FINAL REPORT

THE SEARCH TO FIND AND IDENTIFY THE WRECKS OF

HMAS *SYDNEY* (II) AND

HSK *KORMORAN*

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EXECUTIVE SUMMARY

History was made at 1103 hours (Australian Western Summer Time) on Sunday 16th March 2008 when the wreck of HMAS *Sydney* (II) was found in water depths ranging from 2220m to 2480m across the debris site at latitude 26° 14′ 45″ S and longitude 111° 12′ 55″ E, 112 nautical miles (207 km) west of Steep Point, Western Australia, sixty six and one half years after her disappearance.

This was clearly an outstanding achievement and one led by a small group of ordinary Australians, the Finding Sydney Foundation (FSF), contracting with world leaders in the management and execution of deep water search operations and technology.

Sydney sank with all hands following a battle with the German armed merchant raider HSK *Kormoran* on 19 November 1941. The *Kormoran* was irreparably damaged and later scuttled. Most of her crew survived.

The search was principally funded by the Australian Government together with large contributions by the Western Australian and New South Wales Governments, individuals and the private sector and by many smaller donations from all over Australia.

The deep-tow side scan sonar search commenced on Friday 29th February 2008 when the survey vessel chartered by the Finding Sydney Foundation, SV *Geosounder*, sailed from Geraldton, Western Australia. Following some delays due to weather and equipment malfunctions, the wreck of *Kormoran* was located at 1730hrs on Wednesday 12th March 2008 in 2560 metres of water at latitude 26° 06′ 32″ S and longitude 111° 04′ 21″ E. Using *Kormoran* as the datum, the search for *Sydney* was further refined. Four days later the *Sydney* was found.

Geosounder was equipped with a remotely operated vehicle (ROV) capable of conducting still and video photography at depths of up to 3000 metres, well within the depths of both wrecks. As sufficient charter time and budget funds remained, the *Geosounder* was remobilised for ROV operations and photographic surveys. All works were completed and the *Geosounder* demobilised at Geraldton on 10th April 2008.

Records obtained prior to and during the search execution are provided within and consist of:

- Research works completed by the Search Director including supporting leeway analyses undertaken by the Bureau of Meteorology and CSIRO;
- Offshore search logs comprising the Search Director's search diary; daily operations search reports; survey, ROV, Search Director, Vessel Master and Survey Chief logs;
- Survey and ROV results including acoustic data and 1435 still photographs and approximately 60 hours of video records; and
- Vessel and equipment specifications, geodetic parameters and offshore personnel and HSE records.

This information is provided in the appendices of this report and complies with the Commonwealth of Australia's Funding Agreement.

It provides a background on the remarkable events, organisation and people who achieved this great feat in Australia's maritime history.

INTRODUCTION

1.1 Report Structure

This report presents the activities completed by the Finding Sydney Foundation (FSF) in the search to find and identify the HMAS *Sydney* (II) and HSK *Kormoran* from February to April 2008 in deep water off Shark Bay, Western Australia.

It contains a précis of the FSF; project search records including research and supporting wind and current leeway analyses, offshore records from deep-tow side scan sonar and ROV identification, all equipment and personnel on board, and results of the search and inspection phases, including all ROV photographs and video records.

The report is presented in five written volumes viz:

Volume	Description
Volume 1	Provides a brief history of the FSF, research completed by the Search Director and a summary of the search and identification works undertaken by deep-tow side scan sonar surveys and ROV visual inspections.
Volume 2	Appendices A and B Includes offshore vessel search logs and records including third party leeway drift and metocean analyses.
Volume 3	Appendices C, D, E, F and G Comprises side scan sonar wreck and debris field images, equipment calibration records, vessel and equipment specifications, HSE records and the FSF website and associated records captured during the search, including the Roll of Honour of the *Sydney* crew.
Volume 4	Appendix H Comprises ROV photograph index and drawings
Volume 5	Appendix H Comprises ROV Photographs.

Due to reprographic restrictions and data capacity constraints in capturing all data in written format and/ or DVDs, in addition to the above information, the following records are provided as electronic files via a portable hard drive entitled Volume 6:

(a) Electronic sonar records of the reconnaissance of the wrecks or wreckage field of *Sydney* and *Kormoran*;

(b) Project photographs taken from the time of vessel mobilisation through the offshore works, including intermediate sonar and final vessel and ROV demobilisation activities; and

(c) Video records taken via ROV surveys of the *Sydney* and *Kormoran*.

In addition a native format paper copy of sonar records is provided separately from the above records as a 300mm roll file.

1.2 The Finding Sydney Foundation

1.2.1 Introduction and Background

The wreck of HMAS *Sydney* (II) was found on Sunday 16th March 2008 in water depths ranging form 2220m to 2480m across the debris site some 112 nautical miles (207 km) west of Steep Point, Western Australia, sixty six and one half years after her disappearance.

Finding HMAS *Sydney* (II) and HSK *Kormoran* was clearly an outstanding achievement. A small group of ordinary Australians, on the bedrock of the work of many individuals, organisations and associations and backed by years of Australian and overseas research and expertise, worked diligently, effectively and quietly to achieve a great feat in Australian maritime history.

1.2.2 Formation of the Company and the Trust

HMAS Sydney Search Pty Ltd (ACN 096 017 275) was formed as a not-for-profit company in February 2001. In February 2003 it was appointed Trustee for The Finding Sydney Foundation. Its objectives were to find the wrecks of HMAS *Sydney* (II) and the German raider HSK *Kormoran* off the Western Australian coast, and to commemorate the crew members killed.

Throughout this report the Company and the Foundation are collectively referred to by the acronym FSF – Finding Sydney Foundation.

1.2.3 The Directors

The following is the history of the Board of the Company and Members of the FSF:

Name	Director and Member from	Director and Member to
Donald Francis Pridmore	23 February 2001	Current Director
Edward (Ted) Douglas Graham	23 February 2001	Current Chairman and Director
Kim Paul Kirsner	23 February 2001	Resigned 15 November 2004
Ronald Edward Birmingham QC	9 December 2002	Resigned 5 October 2006
Robert Neil Trotter	9 December 2002	Current Director
Keith Bowden Rowe	28 April 2004	Current Director
Robert William King OAM	13 May 2005	Resigned 1 June 2006
Glenys Eileen McDonald AM	16 November 2006	Current Director

Ron Birmingham, Bob King and Kim Kirsner resigned for personal reasons and their invaluable contribution is gratefully acknowledged by the present Directors.

The Directors responsible for organising the search phase of the project in 2008 were:

- Ted Graham, Chairman;
- Don Pridmore;
- Glenys McDonald AM;
- Bob Trotter; and
- Keith Rowe.

Ted Graham stood aside for probity reasons from the vessel tender selection process but remained a Director during that time.

All Directors, past and present have been unpaid except for a period of approximately six months from August 2005 until February 2006 when Bob Trotter was paid a monthly fee to act as CEO.

The Foundation in 2008 consisted of five Australians as volunteer Directors. Each has contributed much to the Foundation and, together, achieved a successful outcome.

1.2.4 Background

Sydney sank with all hands west of Shark Bay, Western Australia, following a battle with the armed merchant raider *Kormoran* on 19 November 1941. The German ship was irreparably damaged and later scuttled, the majority of its crew surviving.

The total loss of *Sydney* and all of her crew of 645 young men is Australia's greatest ever maritime tragedy in war, or peace and came at a particularly challenging time for the nation as it preceded the entry of Japan into World War II by a few weeks. This tragic event faded from public view but later re-entered the public arena. In the 1970's, 1980's and 1990's a number of books and articles were published and some unsuccessful shallow water searches were undertaken using Defence and private company assets. Several symposia were held and the Federal Parliament conducted a formal Inquiry during 1997/1998 with the report being issued in March 1999. The most recent seminar was conducted by the Royal Australian Navy on the recommendation of the Parliamentary Inquiry, in November 2001, the 60th Anniversary of *Sydney*'s loss. None of this resolved any of the major issues and the controversy moved on to basic questions of the location of the wrecks. During the 2001 forum, argument was presented for alternative wreck positions in shallow water off the Abrolhos Islands and between the Abrolhos Islands and the mainland near Port Gregory.

Over the years it remained the hope of the many families and loved ones of those lost that the final resting place of *Sydney* would be found so that present and future generations could truly come to terms with this tragedy, learn from its historical implications and put a close to the years of mystery and uncertainty.

It was this background that inspired founding members Ted Graham, Don Pridmore and Kim Kirsner to form the view that a well researched, funded and planned search could be successful, and thus to form the company in early 2001. The founders enlisted the aid of similarly minded persons who became Directors of the fledgling company and carried its objectives forward to the success now achieved.

1.2.5 Patrons

Patrons make a valuable contribution to organisations like the FSF where there is a strong interest in their activities from the public, corporate sector and government. FSF made considered choices and was pleased to appoint Professor Geoffrey Blainey AC, the Hon. Tim Fischer AC, and Rear Admiral David Holthouse AO, (RAN Rtd) as its Patrons.

1.2.6 Search Area and Research

In the early stages, the FSF successfully implemented a number of technical reviews and established the framework and requirements for both shallow and deep-water searches for first the *Kormoran* (considered a pre-requisite for finding *Sydney*) and then *Sydney*.

FSF considered the German testimonies held the key to determining the search box. In particular, the work of Kim Kirsner and John Dunn, which was funded by the University of Western Australia, the Australian Research Council and the Australian War Memorial, together with the work of David Mearns and Peter Hore was considered pivotal.

The confluence of the above research led the Royal Australian Navy, Department of Defence and Australian State and Federal Governments to agree that a search area was definable and that success was technically possible such that they all became supportive of FSF's endeavours.

Even following receipt of Commonwealth funding, the final search box was undergoing continual refinement as further information came to light.

Studies using the latest technical advances in hind casting, ocean current and meteorological data were commissioned in early 2008. Determination of the final search box was the responsibility of the offshore Search Director David Mearns.

1.2.7 Funding

At the time the search commenced FSF had raised approximately A$5.3m.

Deductible Gift Recipient (DGR) status was conferred on the FSF in August 2004, and will remain current until 2009.

Government Grants

Sharing Australian Stories

The then Department of Environment and Heritage (now Department of Environment and Water Resources - DEWR), as part of its Sharing Australian Stories Program, provided a grant of $55,000 inclusive of GST in July 2005 to tell the story of *Sydney* to the Australian community. This grant was used to develop and produce promotional leaflets/brochures, presentation folders and CD ROMs, archive photographic/video material, and for the development of the website and the Virtual Memorial.

Australian Government

On 14th August 2005, then Prime Minister the Hon. John Howard announced a grant of $1.43m inclusive of GST. The background work that culminated in the successful grant was undertaken by the FSF and was greatly supported by Senator the Hon. Chris Ellison, the then Senator the Hon. Ian Campbell and Senator the Hon. David Johnston, and the Hon. Julie Bishop MP, all of whom the FSF acknowledges for their support over many years.

In May 2007 the FSF made a fresh approach to the then Minister for the Environment and Water Resources, the Hon. Malcolm Turnbull MP for an additional $2.9m and for a workable Funding Agreement with the Commonwealth. The then Minister for Veterans' Affairs and Minister Assisting the Minister for Defence, thed Hon. Bruce Billson MP, took up the task, working tirelessly with the FSF and the Navy's Sea Power Centre - Australia to build a strong case to support our funding request which he then took to Prime Minister Howard.

On 24 August 2007 onboard HMAS *Sydney* (IV) at Fleet Base East, and with the FSF Directors in attendance, Minister Billson announced that the Howard Government had approved a further $2.9m. The consequent Funding Agreement was managed by the Department of Defence via the Royal Australian Navy. Commander Fiona McNaught was the Foundation's principal contact.

Commonwealth funding was granted by the Howard Government and the search was undertaken under the Rudd Government. The Foundation has received enormous support from the key office holders of the day, each Prime Minister, Government Ministers, the Chief of the Defence Force, the Chief and Deputy Chief of Navy, and support of the Navy and Defence staff involved with the search. We have greatly appreciated that support.

State Government Grants

The Western Australian and New South Wales Governments provided grants of $500,000 and $275,000 (inclusive of GST) in September 2005 and April 2006 respectively. Importantly, the WA Government grant advanced $100,000 to enable the FSF to fund its management, research, search planning and fundraising activities.

Corporate and Individual Donations

The knowledge and networks of the Directors influenced initial corporate fund-raising to concentrate on the smaller oil and gas companies in Western Australia and the FSF received much needed seed funding from them, including Voyager Energy and Apache Energy and its associates. Volunteer John Begg was instrumental in raising these seed funds.

From the earliest days FSF continuously received a steady stream of small but highly significant private donations from all over Australia.

The Foundation also acknowledges a personal contribution of $100,000 from Mr Mark Creasy.

In-kind and Pro-bono Work

FSF received substantial in-kind assistance and we acknowledge, with thanks, the donations made by those companies and individuals not acknowledged elsewhere, notably: Ric Clarke of Gault Armstrong and Kemble for maritime insurance advice; Alan Coney of Jardine Lloyd Thompson for non marine insurance advice; Pat Saraceni of Mallesons Lawyers; Justin McPherson of International Maritime Consultants for vessel engineering advice; Captain Kenny Polson and Woodside Energy Limited for maritime consultant support; Kim Kay and Anton Errington-Wood of BKay Design for promotional material design and advice; Simon Owen and Michael Tucak for legal assistance; Ron Birmingham QC for management and legal assistance; Harold Payne of Ernst & Young for taxation advice; Mal Hartford of Michael White & Co; Intierra Pty Ltd for supporting Director Don Pridmore and Mermaid Marine Australia Limited for supporting Chairman Ted Graham.

The FSF Office

FSF has used a small serviced office in Perth at Level 3, 267 St Georges Terrace for some years. FSF Directors past and present have all volunteered their time to assist with the running and management of this office.

In 2007 Penny Buchan became our first contractor as office manager, and Lee-Anne Evans joined Penny later that year.

In line with our Funding Agreement we appointed Patrick Flynn as the FSF's Project Manager and we pay tribute to Patrick for his professionalism, dedication and work.

Website www.findingsydney.com

FSF launched and managed its Finding Sydney Appeal website http:// www.findingsydney.com as a portal to disseminate news and information about the search. The website catalogues the general history of *Sydney*, its loss, information on her crew and offers avenues for public donations.

Apart from specific orders placed under the Sharing Australian Stories Program grant, Richard Sojka worked without remuneration for approximately six years establishing and running our website.

The FSF subsequently established a contractual relationship with Richard's company Glenfield Systems of Perth and Richard established and managed our highly successful website.

During and after the search the website received some 15 millions hits and was freely accessed on a daily basis by the world's press to extract the great deal of information placed on the site.

The FSF has had numerous calls and emails complimenting the website, its content, ease of use and openness to all.

1.2.8 Acknowledgements

The FSF acknowledges that material used in writing this summary of the FSF has come from a variety of public source material as well as from FSF Directors, past and present. Moreover, many individuals and companies, elected representatives and governments contributed much to the successful search operation. Some are listed below:

- Former Prime Minister the Hon. John Howard AC for his support of our funding applications and his personal interest in our work;
- The current Australian Prime Minister, the Hon. Kevin Rudd MP;
- The current Minister for Defence Science and Personnel, the Hon. Warren Snowdon MP;
- The Hon. Bruce Billson MP, Minister for Veterans' Affairs and Minister Assisting the Minister for Defence in the Howard Government, for his untiring work on our behalf obtaining the $4.3 million in funding from the Howard Government;
- The Hon. Malcolm Turnbull MP, Minister for the Environment and Water Resources in the Howard Government;
- Senator the Hon. Chris Ellison, former Senator the Hon. Ian Campbell, Senator the Hon. David Johnston, and the Hon. Julie Bishop MP. Their work was crucial in our obtaining recognition by the Howard Government;
- Dr. Michael McCarthy, Western Australian Museum Department of Maritime Archaeology;
- The Royal Australian Navy through the then Chief of Navy Vice Admiral Russ Shalders AO, CSC, RAN and the then Deputy Chief of Navy Rear Admiral Russell Crane CSM, RAN, and their staff;
- The former Chief of Navy Vice Admiral (Rtd) Chris Ritchie AO RANR;
- Commander Fiona McNaught RAN as our Australian Government Funding Agreement Contract Representative and for her friendship and advice;
- Lieutenant John Perryman RANR, Senior Naval Historical Officer, for his untiring work and support, and
- The RAN Sea Power Centre - Australia.

Directors would also like to thank their families and friends for their support during the many years leading up to the successful search.

1.3 Project Research

This section of the Final Report ("1.3 Project Research") was prepared and written by David L Mearns. The Finding Sydney Foundation does not accept any responsibility in respect of this section. Copyright in the material contained in this section vests in David L Mearns.

1.3.1 Rationale for the Search for HMAS *Sydney* (II)

The search for HMAS *Sydney* (II) has been invariably described as one of the most, if not the most challenging deepwater shipwreck searches ever undertaken. The simple reason why this search was such an enormous challenge is that the sinking position of *Sydney* had never been reliably known and thus the starting point for a search for *Sydney* had been impossible to determine with any sort of reasonable certainty. This also explains, at least in part, why the search wasn't conducted sooner.

When *Sydney* finally sank after the battle with HSK *Kormoran*, taking with her the lives of virtually the entire ship's company, there were no witnesses on hand to record her final sinking position. The testimony from *Kormoran* survivors who had seen *Sydney* drifting off into the night indicated that she had just disappeared from their view. By this time the opposing vessels had been moving apart for roughly six hours and the necessity for maintaining accurate navigation had long since expired. In any event, no original navigation logs or charts from either ship survived the event.

There has been speculation by some researchers that *Sydney* was able to send a distress or mayday signal by radio during her final moments afloat but no reliable evidence has been offered to prove this belief. In fact, the uncertainty about the precise time that *Sydney* sank means we have no way of knowing for sure whether *Sydney* sank on 19 November 1941 (the day of the battle) or in the early hours of the following morning on 20 November 1941. In as much as the most basic question about *Sydney*'s loss – which day did it occur on – is unknown, it should be easy to understand why any search for *Sydney* was always going to be quite risky and entail a high probability of ending in failure.

While there has always been a dense cloud of uncertainty about when and where *Sydney* sank, there has been far more information from the German side regarding *Kormoran*. Numerous German survivors, including officers in positions of authority and knowledge, who had witnessed the action and scuttling of *Kormoran* had given their testimony to their Australian interrogators following their rescue. Most important of these, *Kormoran*'s Captain (Theodor Detmers) and Navigating Officer (Henry Meyer) would have been keeping and recording *Kormoran*'s position at the time of the battle and her movements leading up to that time. Detmers and Meyers did provide very similar positions for the action in their testimony, which although based on memory alone, appeared to be reasonably accurate.

Crucially, Captain Detmers and the Gunnery Officer Fritz Skeries also reported the distance and direction they had seen *Sydney* moving away from *Kormoran* at the end of the action when *Kormoran* herself was dead in the water. This information, if truthful and accurate, would in effect be a pointer to *Sydney*'s final position if she had sank while on this course. If *Kormoran* could be found, based on the positions provided by Detmers and the other German survivors, then her known position could be used as a beacon to estimate the possible position of *Sydney* and thus the starting point for a search for *Sydney*'s wreck. Furthermore, it was also believed that once *Kormoran*'s wreck was located it would eliminate a large element of the overall navigational uncertainty surrounding Detmers' position and thus lead to a much smaller search effort to locate the wreck of *Sydney* .

Although the primary objective of this search was to find the wreck of *Sydney* there was a clear rationale that in order to find *Sydney* the wreck of *Kormoran* would have to be searched for and found first. As a reflection of the overall navigational uncertainty the area to be searched for *Kormoran* was still going to be extremely large and the risk of failure relatively high. However, once *Kormoran* was found the chances of finding *Sydney*

would be greatly increased and there would be a much smaller and better localised search area to cover. This rationale dictated the search planning in the case of both wrecks.

1.3.2 Historical Research Information

The historical research, analysis, rationale and planning for this search for the wrecks of *Sydney* and *Kormoran* is based primarily on the work of David L. Mearns of Blue Water Recoveries Ltd (UK). While David had full responsibility and control in determining the areas to be searched and how the at-sea search was conducted, he was aided and assisted by a number of other researchers and historians in gaining access to key historical documents and in the assessment of those documents. David's principal collaborators in this work were Capt. Peter Hore RN (retired) and Mr. Wes Olson, who had previously written their own books on the loss of *Sydney*.

The objective at all times for David in his research was to determine the most probable sinking positions of the wrecks in order to mount a successful search for them. His complete focus, therefore, was on the navigational movements of the two ships before, during and after their battle up to the time they sank. The basic approach to this research was to locate, assess and analyse every piece of historical informational and physical clue relating to the possible location of the wrecks. Only after this information was shown to be truthful would it then be plotted on navigational charts created to determine the most probable sinking positions of the wrecks and where the searches should take place.

A full discussion of the research and analysis conducted in determining the search areas for the wrecks is beyond the scope of this report. Instead this section will give a brief discussion and summary of the key pieces of primary source information that were judged to be credible and accurate and that factored into the final plots that were used to determine the search areas.

Despite the great number of widely differing theories about the action between *Sydney* and *Kormoran*, and where it took place, the plain fact is that the most specific, precise and credible positional information we have with regard to the action stems directly from written documents and statements made by just a handful of the German officers and crew who were on the bridge of *Kormoran* at the time of the action. The single most important piece of information documented was the navigation coordinates (26°34'S 111°E) recorded by *Kormoran*'s Commander, Captain Theodor Detmers, without which no search could even be contemplated.

As Commander of *Kormoran*, Detmers was officially responsible for recording and submitting to his superiors in the German Navy a full and detailed report of the action with *Sydney* that also explained the loss of his own ship. The fact that Detmers was taken prisoner of war and remained in an Australian POW camp until beyond the end of the war did not remove him of this responsibility, which he obviously intended to fulfil. The history shows that Detmers took extraordinary measures, despite his captivity, to create and maintain his Gefechtsbericht (Action Report) and was successful in transmitting it to Germany via Dr. Siebelt Habben (*Kormoran*'s Doctor who was made to memorise the report) who verbally delivered Detmers' report when repatriated in 1943 as part of a prisoner exchange.

Despite the obvious promise of Detmers' report as an important clue to the location of the wrecks, it has been the subject of severe questioning by other researchers who deemed it to be fictitious on a number of points, including the reported location of the battle. Indeed, these doubts extended to the testimony of all German survivors whose statements matched Detmers' and were thought by the same researchers to be the product of Detmers ordering *Kormoran*'s entire crew to give the same fictitious account if captured and interrogated. If, therefore, a search for the wrecks were to be based on the location reported by Detmers, his report would need to be thoroughly scrutinised and tested to ensure its truthfulness and accuracy.

The basic approach of this work was to locate each and every report either written by or directly attributed to Detmers and to compare them word by word in order to spot any inconsistencies, alterations or details in the accounts which did not fit with other independent information and/or physical clues. A strict emphasis was

placed on relocating the original primary source documents and assessing them from scratch. This involved making all new transcriptions, decodes and translations of the various reports because it was found that there were errors in some of the original assessments made by the Australian intelligence agencies during the war and these errors had misled other researchers.

In the end five different reports or accounts by Detmers were found and assessed. These are: 1) the "Dictionary" account created by Detmers in early 1942 and hidden within a German-English dictionary given to him in POW camp. This account is, in our opinion, the original master account made by Detmers and is the reference for all subsequent accounts, 2) the "Dr. Habben" account which became the official German account known as Heft 10 and was memorised and verbally delivered by Dr. Habben to the German Navy when he was repatriated in 1943, 3) the "coded" account which was confiscated from Detmers when he was captured after an attempted escape whilst still a POW in Australia in 1945, 4) the "Gefechtsbericht" account which was confiscated from Detmers when he was repatriated back to Germany after the war in 1947, and finally, 5) the original German version of Detmers' book *Hilfskreuzer Kormoran* written with Jochen Brennecke and published in 1959.

Although created under very different circumstances over a period spanning 17 years these accounts, when compared, were virtually identical in their detail of where and when the battle took place. In particular, the exact same navigation coordinates - 26°34'S 111°E – were given in all five accounts. Detmers had taken extraordinary measures to keep these accounts secret and hidden from his captors and had nothing to gain from holding onto a fictitious account. In short we found nothing in Detmers' written accounts, or in his character as a Naval Commander, to indicate or suggest that he was being untruthful. In our opinion there was also no logical reason or motivation for Detmers to knowingly lie about the position where the action took place.

The final test of the credibility of Detmers' account was a simple manual plotting of the detailed navigation and gunnery information he provided in relation to the position and movement of both ships. This information included courses, speeds, times, ranges, bearings, wireless radio transmissions and sun position. If any single piece of this inter-connected information provided by Detmers were fictitious then the resulting plot would not fit and the fictitious information would be exposed. Instead, the resulting plot did in fact fit and it was entirely consistent with the narrative of Detmers' account.

In the end, after much analysis, our conclusion was that Detmers' report was both a truthful and accurate accounting of *Kormoran*'s action with *Sydney* and that the position 26°34'S 111°E could be relied upon with confidence to determine the most probable sinking positions of the wrecks. While Detmers' position was the key to the final plot outlining where the searches would take place, there were several other important pieces of independent information (summarised below) that corroborated Detmers' position and account and were used in the final plot to determine the search areas.

Previous Voyage Tracks of *Sydney*

The previous tracks for *Sydney* on her routine voyages from the Sunda Straits to Perth, and in particular the October and June 1941 transits made under the command of Capt. Burnett, all coincided very closely with Detmers' position. Given that the two vessels originally sighted each other from a probable distance of approximately 16 nautical miles, *Sydney*'s previous tracks are within just a few miles of Detmers' position and thus independently corroborate that the action is likely to have taken place where Detmers said it did.

QQQQ Signal Heard by Geraldton Radio

The QQQQ signal sent (twice) by *Kormoran* approximately half an hour before the action started was partially heard by a wireless receiving station based in Geraldton. Although the signal was badly heard and the position only partially received, it is an extremely important piece of information because it was independently

recorded by Australian radio operators and thus provided a solid basis for verifying and corroborating the German testimony. While the latitudinal coordinate of the position was unintelligible and thus could not be trusted, the longitudinal coordinate (111°15'E) appeared to be reliably heard and did provide a basis for further refining the most probable sinking position of *Kormoran*.

Other German Testimony

There is a considerable body of statements, documents and more recent interviews from key officers on board *Kormoran*, which by and large corroborate the position reported by Detmers. This information includes statements from various officers during interrogation that place the action at 26°30'S 111°E (Meyer) or 120nm from the coast (Bunjes and Wagner). While this information generally agrees with the position reported by Detmers it is still somewhat vague and suffers from the obvious fact that the sources had no reason to give anything other than very approximate, rounded figures whereas Detmers had a duty to be as precise as possible in his testimony and account.

1.3.3 Analysis of Drifting Rafts from HSK *Kormoran*

Objects at sea that drift passively with the wind (leeway) and current, as opposed to being actively propelled through the water by sails or oars, can be used in an analysis to determine the origin or starting point from where the objects began their drift. Such a drift analysis requires a reliable estimate of wind speed and direction, surface current speed and direction, a leeway factor (generally quoted as a percentage of wind speed) specific to the drifting object itself and a precise knowledge of the duration (time) of the drift period in order to compute a final solution for the origin of the object's drift.

This information is routinely used by Search and Rescue (SAR) teams around the world to find survivors from mishaps and the sinking of boats and ships at sea. In most cases real life SAR exercises take place with a precise knowledge of where the ship sank – based on a mayday or EPIRB signal – and the SAR team conducts its analysis to find survivors drifting in the water down-wind and down-current from the known sinking position. This is a forward or predictive method to determine where the survivor might be found. However, with respect to historical cases like the sinking of *Kormoran* and *Sydney* , it is possible to run this analysis backwards (commonly called back-tracking) by using the object's rescue or pickup position and a knowledge of the wind and surface current parameters along with the object's leeway factor to estimate the most probable sinking position of the ship.

While a variety of objects were left behind and eventually recovered from the sea after *Kormoran* and *Sydney* sank, there were a number of difficult challenges in determining how to best use them to help estimate the sinking positions of the wrecks. The first challenge was deciding which object was best suited to be the subject of a drift analysis. Some of the large wooden life boats launched from *Kormoran* were made the focal point of numerous drift analyses conducted by other researchers over the years, despite the fact that these boats, full of German sailors desperate to reach land and survival, were being actively sailed and rowed for much of their journey thus violating the first criteria that the object is a purely passive drifter.

Another problem was the relatively long period of time the objects were at sea before they were either spotted or picked up. This period ranged from approximately 3.4 days for the first object to be picked up (a pneumatic life raft from *Kormoran*) to 8.5 days for the last object (a Carley float from *Sydney*). Because errors inherent in the estimating process compound with time it is imperative to use the object that was drifting in the water for the least amount of time. Fortunately, the first two objects that were picked up after the battle were pneumatic life rafts from *Kormoran*.

The rafts were heavily overloaded with German sailors and were not equipped with a rudder, paddles or a proper sail. Thus it was safe to consider these rafts as being pure drift objects. In terms of a drift analysis the other positive aspect of these rafts was that they were picked up by Australian vessels capable of accurately

determining their positions at the time. The troopship *Aquitania* recovered the first life raft north of Detmers' position after 82 hours adrift while the tanker *Trocas* recovered the second life raft even further north after 115 hours adrift. On the basis of least time in the water the *Aquitania* life raft was selected as the primary object for our drift analysis and the *Trocas* life raft as the secondary object.

The biggest challenge in this analysis, however, was finding a way to reliably estimate the speed and direction of both the winds and surface currents during the period of drift in late November 1941. Relatively small errors in the estimates could result in very large errors in the computed drift origin position. For example, an overestimate in the current speed of just 0.25 knots – say from 0.5 to 0.75 knots, which was the range of speeds indicated in the Pilot and Routing Charts used by many other researchers – would shift the starting drift point of the *Aquitania* life raft 22.5 nautical miles further south. Previous attempts to improve these estimates have been limited by available sources of data and also by the state-of-the-art in the relevant scientific fields of meteorology and physical oceanography. The last attempt by professional meteorologists to estimate the wind conditions was made in 1991, and as far as we know, no serious attempt has ever been made to determine or measure current conditions at the location of the battle. To improve this situation, two new analyses were commissioned to come up with the best possible estimates of wind and surface current conditions that would have been similar to the conditions experienced during the period of the actual drift in late November 1941.

The first analysis dealing with wind conditions was conducted by Mr. Len van Burgel, a former Australian Bureau of Meteorology (BOM) meteorologist now working as a consultant, and Mr. Grant Elliott the Regional Manager of the BOM's Special Services Unit based in Perth. Messrs. van Burgel and Elliott were tasked with developing simulations of the daily wind speeds and direction for the nominal battle location covering the period November 19-28, 1941. This analysis, also referred to as a wind hindcast, was used to determine the leeway component of the total drift experienced by the life rafts picked up by *Aquitania* and *Trocas*.

Two different methodologies were employed by Messrs. van Burgel and Elliott to simulate the historical wind conditions. One was based on an extremely careful re-analysis of the historical Mean Sea Level (MSL) pressure charts from November 1941 that was used to derive the pressure gradient and ultimately the wind direction and speed using the geostrophic wind equation. A number of corrections were then made to the calculated geostrophic wind to produce the most realistic set of historical wind conditions.

The second method, referred to as Pattern Matching, is based on matching the historical pressure gradients discussed above against a computerised database of pressure gradients assembled for the period 1968-2007. The main value of this method is that because the matching is done by computers, an extremely large 39 year database can be quickly scanned to come up with most closely matched dates when the recent winds would have been similar to the historical winds during November 19-28, 1941. With the matched dates in hand it was possible to access a variety of state-of-the-art weather sources around the world in order to compile the most accurate recent wind conditions for comparison with the historical wind conditions discussed above.

Ultimately, three sources of measured and computed wind data were compiled and compared with the re-analysed historical data: QuikScat – a satellite-based measuring system operated by NASA's Jet Propulsion Laboratory; NCEP-DOE Reanalysis 2 – a numerical forecast system provided by NOAA's Earth System Research Laboratory; and LAPS – a regional numerical forecast model provided directly by the BOM. Additional information about these sources can be found on their respective websites listed below.

QuikScat:	http://winds.jpl.nasa.gov/missions/quikscat/index.cfm
NCEP-DOE Reanalysis 2:	www.cdc.noaa.gov/cdc/data/ncep.reanalysis2.html
LAPS:	www.bom.gov.au/nmoc/ab_nmc_op.shtml#LAPS

A review of errors inherent in the methodologies used indicates that absolute errors in the wind speed are up to +/- 4 knots and error in the direction up to 20-30 degrees. However, as these errors are random they will tend to cancel out over the period in question. Although estimating historical wind conditions over the open ocean without the benefit of actual observations is very difficult, we believe this analysis has produced a very good set of data and is a considerable improvement over what was known about wind conditions since the previous estimates were made in 1991. The complete report of this analysis is included herein as Appendix A1.

The second analysis dealing with surface current conditions was conducted by Dr. David Griffin of the CSIRO Marine and Atmospheric Research Division based in Hobart. Dr. Griffin is a physical oceanographer and the CSIRO Project Leader for BLUElink, a Government, Royal Australian Navy and CSIRO funded project that uses oceanographic and current data and advanced super computer technology to provide ocean forecasts around Australia. One of the focal areas for the BLUElink project is the Leeuwin current in the Indian Ocean. This area also happens to cover Detmers' position of the battle location. When it became apparent that the BLUElink database and computing power could be used to give us the first real measurements of the current field in this location, Dr. Griffin generously volunteered his expertise and time to complete the final step in our analysis of the life rafts' drift.

The ocean current data used by BLUElink is based on satellite radar altimetry that measures the height of the sea surface with such extraordinary precision that it is possible for powerful super computers to accurately estimate ocean currents. While the satellites carrying accurate altimeters have been in orbit since 1992 – and collecting many years of data that is now available to BLUElink scientists – the super computing ability to estimate ocean currents from the sea surface altimetry is a much more recent development. The BLUElink project was initiated in 2002. Before then physical oceanographers were more or less unaware of the complex dynamics of the ocean currents off the northern WA coast that featured large eddy currents.

Previous attempts by *Sydney* researchers to estimate the ocean current effect on the drift of the life rafts and other objects relied on a simplistic decades-old understanding that the currents in this area were uniformly northward flowing. The possible presence of transient eddy currents that could flow in a multitude of directions makes it virtually impossible for anyone to know how they might have affected the drift in late November of 1941. Any estimate of a probable sinking position for *Kormoran* based upon average or mean current speed and direction that doesn't take in the variability of the current field is likely to be invalid. Therefore, the previous attempts to precisely pinpoint the sinking position of *Kormoran* - in the form of an "X" on a chart – based upon drift analysis have been misguided.

In contrast, we have used the drift analysis to determine the full range of possible sinking positions for *Kormoran* taking into account the known variability of the ocean current and wind conditions. The unpredictability of the ocean currents are a major source of potential error in the drift analysis that needed to be understood and factored into determination of the final search box. This approach is standard practice in wreck searches and is essential to ensure that the area to be covered during the search encompasses all the possible sinking positions.

The BLUElink dataset provided estimates of currents for 15 consecutive years for the period 1992-2006. To take into account any seasonal effects our analysis was restricted to the latter half of November to best match the period the life rafts were actually drifting. This yielded a total of 225 scenarios showing what the current field, including eddies, might have been in November 1941. A further attempt to match the actual conditions was made by adding a variation of the same data for the years 1993-1997 when the coastal sea level was low, as it was in 1941, thereby indicating that the Leeuwin was weaker than usual. This increased the total number of scenarios available for the analysis to 300.

The final analysis was made by a computer programme, specially developed by Dr. Griffin, which produced a simulated trajectory of the possible drift tracks of the *Aquitania* and *Trocas* life rafts for each of the 300

scenarios in both back-tracking and forward-tracking modes. The programme calculated the total drift as a vector sum of the current drift from the 300 scenarios and the leeway drift from an average of the wind conditions provided by Messrs. van Burgel and Elliott. A leeway factor of 3% of the average daily wind speed was used for the life rafts as recommended by Mr. Art Allen of the U.S. Coast Guard's Office of Search and Rescue. Prior to recommending this leeway factor Mr. Allen, who is considered the world expert in the leeway drift of small search objects and has conducted numerous in-situ leeway experiments, was given full details of the German life rafts, including a picture of the overloaded *Aquitania* life raft.

As expected, the final results of the analysis revealed a very large spread of back-calculated launch points for the two life rafts. The main orientation of the spread was in the north-south direction indicating greater variability in drift speed versus direction. A summary plot was made to show the average-annual (for each late November period) back-calculated launch points (see the full report included herein as Appendix A2). Of the 40 possible launch points only three were south of Detmers' position; three more were approximately level with the latitude of the Detmers' position; while the remaining 34 points were all well north of Detmers' position.

The clear conclusion to be drawn from this drift analysis was that while it was certainly possible that the life rafts could have been launched from Detmers' 26°34'S 111°E position, it is far more probable that the actual launch point was some way north of this position. Despite the many crosses on the summary plot in Dr. Griffin's report it must be stressed that this analysis was not designed, nor expected, to provide a magical "X" on a chart indicating the precise sinking position of *Kormoran,* as we have already commented that this approach to the problem and the search would have been misguided.

Instead, the value of this analysis was threefold; 1) it confirmed that the sinking of *Kormoran* at Detmers' position was within the realm of possibilities and thus provided a means of independent corroboration for his account based on physical clues alone, 2) it demonstrated the evident variability of the surface currents and the problems in using drift analysis to determine a single specific sinking position, and 3) it strongly suggested that the most probable sinking position of *Kormoran* was in fact north of Detmers' position.

1.3.4 The HSK *Kormoran* Search Area

As discussed above, the position 26°34'S 111°E reported by Captain Detmers is the single most important and credible piece of historical information available to determine the most probable sinking positions of the wrecks. However, this position is not without its uncertainty.

The main questions about this position, which have been exhaustively investigated but impossible to answer conclusively, are; 1) which of the two most likely times does the position refer to – either the start of the battle at roughly 1730(G) or the noon 1200(G) position of *Kormoran* that same day, and 2) is 111°E the accurate longitude of the position or has it been rounded to the nearest degree because the minutes have not been remembered? These unresolved questions explain the general uncertainty surrounding Detmers' position and the challenging nature of this search.

Assuming that Detmers' 26°34'S 111°E position refers to where *Kormoran* was at the time the action began at 1730(G), the sinking position of the ship when it was scuttled at 0035(G) was plotted to be 26°31'S 110°53.5'E. This final position is based on dead reckoning the movement of *Kormoran* using the courses and speeds reported by Detmers up to the moment the engines became disabled and stopped at about 1745(G), and it also takes into account the drift due to current and winds up to the time *Kormoran* was scuttled and finally sank at 0035(G).

A second probable sinking position, also keyed to Detmers' 26°34'S 111°E position, was determined by dead reckoning exactly as above except that the plot factored in our firm belief that the longitudinal coordinate 111°15'E in the QQQQ signal heard by Geraldton radio at 1700(G) was probably the correct longitude for

Kormoran at that time. The net effect of this variation was to shift the probable sinking position approximately seven nautical miles east to a second probable position plotted as 26°28.5'S 111°01.5'E.

As indicated above it is also equally possible that Detmers' 26°34'S 111°E position refers not to where *Kormoran* was when the action began but to where she was at midday (1200G) approximately four hours prior to sighting *Sydney*. It is a standard maritime practice to determine, by either direct observation of the sun's position or by dead reckoning in case the sun is not visible, the noon position of a ship at sea and to record this position in the ship's logbook on a daily basis. The German Naval logbook (Kriegstagebuch or KTB) used by Detmers had a dedicated column to log the noon position in addition to wind, sea and sky conditions in a specific format and a careful review of *Kormoran*'s earlier KTB (sent back to Germany via the supply ship Kulmerland) shows that Detmers never failed to record his noon position this way. Crucially, each of Detmers' written accounts of the action records the 26°34'S 111°E position in the exact same format he would have used in recording his daily noon position, as shown below in German and English.

Mittwoch, 19.11.41. 111° Ost, 26°34' Süd, SSO 3-4, See 3, mittl. Dünung aus SW, sehr klar. Kurs 25°, 11 Sm.

Wednesday, 19.11.41. 111° East, 26°34' South, SSE 3-4, Sea 3, medium swell from SW, very clear. Course 25°, 11 knots.

A number of other clues also point to the possibility that Detmers' 26°34'S 111°E position refers to the noon position and not the action position. These involve statements by other officers regarding the location of the action, the distance it took place from the coast and also a statement by Detmers about his plan for having *Kormoran* in a position near the entrance of Shark Bay later that evening. Assuming, therefore, that Detmers' 26°34'S 111°E position actually refers to the noon position, it would place the two probable sinking positions for *Kormoran* discussed above approximately 33 nautical miles to the north at 25°57.5'S 110°50.5'E and 25°55.5'S 110°58.5'E, respectively.

To ensure the maximum chance of success for locating the wrecks it was decided that the minimum precaution would be for the search box for *Kormoran* to encompass all four of the possible sinking positions discussed above. In addition, margins for error were selectively applied to each of the four positions to take into account their inherent navigational uncertainty. These margins were applied while taking into account other navigational clues and ultimately they were used to determine the boundaries of all four sides of the search box. The search box for *Kormoran* was therefore defined as follows:

- Southern boundary (26°46'S); based upon a 12nm error applied to Detmers' 26°34'S 111°E position, which is the most southern of all positions.
- Western boundary (110°40'E); based upon a 12nm error applied to the first probable sinking position 26°31'S 110°53.5'E discussed above, which is the most western of all positions.
- Eastern boundary (111°17.5'E); based upon a 15nm error applied to the second probable sinking position 26°28.5'S 111°01.5'E discussed above, which is the most eastern of all positions. Also, this boundary is just a few nautical miles east of the longitudinal coordinate 111°15'E in the QQQQ signal and our belief was that the action and sinking certainly took place to the west of this longitude.
- Northern boundary; (25°54'S); based upon the minimum precaution of having the search box encompass all four of the possible sinking positions. Also, the sighting by Detmers of the troopship *Aquitania* after she had picked up the life raft with 26 German sailors and resumed her transit south, took place in a position that made it virtually impossible for *Kormoran* to have sunk any further north of this latitude.

The resulting search box for *Kormoran* measured approximately 52nm (north-south) by 34nm (east-west) and encompassed 1,768 square nautical miles. This is an extraordinarily large area to be covered for a deepwater shipwreck search and directly reflects the challenging nature of the search. In comparison, the search box for RMS *Titanic* found by Dr. Robert Ballard in 1985 measured approximately 150 square nautical miles while the search box for HMS *Hood* found by David Mearns in 2001 measured approximately 600 square nautical miles.

1.3.5 The HMAS *Sydney* (II) Search Area

The search for the wreck of *Sydney* began immediately following the location and positive identification of *Kormoran*'s wreck. As per the original search rationale the known seabed position of *Kormoran*'s wreckage was used as the pointer to estimate where *Sydney* might have sunk. However, as no navigational coordinates were ever reported for the sinking position of *Sydney* and none of the many Germans who saw *Sydney* in her final stages could actually be sure whether she had actually sunk or not, it was only possible to estimate the general area that *Sydney* might have sunk on the basis of three key navigational clues, as summarised below:

Sydney's Course

After the initial gun battle with *Kormoran*, which saw *Sydney* suffer heavy damage including a torpedo strike on her bows, *Sydney* was reported by Captain Detmers to have steamed away on a course of approximately 150° True. This course, if deliberately made, would make sense if those in command of *Sydney* had decided to head directly to port for repairs – either Geraldton or Fremantle. A slightly different clue was provided by Lieutenant Fritz Skeries, *Kormoran*'s gunnery officer, who noted that the relative bearing to *Sydney* was 225° at the time the last gun range was taken at approximately 1825(G). We estimate this would make *Sydney*'s final course to be 120° True.

Sydney's Speed

The last documented speed of *Sydney* was made by Detmers in his account when he reported that at 1800(G) *Kormoran* fired her last torpedo at *Sydney*. The settings used in firing this torpedo indicated that *Sydney*'s speed at the time was five knots. Based upon the detailed gunnery information from *Kormoran,* a plot of *Sydney*'s movements indicates that her speed was further reduced to below 3.5 knots by approximately 1900(G). Finally, in his book Detmers described *Sydney* as "drifting rather than sailing" after the last shots were fired by *Kormoran*.

Time of the Last Sighting of *Sydney*

Various statements by German survivors point to *Sydney* being seen on the horizon, burning fiercely in several locations up until 2200(G) and possibly as late as 2300(G), before her fires were seen to disappear. Captain Detmers provides the best clue, however, saying in his interrogation on 7 January 1942 that "Before leaving I looked around and in the darkness, I could see *Sydney* still blazing fiercely. Then just before I abandoned ship I looked for *Sydney* and she was gone. All was blackness". The importance of Detmers' statement is that we know he cast off his life boat from *Kormoran* at approximately midnight and as he was unable to see any glow of fire on the horizon from his elevated position on *Kormoran,* it is possible that *Sydney* sank before this time.

Using the position of *Kormoran*'s wreck as the key reference point, the three navigational clues discussed above were used to plot the general area that *Sydney* might have sunk. Large margins of error were applied to the estimated course, speed and time of *Sydney*'s final movements and these dictated the boundaries of the search box as summarised below.

- Southern boundary (26°27.5'S); as *Sydney's* final course was believed to be generally southeast, the most critical boundaries of the search box were obviously the southern and eastern boundaries. Our conclusion from the plots of *Sydney's* final course was that it was likely that *Sydney* sank anywhere from 10 to 15 nm away from *Kormoran*, with the worst case being 20 nm. With an additional margin for error the southern boundary of the search box was placed approximately 25 nm south of *Kormoran*'s wreckage.

- Western boundary; (110°00'E); assuming that *Sydney's* final course was 150°T, and applying an absolute worst case error of +/- 30° for this course, it would be virtually impossible for *Sydney* to have sunk west of 110°00'E.
- Eastern boundary (111°20'E); for the same reasoning used to set the southern boundary, the eastern boundary of the search box was placed approximately just over 20 nm east of *Kormoran*'s wreckage.
- Northern boundary; (26°07.5'S); even though it was highly unlikely to find Sydney this far north it was decided to place this boundary just a couple of miles south of *Kormoran*'s wreckage in case *Sydney* began to break up as she ran to the southeast and in the hope that any debris found would lead directly to the main wreckage of *Sydney*.

The resulting search box for *Sydney* measured approximately 20nm (north-south) by 18nm (east-west) and encompassed 360 square nautical miles. Despite the considerable uncertainty about the time *Sydney* sank and whether she was still underway or not, it is worth noting that the search box for *Sydney* was nearly five times smaller that the search box for *Kormoran*. This was entirely in keeping with the stated search rationale that the location of *Kormoran*'s wreck very near to where it was predicted to be found based on Detmers' position would eliminate a large element of the overall navigational uncertainty surrounding Detmers' account.

1.4 Search Scope of Work

Williamson & Associates Inc (W&A) of Seattle, USA, was contracted to the FSF to provide deep-water side scan sonar equipment and personnel to find the *Sydney* and *Kormoran* wrecks off Shark Bay, Western Australia in depths of approximately 2,000m to 4,000m.

DOF Subsea Australia Pty Ltd (DOF) of Perth, Western Australia, was contracted to provide the *Geosounder* with navigation equipment, a remotely operated vehicle (ROV) and marine, survey and ROV personnel to undertake a search for, and subsequently complete a visual inspection of, the wrecks.

The objectives of the project were to search for and locate the above-mentioned wrecks by sonar imaging, and thereafter with the aid of an ROV, provide absolute confirmation of the wrecks through photographic and video images.

The side scan sonar survey plan was provided by the Search Director, Mr. David Mearns, of Blue Water Recoveries Ltd. This plan was based on the research undertaken by David Mearns prior to the commencement of the offshore survey operations as detailed in Section 1.3.

The sonar survey search area for the *Kormoran* wreck was to cover an initial rectangular area of approximately 69km x 108km bounded by the coordinates provided in Table 1-1.

Datum: GDA94, Spheroid: GRS80		
	Latitude (S)	Longitude (E)
NW Corner	25º 48' 00"	110º 40' 00"
NE Corner	25º 48' 00"	111º 17' 30"
SW Corner	26º 46' 00"	110º 40' 00"
SE Corner	26º 46' 00"	111º 17' 30"

Table 1-1 : Initial sonar search area coordinates.

Proposed survey run-lines for the initial search site comprised 12 parallel, north/south oriented primary lines, approximately 110km in length, at a nominal line spacing of 5,000m. Line spacing was, however, reduced after survey operations commenced due to a reduction in usable sonar swath from the W&A equipment.

On finding the *Kormoran* wreck site a second, smaller search area of approximately 37km x 37km was to be surveyed to search for the *Sydney* wreck. The *Sydney* site boundary coordinates are provided in Table 1-2.

Datum: GDA94, Spheroid: GRS80		
	Latitude (S)	Longitude (E)
NW Corner	26º 07' 30"	111º 00' 00"
NE Corner	26º 07' 30"	111º 20' 00"
SW Corner	26º 27' 30"	111º 00' 00"
SE Corner	26º 27' 30"	111º 20' 00"

Table 1-2 : HMAS *Sydney* (II) sonar search area coordinates.

An ROV inspection survey was to be undertaken to confirm the two wreck sites to be that of the *Sydney* and *Kormoran* and confirm their position, if water depth were favourable.

A survey location diagram is presented as Figure 1-1.

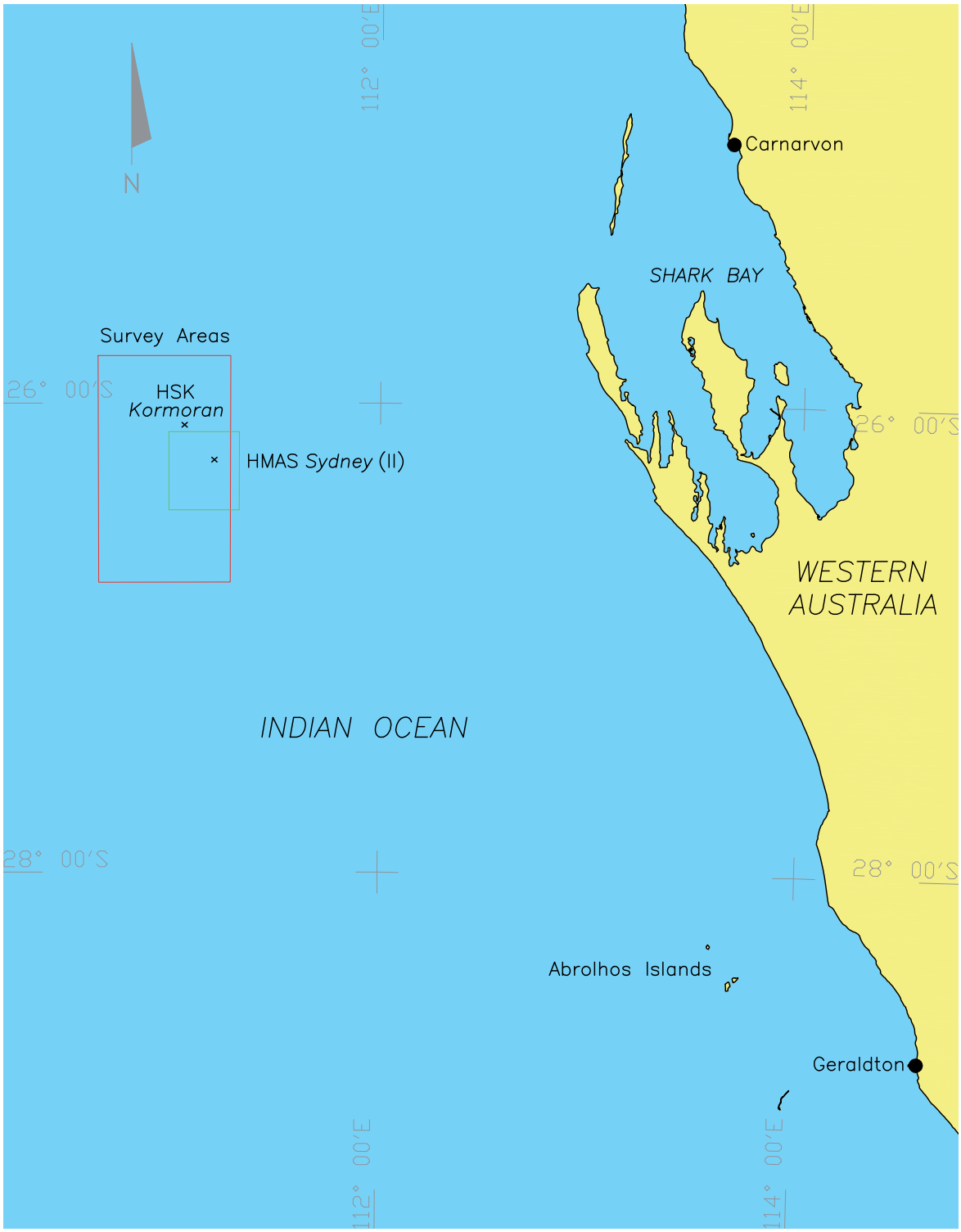

Figure 1-1 : Survey location diagram.

2.0 SURVEY OPERATIONS

Survey operations for the search for the *Sydney* and *Kormoran* were undertaken between 27th February and 9th April 2008 on board the survey vessel *Geosounder*.

The survey was conducted in two phases:

- Phase 1: Deep-water side scan sonar survey for initial wreck location
- Phase 2: ROV inspection and confirmation of wrecks once located

As the wreck sites are designated protected zones under Section 15 of the Historic Shipwrecks Act 1976 a permit to re-enter the sites with the ROV spread was required. A permit application was forwarded to the Department for the Environment, Water, Heritage and the Arts on the 22nd March 2008 and permission for one month's entry was granted on 23rd March 2008. Designated wreck protection zone coordinates were determined from the side scan sonar data as shown in Tables 2-1 and 2-2.

Datum: GDA94, Spheroid: GRS80		
	Latitude (S)	Longitude (E)
NW Corner	26º 14' 25.9''	111º 12' 40.1''
NE Corner	26º 14' 25.9''	111º 13' 00.5''
SW Corner	26º 14' 52.4''	111º 12' 40.1''
SE Corner	26º 14' 52.4''	111º 13' 00.5''

Table 2-1 : HMAS *Sydney* (II) wreck protection zone coordinates.

Datum: GDA94, Spheroid: GRS80		
	Latitude (S)	Longitude (E)
NW Corner	26º 05' 17.5''	111º 03' 52.7''
NE Corner	26º 05' 17.5''	111º 04' 51.2''
SW Corner	26º 06' 11.0''	111º 03' 52.7''
SE Corner	26º 06' 11.0''	111º 04' 51.2''

Table 2-2 : HSK *Kormoran* wreck protection zone coordinates.

A copy of the permit application and permit are provided in Appendix B2.

2.1 Side Scan Sonar Survey Phase

The W&A deep-water sonar winches and DOF's ROV were mobilised in Singapore prior to the survey vessel *Geosounder* sailing to Geraldton on the 15th February 2008. Mobilisation of the remaining vessel crew, DOF survey equipment, remaining W&A deep-water side scan sonar equipment, all survey personnel and client representatives was undertaken in Geraldton between 24th and 29th February 2008.

The side scan sonar survey was conducted between 29th February and 20th March 2008 using W&A's SM-30 (30 kHz) and AMS-60 (60 kHz) deep-water sonar towfish, each with integrated 4.5 kHz sub-bottom profiler (for target detection within an acoustic 'dead' zone directly below the towfish). This period includes transit time between Geraldton, the location of sea trials off the Abrolhos Islands and the wreck search areas.

Proposed survey run-lines for the initial 69km x 108km search area comprised 12 parallel, north/south oriented primary lines, approximately 110km in length, at a nominal line spacing of 5,000m. This provided 100% sonar coverage at a sonar swath width of 6km. However, once sonar operations commenced it was determined that the acoustically strong echo from the sea-surface return resulted in data blanking of the outer sonar range data. Run-line spacing was reduced to between 3,400m and 3,700m to ensure 100% sonar coverage.

A vessel survey speed of two to three knots, and tow cable length of up to 9,000m, was required to maintain the sonar towfish height above the seabed of 5% to 7.5% of the sonar swath width. This ensured the required sonar 'grazing' angle for target detection. For example, a sonar swath setting of 6km required a towfish height of 350m above the seabed.

The scope of work did not require sonar towfish tracking therefore all survey lines were run in opposite directions wherever possible in order to minimise layback errors. A cable-counter was used to monitor the amount of cable paid out through the sheave block located on the A-frame at the stern of the vessel. An indicative towfish layback position along any point of the survey run-line could thus be determined.

All sonar data was acquired and processed using ISIS and SonarWiz sonar acquisition and processing software, and interpreted using W&A proprietary mapping software. Hard copy sonar data was output to an EPC 9800 graphic recorder. Final sonar target positioning was supported by processed, albeit, uncalibrated, multibeam echo-sounder (MBES) data acquired using DOF's hull-mounted Simrad EM300.

The survey was initially concentrated around the central and eastern portion of the site and four (Lines 6 to 9) of the 12 north/south survey run-lines were completed before the *Kormoran* wreck site was located at 1730hrs AWT (0930hrs UTC) on 12th March 2008. A fifth and final north/south survey line, Line 10 (run in two parts), was only run as far north as the *Kormoran* wreck location.

Two high resolution sonar passes were undertaken using the SM-30 sonar towfish at swathes of 1.5km and 750m, and line headings of 352º and 172º respectively to investigate the *Kormoran* wreck site and establish a best-coordinated position.

Strong sonar targets south of the initial site were discounted as being geological in origin after one investigation sonar pass was carried out (see Line 9.Ext on Figure 1-2). In addition, one high resolution survey line was run using the SM-30 towfish on 750m swath setting and line heading of 180º to investigate what was thought to be the possible battle site. This site was found to be a number of large rock outcrops during the ROV inspection phase.

Two of the original 12 north/south run-lines (Lines 11 and 12) were then surveyed across the 37km x 37km *Sydney* survey area using the SM-30 sonar on a 6km swath setting before the *Sydney* wreck site was located at 1103hrs AWT (0203hrs UTC) on 16th March 2008.

Three high resolution survey lines were then run at swath widths of 3km, 1.5km and 750m and line headings of 180º, 319º and 139º respectively to further investigate the *Sydney* wreck site. The latter two lines were run parallel to the wreck's hull.

The SM-30 sonar towfish was recovered upon completion of the high resolution survey lines. The higher resolution AMS-60 system was then used for one further high resolution pass parallel to the hull sections of the *Kormoran* (line heading 026º) and *Sydney* (line heading 141º). A swath width of 600m was used for these passes.

This concluded the sonar phase of the project.

The proposed survey run-line plan and actual surveyed run-lines are presented in Figure 2-1.

2.2 ROV Inspection Phase

After verification of the wreck and debris field positions from the sonar and MBES data sets, and confirmation that water depth at the sonar target sites was within dive limits (3,000m) of DOF's ROV, the inspection phase of the works was undertaken.

Systems testing of the Comanche sub-Atlantic small work class ROV took place alongside Geraldton Port between 21st and 29th March 2008. A number of electrical and mechanical problems encountered during preparation and testing contributed to the length of time taken.

Offshore ROV operations were eventually undertaken between 29th March and 9th April 2008. This period includes transit time to and from Geraldton, sea trials off the Abrolhos Islands, operating durations, and equipment breakdown and weather standby periods.

A total of seven ROV dives were undertaken between 3rd and 7th April 2008 as summarised in Table 2-3.

Dive No.	Dive Location	Date
Dive 1	HMAS *Sydney* (II) wreck	03/04/08
Dive 2	HMAS *Sydney* (II) wreck	04/04/08
Dive 3	HMAS *Sydney* (II) debris field NNW of wreck	05/04/08 to 06/04/08
Dive 4	Discounted 'battle site' located approximately 18km WNW of the HMAS *Sydney* (II) wreck site.	06/04/08
Dive 5	HSK *Kormoran* wreck	07/04/08
Dive 6	HSK *Kormoran* debris fields #1 and #2	07/04/08
Dive 7	HMAS *Sydney* (II) debris field and wreck	07/04/08

Table 2-3 : ROV inspection dive program.

Each ROV dive was carefully planned prior to launch to maximise the subsea inspection durations and to ensure maximum capture of imagery. Pre-dive meetings were held between the search director, surveyor, ROV supervisor, sonar data analyst and the vessel officer.

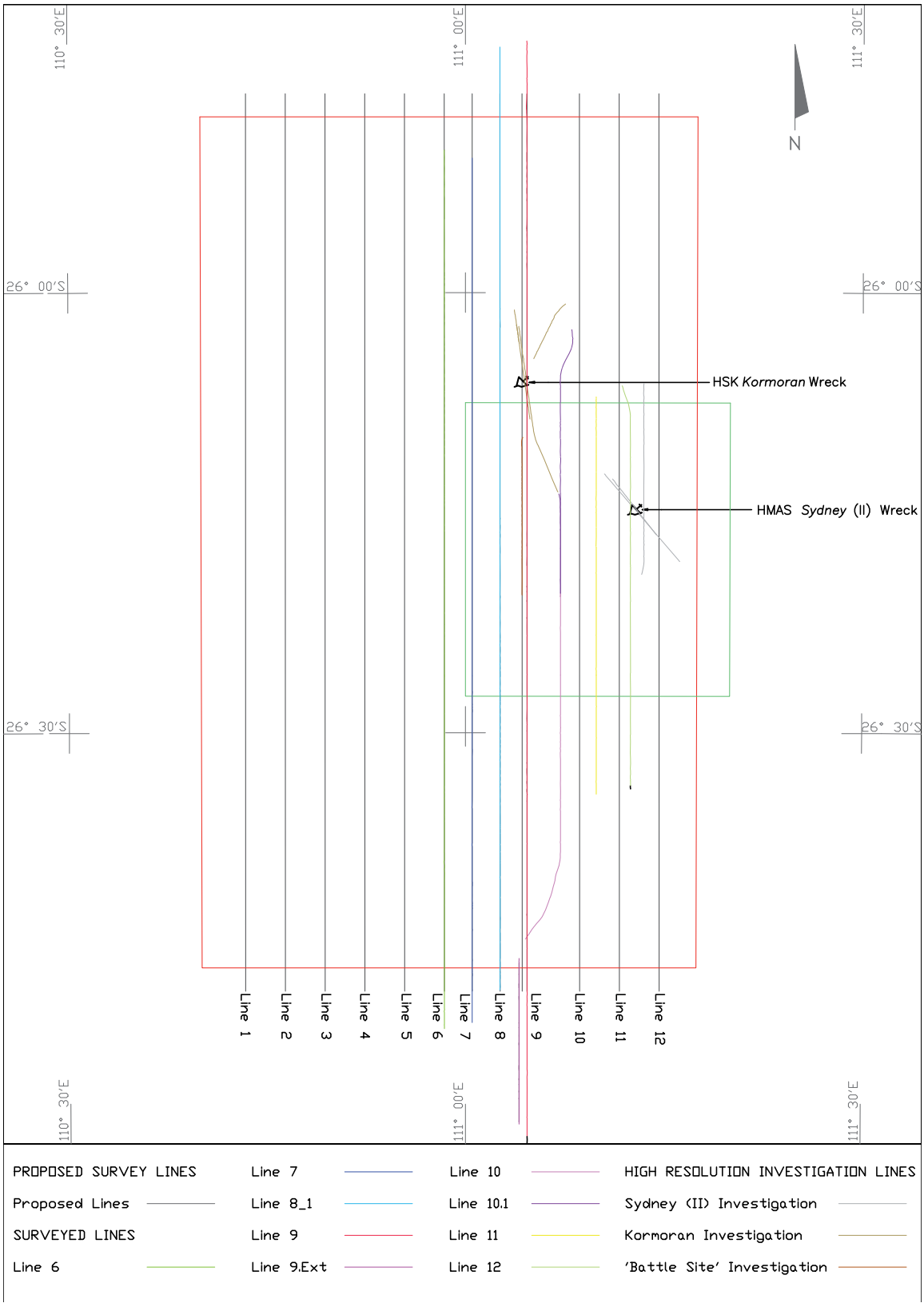

Figure 2-1 : Survey line plan showing proposed and surveyed run-lines.

Proposed dive locations were based on the best 'as-found' sonar target positions derived from the side scan sonar and MBES data sets. The surveyor added the derived position as a way-point on the helmsman's display located on the bridge of the vessel to assist in positioning the vessel over the dive location. The vessel then maintained position over the dive target using the vessel's Dynamic Positioning (DP) system.

After completion of pre-dive checks the ROV, inside its Tether Management System (TMS) garage, was launched from the port side of the vessel using the Launch and Recovery System (LARS). The ROV was then lowered to a height of approximately 50m above the seabed using the main lift winch. At the required water depth the ROV, connected to the TMS unit by a 300m control umbilical was manoeuvred out of the garage using its thrusters and positioned on the seabed near the dive target.

The ROV was tracked using the DOF HIPAP hydro-acoustic positioning reference system consisting of a through-the-hull transducer pole and mini responder/transponder beacons located on the TMS garage and ROV, and top-side unit. It must be noted that this system was not calibrated for this project; hence ROV positions were often unreliable.

Once the position of the ROV was established relative to a side scan sonar target, the ROV was raised to a few metres off the seabed and the on-board scanning sonar was used to detect nearby objects before moving off to commence inspection.

ROV inspection of sonar targets was undertaken at a safe working height and distance to avoid entanglement of the ROV control umbilical. High resolution still photos were saved as .JPG files to a 4GB SD flash card while video imaging was relayed in real-time to the surface and saved as 5min .MPG files to two NAS data storage units. Video overlay information consisting of dive location, date, local time and dive depth are provided for dives 3 to 7.

On completion of the inspection survey the ROV returned to its TMS garage, which was then raised to the surface. The ROV and TMS garage were then recovered to the vessel deck using the LARS, where post-dive checks were carried out and still photos downloaded from the SD flash card. The ROV was then prepared for the next dive.

The vessel remained on DP between launches and during ROV transits between dive targets when required.

A summary of events is provided in Section 7.0 of this report.

For more detailed information on operations refer to Appendix B3 – Daily Operations Reports, Appendix B4 – Survey Run-Line Log sheets and Appendix B5 – ROV Daily Progress Reports and Dive Logs.

A complete set of ROV still photographs with photo and video image index is presented in Appendix H (Volumes 4 and 5) of this report. ROV video footage in .MPG file format is provided on the accompanying hard drive.

2.3 Environmental Constraints

A number of environmental constraints were encountered during the offshore survey operations which impacted on the ease of operations and the time-frame within which these operations were conducted.

2.3.1 Isolated Location

The *Sydney* site is located approximately 200km west of Shark Bay, off the coast of Western Australia. A transit time of approximately 24 hours was required between the Port of Geraldton and the site. Facilities at the Port of Carnarvon were considered to be inadequate for the mobilisation/demobilisation of the survey vessel. The Port of Dampier was discounted due to the severe congestion and limited support facilities resulting from the extraordinarily high usage and demands created by the oil and gas industry in the NW Shelf area. Geraldton,

however, offered the search team a town that was fully supportive of the search and in hindsight this afforded the project superior services that would have not been present in Dampier. It is fitting to note that the Mayor of Geraldton-Greenough, port service companies and accommodation providers assisted the FSF and our contractors greatly during all mobilisation and demobilisation periods.

The isolated nature of the site meant thorough pre-project planning was required to ensure that there were sufficient provisions on board the vessel for a five-week survey and that all contractors carried adequate spares for their equipment in case of break-down. This was especially the case for W&A who had shipped their deep-water sonar equipment in from Seattle, USA.

An emergency response plan was drafted by DOF's Health, Safety and Environment department prior to the vessel departing Geraldton. This included telephone numbers for AusSAR-MRCC (Australian Search and Rescue – Maritime Rescue Coordination Centre), Geraldton Port Authority, local police and hospitals in Carnarvon and Geraldton, as well as contact telephone numbers for the FSF, DOF and W&A management.

2.3.1 Water Depth

The search area is located on the edge of the Australian continental shelf. Water depth within the initial search area ranges from a minimum of 2700m in the north to a maximum of 3200m in the south.

The W&A SM-30 and AMS-60 side scan sonar systems are designed to provide cost-effective search coverage over a large swath of seabed up to 6000m. The sonar towfish are depth rated to 6000m. A vessel speed not exceeding three knots and a tow cable length of up to 9000m was required to maintain the sonar towfish at an optimum survey height above the seabed. This meant that survey run-line and line turn times were considerable. For example, run-line time for the initial search area (108km long north/south lines) was in the order of 20 hours, with line turns taking up to five hours.

In addition, the length of tow cable deployed and therefore the distance of the sonar towfish behind the vessel precluded the possibility of towfish tracking by means of a conventional ultra-short baseline (USBL) hydro-acoustic positioning reference system. Project cost constraints also precluded use of a 'chase' boat for USBL tracking.

Sonar target positioning was therefore calculated using a combination of towfish layback and processed MBES data and, as a result, accuracy of quoted positions is in the order of +/- 20m.

It was fortuitous that the water depth at the wreck sites fell within the capabilities of the DOF ROV, albeit close to its limit of 3000m. ROV inspection dive depths ranged from 2220m at the *Sydney* debris field to 2786m at the discounted 'battle site'. Resultant ROV descent and ascent times between the vessel and the seabed were in the order of one hour.

2.3.2 Weather

Weather and sea state conditions encountered during the period of offshore operations were generally marginal to occasionally poor, although conditions improved between 4th and 6th April 2008 during the ROV inspection phase. Wind speed varied between 11 and 22 knots (generally SE to SSW), while swell height was generally between 1.5 and 2.0m.

Offshore operations were affected by the tail-ends of two tropical cyclones "Ophelia" and "Pancho" between 6th and 8th March, and 30th March and 3rd April 2008 respectively. Cyclone "Ophelia" had category two status on 5th March and became a tropical low by 7th March, while cyclone "Pancho" attained category four status on the 27th March becoming a tropical low by 29th March. Wind speed and swell height on site during the above-mentioned periods reached 45 knots and 3.5m respectively.

An approximate total time lost to weather standby as a result of the cyclones was 118 hours (five days).

2.4 Vessel and Equipment Breakdown

Although the final outcome and results were very positive, the project was fraught with vessel and equipment failure that significantly impacted on operations.

Although the *Geosounder* generally performed well in the often trying conditions encountered during offshore operations, there were problems with the vessel that impacted on the sonar survey operations. These included failure of the onboard VSAT internet system during initial mobilisation, the discovery of a fuel leak on departure from Geraldton Port on 29th February, and engine room problems resulting in significantly reduced maximum vessel speed from 17th March until the vessel's arrival in Geraldton on 20th March 2008.

All vessel problems were promptly addressed by DOF and repairs were carried out as expeditiously as possible. Total lost time approximated 100 hours (4.1 days).

Equipment problems were encountered during both the sonar and ROV phases of the project.

Mobilisation wet tests alongside Geraldton Port and subsequent sea trials of the W&A side scan sonar systems were favourable, however SM-30 sonar ground faults, loss of telemetry control, transducer power loss and poor image quality significantly delayed sonar operations between 5th and 11th March. Loss of telemetry control was also experienced during the start-up of the AMS-60 high resolution sonar survey on the 17th March 2008.

Approximately 148 hours (6.1 days) were lost due to sonar systems failure. Deck repairs and testing were often hampered by rough sea state and poor weather conditions during the above-mentioned periods.

The ROV inspection phase start-up was delayed by eight days due to technical problems experienced after mobilisation commenced on 21st March 2008. Problems with the ROV during mobilisation and offshore operations were numerous and included TMS Lims grounding faults, ground fault and blown transformers on HMI lights, poorly maintained HPU slip rings, inoperable thrusters motors, loss of TMS telemetry, loss of sonar communication, blown TMS transformer fuses, inoperable velocity probe unit and camera pan motors, intermittently operable bathymetry unit, and winch level winder failure.

The ROV was unable to leave its TMS garage due to an inoperable TMS drive motor during the first ROV dive on the *Sydney* wreck on 3rd April, and again due to a jammed manipulator arm during the first ROV dive on the *Kormoran* wreck on 6th April 2008. Both incidents necessitated a recovery and relaunch before wreck site inspection could re-commence.

Approximately 257 hours (10.7 days) were lost due to problems with the ROV system.

Both the W&A and DOF technicians worked hard, often in very trying conditions, to overcome the technical problems and completed significant electrical and mechanical repairs at sea. The outcome of both the sonar survey and ROV inspection phases bears testament to the determination of both survey teams.

For detailed information regarding equipment failure refer to Appendix B3 – Daily Operations Reports and Appendix B5 – ROV Daily Progress Reports and Dive Logs.

3.0 SURVEY RESULTS

3.1 Overview

Survey operations for the search for the *Sydney* and *Kormoran* were undertaken between 27th February and 9th April 2008 on board the survey vessel *Geosounder*. The objectives of the project, as outlined in the scope of work, were successfully met.

This section provides a précis of the results of the sonar survey and ROV wreck inspection phases of the project. It must be stressed that no attempt has been made to interpret the results of either the sonar survey or ROV inspection with regard to the sequence of events that may have occurred during the battle between *Sydney* and *Kormoran*, and any attempt at such is beyond the scope of this report.

All wreck and associated debris positions quoted in this section are based on repositioned sonar target data. Original sonar target locations measured from the sonar data were repositioned using more accurate processed, hull-mounted multi beam echo sounder (MBES) data where possible as reference. The accuracy of all quoted positions in this section is considered to be in the order of +/- 20m.

Positions were confirmed where possible during the ROV inspection phase using the HIPAP hydro-acoustic positioning reference (HPR) system. However, as a calibration of this system was not part of the contract agreement between the FSF and DOF, derived positions were found to be erratic.

Reference should be made to the accompanying wreck location drawings (Drawing Nos. 27098-001 to 27098-003). All images of the *Sydney* and *Kormoran* wrecks and associated debris fields, where identified on the sonar data, are presented in Appendices C1 and C2. A complete set of ROV still photographs with photo and video image index is presented in Appendix H of this report. ROV video footage in .MPG file format is provided on the accompanying hard drive.

Online event logging during the sonar survey and ROV inspection phases is provided in the Chief Officer's Log Book and FSF, Online Surveyor, Sonar Party Chief and ROV Supervisor Survey Log Books, copies of which are presented in Appendix B of this report.

3.2 HMAS *Sydney* (II)

(Refer to Appendix H2, Drawing Nos. 27098-001 and 27098-002)

3.2.1 Side Scan Sonar Survey

The *Sydney* wreck site was identified along Line 12, on 6km swath SM-30 side scan sonar data at 1103hrs AWT (0203hrs UTC) on 16th March 2008.

Sonar data revealed the wreck to be lying upright on the seabed; its hull orientated generally NW/SE with the stern to the north. A large section of the bow lies detached from the main wreck approximately 450m to the NNW.

Key wreck site coordinates are provided in Table 3-1.

Datum: GDA94, Spheroid: GRS80		
Location	Latitude (S)	Longitude (E)
HMAS *Sydney* (II) wreck - centre	26º 14' 45"	111º 12' 55"
HMAS *Sydney* (II) wreck - centre of bow section	26º 14' 31"	111º 12' 48"
HMAS Sydney (II) wreck - centre of debris field	26º 14' 33"	111º 12' 49"

Table 3-1 : HMAS *Sydney* (II) wreck site coordinates.

A full 6km swath sonar image showing the location of the *Sydney* wreck site on the starboard sonar channel is provided in Figure 3-1. The red colour of the sonar target is indicative of an acoustically strong, hard contact. Another indicator that this was the wreck site was the anomalous nature of the sonar contact relative to the surrounding seabed, which is featureless and of low acoustic reflectivity.

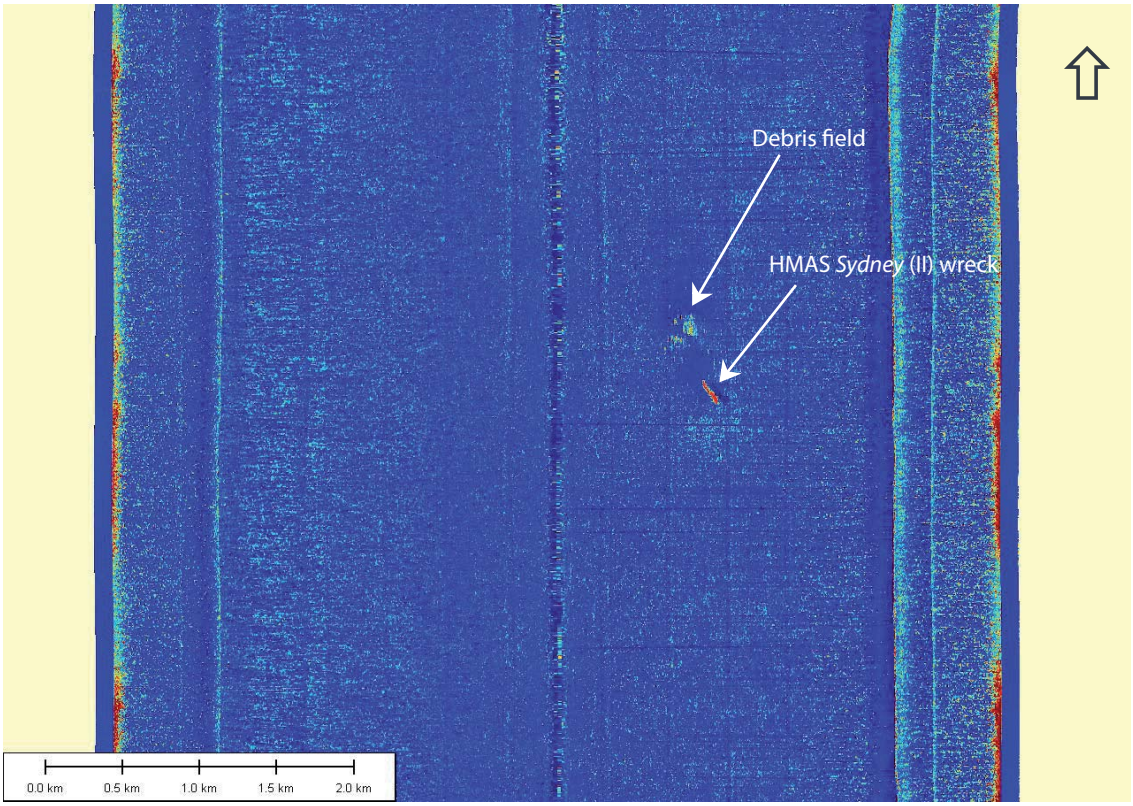

Figure 3-1 : Full 6km swath sonar image showing HMAS *Sydney* (II) wreck and debris field.

After finding the wreck site a number of high resolution and reduced swath investigation lines using the SM-30 and AMS-60 sonar systems were run in order to the confirm that the sonar target was *Sydney*. Investigative parameters included target length and width and any salient structural features typical of the cruiser.

Interpreted main wreck length and width values determined from sonar images are 166m and 18m respectively. Dimensions of the interpreted dislodged bow section are approximately 28m long and 14m wide. Acoustic shadowing observed on the sonar images revealed a maximum main wreck height of approximately 14m, and bow section height of 10.5m above surrounding seabed. These dimensions correlate well to those of the *Sydney*.

Two enlarged high resolution AMS-60, 600m swath sonar images showing the main wreck and dislodged bow section are presented in Figures 3-2 and 3-3 respectively.

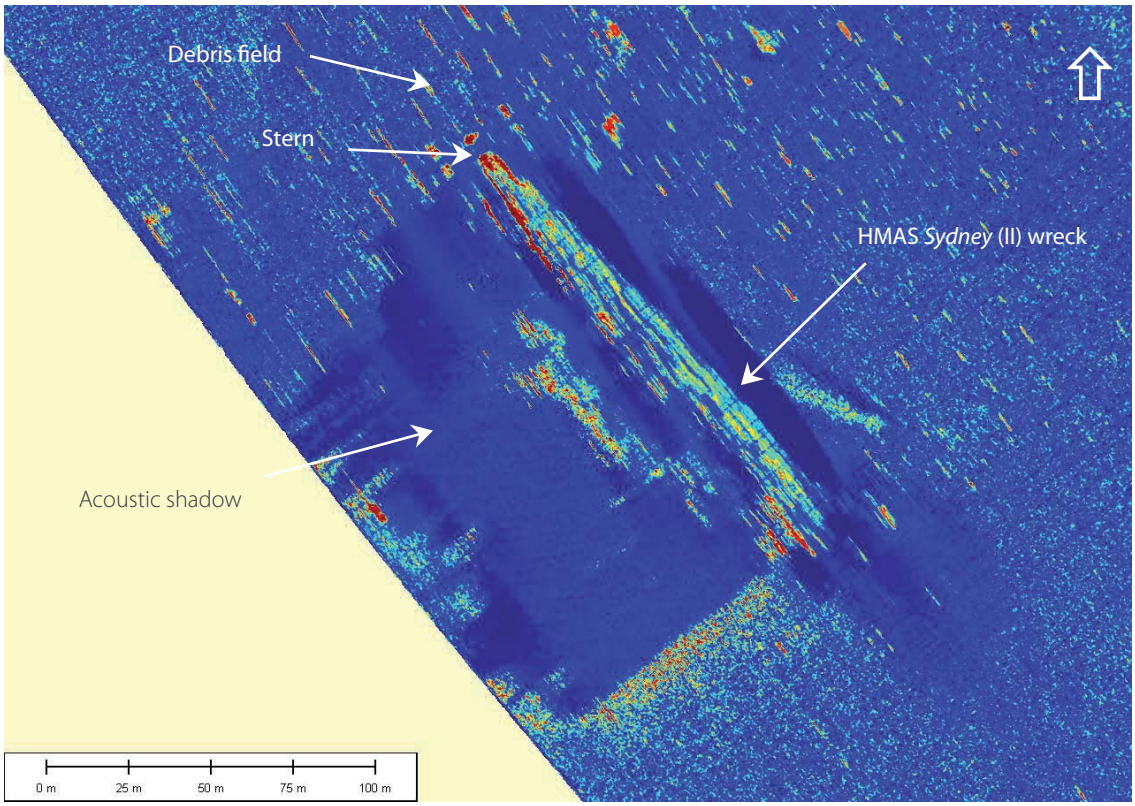

Figure 3-2 : Enlarged 600m swath sonar image showing HMAS *Sydney* (II) wreck.

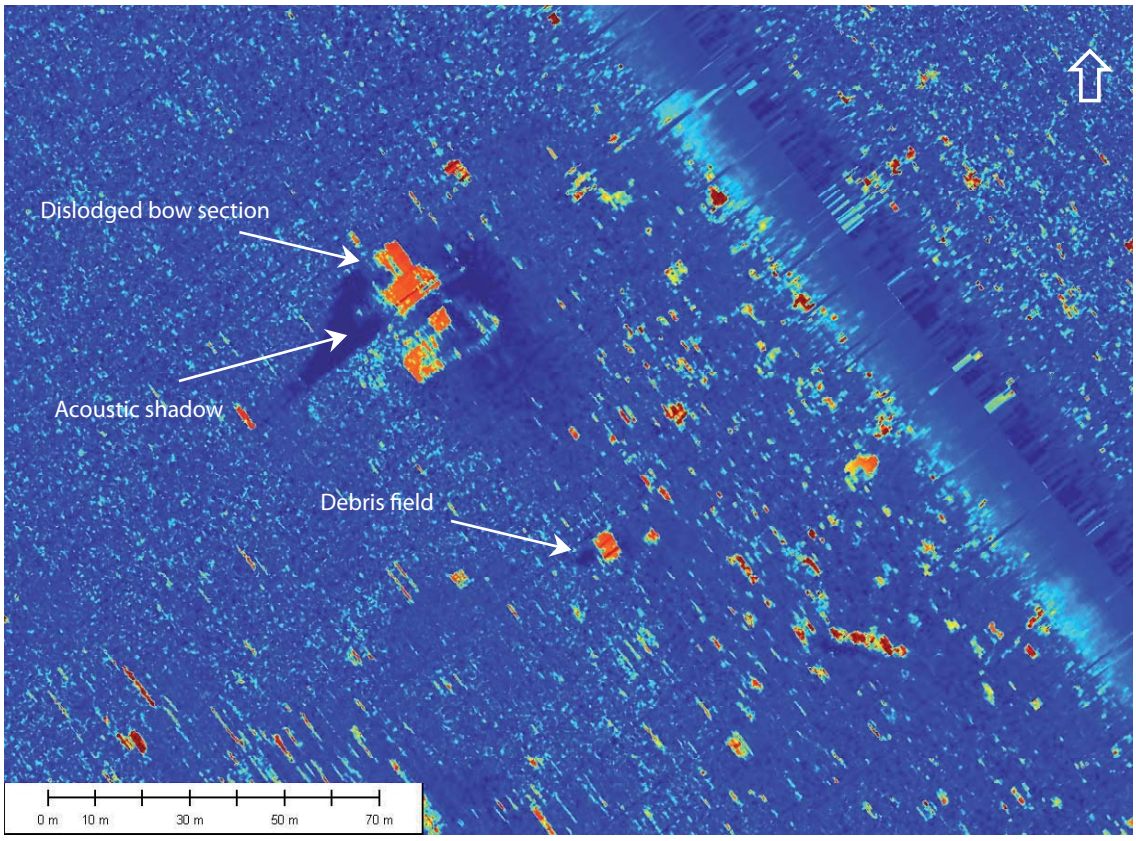

Figure 3-3 : Enlarged 600m swath sonar image showing bow section within debris field.

3.2.2 ROV Inspection

An ROV inspection of the *Sydney* wreck site provided visual confirmation of the wreck. High quality still photographic and video imaging confirmed the nature of the sonar targets, including not only the main wreck but also the numerous items of debris and wreckage within the debris field to the NNW.

A summary of the *Sydney* dive program and approximate water depth at each location is provided in Table 3-2.

Dive Location	Date	Dive No.	Approx. Water Depth
HMAS *Sydney* (II) wreck	03/04/08	Dive 1	2410m
HMAS *Sydney* (II) wreck	04/04/08	Dive 2	2480m
HMAS *Sydney* (II) debris field NNW of wreck	05/04/08 to 06/04/08	Dive 3	2220m
HMAS *Sydney* (II) debris field	07/04/08	Dive 7	2220m
HMAS *Sydney* (II) wreck	07/04/08	Dive 7	2430m

Table 3-2 : HMAS *Sydney* (II) ROV dives.

ROV inspection Dive 1, Dive 2 and the latter part of Dive 7 concentrated on the main wreck section. Dive 1 was generally unsuccessful as the ROV was unable to exit the TMS garage and was therefore vulnerable to surface vessel movement. This resulted in blurred photographs and the inability of the ROV to approach the wreck safely. This dive was eventually aborted and superseded by Dive 2.

Three *Sydney* ROV photo location guides from photos acquired during Dive 2 and Dive 7 are presented in Figures 3-4 to 3-6.

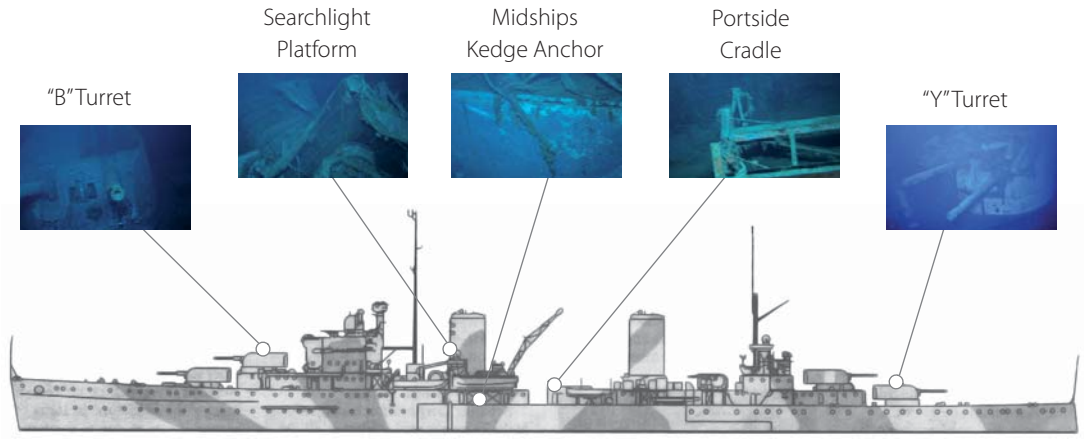

Figure 3-4 : HMAS *Sydney* (II) ROV photo location guide.

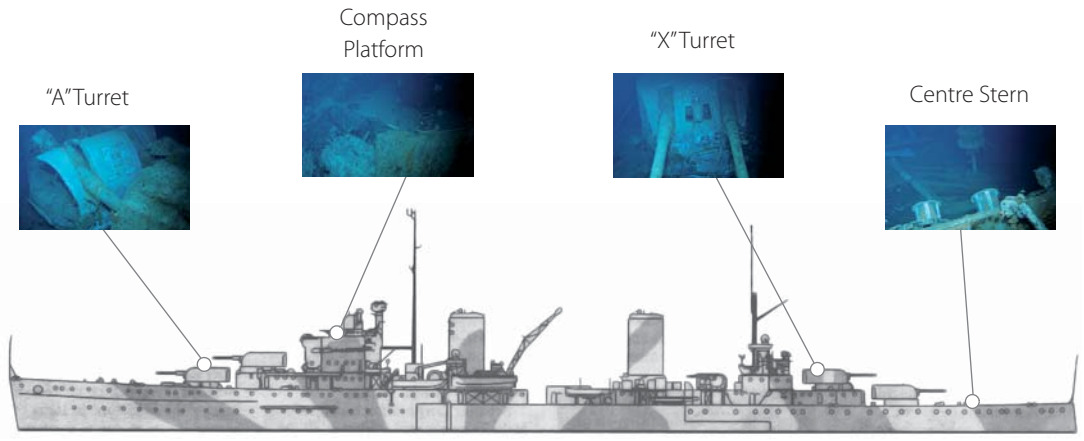

Figure 3-5 : HMAS *Sydney* (II) ROV photo location guide.

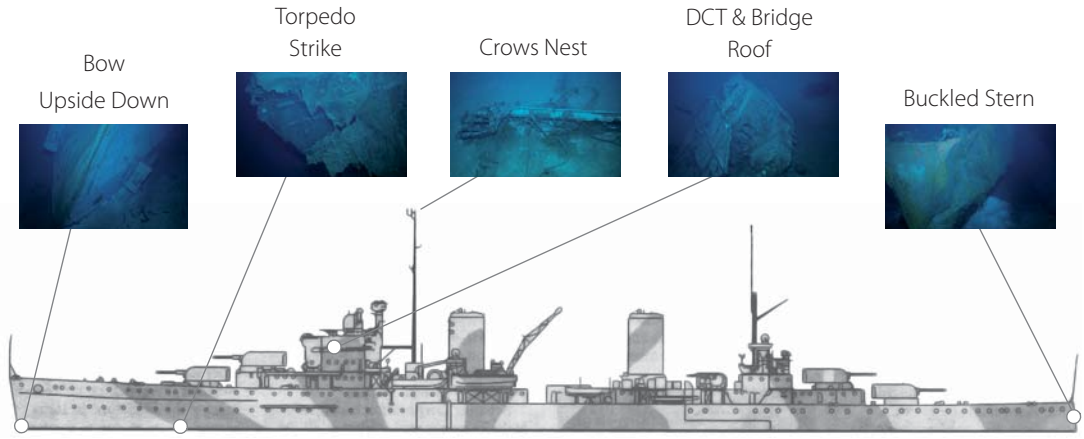

Figure 3-6 : HMAS *Sydney* (II) ROV photo location guide.

ROV inspection Dive 3 and the initial part of Dive 7 were undertaken within the debris field that extends generally NNW from the main wreck. These ROV dives were based primarily on repositioned sonar target data.

A number of large sonar targets were identified within the debris field and although these formed the basis of the respective dive plans, numerous items of both identifiable and unidentifiable debris and wreckage were also observed while the ROV was transiting between them.

The description and position of some of the largest targets identified within the debris field are provided in Table 3-3. An AMS-60, 600m swath sonar image showing the position and description of salient items identified during the ROV inspection of the debris field is provided as Figure 3-7.

Sonar Target No.	Description based on ROV inspection	Latitude (S)	Longitude (E)
S1	27-ft whaler boat	26° 14' 44"	111° 12' 49"
S2	Large piece of unidentified debris	26° 14' 43"	111° 12' 54"
S3	Large piece of unidentified debris	26° 14' 42"	111° 12' 54"
S4	Large piece of unidentified debris	26° 14' 42"	111° 12' 56"
S5	Large drum and wire used for berthing	26° 14' 35"	111° 12' 56"
S6	Torpedo tubes	26° 14' 37"	111° 12' 54"
S7	Boat lying across what is believed to be 36 ft motor pinnace	26° 14' 39"	111° 12' 48"
S8	(Not found)	26° 14' 36"	111° 12' 46"
S9	Aeroplane catapult and adjacent boat	26° 14' 33"	111° 12' 50"
S10	Direction control tower and bridge roof	26° 14' 33"	111° 12' 49"
S11	Dislodged bow section	26º 14' 31"	111º 12' 48"
S12	Foremast	26° 14' 28"	111° 12' 45"
S13	(Not Found)	26° 14' 27"	111° 12' 51"

Table 3-3 : HMAS *Sydney* (II) debris field ROV target coordinates.

3.3 HSK *Kormoran*

(Refer to Appendix H2, Drawing Nos. 27098-001 and 27098-003)

3.3.1 Side Scan Sonar Survey

The *Kormoran* wreck site was identified along Line 9, on 6km swath SM-30 side scan sonar data at 1730hrs AWT (0930hrs UTC) on 12th March 2008.

Sonar data showed one large section of superstructure lying upright and orientated generally SSW/NNE with the bow to the north, an extensive debris field (debris field #1) approximately 500m to the north east containing another large section of intact superstructure, and a smaller debris field (debris field #2) approximately 1.3km to the north.

Key wreck site coordinates are provided in Table 3-4.

Datum: GDA94, Spheroid: GRS80		
Location	Latitude (S)	Longitude (E)
HSK *Kormoran* wreck - centre of superstructure	26º 06' 32"	111º 04' 21"
HSK *Kormoran* wreck - centre of large piece of superstructure within extensive debris field #1	26º 05' 46"	111º 04' 33"
HSK *Kormoran* wreck - centre of largest piece of wreckage within northernmost debris field #2	26º 05' 23"	111º 04' 15"

Table 3-4 : HSK *Kormoran* wreck site coordinates.

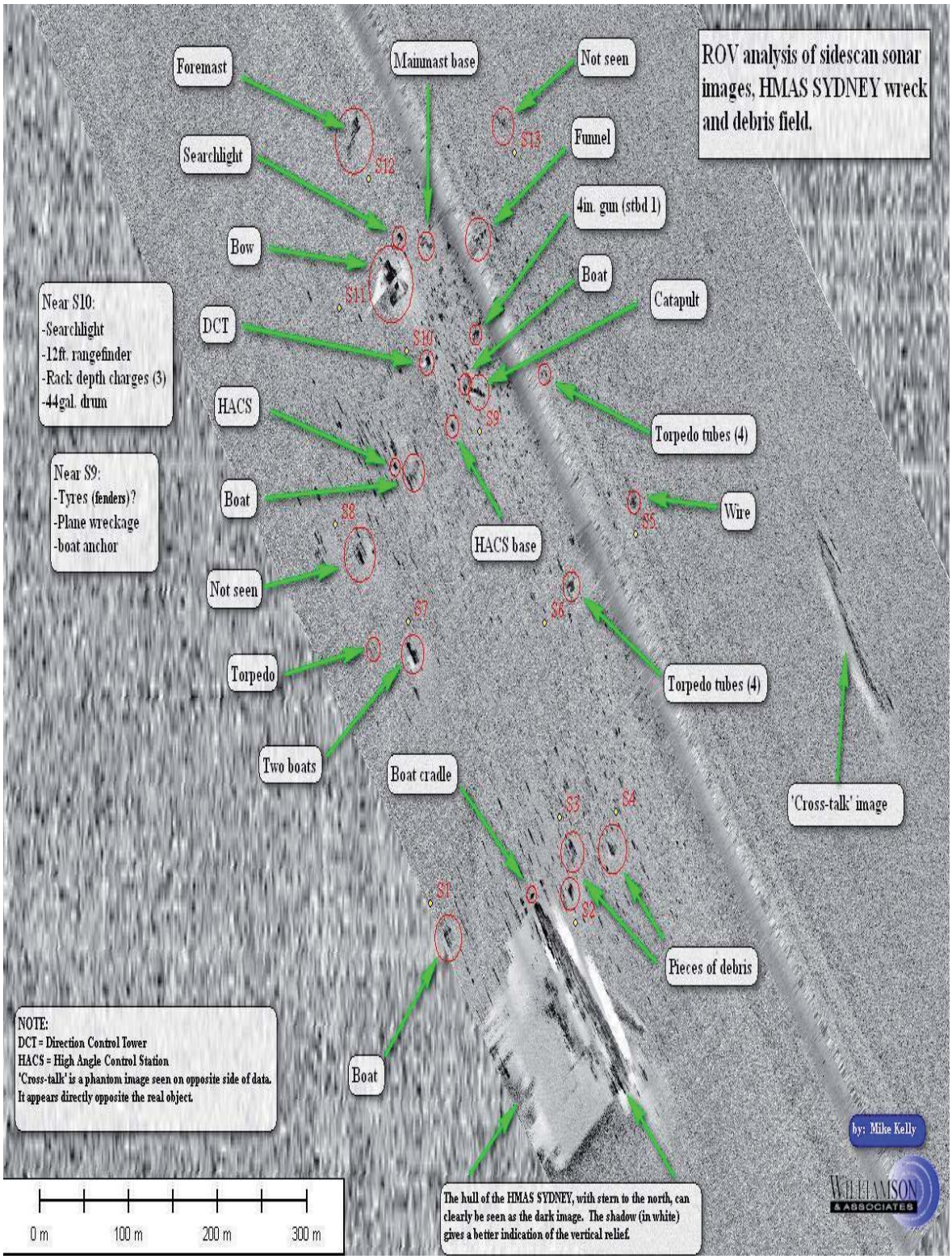

Figure 3-7 : ROV inspection results for HMAS *Sydney* (II) wreck and debris field.

Full 6km and 1.5km swath sonar images of the *Kormoran* wreck site on the port sonar channel are shown in Figures 3-8 and 3-9. The red colour of the sonar targets is indicative of acoustically strong, hard contacts. As with the *Sydney* wreck site, this wreck site exhibited anomalous sonar returns relative to the surrounding featureless seabed.

A number of high resolution and reduced swath investigation lines using the SM-30 and AMS-60 sonar systems were run in order to the confirm that this was the *Kormoran*.

The main section of superstructure to the south is approximately 90m long, 20m wide and up to 20m high, as determined from the sonar images. These dimensions correlated to known dimensions between the midships accommodation and the bow, and were later confirmed by ROV inspection. An enlarged high resolution AMS-60, 600m swath sonar image of the main wreckage is provided as Figure 3-10.

Debris field #1 to the north east is extensive, measuring nearly 1km across and is centred on a large piece of superstructure approximately 50m long, 20m wide and 15m high. An enlarged high resolution AMS-30, 1.5km swath sonar image of debris field #1 is provided as Figure 3-11.

Debris field #2 contains only a few sonar targets, the largest measuring approximately 35m long, 15m wide and 15m. A high resolution AMS-30, 1.5km swath sonar image acquired over debris field #2 is presented as Figure 3-12.

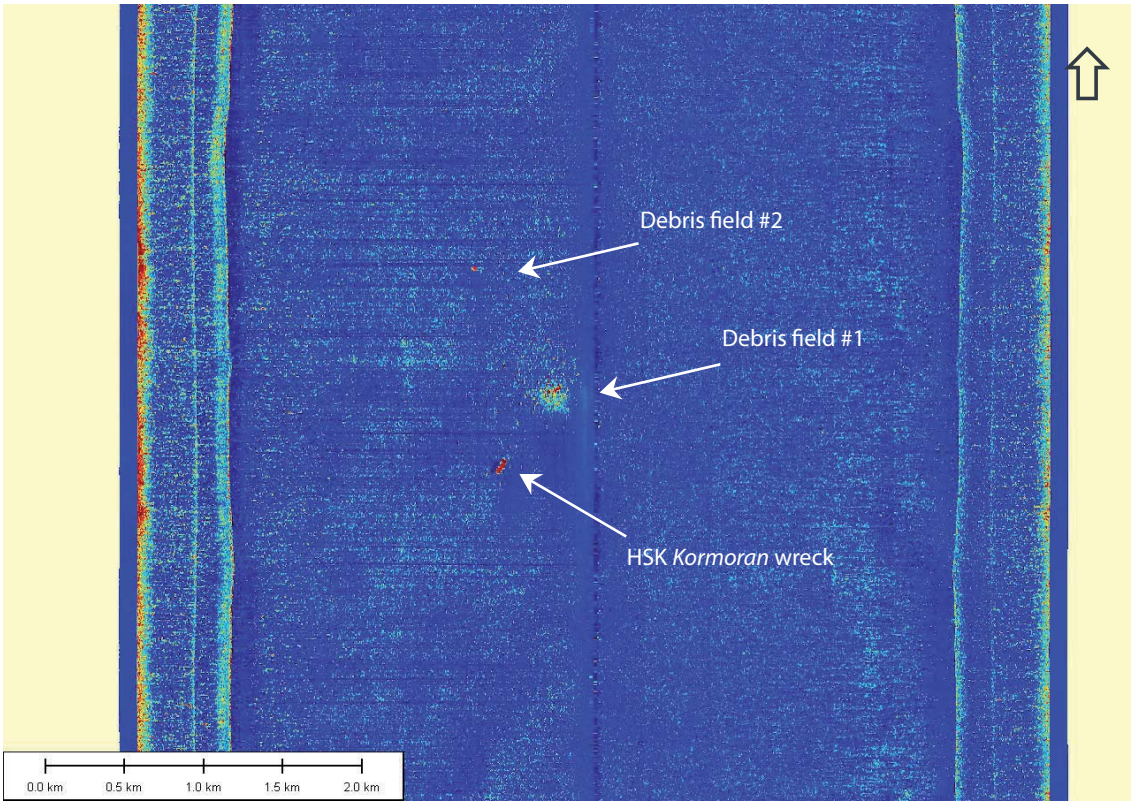

Figure 3-8 : Full swath (6km) sonar image showing HSK *Kormoran* wreck and debris fields #1 and #2.

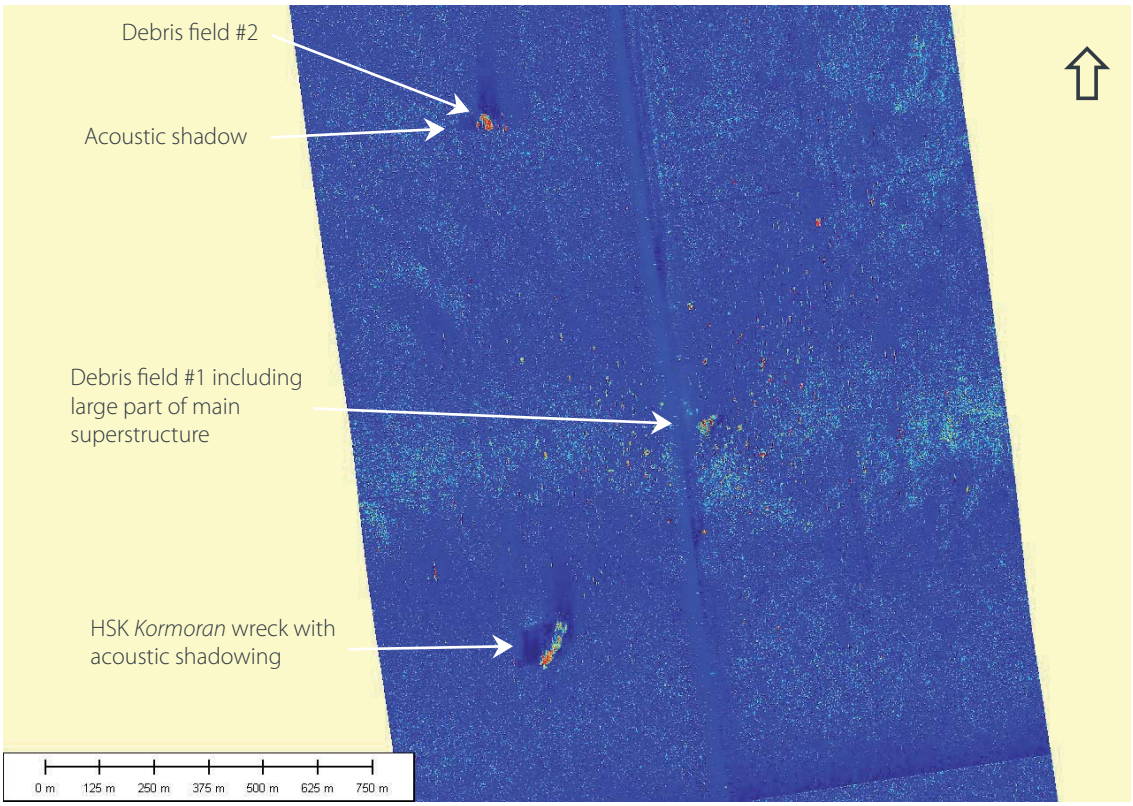

Figure 3-9 : Full 1.5km swath sonar image showing HSK *Kormoran* wreck and debris fields #1 and #2.

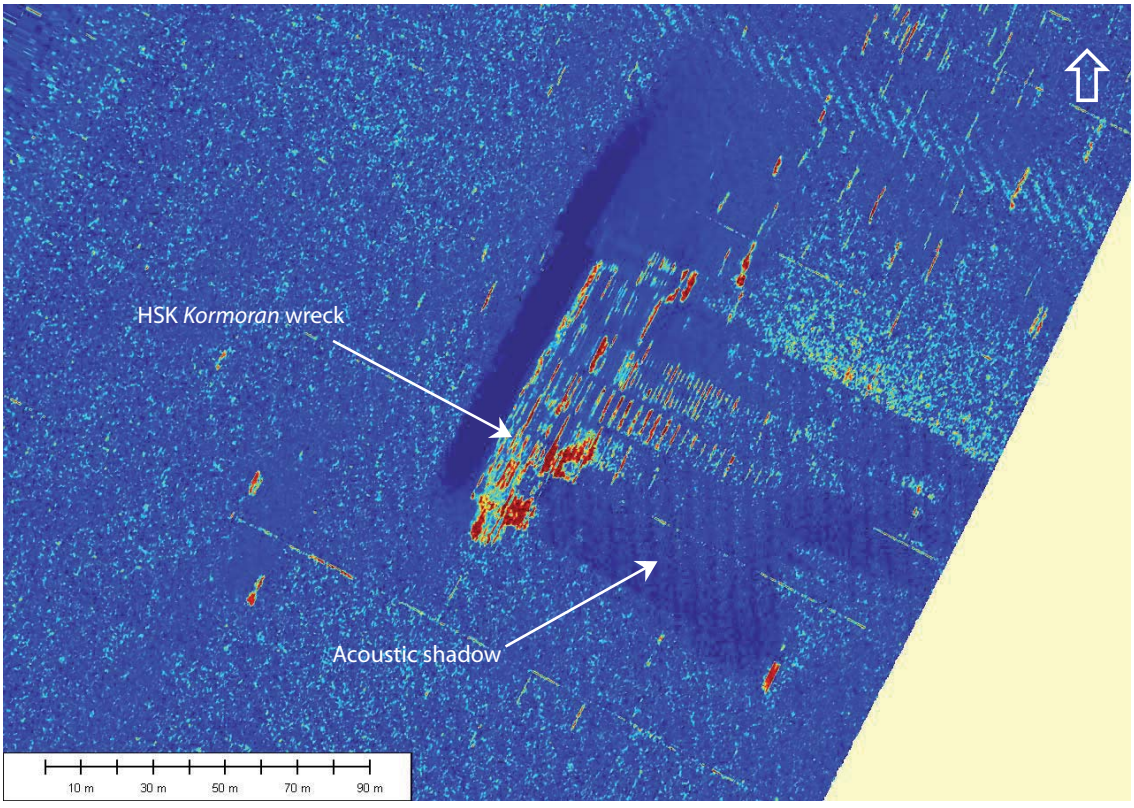

Figure 3-10 : Enlarged 600m swath sonar image showing HSK *Kormoran* wreck.

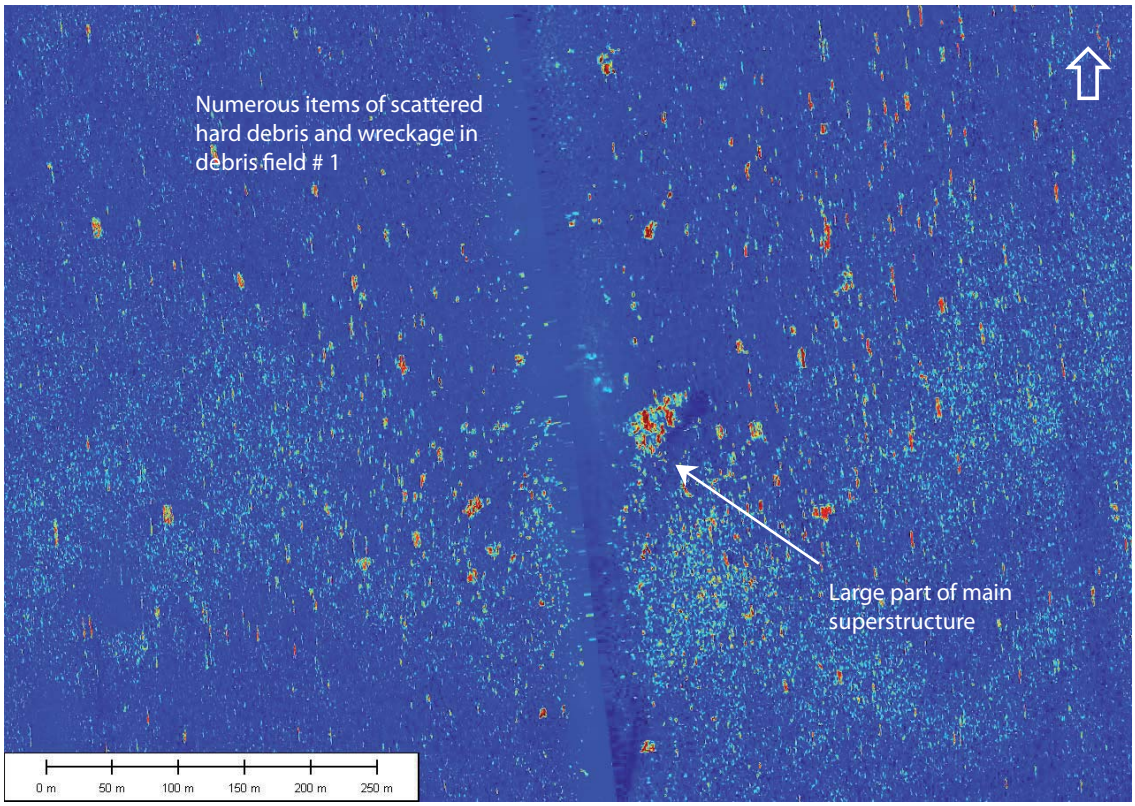

Figure 3-11 : Enlarged 1.5km swath sonar image showing debris field #1.

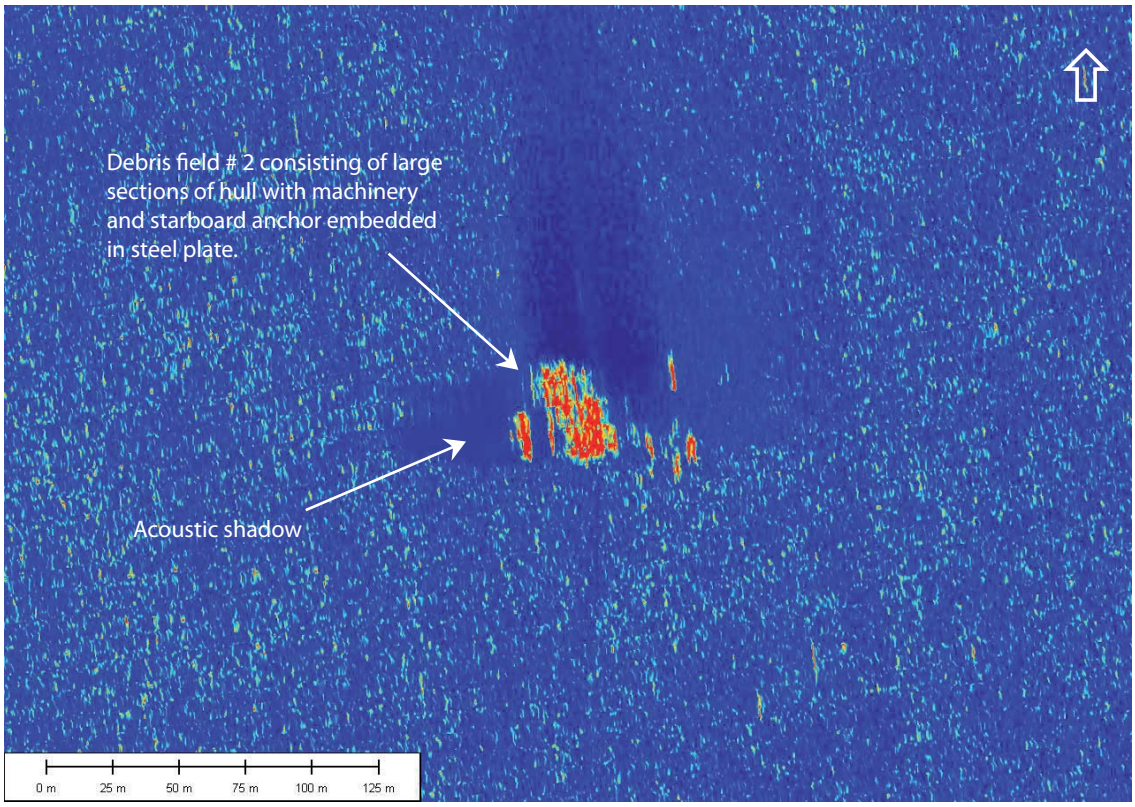

Figure 3-12 : Enlarged 1.5km swath sonar image showing debris field #2.

3.3.2 ROV Inspection

An ROV inspection of the *Kormoran* wreck site provided visual confirmation of the wreck. High quality still photographic and video imaging confirmed the nature of some of the largest sonar targets. Due to time constraints, ROV inspection concentrated on the main wreck section with some time spent investigating the largest items of wreckage identified on the sonar within each of the two debris fields.

A summary of the *Kormoran* dive program and approximate water depth at each location is provided in Table 3-5.

Dive Location	Date	Dive No.	Approximate Water Depth
HSK *Kormoran* wreck	07/04/08	Dive 5	2580m
HSK *Kormoran* debris field #1	07/04/08	Dive 6	2583m
HSK *Kormoran* debris field #2	07/04/08	Dive 6	2602m

Table 3-5 : HSK *Kormoran* ROV dives

The wreck of the *Kormoran* was positively identified during ROV inspection Dive 5. However, the dive was aborted because a jammed manipulator arm prevented the ROV from exiting the TMS garage. Video footage was acquired but no still photographs were taken due to excessive movement of the ROV and TMS unit.

Dive 6 was undertaken in three parts: inspection of the largest section of wreckage followed by an inspection of each of the largest pieces of wreckage within debris fields #1 and #2.

Inspection of the forward section of the wreck confirmed that the vessel had broken near the aft of the main accommodation block. Inspection of the largest item of wreckage within debris field #1 revealed another large section of the superstructure surrounded by numerous items of wreckage. The height of this section was confirmed during the inspection.

Finally, inspection of the smaller debris field #2 to the north revealed the largest item of debris to be a large section of the port midships and included what appeared to be machinery or main engine block, with lettering reading "08KO" found on plating just above the bilge keel. The lettering is consistent with that found on *Kormoran* ship's drawings.

A *Kormoran* ROV photo location guide from photos acquired during Dive 6 is presented in Figure 3-13.

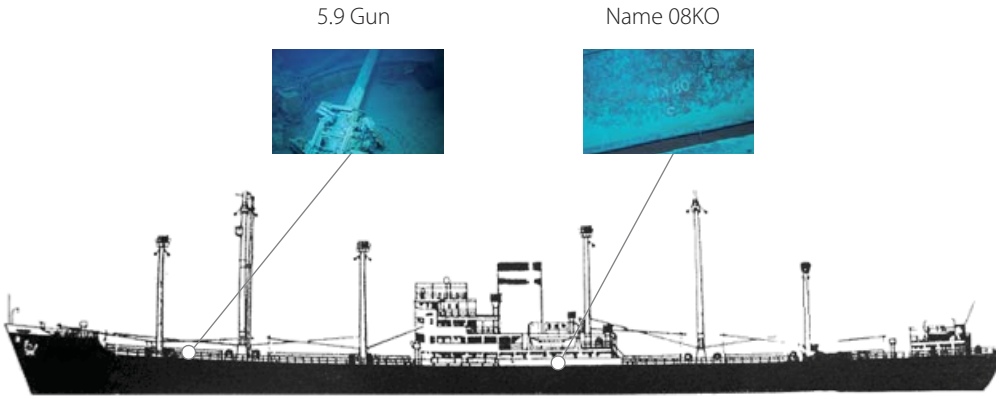

Figure 3-13 : HSK *Kormoran* ROV photo location guide.

3.4 Possible Battle Site (Revealed to be Rock Outcrops)

3.4.1 Side Scan Sonar Survey

Prior to finding the *Kormoran* wreck site, a zone of acoustically strong sonar targets was identified during the survey of Line 9, approximately 8.5km to the south of the wreck site. Once the wreck site of the *Kormoran* had been identified it was suggested that this zone may have been the battle site between *Sydney* and *Kormoran*.

Although these sonar targets appeared to be very large, they could not be confidently attributed to geological features (unlike other parts of the survey area) because of their acoustic nature and anomalous situation within a predominantly featureless seabed. Six km swath sonar data revealed what appeared to be man-made attributes such as straight edges and very high acoustic amplitude commonly indicative of metallic objects.

An additional high resolution survey line was run using the SM-30 towfish on a 750m swath setting to further investigate the area. It centred on the largest and highest sonar target, coordinates of which are provided in Table 3-6.

Datum: GDA94, Spheroid: GRS80		
Location	Latitude (S)	Longitude (E)
Largest sonar target – rock outcrop	26º 10' 36"	111º 04' 18"

Table 3-6 : Discounted battle site coordinates.

An ROV inspection of the area on 6th April 2008 found the sonar targets at the 'battle site' to be outcrops of igneous rock.

A full 6km swath sonar image acquired over the surmised battle site showing a number of acoustically strong sonar targets on the port sonar channel is shown in Figure 3-14, while an enlarged high resolution 750m swath sonar image presented as Figure 3-15 shows the largest target, approximately 40m x 21m and up to 13m high.

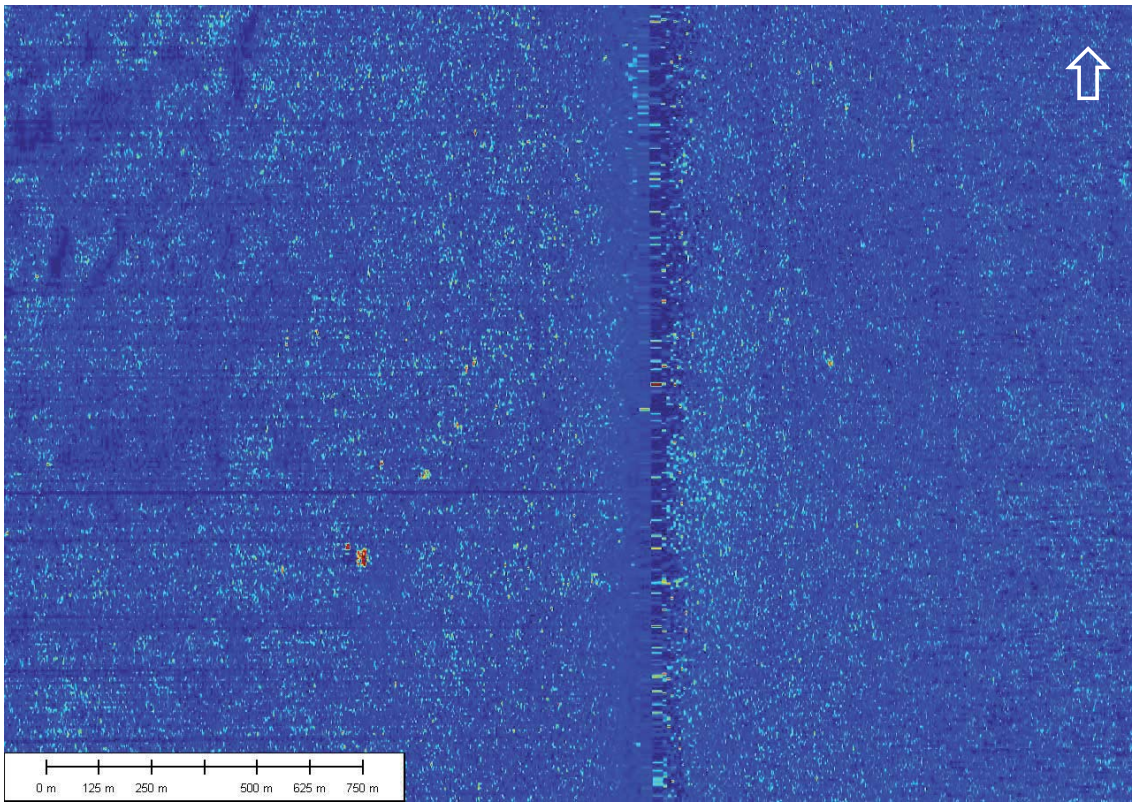

Figure 3-14 : 6km swath sonar image showing strong acoustic targets.

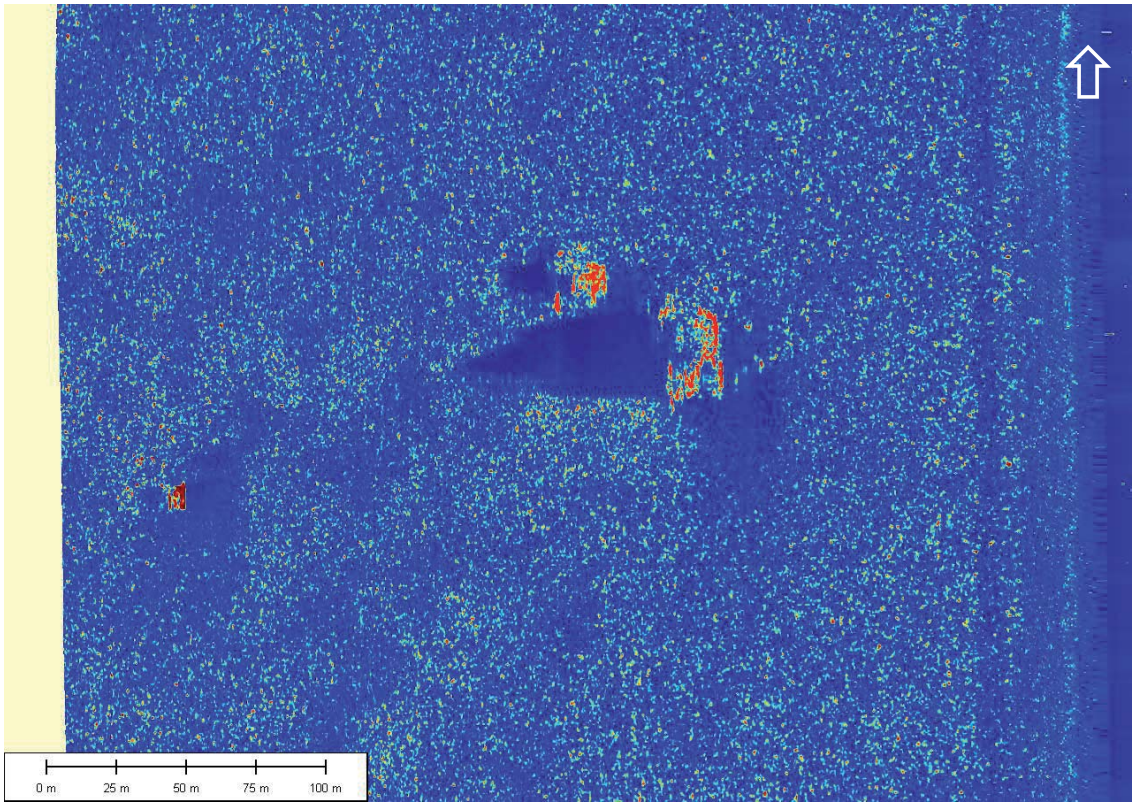

Figure 3-15 : Enlarged 750m swath sonar image showing largest target (See also Figure 3-17).

3.4.2 ROV Inspection

An ROV inspection of the 'battle site' was undertaken to confirm the nature of the large sonar targets identified on side scan sonar data. Water depth was approximately 2786m, which is close to the 3000m depth rating of the ROV.

A summary of the 'battle site' dive program and approximate water depth at the dive location is provided in Table 3-7.

Dive Location	Date	Dive No.	Approximate Water Depth
Discounted battle site located approximately 18km WNW of the HMAS *Sydney* (II) wreck site.	06/04/08	Dive 4	2786m

Table 3-7 : Discounted battle site ROV dive.

The ROV scanning sonar was used to identify any targets within a range of up to 200m. Sonar sweeps revealed no significant contacts during an initial north-running search. A southerly search was then undertaken towards the larger targets and it became evident that the targets identified during the sonar phase were in fact large outcrops of igneous rock (predominantly granite and some pillow lava). No man-made items of debris or wreckage were identified during the ROV inspection.

Examples of the outcrops identified during the ROV inspection are presented as Figures 3-16 and 3-17. The photograph presented as Figure 3-17 was taken at the location of the largest sonar target (see Figure 3-15).

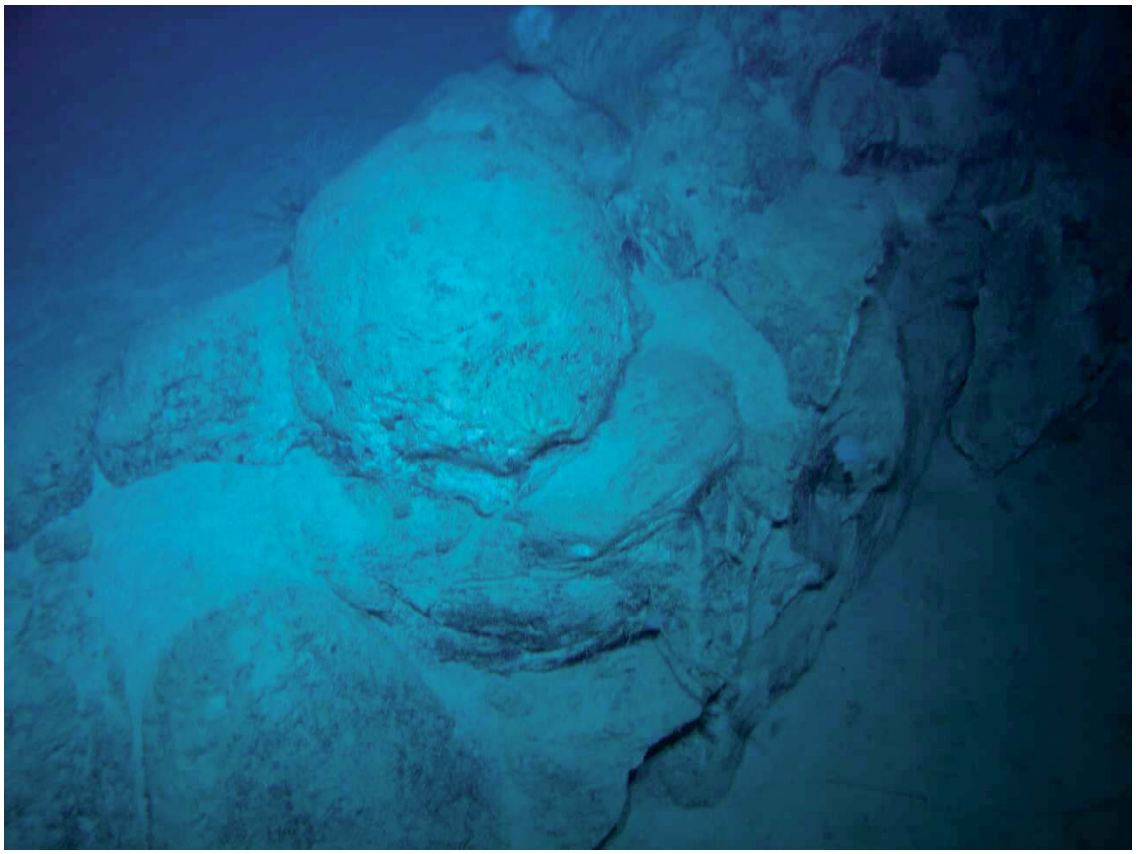

Figure 3-16 : Image #IMG_2561 showing pillow basalt outcrop.

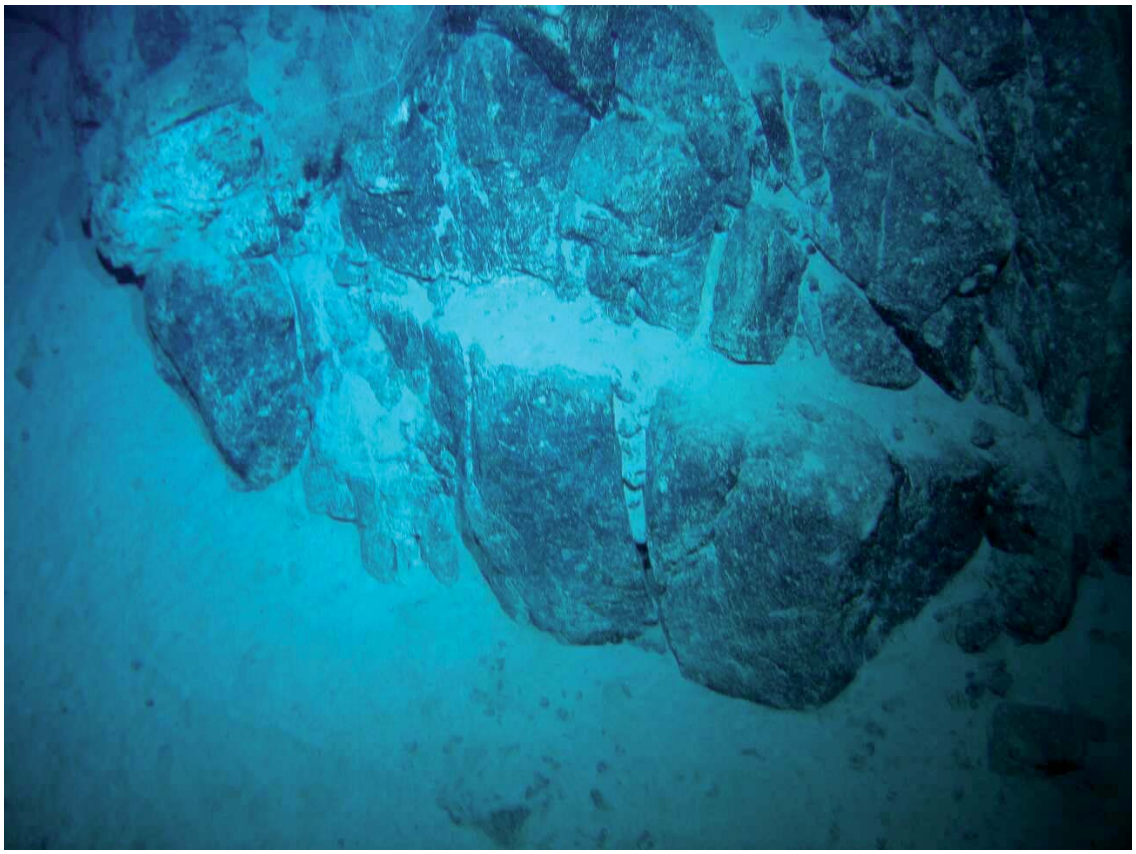

Figure 3-17 : Image #IMG_2569 showing part of largest granite outcrop (See also Figure 3-15).

4.0 EQUIPMENT CALIBRATIONS

4.1 Gyrocompass Calibration

Calibration of the primary and secondary vessel gyrocompass systems was carried out whilst alongside Geraldton Port on 28th February 2008.

Simultaneous tape measurements were taken to the vessel from two points located on the quayside. The baseline distance between the two points was measured and calculated vessel heading values were then computed. These calculated heading values were then compared to coincident data logged directly from both the primary and secondary gyrocompasses. The comparisons between the measurements are summarised below:

Gyrocompass	C-O	Standard Deviation
Seapath Heading (Primary)	-0.33º	0.1º
Anshultz Gyro (Secondary)	-2.68º	0.1º

Table 4-1 : Gyrocompass calibration results.

As a result of the calculations, a mean C-O correction of -0.33° was applied in QINSy navigation software to correct the primary gyrocompass. The secondary gyrocompass was adjusted by a value of -2.68° within the QINSy navigation software.

Gyrocompass calibration field observations and results are provided in Volume3, Appendix D1.

4.2 Globally Corrected Global Positioning System (GcGPS) Verification

Prior to the commencement of survey operations two positioning system health checks were carried out on 28th February 2008. The Veripos Globally Corrected Global Positioning Systems (GcGPS) installed onboard the *Geosounder* were checked using conventional offset surveying techniques at the quayside at Geraldton Port. Survey control mark MCP 2, identified adjacent to the vessel on the quayside with the assistance of the Geraldton Port Authority surveyor Ian Roberts, was used to conduct offset GcGPS observations to both the primary and secondary GPS antennas.

The results of the GcGPS verification are summarised in Tables 4-2 and 4-3:

	Mean Difference Easting (m)	Mean Difference Northing (m)
Veripos Primary GcGPS	0.79	-0.69
Standard Deviation	0.17	0.152

Table 4-2 : Primary GcGPS verification results.

	Mean Difference Easting (m)	Mean Difference Northing (m)
Veripos Secondary GcGPS	0.77	1.29
Standard Deviation	0.21	0.29

Table 4-3 : Secondary GcGPS verification results.

The relatively small difference between the known station mark MCP 2 coordinates and the GcGPS observations may be attributed to vessel movement and the difference of approximately 0.7m between World Geodetic System 1984 (WGS84) and Geocentric Datum of Australia 1994 (GDA94) coordinates.

Field observations of the Veripos GcGPS verification are provided in Volume 3, Appendix D2.

5.0 GEODETIC PARAMETERS

All coordinates are referenced to the Geocentric Datum of Australia 1994 (GDA94) unless otherwise stated. The Global Positioning System (GPS) operates on the World Geodetic System 1984 (WGS84) datum.

The geodetic parameters used for this project are listed below:

Datum		**World Geodetic System 1984 (WGS84)**
Reference Spheroid	:	World Geodetic System 1984
Semi Major Axis	:	6378137.000m
Inverse flattening	:	298.257223563
Datum		**Geocentric Datum of Australia 1994 (GDA94)**
Reference Spheroid	:	Geodetic Reference System 1980 (GRS80)
Semi Major Axis	:	6378137.000m
Inverse flattening	:	298.257222101

No transformation values were used to transform between WGS84 satellite-derived positions and GDA94. For most practical purposes WGS84 and GDA94 positions may be considered the same.

Although all coordinates in this report are quoted in latitude and longitude some grid coordinates may be found in observers' logs and other field data. All grid projection coordinates are referenced to the Map Grid of Australia.

Grid	**:**	**Map Grid of Australia 1994 (MGA94)**
Projection	:	Universal Transverse Mercator (UTM)
Latitude of Origin	:	0°
Central Meridian	:	111° E (UTM Zone 49 South)
Central Scale Factor	:	0.9996
False Easting	:	500000m
False Northing	:	10000000m
Units	:	Metres

6.0 VESSEL, EQUIPMENT AND PERSONNEL

6.1 Vessel

Offshore survey operations were conducted from the DOF survey vessel *Geosounder*, details of which are provided below:

Name:	*Geosounder*
Type:	Survey vessel
Owner:	DOF Subsea Pte Ltd
Flag:	Panama
Year of build:	1972
Length overall:	59.5m
Beam:	10.2m
Maximum draught:	4.1m
Speed:	11 knots

Detailed survey vessel specifications and photograph are provided in Appendix E1.

6.2 Equipment

6.2.1 Side Scan Sonar Survey Phase

Blue Water Recoveries (BWR)

- 1 x CODA DA100 sonar acquisition system

DOF Subsea

- 1 x Simrad EM300 multibeam echo-sounder
- 1 x Veripos GcGPS positioning system (primary)
- 1 x Veripos GcGPS positioning system (secondary)
- 1 x Seapath dGPS positioning system and altitude sensor
- 1 x TSS DMS-305 motion sensor
- 1 x Anshultz gyro-compass
- 1 x QINSy navigation software

Williamson & Associates (W&A)

- 1 x SM-30 (30 kHz) deep-tow side scan sonar towfish with integrated sub-bottom profiler
- 1 x AMS-60 (60 kHz) swath bathymetric deep-tow side scan sonar towfish with integrated sub-bottom profiler
- 1 x Dynacon deep oceanographic winch c/w 10,000m of marine co-axial tow cable
- 1 x B1 deep oceanographic winch with 9,500m of marine co-axial tow cable
- 2 x 2000lb depressors
- 2 x Sheave blocks
- 1 x Sonar towfish cable counter and tension meter
- 1 x Back deck video system

- 1 x Back deck VHF communications system
- 2 x EPC 9800 graphic recorder
- 1 x ISIS sonar acquisition and image processing system
- 1 x SonarWiz sonar acquisition and image processing system
- 1 x W&A sonar processing and mapping software
- 1 x AutoCAD package and plotter

A Navigation and Sonar Systems Integration flow diagram is presented in Appendix E2. Detailed W&A equipment specifications are provided in Appendix E3.

6.2.2 ROV Inspection Phase

DOF Navigation and Positioning

- 1 x Veripos GcGPS positioning system (primary)
- 1 x Veripos GcGPS positioning system (secondary)
- 1 x Seapath dGPS positioning system and altitude sensor
- 1 x Anshultz gyro-compass
- 1 x QINSy navigation software
- 1 x HIPAP hydro-acoustic positioning reference system (permanently installed on vessel but not contracted for this project and therefore not calibrated)

DOF ROV

- 1 x Comanche sub-Atlantic small work class remotely operated vehicle (ROV)
- 1 x 20ft top-side control container
- 1 x Gravity-based launch & recovery system (LARS)
- 1 x Winch c/w 3,200m main lift umbilical
- 1 x TMS unit c/w 300m control umbilical
- 1 x Kongsberg Mesotech MS1000/1071 scanning sonar
- 1 x Mini temperature/salinity meter
- 1 x Tritech 704-400 bathymetry unit
- 1 x Kongsberg 1007 altimeter
- 1 x Wide-angle SIT camera (supplied by BWR)
- 1 x Kongsberg digital stills camera c/w flash unit OE14-208/OE14-242
- 1 x Kongsberg broadcast camera OE14-120
- 4 x 250W lights
- 2 x NAS data storage units

Detailed DOF ROV equipment information and specifications are provided in Appendix E4.

Williamson & Associates (W&A)

- 1 x ISIS sonar acquisition and image processing system
- 1 x W&A sonar processing and mapping software
- 1 x AutoCAD package and plotter

6.3 Personnel

The following personnel were involved with the project on board the SV *Geosounder*:

6.3.1 Client Representatives

Name	Position	Date on Vessel	Date off Vessel
David Mearns	FSF Search Director	28/02/08	09/04/08
John Perryman	Commonwealth Representative (Senior Navy Historical Officer)	27/02/08	09/04/08
Robert Bruinsma	FSF Contracted Watchkeeper	27/02/08	09/04/08
Glenys McDonald	FSF Director (Observer)	27/02/08	09/04/08
Dr. M. McCarthy	Western Australian Maritime Museum (WAMM) Observer	23/03/08	09/04/08

6.3.2 Williamsons & Associates Survey Personnel

Name	Position	Date on Vessel	Date off Vessel
Art Wright	Sonar Party Chief	27/02/08	20/03/08
Jeff Koch	Watch Leader / Geophysicist	27/02/08	20/03/08
Brian Bunge	Watch Leader / Sonar Technician	27/02/08	09/04/08
Mike Kelly	Data Analyst / Report Manager	27/02/08	09/04/08
Phil Colvin	Sonar Operator / Technician	27/02/08	20/03/08
Bill Heather	Sonar Operator / Winch Technician	27/02/08	20/03/08
Kelly Curtis	Data Processor	27/02/08	20/03/08
Carter Le	Sonar Operator / Engineer	27/02/08	20/03/08

Note: Date on vessel 27/02/08 for above corresponds to start of project date, while date off vessel 09/04/08 corresponds to end of project date.

6.3.2 DOF Survey Personnel

Name	Position	Date on Vessel	Date off Vessel
Nigel Meikle	Senior Surveyor	27/02/08	09/04/08
Stephen Bagnell	Survey Technician	27/02/08	21/03/08
Johannes Van Rooyen	Survey Technician	21/03/08	09/04/08

6.3.3 DOF ROV Personnel

Name	Position	Date on Vessel	Date off Vessel
Simon Hall	Senior ROV Technician	20/03/08	09/04/08
David Norton	Senior ROV Technician	20/03/08	09/04/08
Dean Glazebrook	ROV Technician	20/03/08	09/04/08
Brett Murray	ROV Technician	20/03/08	09/04/08
Phillip Grennan	ROV Technician	20/03/08	28/03/08
Stephen Linney	ROV Technician	20/03/08	28/03/08
Kaamil Douglas	ROV Technician	21/03/08	09/04/08
Mick Stokes	Senior ROV Technician	28/03/08	29/03/08
Peter Joel	ROV Technician	28/03/08	29/03/08
Peter Skinner	ROV Technician	28/03/08	09/04/08
Bruce Burman	ROV Technician	29/03/08	09/04/08

Note: Date off vessel 09/04/08 for above corresponds to end of project date.

6.3.5 DOF Vessel Crew – Sonar Survey Phase

Name	Position	Date on Vessel	Date off Vessel
Charles Blair Cliff	Master	27/02/08	21/03/08
Rupert Saville	Chief Officer	27/02/08	21/03/08
Graham Cann	2nd Mate	27/02/08	21/03/08
Patrick Wildermoth	Chief Engineer	27/02/08	21/03/08
Sydney Villanueva	2nd Engineer	27/02/08	09/04/08
Howard Sarmiento	3rd Engineer	27/02/08	09/04/08
Nelson Largo	Motorman	27/02/08	09/04/08
Graeme Luckie	Electrician	27/02/08	21/03/08
Dennis Hicks	Integrated Rating	27/02/08	21/03/08
Luke Harris	Integrated Rating	27/02/08	21/03/08
Louis Jacomos	Integrated Rating	27/02/08	21/03/08
Peter Morgan	Cook	28/02/08	21/03/08
Joseph Larsen	Cook	27/02/08	21/03/08
Ashley Kelly	Steward	27/02/08	21/03/08

Note: Date on vessel 27/02/08 for above corresponds to start of project date, while date off vessel 09/04/08 corresponds to end of project date.

6.3.6 DOF Vessel Crew – ROV Inspection Phase

Name	Position	Date on Vessel	Date off Vessel
Deland van Wieringen	Master	21/03/08	09/04/08
John Barnard	Chief Officer	21/03/08	09/04/08
Peter Sedgwick	2nd Mate	21/03/08	09/04/08
Preben Christensen	Chief Engineer	21/03/08	09/04/08
Howard Sarmiento	2nd Engineer	27/02/08	09/04/08
Sydney Villanueva	3rd Engineer	27/02/08	09/04/08
Nelson Largo	Motorman	27/02/08	09/04/08
John Spooner	Electrician	21/03/08	09/04/08
Neil Anderson	Integrated Rating	21/03/08	09/04/08
Robert McBride	Integrated Rating	21/03/08	09/04/08
Geoff Rickets	Integrated Rating	21/03/08	09/04/08
Joanne Ham	Cook	21/03/08	09/04/08
Leslie Perso	Cook	21/03/08	09/04/08
Sonia Sovor	Steward	21/03/08	09/04/08

Note: Date on vessel 27/02/08 for above corresponds to start of project date, while date off vessel 09/04/08 corresponds to end of project date.

7.0 SUMMARY OF EVENTS

7.1 Side Scan Sonar Survey Phase

Date	Event
13/02/08 to 15/02/08	Survey vessel *Geosounder* alongside in Singapore. Mobilise Williamson & Associates (W&A) deep-tow sonar winches on board vessel. Mobilise DOF's remotely operated vehicle (ROV).
15/02/08	Vessel departs Singapore for Geraldton, Western Australia (WA). W&A equipment container arrives in Fremantle, WA.
19/02/08	W&A advance party arrives in Perth, WA, to coordinate shipment of equipment to Geraldton, WA.
22/02/08	HAZID meeting held at DOF's offices in Perth.
24/02/08	Client representatives Patrick Flynn, David Mearns, John Perryman, Robert Bruinsma and Glenys McDonald arrive in Geraldton from Perth.
25/02/08	Remaining W&A sonar team from Seattle, USA, and DOF survey personnel from Perth arrive in Geraldton.
26/02/08	DOF job safety induction for all newly joining personnel. All personnel visit HMAS *Sydney* (II) Memorial in Geraldton. Survey vessel arrives alongside in Geraldton Port.
27/02/08	Commence mobilisation of W&A sonar equipment. Victuals on board vessel.
28/02/08	DOF job safety induction for recently arrived *Geosounder* crew. Continue mobilisation of W&A sonar equipment and set up survey laboratory and client office on board. Commence welding works for A-frame beam installation (for sonar sheave block). Vessel fuel bunkering completed.
29/02/08	Complete welding works and load testing of A-frame beam installation. Conduct wet test and systems checks for SM-30 and AMS-60 sonar equipment. VSAT internet system repaired and verified. Sea-fasten all equipment prior to departure for sea trials. Vessel underway when fuel leak discovered in engine room. Vessel at anchor off Geraldton to investigate fuel leak.
01/03/08	Vessel returns to Geraldton Port to carry out repairs to leaking fuel tank.

Date	Event
	Offload fuel from damaged tank.
	Set up and test AMS-60 sonar system and troubleshoot problems with the B1 winch tow cable.
02/03/08	Fuel tank repairs carried out, and tested by DNV surveyor.
	Tank refilled.
	Vessel standing by awaiting port pilot.
03/03/08	Depart Geraldton and transit to sea trials site west of the Abrolhos Islands.
	Muster drill held for all crew on board.
	Arrive on site and undertake sea trials of the SM-30 and AMS-60 sonar equipment.
	Transit to the wreck search area.
	Set up search run-line database.
04/03/08	Continue and complete transit to search area.
	Arrive on site and commence survey operations with the SM-30 sonar towfish deployed (6km swath setting).
05/03/08	Continue survey operations. (SM-30 sonar not functioning optimally)
06/03/08	Complete survey run-line and recover SM-30 towfish to determine sonar system faults.
	Complete repairs and tests to SM-30 sonar.
	Deploy SM-30 towfish and re-commence survey operations. (SM-30 sonar still not functioning optimally)
	Monitor tropical cyclone "Ophelia".
	Commence recovery of SM-30 towfish and head NE to avoid cyclone.
07/03/08	Complete recovery of SM-30 towfish and repair remaining faults.
	Vessel running NE to avoid cyclone "Ophelia" (category 1).
08/03/08	Vessel standing by waiting on weather while heading for launch point, north of site.
	Deploy SM-30 towfish and re-commence survey operations. (SM-30 sonar still not functioning optimally)
	Set up BWR CODA system to acquire and monitor sonar imagery in client office.
09/03/08	Complete survey run-line and recover SM-30 towfish to determine sonar system faults.
	Complete repairs and tests to SM-30 sonar and redeploy towfish.

Date	Event
10/03/08	Continue survey operations until termination due to systems fault. Safety meeting held, attended by all department heads. Recover SM-30 towfish and commence repairs. Vessel standing by awaiting completion of repairs prior to launch.
11/03/08	Vessel standing by awaiting completion of repairs prior to launch. Launch SM-30 towfish and re-commence survey operations. Undertake fire drill and muster.
12/03/08	Continue survey operations. *Kormoran* wreck site identified at 1730hrs AWT (0930hrs UTC).
13/03/08	Continue survey operations with search run-line extended over sonar targets identified south of the survey area. Extra run-line runs on 3km swath setting to investigate sonar targets. (Sonar targets discounted as geological outcrops)
14/03/08	Continue survey operations. Run-line Line 10 terminated to run two high resolution (1.5km and 750m swath) survey lines to investigate *Kormoran* wreck site. Commence high resolution (750m swath) search survey line to investigate possible 'battle site' location (found to be geological outcrops during the ROV inspection phase).
15/03/08	Complete high resolution (750m swath) survey line over possible battle site. Recommence survey operations with continuation of run-line Line 10 (6km swath setting) to continue search for *Sydney* wreck. Small boat transfer of fresh provisions to, and EP Pictures' videos from, vessel. (Survey operations suspended)
16/03/08	Continue survey operations. *Sydney* wreck site identified at 1103hrs AWT (0203hrs UTC). Run-line Line 12 terminated. High resolution (3km and 1.5km swath) survey lines run to investigate *Sydney* wreck site.
17/03/08	Commence and complete high resolution (750m swath) survey line over *Sydney* wreck site. Recover SM-30 sonar towfish while vessel heads for *Kormoran* wreck site to run further high resolution investigation survey lines using the AMS-60 sonar system. Vessel experiences engine problems reducing effective transit and survey speeds. Memorial service held at *Kormoran* wreck location.

Date	Event
	AMS-60 sonar towfish deployed recommencing survey operations. (AMS-60 sonar not functioning optimally)
	AMS-60 towfish recovered to carry out repairs and redeployed on completion to recommence survey operations.
18/03/08	Run high resolution (600m swath) investigation survey line parallel to hull of *Kormoran* wreck.
	Transit to *Sydney* wreck site.
	Run high resolution (600m swath) investigation survey line parallel to hull of *Sydney* wreck. AMS-60 towfish recovered on completion.
	Conduct memorial service at *Sydney* wreck location.
	Commence transit to Geraldton for demobilisation of W&A sonar equipment and personnel, mobilisation of ROV, and vessel crew change.
19/03/08	Continue transit to Geraldton.
20/03/08	Arrive alongside Geraldton Port.
	Commence demobilisation of W&A equipment and personnel.
	Commence mobilisation of DOF ROV personnel.

7.2 ROV Inspection Phase

Date	Event
21/03/08	Vessel alongside Geraldton Port.
	Continue demobilisation of W&A equipment and personnel.
	Commence systems testing of DOF ROV.
	Carry out DOF vessel crew change.
22/03/07	Alongside Geraldton Port.
	Complete demobilisation of W&A equipment and personnel.
	Continue testing of DOF ROV system and ROV personnel.
	Vessel fuel bunkering and victualling.
23/03/08 to 28/03/08	Alongside Geraldton Port continuing repairs and testing of the ROV system.
29/03/08	Alongside Geraldton Port completing repairs and wet-testing ROV.
	Depart Geraldton Port and commence transit to Abrolhos Is. for ROV sea trials.
30/03/08	Arrive at the Abrolhos Islands.
	Waiting on weather. (Cyclone "Pancho" reduced to a tropical storm from a Category 4 on 29/03/08.

Date	Event
	Fire drill and muster attended by all personnel.
	Commence transit to *Sydney* wreck site in light of poor weather conditions for ROV sea trials.
31/03/08	Continue transit to *Sydney* wreck site.
01/04/08	Arrive at *Sydney* wreck site.
	Attempt ROV sea trial dive to 500m but dive terminated due to equipment failure.
	Recover ROV and carry out repairs and tests.
	Vessel standing by waiting on weather.
02/04/08	Vessel standing by waiting on weather.
03/04/08	Vessel standing by waiting on weather.
	Commence ROV inspection of *Sydney* wreck (ROV in garage as TMS unit inoperable).
	Vessel standing by while video images are sent to shore for assessment of quality.
	Recover ROV to carry out repairs to TMS unit.
04/04/08	Complete repairs to ROV TMS unit.
	Carry out ROV inspection of *Sydney* wreck.
	ROV recovered to deck on completion of dive
05/04/08	ROV prepared for inspection dive within *Sydney* debris field NNW of wreck but dive postponed due to electrical fault while ROV on deck.
	ROV electrical fault repaired.
	ROV deployed and inspection of *Sydney* debris field commenced.
06/04/08	Continue and complete ROV inspection of *Sydney* debris field.
	Recover ROV and transit to possible battle site.
	ROV inspection of 'battle site' reveals sonar targets are rock outcrops.
	Recover ROV and transit to *Kormoran* wreck site.
	Commence ROV inspection of *Kormoran* wreck site (ROV in garage as manipulator arm is jammed in TMS).
	ROV recovered and redeployed to recommence inspection.
07/04/08	Complete ROV inspection of *Kormoran* wreck site.
	Recover ROV for return transit to *Sydney* wreck site.
	Complete final inspection of debris field and wreck. All ROV inspection work complete.

Date	Event
	Commence recovery of ROV.
08/04/08	Complete recovery of ROV and commence transit to Geraldton Port for demobilisation.
09/04/08	Arrive alongside Geraldton Port.
	Commence demobilisation of ROV equipment and personnel.
10/04/08	Complete demobilisation of ROV equipment and personnel.

For more detailed information and times of events refer to the Daily Operations Reports provided in Appendix B3 and the Chief Officer's Log Book and FSF, Online Surveyor, Sonar Party Chief and ROV Supervisor Logs provided in Appendices B6 to B9 of this report.

8.0 HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT

A hazard identification (HAZID) meeting was held at DOF's offices in Perth, WA on 22nd February 2008. The meeting was organised by DOF's Health, Safety and Environment (HSE) department and held primarily to discuss health and risk assessment of vessel mobilisation and offshore sonar operations. The meeting was attended by representatives of the FSF, DOF and W&A.

A project safety induction was held at the City of Geraldton-Greenough offices on 26th February 2008. The induction was organised by DOF's HSE department and was attended by all FSF representatives, DOF management and survey personnel and W&A sonar personnel. A number of vessel crew joining the survey vessel in Geraldton also attended. During this meeting the scope of work and project documentation was discussed, as were safety and environmental concerns related to the proposed sonar survey activities and measures to be taken to address those concerns.

A project management plan, which included an emergency response plan, was drafted by DOF's HSE department prior to the vessel departing Geraldton. This included telephone numbers for AusSAR-MRCC, Geraldton Port Authority, local police and hospitals in Carnarvon and Geraldton as well as contact telephone numbers for FSF, DOF and W&A management.

Vessel inductions for all new offshore personnel joining the vessel were undertaken on 27th and 28th February 2008. The location of the vessel's safety equipment and emergency procedures were outlined.

A pre-mobilisation job hazard analysis (JHA) for all survey personnel was conducted on 27th February 2008. JHA and toolbox meetings were conducted prior to new activities during the sonar survey and ROV inspection phases.

The ROV inspection phase commenced with the mobilisation on 21st March 2008. New vessel and survey crew attended a project safety induction at the Greenough Council Offices on the 21st March 2008 and the new personnel were also inducted onto the vessel.

By completion of the project, a total of four vessel muster and safety drills were conducted which all personnel attended. Two vessel safety meetings were held to discuss HSE issues on board and close out any safety hazards highlighted by means of a hazard observation card system. These meetings were attended by all department representatives.

A total of 14 safety hazards and HSE issues were raised and reported during the survey, as summarised in Table 8-1.

Date	Hazard
01/03/08	Container pad-eye on boat-deck on path to life rafts to be made more visible – trip hazard.
01/03/08	Ship's gang plank stowed along passageway between containers on boat-deck with ropes left untidied – trip hazard.
03/03/08	Aft deck personnel not wearing safety harness while stern barrier removed during deployment and recovery of sonar equipment – potential for man-overboard.
05/03/08	Electrical welding cable run to boat deck extends across stairwell – trip hazard.
23/03/08	Stanchion broken on ship's gangway – potential for personal injury.
24/03/08	Grab handles should be fitted in shower cubicles on main deck.
24/03/08	Acquire rubber matting for shower cubicles.

Date	Hazard
25/03/08	Ladder to boat-deck crane requires attention as ergonomic design is poor.
26/03/08	Side scuttles on main deck require new rubber seals.
29/03/08	Dry stores require improved air circulation to maintain food in good condition.
29/03/08	Bain-marie in mess requires sneeze-guard.
29/03/08	Dishwasher to be repaired as water drains onto galley floor.
29/03/08	Upright fridge in galley requires door hook to keep closed when ship rolls.
04/04/08	Escape hatch from survey laboratory to engine room jammed due to bulk-head movement during operation of starboard side A-frame.

Table 8-1 : Reported safety hazards and HSE issues.

A total of five safety incidents were recorded during the survey as summarised in Table 8-2.

Date	Incident
29/02/08	Vessel fuel leak from No. 2 tank.
03/03/08	DOF vessel electrician slipped on the aft deck and received a cut to his head that bled profusely.
15/03/08	Physical contact made during approach of small craft during boat transfer operations that led to damage of small craft and potential for personal injury.
22/03/08	Potential for personal injury and equipment failure due to incorrect wiring of ROV HMI light unit.
04/04/08	DOF ROV technician cut his finger while lifting metal grating to recover a fallen tool while carrying out maintenance to the ROV.

Table 8-2 : Reported safety incidents.

Of the five incidents highlighted above, only the fuel leak resulted in lost time, which totalled 63 hours (2.6 days). No lost time to injury (LTI) was reported during this project.

A cetacean watch was kept during all offshore operations. Dolphins were occasionally spotted during the sonar phase but no whales were sighted at any time.

The DOF Project Management Plan is provided in Appendix F1. Copies of the Safety Incident Reports are presented in Appendix F2.

9.0 DISTRIBUTION

Copies 1, 2 and 3: (Note *)

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Director Navy Ministerials and Coordination
R1-4-C070
Navy Headquarters
Department of Defence
Canberra ACT 2600
Australia

Copies 4 and 5:

Diana Jones
Acting Chief Executive Officer
Western Australian Maritime Museum
Cliff Street
Fremantle WA 6160
Australia

Note *: As requested by the Commonwealth of Australia (Navy Headquarters), one of the three copies is allocated for delivery via the Commonwealth of Australia to:-

The Ambassador – Mr Martin Lutz
The Federal Republic of Germany
119 Empire Circuit
Yarralumla ACT 2600
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Copy 6:

Mr Ted Graham
Chairman & Director
The Finding Sydney Foundation

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Mrs Glenys McDonald, AM
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