Survey of Mulberry B

By Chris Howlett

Between September 24 and October 8 an international team, led by the UK Hydrographic Office, conducted a detailed bathymetric survey of Mulberry B located off shore near Arromanches in Normandy, France.

Background

When the allies started to plan the invasion to liberate Europe during World War II, it was clear that to ensure that the necessarily massive quantities of stores and reinforcements could always be landed, a port was essential. Unfortunately the Germans also knew this and a major part of their defensive strategy was to turn all ports into fortresses that were capable of holding out until the allied invasion force exhausted its supplies and ground to a halt. The wisdom of this strategy had been confirmed when, on 19 August 1942, the Allies attempted to temporarily capture the small French port of Dieppe. Although not defended as well as the major ports, the defenders easily beat off the attack and forced the attacking force to withdraw after only 6 hours without achieving any of its major objectives. This debacle convinced the allied planners that to attempt to take a fortified port with a sea borne force would be disastrous and an alternative method had to be found.

The alternative method eventually selected was as spectacular as it was technically difficult to achieve. Instead of capturing a French port, the allied invasion force would take one with them. In fact, the allies took two ports with them, each the area of the port of Dover and composed of hundreds of prefabricated segments. They were built in Britain and then towed the 100 miles across the English Channel to Normandy where they were put together like a giant jigsaw puzzle to form the harbours. The two ports were code named Mulberry A, built off Omaha beach for use by the Americans and Mulberry B (though nicknamed Port Winston), built off Arromanches for use by the British and Canadians and, when fully operational, each was able to handle 7,000 tons of stores per day.

Both ports consisted of an outer screen of floating breakwaters called Bombardons. Fourteen of these 200 ft long cruciform-shaped steel structures were moored end to end to provide a one mile long breakwater. Inshore of these was a more permanent breakwater made from giant concrete caissons, which was termed Phoenix. Various sizes of caissons were used to suit the expected water depths, the largest being 200 ft long by 60 ft wide and 60 ft tall and weighing 6000 tons. To extend the breakwaters, block ships (code named Corncobs) were also used with about 12 ships being incorporated into each Mulberry harbour. Within the sheltered water formed by the breakwaters, steel pier heads were built connected to the land by floating roadways. Collectively the pier heads and their roads were code named Whale.

Although the American harbour (Mulberry A) was largely destroyed during the great storm of 19 – 22 June and all the Bombardons were smashed, the British harbour (Mulberry B) was repaired and operated until late November contributing greatly to the smooth supply of reinforcements and stores to the troops at the front. After November, with sufficient permanent ports captured and back in service, Mulberry B was abandoned. The metal components were largely removed for scrap or reuse while the block ships and giant concrete caissons remained as silent sentinels to their previous activity.

Regardless of whether you consider the Mulberry harbours to have been worthwhile or not, as a war time civil engineering project they are probably unsurpassed. The concept was audacious and to have designed and built sufficient prefabricated components to make two harbours, each the size of the port of Dover, in a mere nine months and then tow these 100 miles across the English Channel before constructing them in a couple of weeks on a previously empty shore, is little short of miraculous. Their existence gave the allied planners the confidence to mount the invasion and, in one fell swoop, they negated the German policy of stymieing any invasion by fortifying all significant ports.

Over time the weather took its toll and the once numerous caissons began to crumble beneath the waves. In the 1960s and 70s the French government decided that the debris from the D-Day invasion needed to be cleared and numerous salvage contracts were let. These saw many of the block ships raised or scrapped in situ, the metal feeding the smelters in Caen. Although most of the metal vanished, numerous smaller artefacts were preserved and can be viewed in the Musée des Epaves located near Port en Bessin.

In spite of the weather and the attentions of the scrap men, much of the harbour still remains and can easily be seen from the beach and cliffs near Arromanches where their presence attracts many thousands of visitors each year. Despite this, no systematic survey of the remains had ever been undertaken. SHOM, the French Hydrographic Office, conducted a survey of Mulberry B in late 1993 prior to the 50th anniversary celebrations but, although this was system-

cont'd on page 12

atic, it was carried out using single beam echo sounders with the aim of ensuring safe passage for the ships, including HMY Britannia, which were due to enter the harbour during the celebrations and did not attempt to discover all that remained or its state of preservation. In 2001 the US Navy Historical Centre led a survey of the remains of Mulberry A and other US wreckage and this survey showed what modern systems (now multibeam echo sounders) were capable of. The 2011 survey of Mulberry B, led by a team from the UK Hydrographic Office, sought to map the remains of the British harbour while also providing a platform to test new survey methods and techniques.

The Survey

The survey began on Saturday 24 September when the various parties deployed to Port en Bessin, the port chosen to berth the survey boat "Xplorer". The weather was glorious, no wind and clear sunny skies and, even more encouragingly,

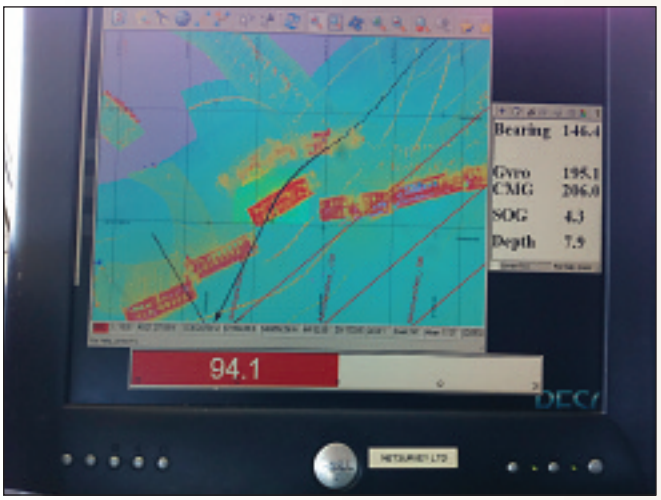
The survey boat 'Xplorer' alongside the pier in Port en Bessin. The multi beam echo sounder, now attached to the boat and in its deployed position, is checked for the accuracy of the fit.

this was set to remain for the whole first week at least.

Sunday was spent mobilising the boat – fitting the multibeam echo sounder (Reson 7125), GPS, motion sensor (Applanix POS Mv) and other equipment needed to run a modern bathymetric survey. Although this went fairly well, not all was working before gathering darkness forced the team to stop work. It had been hoped to complete the mobilisation during the day and then exit the harbour during the afternoon high tide (the ports on the Normandy coast can only be entered or exited at high water) to conduct the calibration. Unfortunately the uncooperative equipment prevented this and saw the team arrive at the boat at dawn on Monday to try and get everything working for the morning tide.

Alas, Monday's morning tide came and went with the equipment still not working, which meant that Monday's survey work had to be abandoned which left all frustrated as the perfect weather was wasted. Fortunately, by mid afternoon all was working well and the boat left port on the evening tide to conduct the calibration, returning home at about 21:30 ready for a full day's survey on Tuesday.

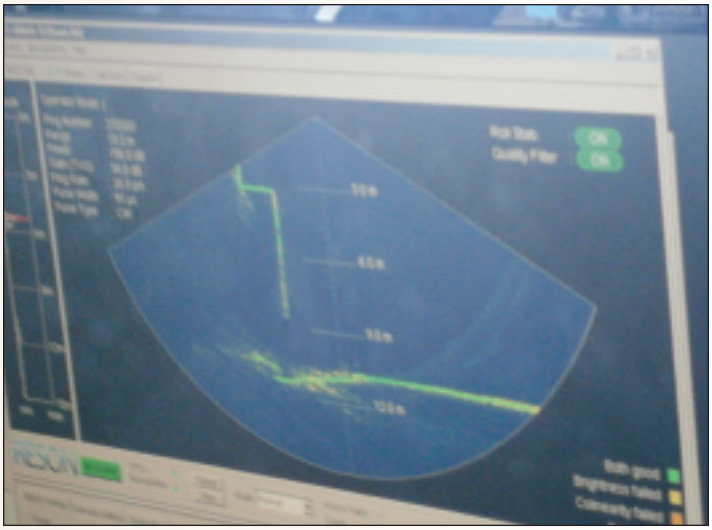
Tuesday saw the boat depart as soon as the lock gates opened and transiting to Mulberry B, where survey operations commenced. With the expectation that debris would be lying around the caissons, the first sounding line was run some 200m seaward from the caissons at the western breakwater. The multibeam maps a swath of seafloor below and either side of the vessel. This swath is approximately four times as wide as the water is deep which, in the depths found, allowed it to map the seafloor about 30 metres either side of the boat. This allowed the boat to reverse its course and run back, keeping just in the previously mapped swath and so it could advance towards the line of caissons at about 25m steps in safety. This cautious approach was quickly found to be justified as huge amounts of debris soon began to appear in the multibeam images. This debris was identi-



An image of the real-time navigation display. Colour coding is by depth (red is shallow, blue is deep) and the submerged remains of several Phoenix caissons are clearly visible (red).

fied as collapsed caissons; the jagged walls of which posed a real danger to the vessel as they rose vertically, giving no warning of their presence. As the skipper tried to follow the edge of the previous swath the surveyor kept up a commentary on what was visible in the real time display "debris appearing to port; moving nearer ship's centre line; least depth 3m. Debris across full swath, least depth 5m. Vertical wall to port 8m from boat." Although encouraging having confirmation of what was below, this was the picture under the transducer, mounted near the boat's middle and hence, if a danger existed, the bow would hit it before the multi beam ever knew! As another safeguard two people were posted to the bow to keep a lookout, although the dark waters offered little opportunity to see submerged concrete walls. This kept progress slow. However, eventually the boat was manoeuvred to within about 10m of the visible caissons allowing the multibeam to sample their vertical walls.

With the tide falling and having got as close as possible to the seaward side of the western breakwater, the boat withdrew into deeper and safer water. By now jagged concrete blocks were emerging from the falling sea which made the area a very unpleasant place to be in a boat! Off shore the survey covered the locations of the wrecks of the



The real-time sonar display showing what is being detected by the multi beam. Clearly shown is the vertical wall of a nearby caisson to port with a flat and featureless sea floor below.

Navigating close to nearly submerged caissons at low water. These caissons are the large AX type, which are 200 feet long, 60 feet wide and 60 feet high. The boat is about 20 feet off the caisson. Only the extremely calm conditions allowed the boat to be this close.

Bombardons before meandering back home across a number of charted wrecks enabling it to enter Port en Bessin when the gates were open that evening, some 14 or so hours after having left that morning.

Wednesday saw the boat again exit Port en Bessin as soon as the gates opened before making a rapid run to Mulberry B, where the multibeam head was deployed. Work continued on the landward side of the western breakwater - not much debris on the sea floor - and the western shore arm - masses of debris, one piece of which was only avoided when the bow lookout shouted "STOP!" causing the skipper to rapidly reverse the engines and back away (this manoeuvre resulted in a rebuke from the surveyor who, being unaware of the near grounding, chastised the skipper for "messing up his survey line!"). As the tide fell the boat moved away from the dangers of the caissons to survey an area around where the Whale pier heads and floating roadways would have been. This was to ensure that the area was clear of obstructions allowing a magnetometer to be towed later on in an attempt to locate any remaining kite anchors, which were used to moor the floating roadways, lying below the sand. As a precaution for future forays into the caissons, at low water, the boat's dinghy was launched allowing two people to move into the exposed caissons and map out areas of potential danger. With no portable survey equipment available, the mapping was done with a navigation 'app' on the Skipper's iPad. When darkness fell the dinghy was recovered and the boat left the harbour to continue surveying in the deeper water offshore.

Thursday saw the boat again encroach on the caissons of the eastern breakwater and extend the coverage of the western shore arm before filling in more of the area where the roadways would have been.

Friday was a disappointing day with a data logging problem forcing the survey to be abandoned after only 3 hours of surveying. It was decided to return home and get this fixed rather than spend time gathering potentially unusable data. The 3 hours did however allow a large wreck in the harbour to be covered (this turned out to be a concrete intermediate buffer pontoon) and the seaward side of the eastern breakwater to be started.

Saturday was a crew change day and also saw the arrival of a laser scanner which was fitted to the vessel to scan the above-water remains of the caissons.

Sunday allowed the new team to settle in with the boat leaving Port en Bessin at noon to survey Mulberry B with the laser. Due to an equipment failure (one of the motion sensors stopped working) the boat could not run the multibeam and laser at the same time. Hence no multibeam work was done. Upon returning to Port en Bessin the laser was used to survey the inner harbour.

Monday saw the boat leave Port en Bessin at 04:00 to catch the morning tide for a full day's survey in Mulberry B. While transiting, the laser was used to scan the coastline before additional scans were gathered over the caissons. With the laser work complete, the multibeam was deployed and work carried out at the entrance channel as well as towards the eastern end of the harbour. Rougher seas prevented any close in work to the caissons.

Tuesday was again fully utilised, although by now the

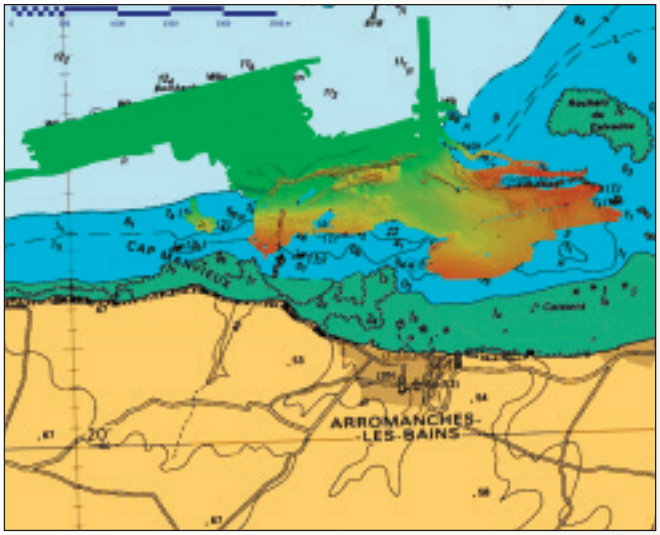
Some of the dangers that remained submerged at high tide but became exposed at low water. The vertical concrete structures and extruding rebar constituted a very real danger for the survey boat.

cont'd on page 14

excellent weather experienced during week one was failing with the increasingly rougher seas making work hard and too dangerous to approach the main caisson walls. The magnetometer was deployed around where the roadways would have been to look for possible locations for the anchors, and the multibeam was run to gather data over wrecks outside the confines of the harbour. With the weather worsening, it was decided to stop the survey early and release the boat to return home, so upon return to Port en Bessin the boat was de-mobbed allowing it to return home on the Wednesday. Although it was disappointing that the survey was ended early, the weather had become quite rough and the decision to allow the boat to leave early proved justified as it took the crew three days to return home to Falmouth. The outward journey had been accomplished in a single passage.

The data is currently being processed and it is expected that final images of the submerged debris will be available early in the New Year.

Progress was slower than originally expected due to the area being far more challenging. However, a large portion of Mulberry B was mapped to a modern standard providing a base line for the state of preservation of the remains.



Coverage diagram showing extent of the multi beam survey overlaid on a UKHO chart. The colours denote depth (red is shallow, green is deep) and the various caissons are clearly visible. This is raw data and still has much noise to be removed but shows the area covered. The large green section to the top left is the area within which the wrecks of the Bombardons lie.

Chris Howlett is the Head of the Seabed Data Centre at the UK Hydrographic Office (UKHO). While working at UKHO he has held various posts in the Geodesy section, IT, Defence, Technical Development and Marketing before heading up the Seabed Data Centre which confirms that all bathymetric survey data that arrives at UKHO is fit for purpose and hence suitable for use within the navigational charts. The Mulberry survey was a training event to enhance the Seabed Data Centre's expertise and to test new data processing methods. More information can be found at the following website: **www.mulberrysurvey.co.uk.**