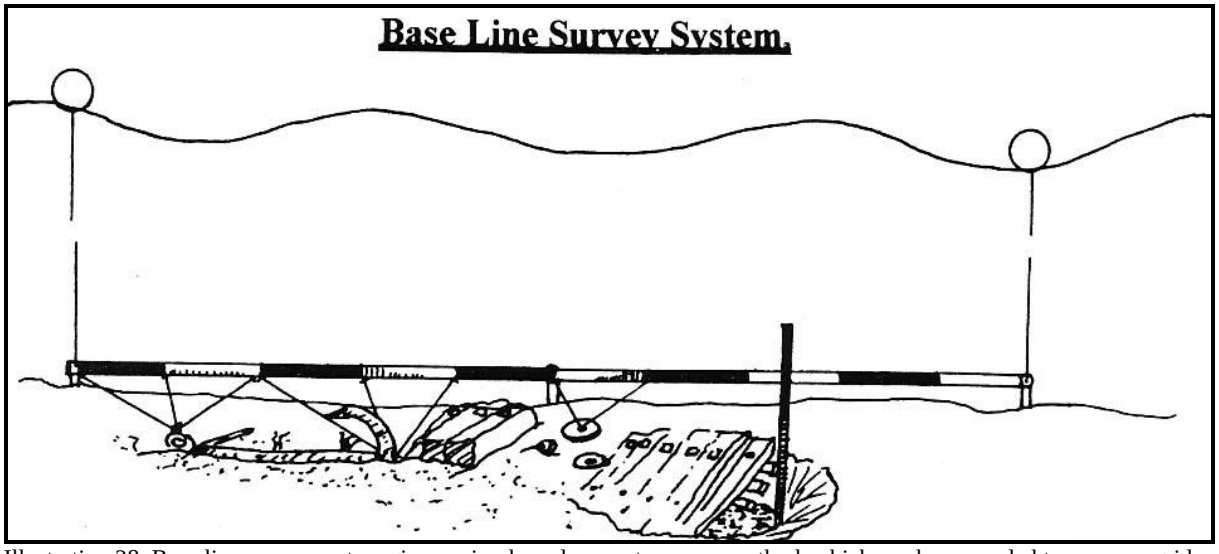

Illustration 28: Base line survey system gives a simple and accurate survey method, which can be expanded to a survey grid system (© ADMAT Archives).

3. Survey Grid System.

a. Introduction.

This system is an extension of the Base Line Survey System. The Base Line has numerous Base Lines running parallel to it with intersections. Obviously this is a complex system, which takes time to set up, and it must be anchored properly. Once this has been completed it will

provide a far more accurate reference system from which measurements can be taken.

The Grid system is the best for accurate survey of sites, which are not flat such as on the side of a reef, or in gullies. If the grid takes on the appearance of a "multi story building", then it must be secured with care to prevent currents from moving it.

b. How to set up the grid.

Exactly the same as above in No:2. Once the first base line is completed then the ends and parallel sides are erected. On each cross section a datum marker and shot line is set up. If a large grid is set up it may look like chess board on the surface as buoys mark each intersection.

c. How to use this method.

Exactly as in No: 2, but this time the measurements can be taken from any side of the grid and any two corners on the same side. A three dimensional survey can be easily achieved by taking measurements from the base lines or fixed grids once the depth of the grid has been established. By using this fixed datum depths can be calculated more accurately than taking a depth reading on the divers depth gauge. Also the tidal range will not effect the measurements

4.6. Practical Drawing Session

By the end of this session you will be able to.

Draw accurate, scaled plans for each of the dives showing all the information obtained in the survey.

[In this session the instructors should help the students draw scaled diagrams of the three survey areas]

On the next pages, illustrations of the plan from the ***Tile Wreck*** are given. The finished work looks simple, but over 250 measurements were taken to achieve this. On the ***White House Bay Wreck***, over 3,000 measurements were taken.

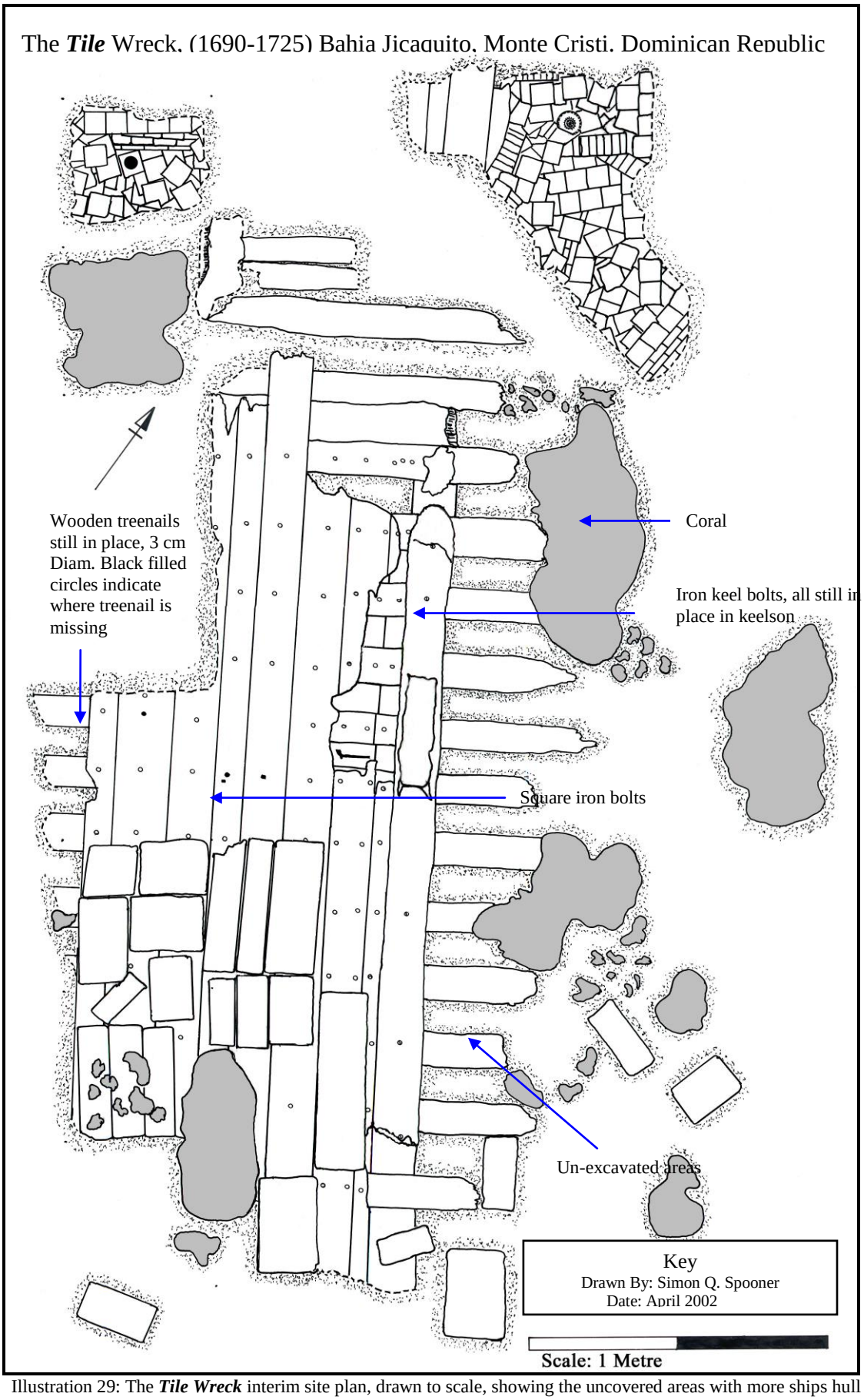

Illustration 29: The ***Tile Wreck*** interim site plan, drawn to scale, showing the uncovered areas with more ships hull to uncover (© ADMAT Archives).

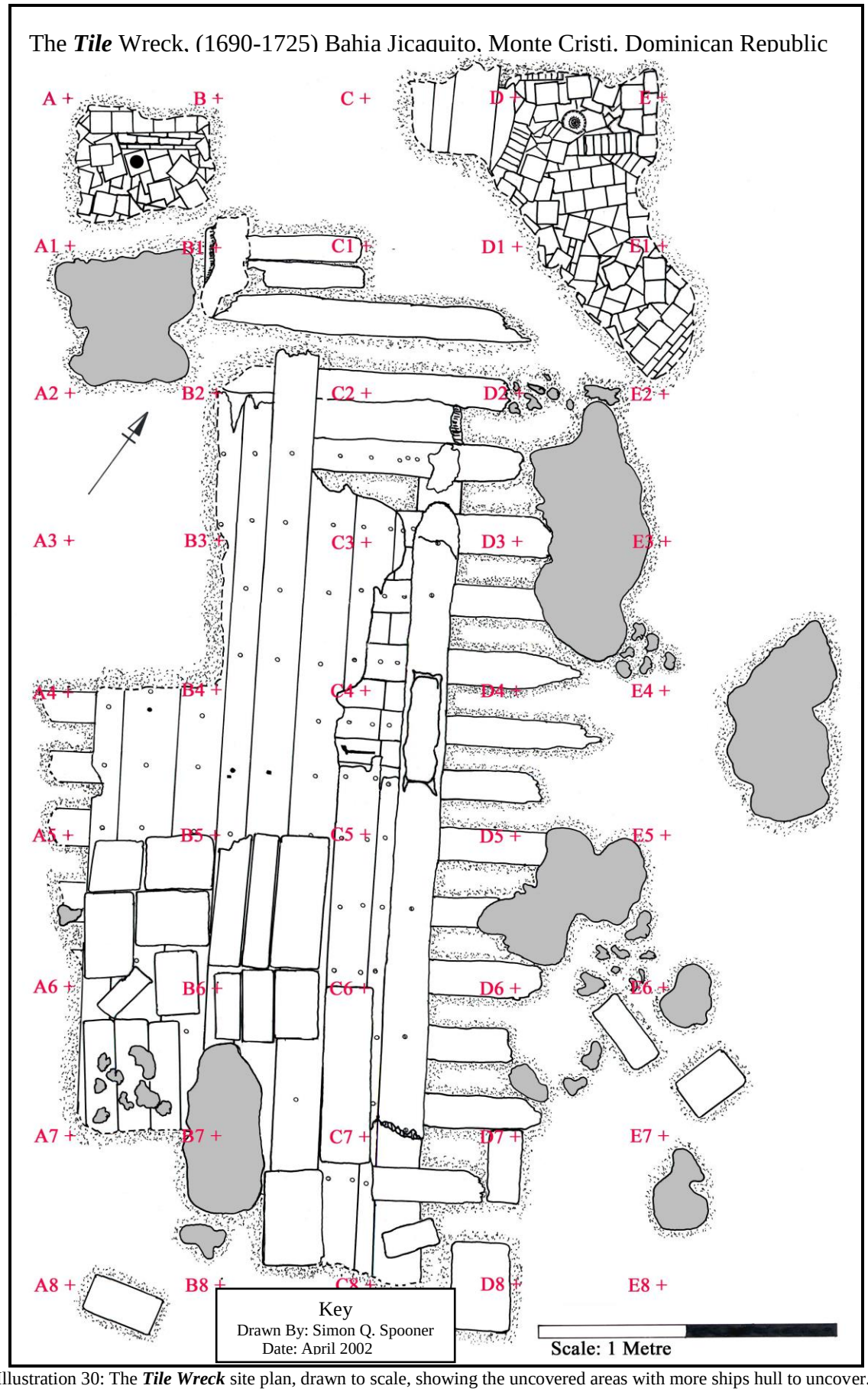

Illustration 30: The ***Tile Wreck*** site plan, drawn to scale, showing the uncovered areas with more ships hull to uncover. Shows the grid intersection points (+). The name of each 1 m sq is the top left alpha numeric (© ADMAT Archives).

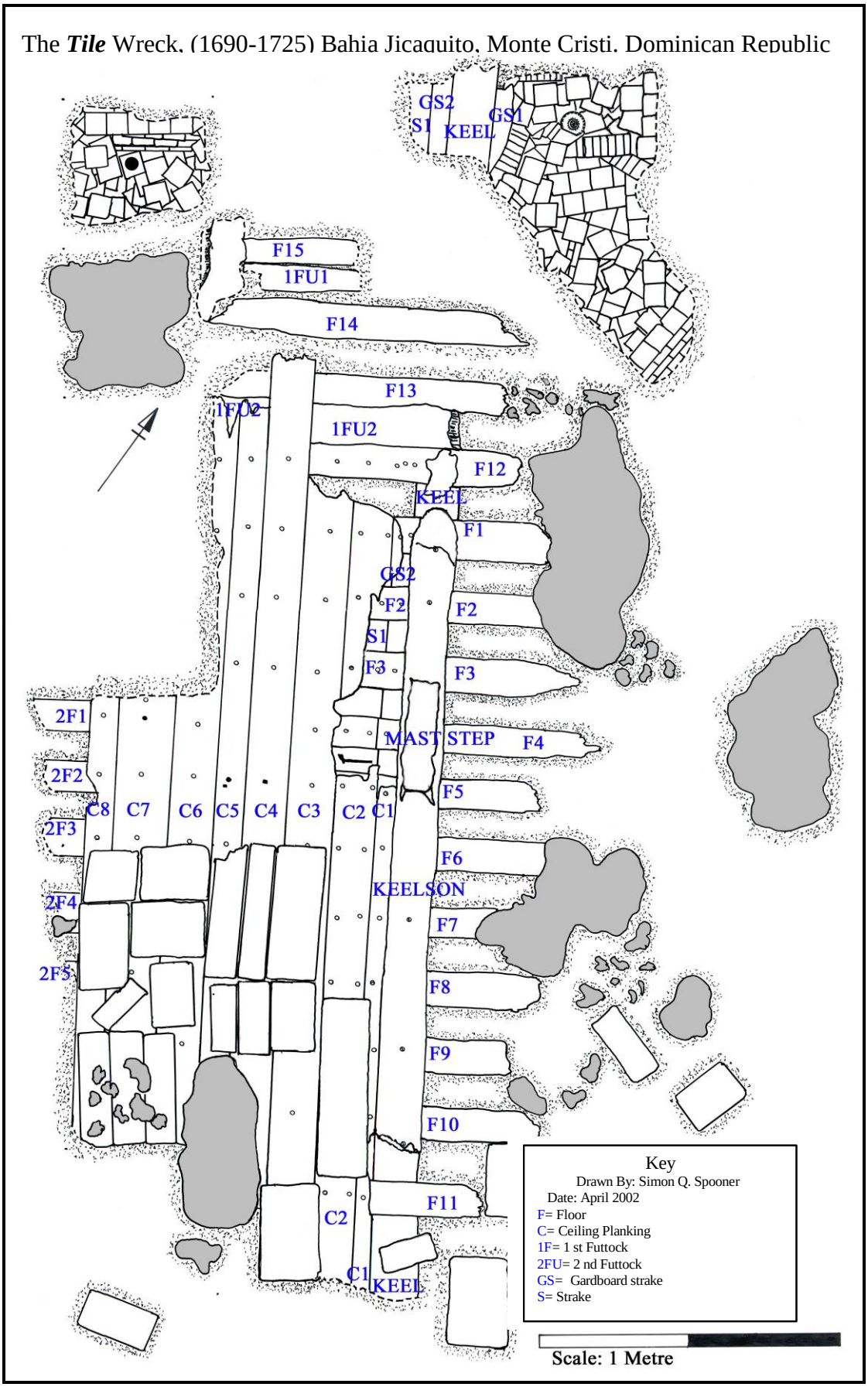

Illustration 31:The ***Tile Wreck*** site plan, drawn to scale, showing the uncovered areas with more ships hull to uncover. Shows the ships construction, which had been uncovered so far (© ADMAT Archives).

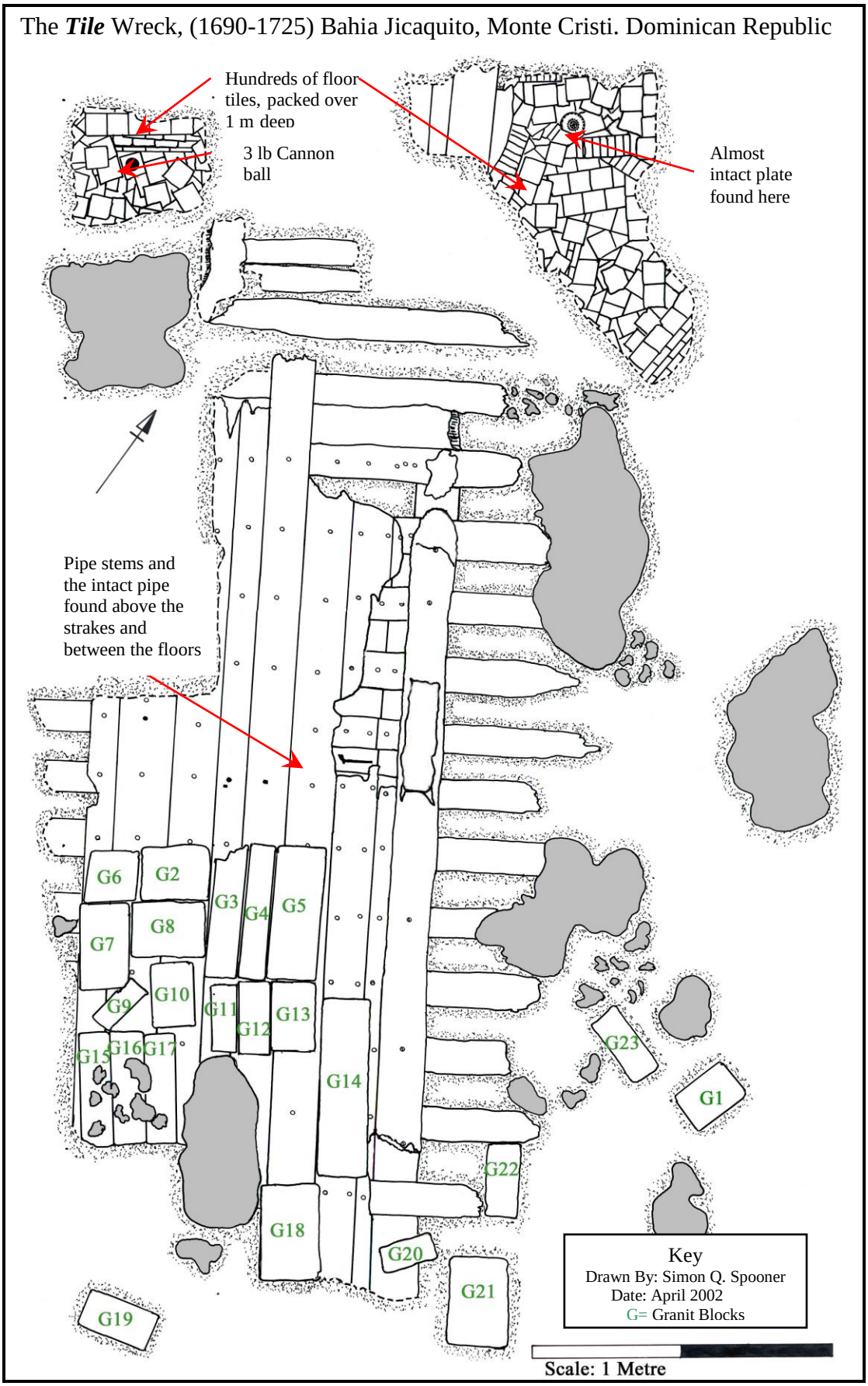

Illustration 32: The ***Tile Wreck*** site plan, drawn to scale, showing the uncovered areas with more ships hull to uncover. Shows the items of cargo found, but not the looted cannons (© ADMAT Archives).

THE *WHITE HOUSE BAY WRECK* IN WHITE HOUSE BAY, ST. KITTS
Phase 1 of ADMAT's St. Kitts Maritime Archaeological Project
Plan showing the floor numbering and positioning

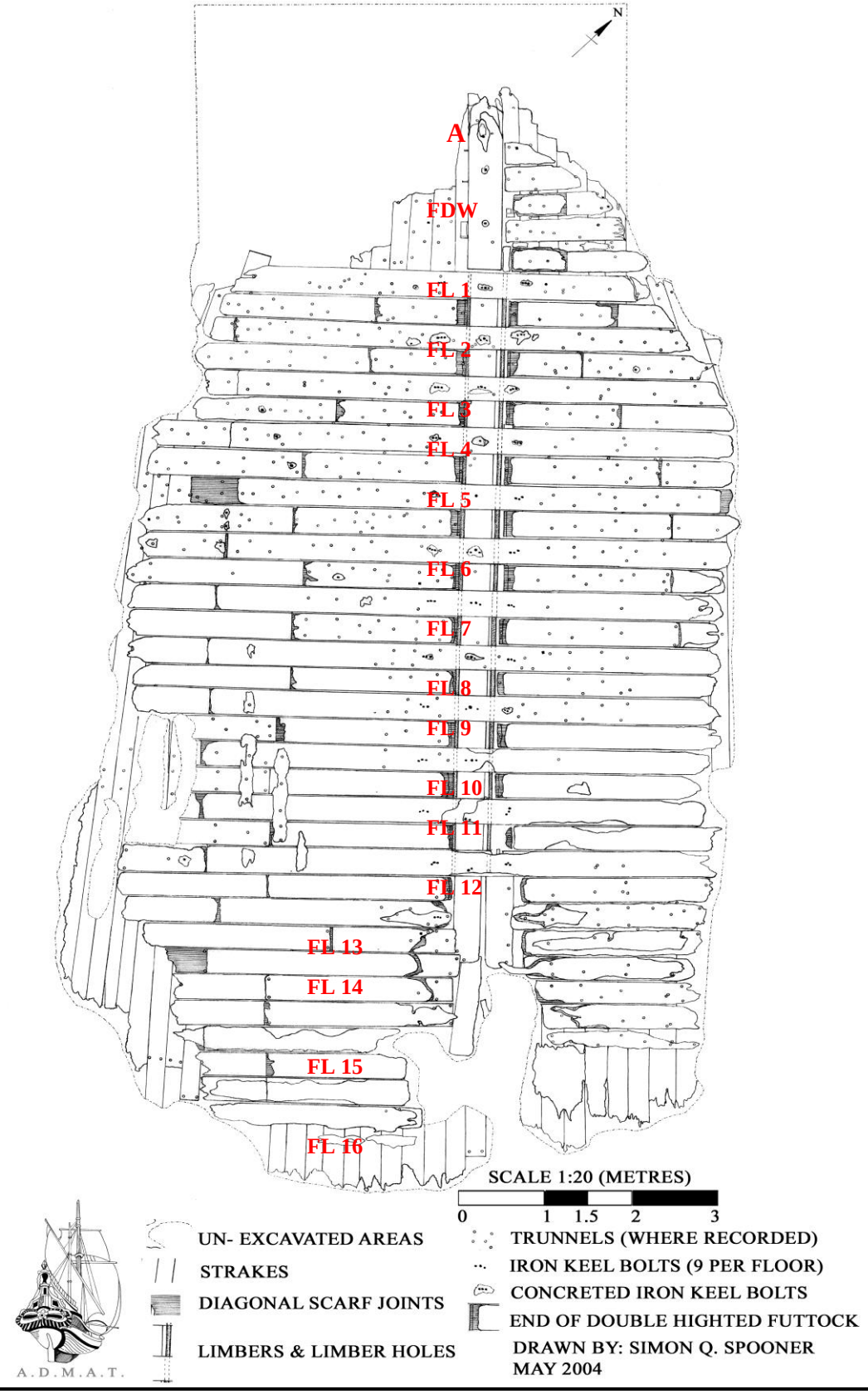

Illustration 33: Scale plan showing the floor numbering and positions on the ***White House Bay Wreck*** (© ADMAT Archives).

THE *WHITE HOUSE BAY WRECK* IN WHITE HOUSE BAY, ST. KITTS
Phase 1 of ADMAT's St. Kitts Maritime Archaeological Project
Plan showing the 1st futtock numbering and positioning, port and starboard

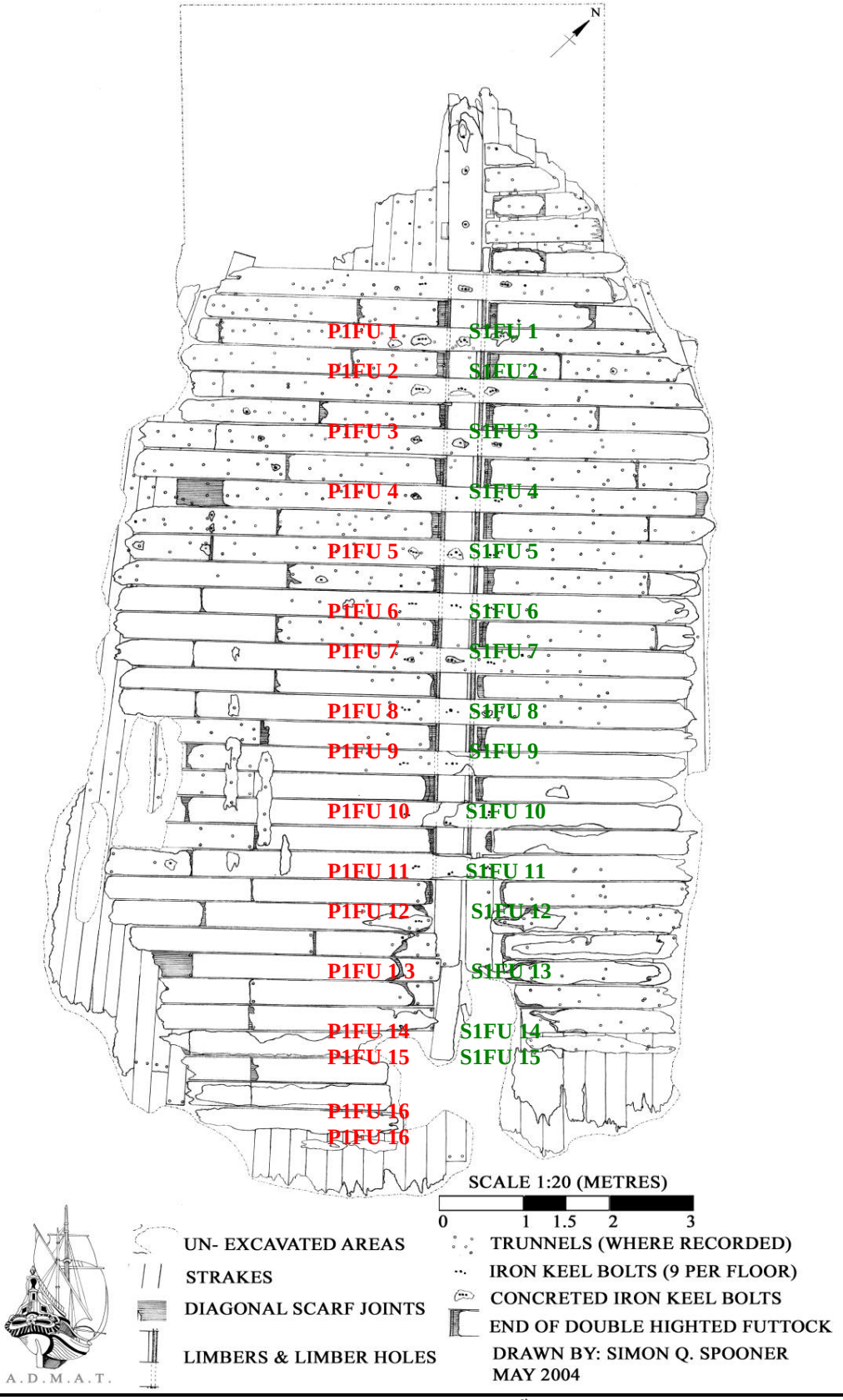

Illustration 34: Plan showing the positioning and numbering of the 1st futtocks on the ***White House Bay Wreck*** (© ADMAT Archives).

THE *WHITE HOUSE BAY WRECK* IN WHITE HOUSE BAY, ST. KITTS
Phase 1 of ADMAT's St. Kitts Maritime Archaeological Project
Plan showing the 2nd & possible 3rd futtock numbering and positioning, port and starboard

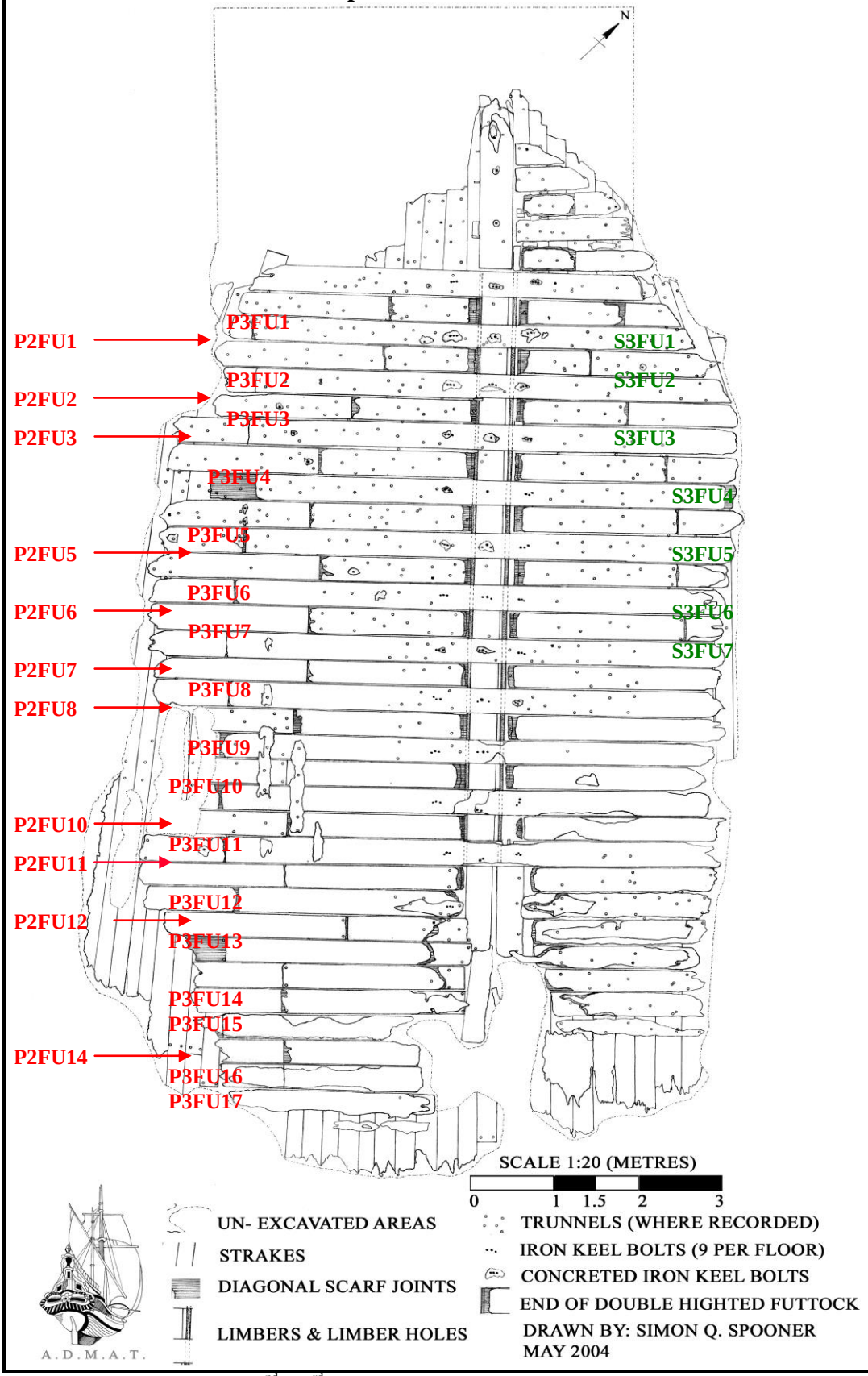

Illustration 35: Plan showing the 2nd & 3rd futtocks on the ***White House Bay Wreck*** (© ADMAT Archives).

4.7 Practical Topics

By the end of this section you will be able to:

Practice on land how to conduct the three methods of surveying a target site.
Demonstrate how to successfully erect a Base Line and Survey Grid.
Demonstrate how to organize a team of divers to construct a three dimensional Survey Grid.
Demonstrate a mastery of the above three points without the intervention of the instructor, prior to conducting the dives.

[Note: After a thorough briefing the instructor should demonstrate all three methods on land in detail. Once a clear demonstration has been performed the students should be split into pairs and should demonstrate what at the have learned. The instructor can give assistance if is required and advice. When practice has been completed then the students must conduct the exercises on there own.]

5.0. Pool Training Dives, and or Open Water Survey Dives

Note: For clarity, each dive is outlined completely. The dives should be made either in clear water of a deep swimming pool or the targets can be found prior to this course in open water. However low visibility, whilst it is a normal occurrence of open water surveys, it should not be a case for the first dives; as the purpose is to increase the students experience not frustrate them. Skills and procedures specific to an individual dive appear **in Non Italic face type.** The training can be conducted in sheltered open water if the conditions are sutiable. The greater number of dives, the better the practical experience.

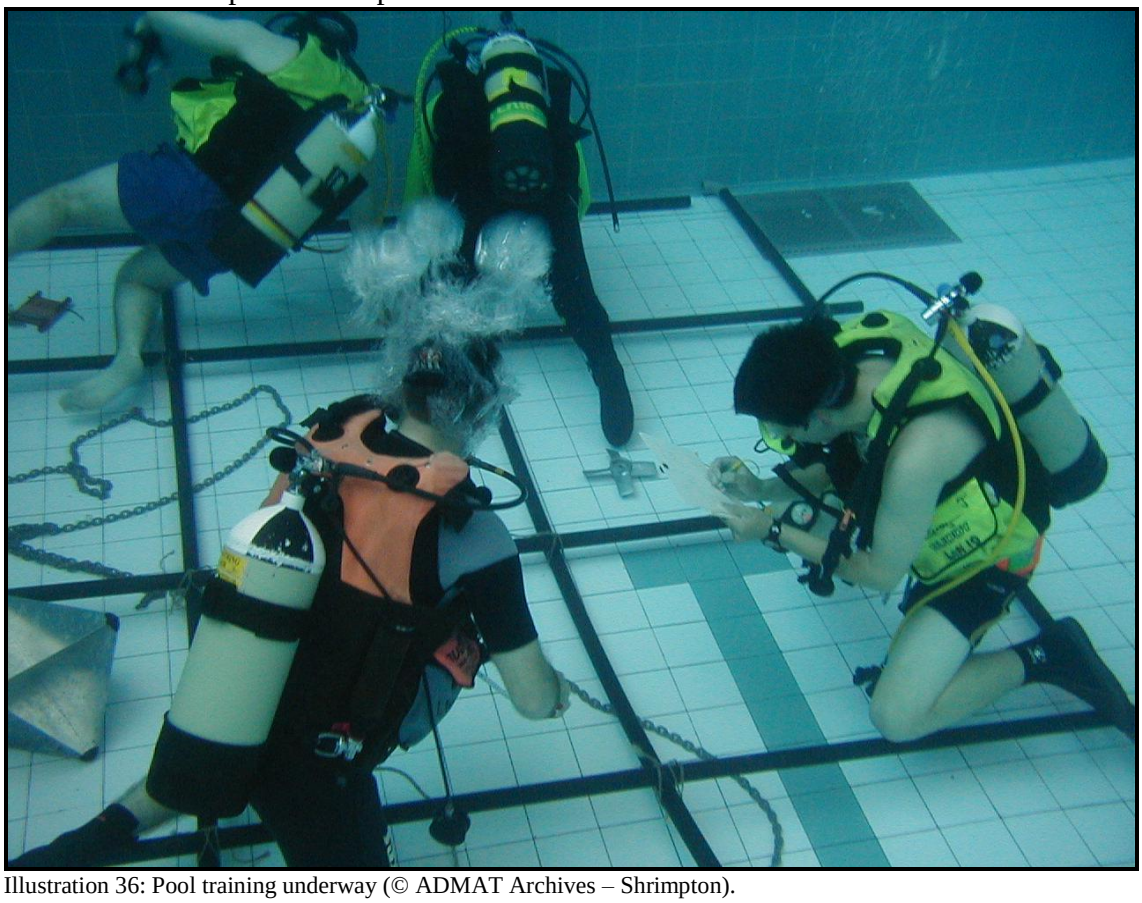

Illustration 36: Pool training underway (© ADMAT Archives – Shrimpton).

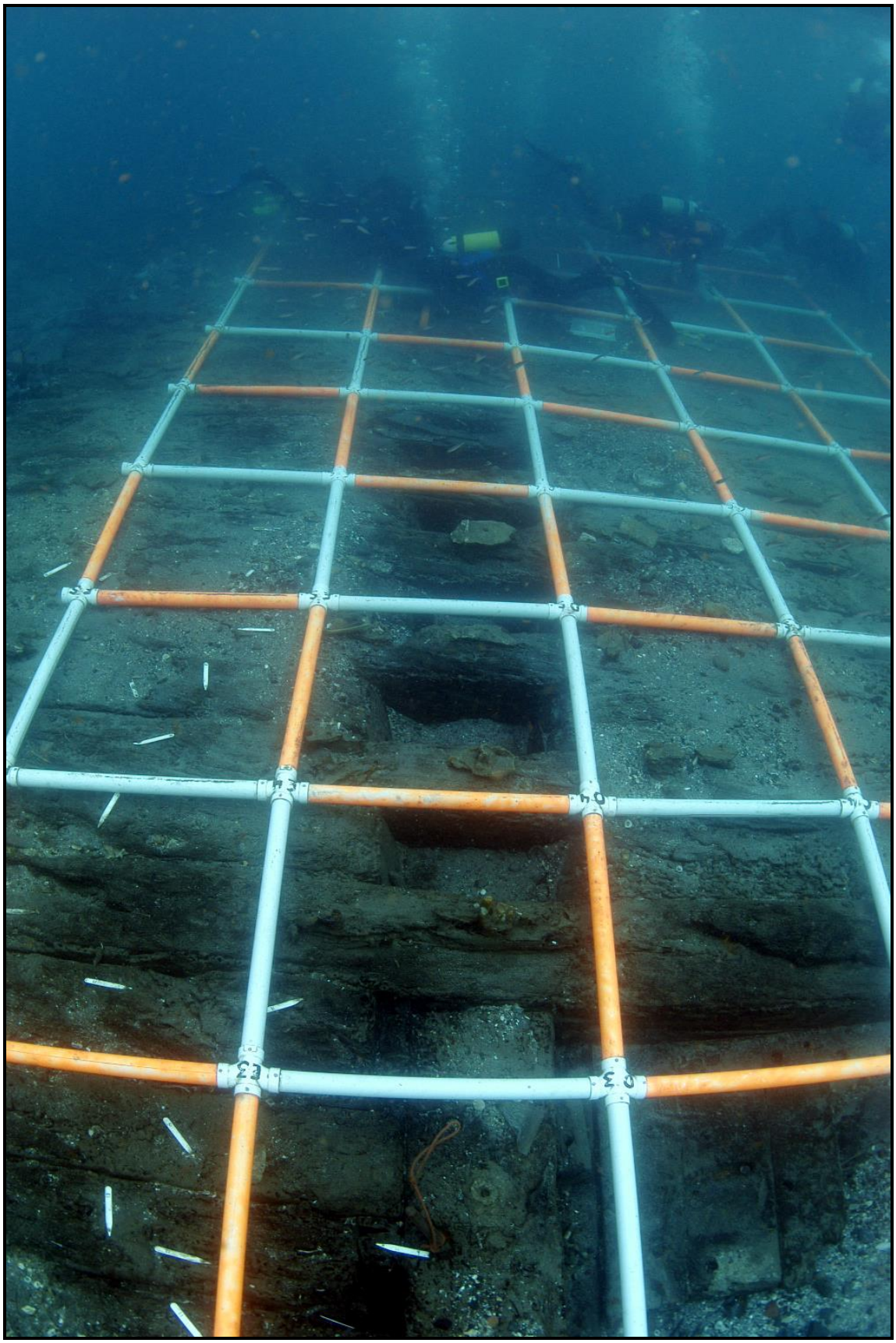

Illustration 37: The *White House Bay Wreck* survey (©ADMAT Archives – Schomberg).

Open-Water Training Dive No:1

By the end of this Open Water Dive you will be able to:

Conduct a general survey of the area.

[Note to instructors. Your role is to act as a dive marshal and monitor the student's prowess not demonstrate the skill. The purpose of this dive is to conduct a general survey of the area, so that the students know where the centre of the target site is and which is the best place to locate the BLB.]

1. Briefing.

a. Evaluate the conditions.
b. Facilities at the dive site.
c. Entry technique and location.
d. Exit technique and location.
e. Description of the target from the data previously collected.
f. Depth ranges.
g. Interesting and helpful facts about the dive site.
h. Sequence of training dive;

Deploy the shot line.
Descend shot line with equipment.
Control buoyancy.
Conduct Survey of the site
Return to Shot line.
Ascend as usual.

i. Special communication or signals.
j. Loss of buddy or class procedures.
k. Emergency procedures.

1. Buddy assignments.

2. Pre dive procedures.

a. Prepare personal equipment.

b. Prepare equipment required for surveying.

c. Calculate no-decompression limits.

d. Don personal diving equipment.

e. Perform pre dive buddy check and safety drill.

f. Proper entry.

g. Proper decent down the shot line.

3. Descent - Vent air, make standard descent to the target.

4. Dive tasks for dive No 1

   a. Demonstrate mastery of working as a buddy pair and conducting the Survey.

   b. At a predetermined time, return to the shot line and ascend to the surface making a safety stop if required according to the dive plan.

5. Post-dive procedures.

   a. Make exit appropriate for environment.

   b. Wash and stow equipment and exchange tanks as appropriate.

6. Debriefing.

   a. Comments on student performance.

   b. Discuss the overall " look" of the Survey

7. Log the dives (instructor signs log].

Open-Water Training Dive No:2

By the end of this Open Water Dive you will be able to:
Deploy a shot line and buoy.
Erect the BLB
Conduct a survey of the target using the Point Line Survey System.

[Note to instructors. Your role is to act as a dive marshal and monitor the student's progress not demonstrate the skill.]

1. Briefing.

   a. Evaluate the conditions.
   b. Facilities at the dive site.
   c. Entry technique and location.
   d. Exit technique and location.
   e. Description of the target from the data previously collected.
   f. Depth ranges.
   g. Interesting and helpful facts about the dive site.
   h. Sequence of training dive;

   Deploy the shot line.
   Descend shot line with equipment.
   Erect the BLB
   Control buoyancy.
   Conduct survey and record data
   Return to Shot line.
   Ascend as usual with equipment.

i. Special communication or signals.
j. Loss of buddy or class procedures.
k. Emergency procedures.
l. Buddy assignments.

2. Pre dive procedures.

   a. Prepare personal equipment.

   b. Prepare any search equipment needed for the dive. Carefully plan the dive with your buddy.

   c. Calculate no-decompression limits.

   d. Don personal diving equipment.

   e. Perform pre dive buddy check and safety drill.

   f. Proper entry.

   g. Proper decent down the shot line.

3. Descent - Vent air, make standard descent to the target.

4. Dive tasks for dive No: 2

   a. Demonstrate mastery of the Point Line Survey System.
   b. At a predetermined time, return to the shot line and ascend to the surface making any necessary safety stop.

5. Post-dive procedures.

   a. Make exit appropriate for environment.
   b. Wash and stow equipment and exchange tanks as appropriate.

6. Debriefing.

   a. Comments on student performance.

   b. Discuss the overall " look" of the Survey area.

   c. Discuss possible structure and if applicable, aquatic life hazards observed on the Site.

7. Log the dives [instructor signs log].

Open-Water Training Dive No:3

By the end of this Open Water Dive you will be able to.

Deploy a shot line and buoy.
Erect the Base Line and deploy a DSMB
Secure the second shot line in place of the DSMB
Conduct a survey of the target using the Base Line Survey System.

[Note to instructors. Your role is to act as a dive marshal and monitor the student's progress not demonstrate the skill.]

1. Briefing.

a. Evaluate the conditions.
b. Facilities at the dive site.
c. Entry technique and location.
d. Exit technique and location.
e. Description of the target from the data previously collected.
f. Depth ranges.
g. Interesting and helpful facts about the dive site.
h. Sequence of training dive:

Deploy the shot line.
Descend shot line with equipment.
Erect the Base Line
Deploy DSMB
Fix replacement shot line
Control buoyancy.
Conduct survey and record data
Return to Shot line.

Ascend as usual with equipment.

i. Special communication or signals.
j. Loss of buddy or class procedures.
k. Emergency procedures.
1. Buddy assignments.

2. Pre dive procedures.

a. Prepare personal equipment.

b. Prepare any search equipment needed for the dive. Carefully plan the dive with your buddy.

c. Calculate no-decompression limits.

d. Don personal diving equipment.

e. Perform pre dive buddy check and safety drill.

f Proper entry.

g. Proper decent down the shot line.

3. Descent - Vent air, make standard descent to the target.

4. Dive tasks for dive No: 3

a. Demonstrate mastery of the Base Line Survey System.

b. At a pre-determined time, finish the survey and return to the second shot line, Disconnect the shot line from the Base Line and dissemble the Base Line.

c. Return to the shot line and ascend to the surface making a safety stop as required & sending the Base Line sections to the surface by lifting bag.

5. Post-dive procedures.

a. Make exit appropriate for environment.

b. Wash and stow equipment and exchange tanks as appropriate.

c. Calculate repetitive group at the end of the dive.

6. Debriefing.

a. Comments on student performance.

b. Discuss the overall " look" of the Base Line Survey.

c. Discuss possible structure and if applicable, aquatic life hazards observed on the Base Line.

6. Log the dives [instructor signs log].

Open-Water Training Dive No:4

By the end of this Open Water Dive you will be able to.

Organize a team of divers how to erect a Survey Grid over the target area.

[Note to instructors. Your role is to act as a dive marshal and monitor the students progress not demonstrate the skill.]

1. Briefing.

a. Evaluate the conditions.
b. Facilities at the dive site.
c. Entry technique and location.
d. Exit technique and location.
e. Description of the target from the data previously collected.
f. Depth ranges.
g. Interesting and helpful facts about the dive site.
h. Sequence of training dive:

Deploy the shot line.
Descend shot line with equipment.
Erect the Base Line.
Deploy DSMB
Fix replacement shot line.
Control buoyancy.
Erect the parallel Base Lines and intersections.
Return to Shot line.
Ascend as usual.

1. Special communication or signals.
j. Loss of buddy or class procedures.
k. Emergency procedures.
1. Buddy assignments.

2. Pre dive procedures.

a. Prepare personal equipment.

b. Prepare equipment required for the Grid.

c. Calculate no-decompression limits.

d. Don personal diving equipment.

e. Perform pre dive buddy check and safety drill.

f Proper entry.

g. Proper decent down the shot line.

3. Descent - Vent air, make standard descent to the target.

4. Dive tasks for dive No: 4

   a. Demonstrate mastery of working as a team and building the grid.

   b. At a predetermined time, finish the survey and return to the shot line, and ascend to the surface making a safety stop as required.

5. Post-dive procedures.

   a. Make exit appropriate for environment.

   b. Wash and stow equipment and exchange tanks as appropriate.

   c. Calculate repetitive group at the end of the dive.

6. Debriefing.

   a. Comments on student performance.

   b. Discuss the overall" look" of the Survey Grid and draw a plan of the Survey Grid and it's Markers.

   c. Discuss possible structure and if applicable, aquatic life hazards observed on the Survey Grid.

7. Log the dives [instructor signs log].

Note 1: Whilst it is not a requirement of the course, where applicable a fifth dive should occur to dissemble the survey grid. Alternately if there is to be another course following this one, the Survey Grid can be in place and a new one added to it to create a larger survey area.

Note 2: If the course is taken on an actual archaeological survey or excavation, the order of the dives may well change, and the skills change to fit the circumstances of the location and archaeological objectives.