

DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 1 ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)



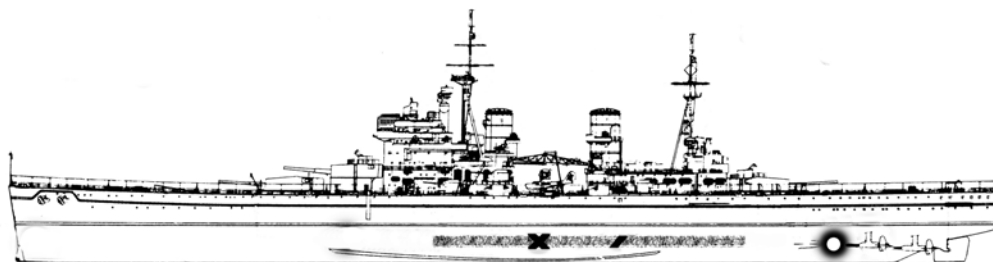
Above 3D image of HMS *Prince of Wales* courtesy Stefan Draminski.



Postcard depicting a Mitsubishi G3M 'Nell' bomber launching a torpedo at HMS *Prince of Wales*.

**ALL VIDEO IMAGES WERE TAKEN DURING EXPEDITION 'JOB 74'
IN MAY 2007, AND THIS REPORT COMPILED BY Kevin Denlay**

DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 2 ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)

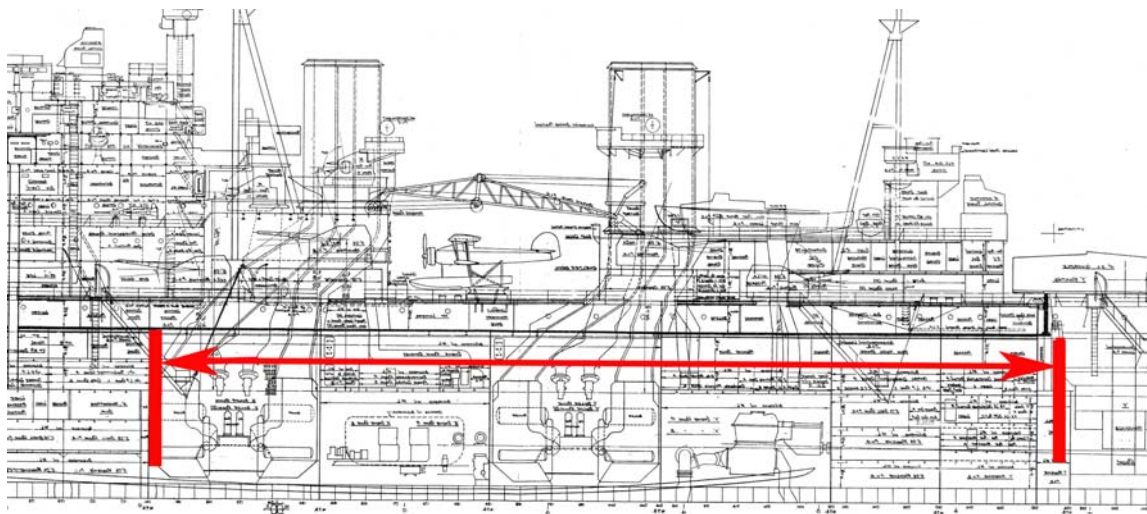


PORT HULL

The above diagram shows the *port* side of Prince of Wales. The shaded area on the hull is the area the indentation covers, which is **approximately 70m/230ft** in length.

The position above marked with an 'X' is where it is deepest (that is, where hull is pushed *inwards* the most from the bottom edge of the amour belt) and there is *some* crumpling of the hull here, but no 'penetration' as it were. The position marked with a slash '/' is also where there is some *slight* crumpling of the hull, but again, no penetration.

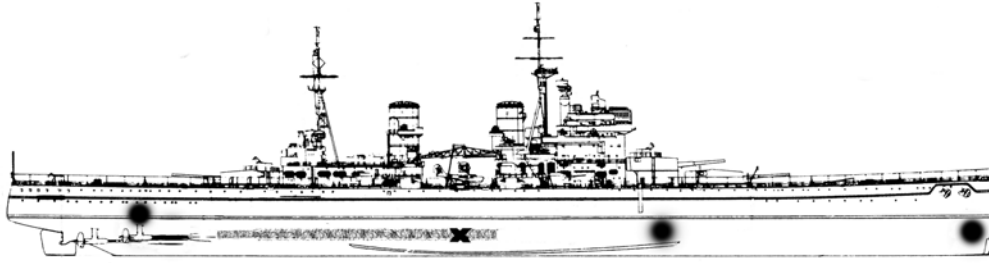
If you can envision the shape of the indentation (see schematic and illustration on page 4), it 'bows in' from well forward of the X to be widest/deepest at point X before gradually blending back into the normal hull shape about *halfway* between bilge keel end and where outer prop shaft exits the hull at the stern tube gland.



PLEASE NOTE: This is a *starboard* hull plan that has been '*flipped*', or rotated horizontally, as *port side* plans were unavailable, and the port hull indentation coverage area marked on it; so text will be unintelligible if enlarged onscreen. (Also note: Red arrow is drawn higher than where the actual indentation is, so if this document is enlarged the compartments inboard of where the indention is can still be discerned.) The port indentation therefore extends the length of the red arrow, from approximately Frame 140 forward to approximately Frame 255 aft; approximately 70m / 230ft in length overall. It is of note that the Side Protection System (or the internal 'sandwich' protective layers) extends from Frame 79 forward to Frame 253 aft, so basically the entire length of the indentation is along an area covered by the SPS.

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 3 ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)

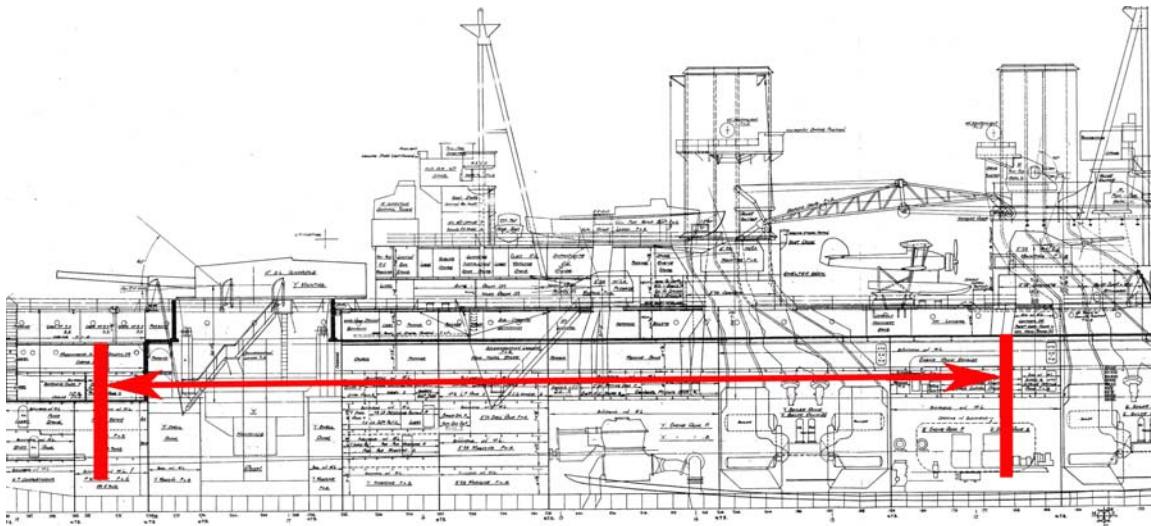


STARBOARD HULL

The above diagram shows the *starboard* side of Prince of Wales. The shaded area on the hull is the area the indentation covers, which is **approximately 65m/213ft** in length. *Pages 6 through 20 show images (from video) of this starboard side indentation.*

The position above marked with an 'X' is where it is deepest (that is, pushed inwards the most from the bottom edge of amour belt) and there is *notable* crumpling of the hull on the forward side (of the X) here, but no penetration.

If you can envision the shape of the indentation (see schematic and illustration on next page), it starts just forward of the X and bows in *immediately* to the X, which is basically the widest/deepest point, and then remains almost as wide for some distance (to past the end of the bilge keel) before gradually blending back into the normal hull shape at about where the outer prop shaft exits the hull at the stern tube gland.

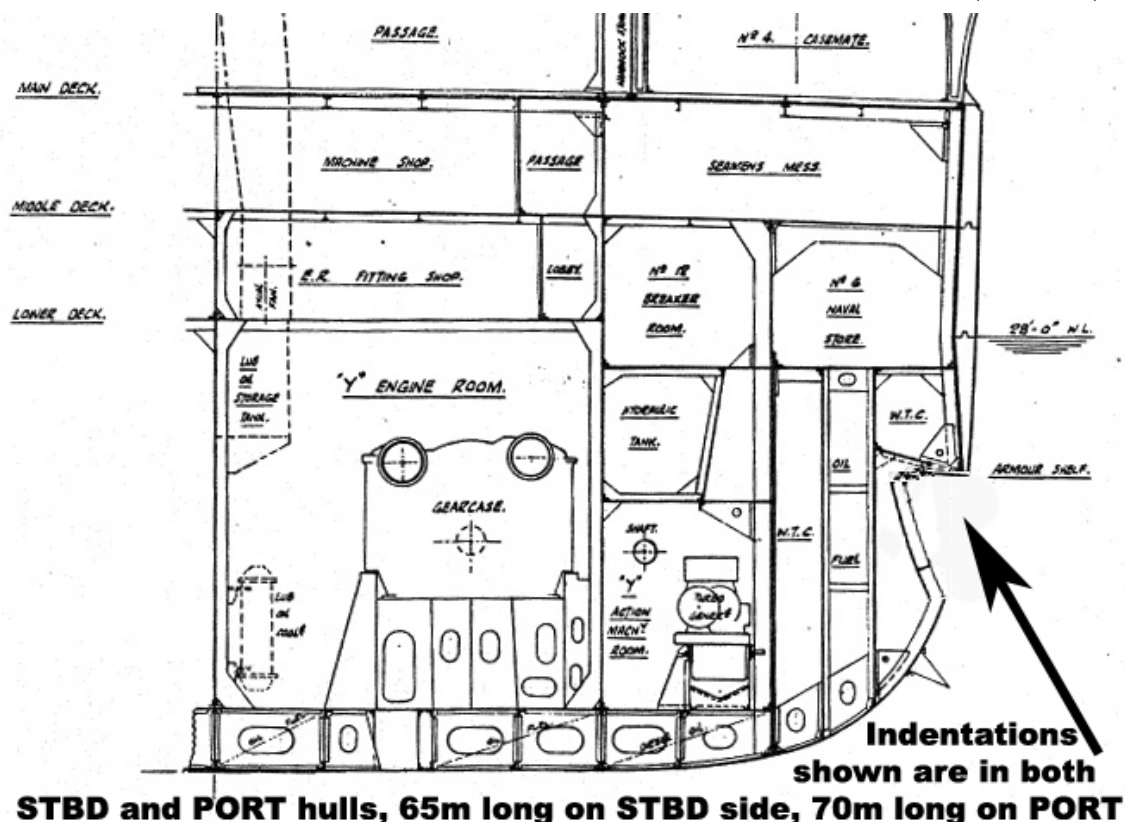


Note: The red arrow is drawn higher than where the actual indentation is, so if this document is enlarged on screen the compartments and text inboard of where the indention actually is can still clearly be discerned

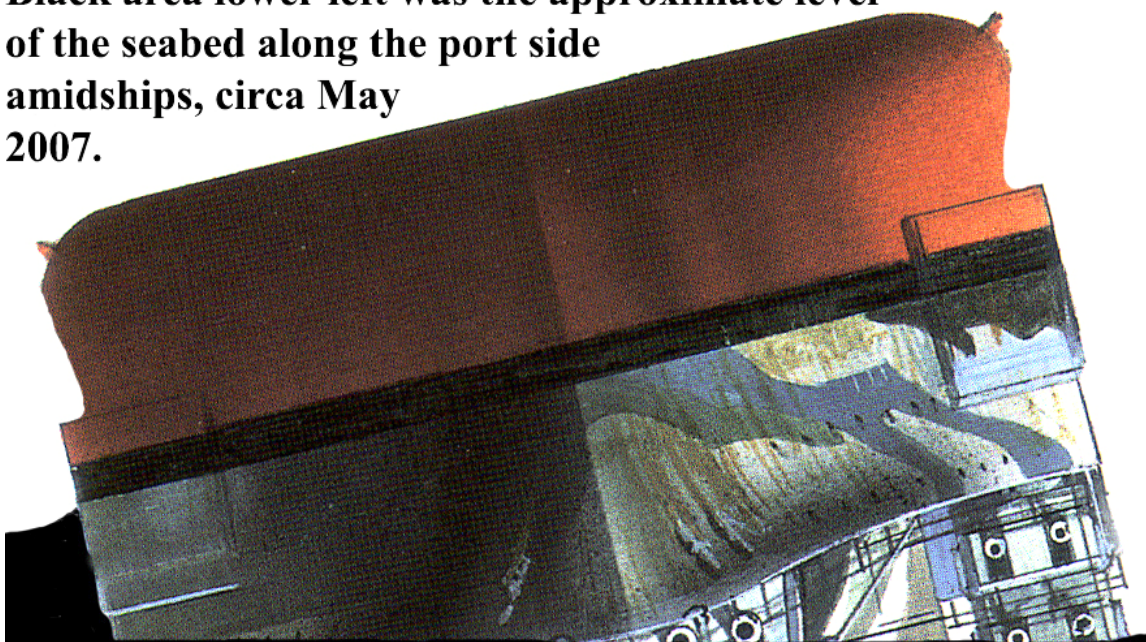
The starboard indentation extends the length of the red arrow, from approximately Frame 170 forward to approximately Frame 282 aft; approximately 65m / 213ft in length overall. *It is of note that the Side Protection System (or the internal 'sandwich' protective layers) extends from Frame 79 forward to Frame 253 aft, so three quarters of the length of the indentation is along an area covered by the SPS. Only from Frame 253 to Frame 282 is outside the SPS, but it is not the most indented or seriously damaged area anyway.*

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20) 4



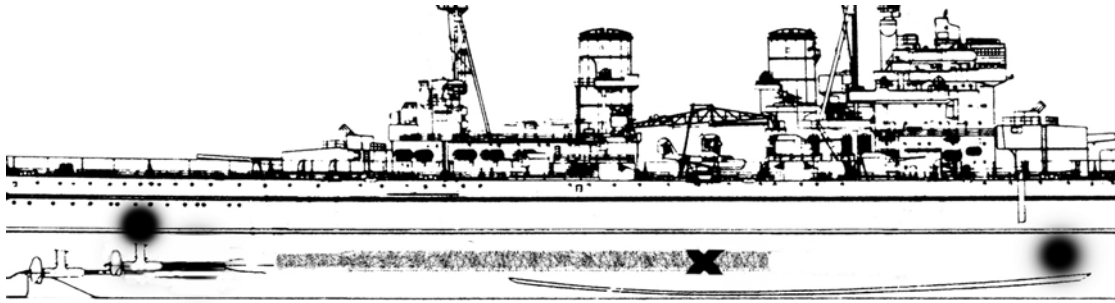
Black area lower left was the approximate level of the seabed along the port side amidships, circa May 2007.



The wreck rests upside down at an angle to port of about 15° *amidships*. The indentations previously described on either hull just below the armour belt are shaped as seen here.

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 5 ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)



STARBOARD HULL

The shaded area on the hull marks the extent of the deformation / indentation along the **starboard** hull and is **approximately 65m/213ft in length**. The black dots are where two of the three torpedoes hit on this side. (Note the height of the aft hit, which gives an indication of just how far the aft section had submerged in the forty odd minutes since the first hit aft on the port hull.) The 'X' marks where the indentation is the deepest, however it continues aft almost as deeply indented past where the bilge keel ends, before gradually reducing to 'a normal shaped hull' where the outer prop shaft exits the hull at the stern tube gland. **(The port side hull deformation is almost identical but covers a slightly different area,** as shown on the drawing and schematic on page 2; *however no images of the port side indentation are shown in this report, as the 'lighting' of the video footage was too poor to 'pull' still images from.*) On both hulls the indentation 'begins', vertically as it were, at the *bottom* edge, or base, of the armour belt – as seen in the schematic on page 4 - where the hull plates have actually been 'sprung' at the seams.

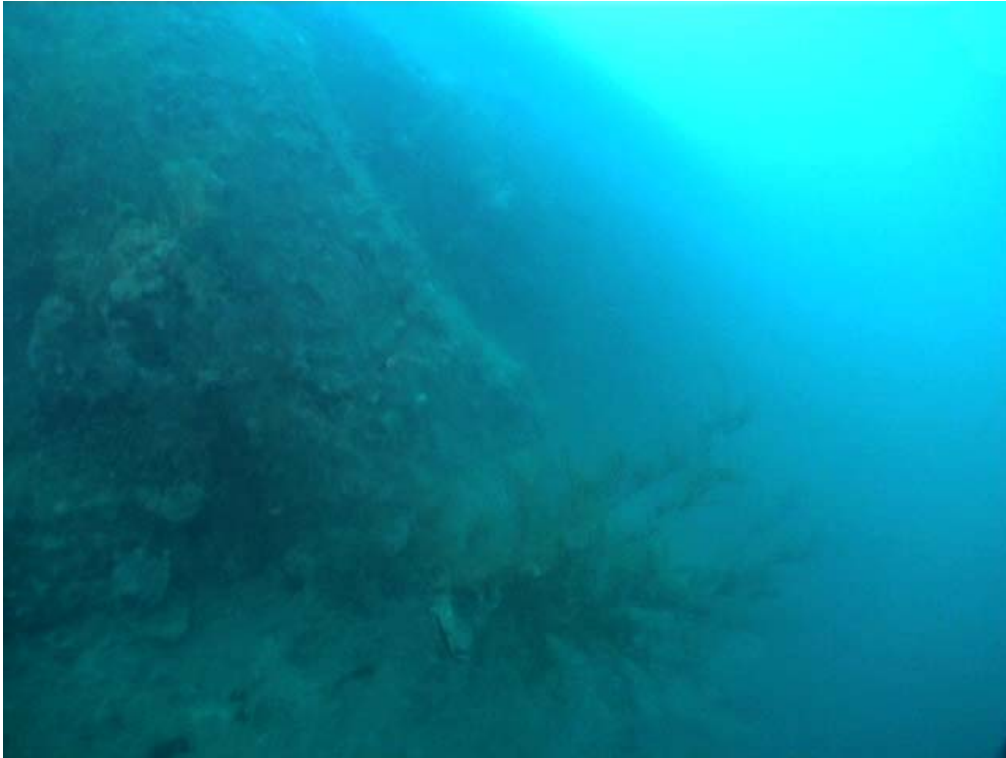
The following statistics are of note when looking at what might *appear* to be relatively minor damage (i.e. seams split along riveted plates), if compared in context to the much larger torpedo holes. However, a small hole below the water line will let in a large amount of water. *For instance, if you have a 2.5cm (1") hole, 10 meters (33ft) below the water line that hole will let in just over 437 liters (115 US gallons) of water per minute.* If you then have 10 sprung riveted hull plates each the equivalent of only a 2.5cm (1") hole, that is 4370lts (1,150 US gals) per minute, or 4370kg (9634 lbs) / 4.37 tonnes (4.3 tons) of water per minute. A hundred such hull 'holes' equals 43.7 tonnes (43 tons) per minute; *or 2622 tonnes (2580 tons) per hour!*

As stated previously, the Side Protection System extends from Frame 79 forward to Frame 253 aft; so only from Frame 253 to Frame 282 is outside the area covered by the starboard SPS - and not as extensively damaged (while only two frames are 'outside' port SPS). What effect then did these extended hull deformations / split seams over the SPS have on, or contribute to, the overall flooding? We know the starboard side SPS had been intentionally counter-flooded early in the action, to help counteract the 11.5° list to port, but the effect of the port SPS flooding is somewhat of an unknown factor. The severity of its flooding (in relation to other compartments) would depend entirely on the extent of the damage to the internal sandwich layers of the SPS, but what of the effect on the stability of the ship; especially if the port SPS flooded late in the action from the near miss bombs.

Note: *The images ('pulled' from video) on the following pages are in sequence and begin at the forward edge of the shaded area on the above diagram, and continue gradually aft along the starboard hull. The first image in the series / sequence is therefore taken looking aft from just below the fore funnel.*

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 6
ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)



Looking aft along Starboard hull from, approximately, beneath the forefunnel. Note crumpling of the lower hull between armour belt and bilge keel in upper half of image.



Looking 'in' at the forward edge of the crumpling of the Lower Hull. The Starboard Bilge Keel can be seen traversing across top from upper left corner. The bottom of the Armour Belt is just *outside* the bottom of the image.

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 7
ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)



Looking forward at the crumple in the hull. The Starboard Bilge Keel can be seen across top from upper right corner. Again, the Armour Belt is just *outside* bottom edge of image.



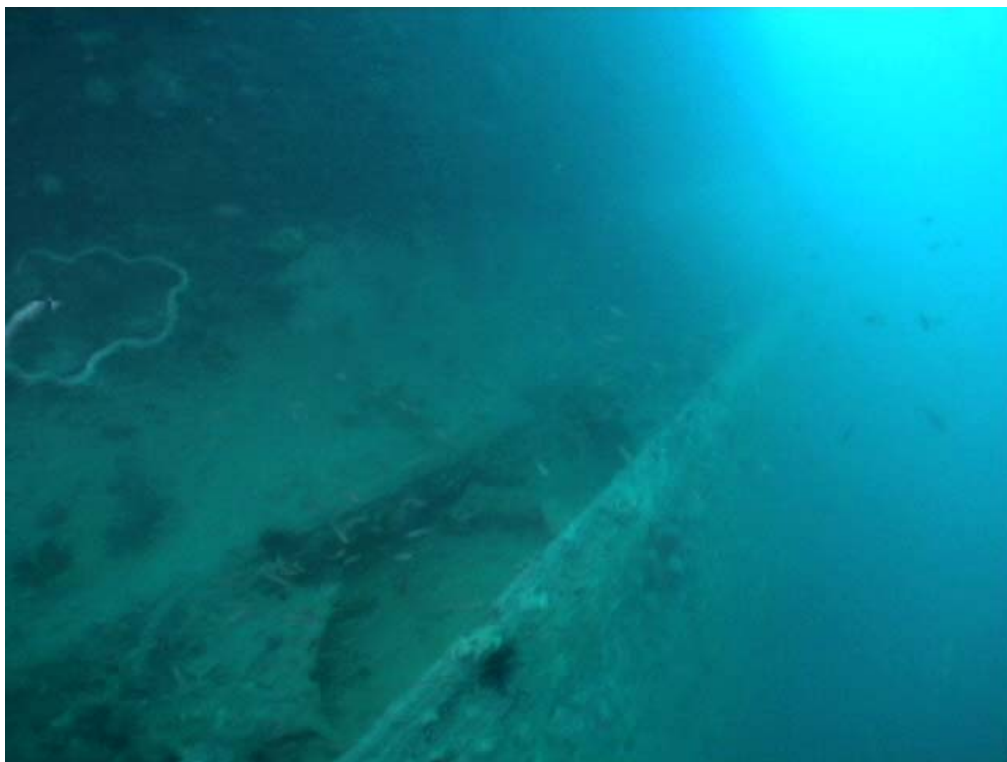
Looking 'down' and aft from the same position as above. The beginning of where the Hull Plate begins cracking away from the base of the Armour Belt can be seen. Bottom of Armour Belt is at right and Lower Hull is indented in to the left.

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 8
ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)



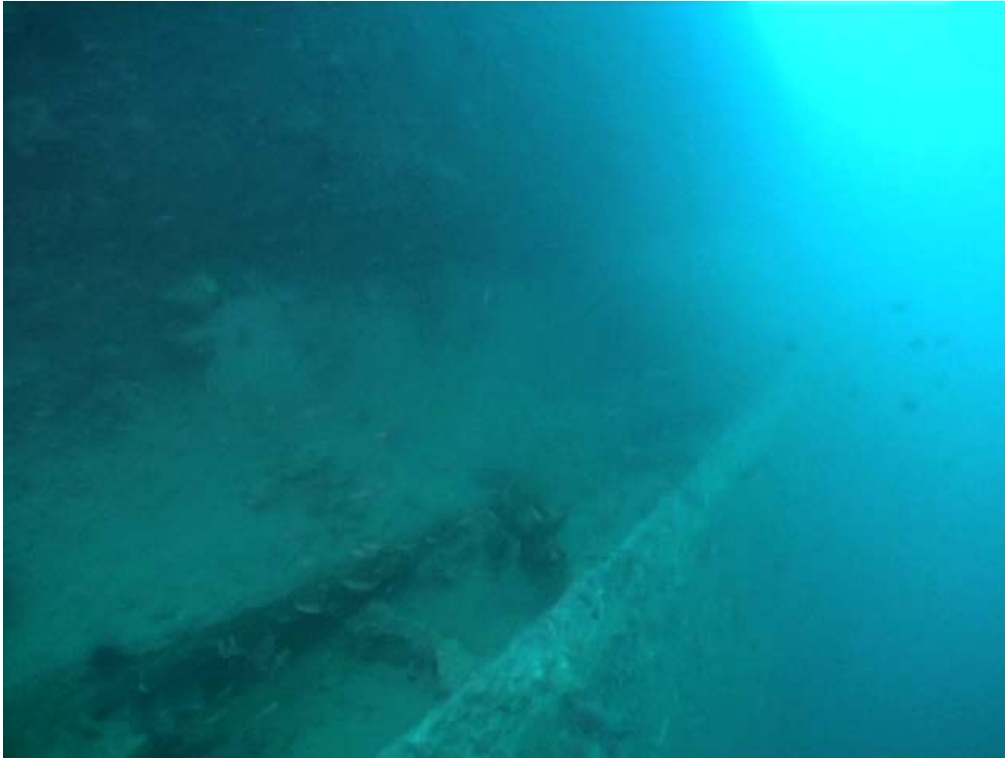
Continuing aft the indentation or 'step' immediately gets noticeably wider.



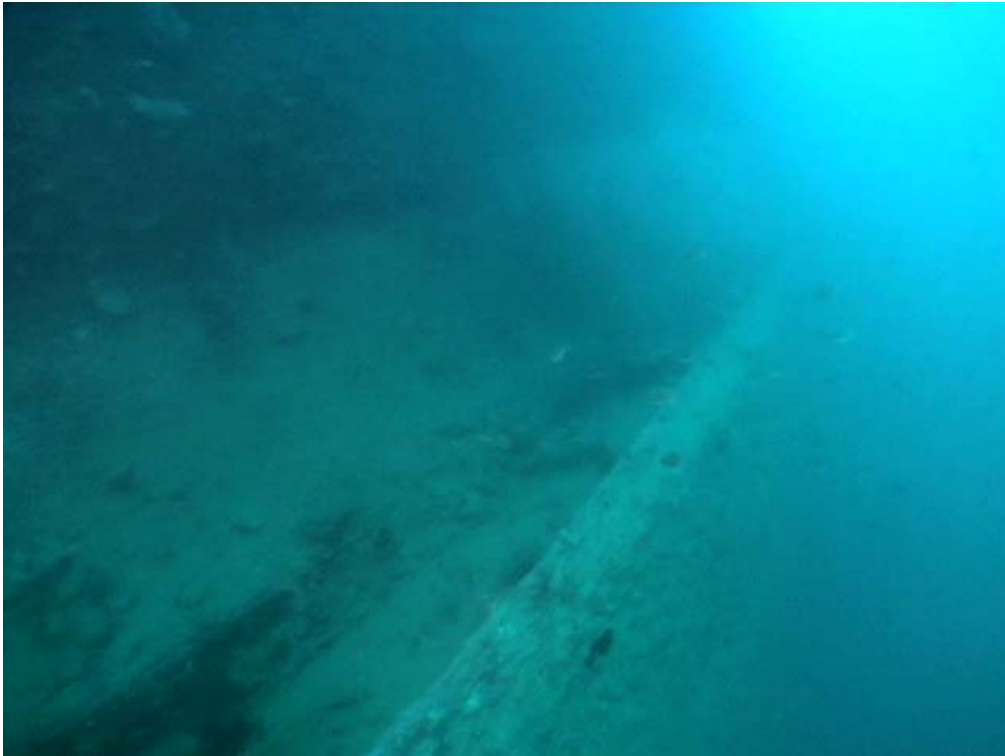
A split can now be seen to have developed under the Hull Plate (left) where it has pulled away from the Armour Belt (right).

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 9
ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)



The split continues (from lower left corner) and one starts to get a better idea of how far in the hull is indented. (Left and above is Lower Hull Plate, lower right is Armour Belt.)



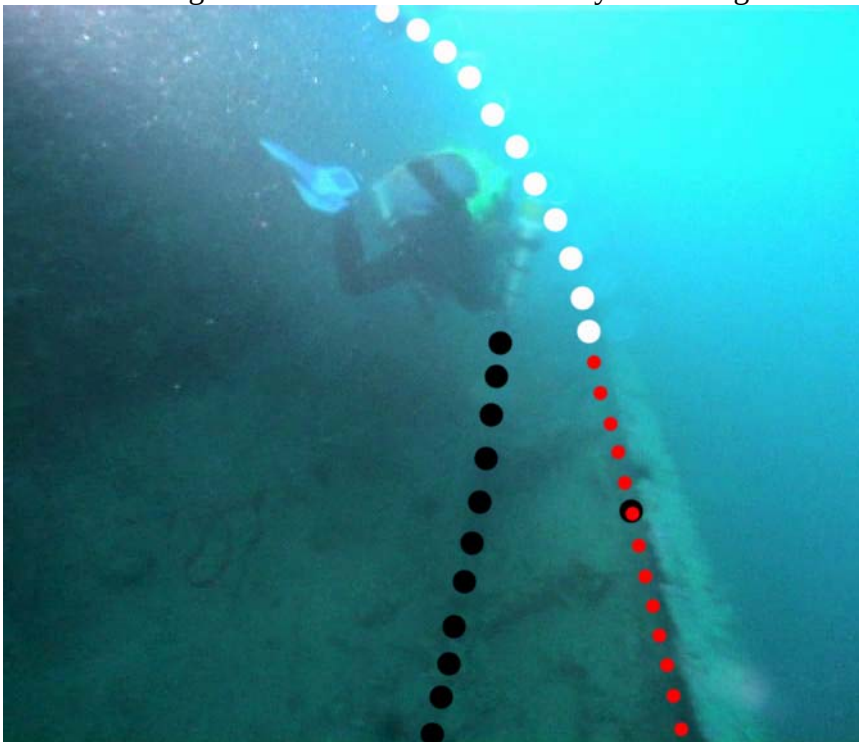
The split under the Hull Plate gradually 'closes up', temporally. The location of this image is approximately below the aft edge of the *rear* Funnel.

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 10
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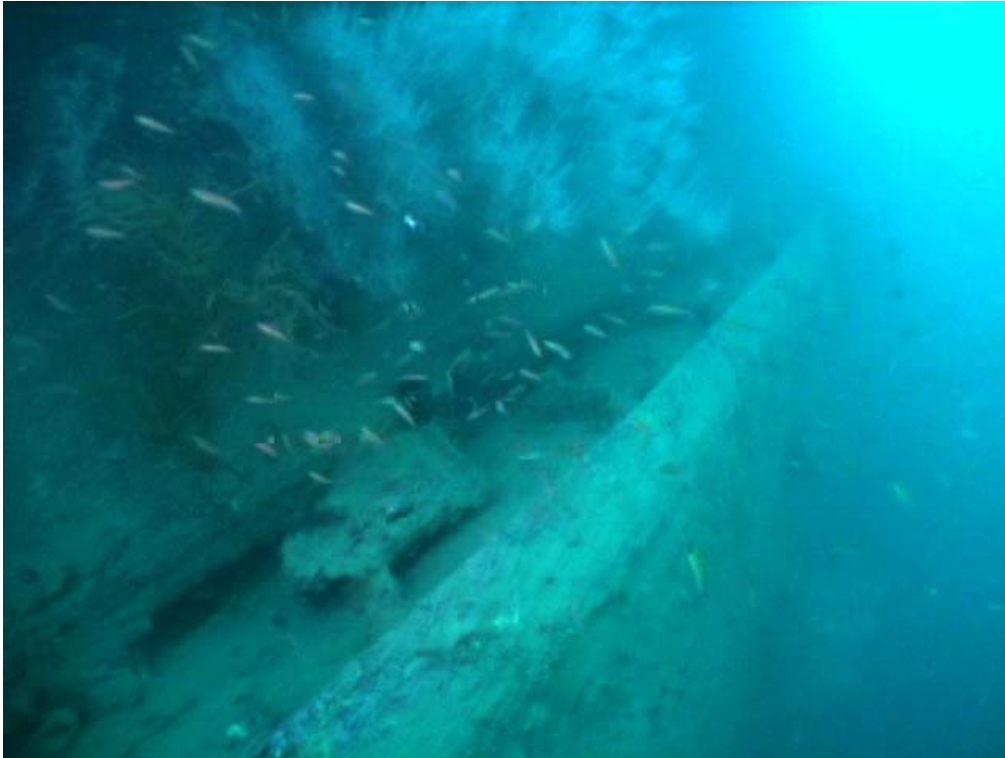
To get an idea of scale, a diver can be seen swimming along the 'step' in the exact same location as the previous photo, showing just how wide the 'step' or indentation is. Lower or 'bottom' edge of Armour Belt can be clearly seen at right.



Dotted **white line** is the convex shape the Lower Hull side curve should actually take, but Lower Hull is now concave (left); while the longitudinal edge of the Lower Hull Plate shown by the **black dots** should actually join to the **red dots** (which is the base of the Armour Belt).

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 11
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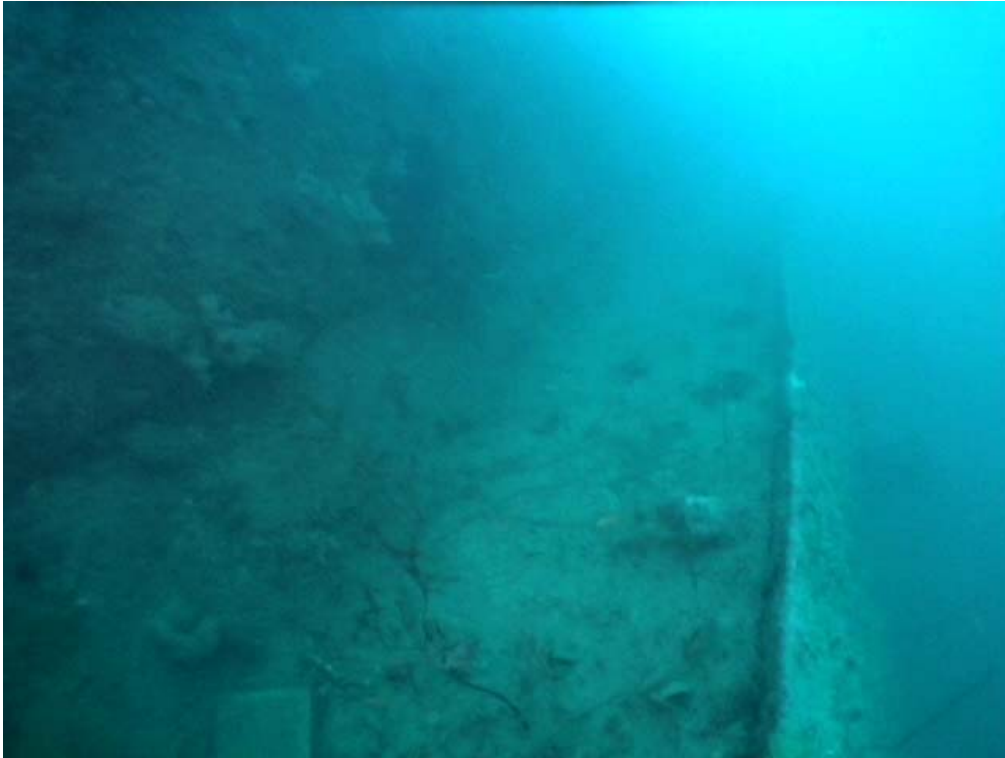


Slightly further aft, but still forward of where the Starboard Bilge Keel ends. Note that the split under the Hull Plate has again become prominent.



The split continues, but is gradually starting to 'close up'.

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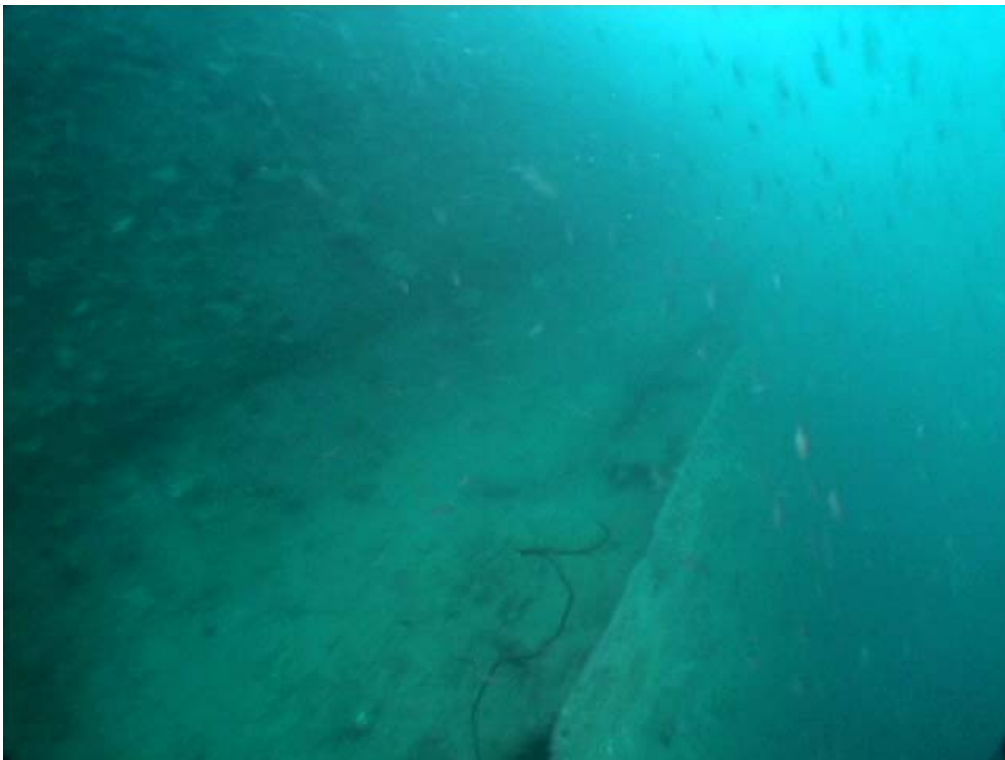
The split has 'closed' but the wide 'step', or indentation, still remains.



This image is taken directly below where the Starboard Bilge Keel ends.

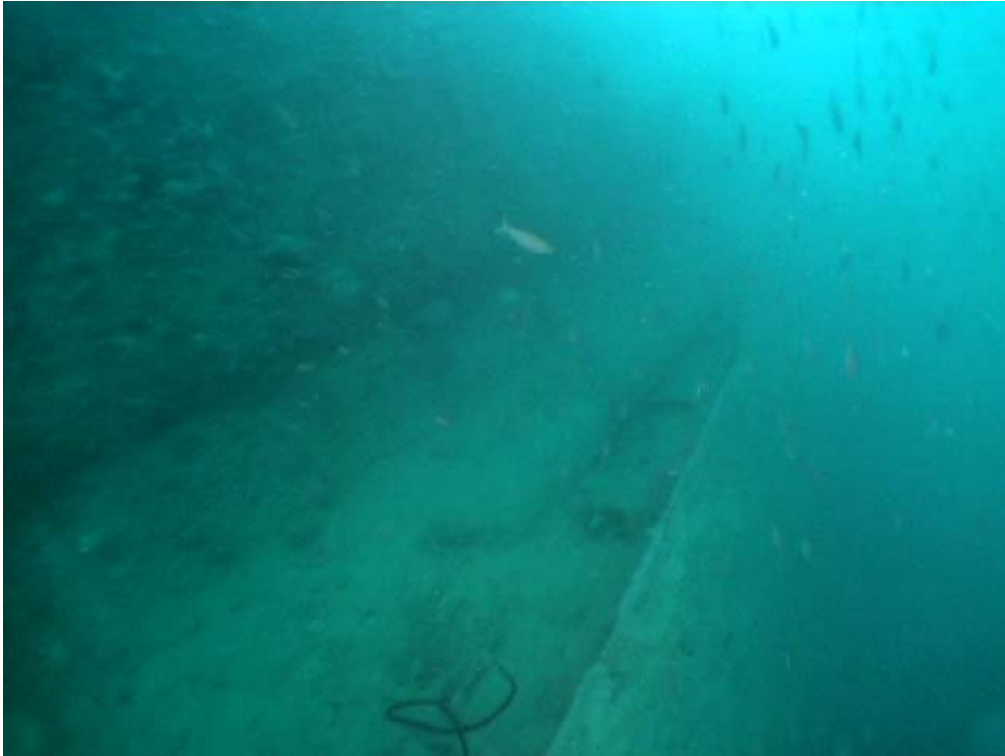


Looking up at end of Starboard Bilge Keel from where the previous image was taken.



Looking aft, the end of the Starboard Bilge Keel would be above left.

DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 14
ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)



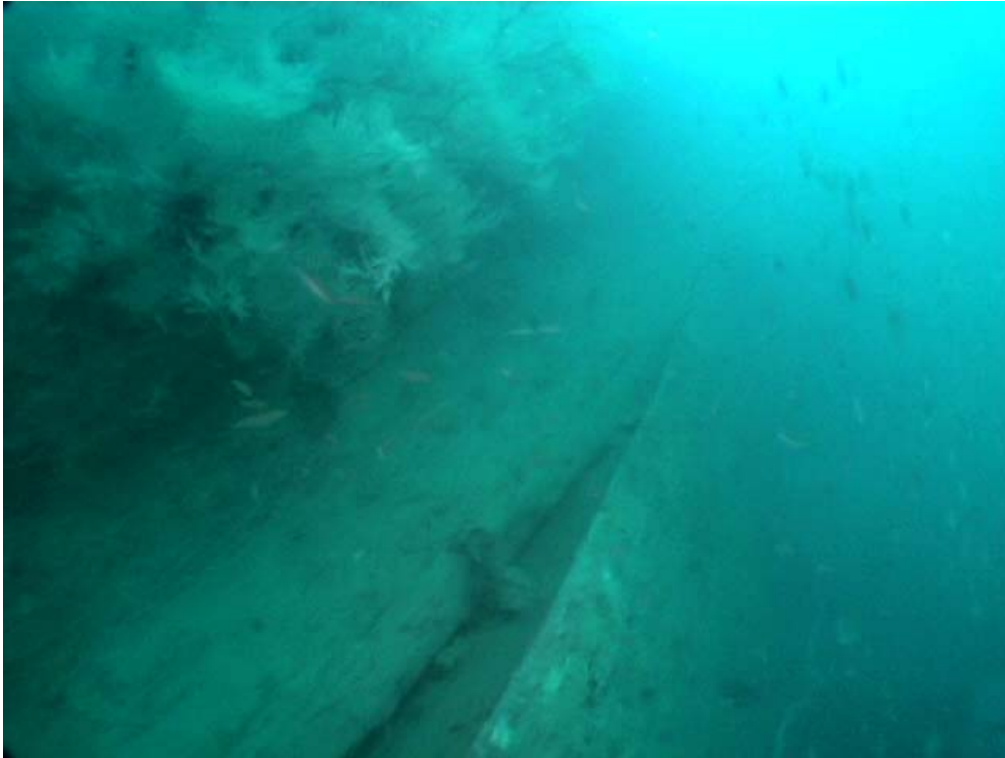
Continuing further aft the split begins to open up again, seen here in middle distance.



The split has opened up again slightly, but not as much as further forward. Step / indentation however is still quite wide.

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 15
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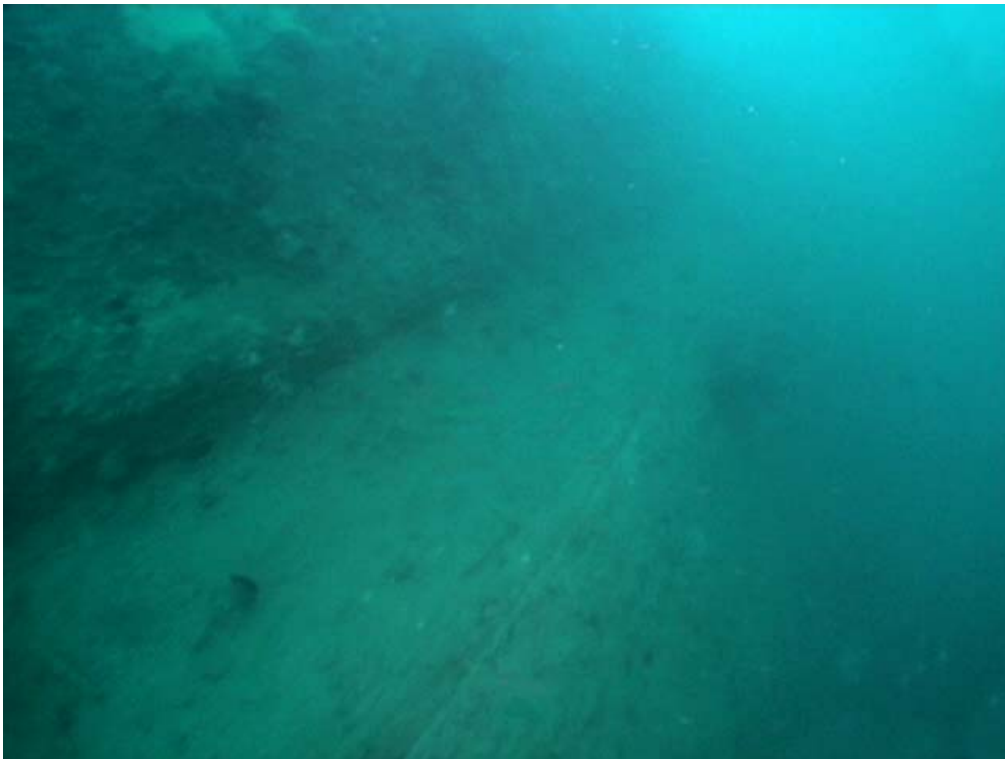
Split gradually closes up again and step / indentation begins to lessen slightly.



Split has almost closed up and indentation is gradually getting narrower (as shown over next several images).

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 16
ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)



This image is taken approximately halfway from the end of the Bilge Keel to where the outer Starboard propeller shaft exits the hull at the stern tube gland.



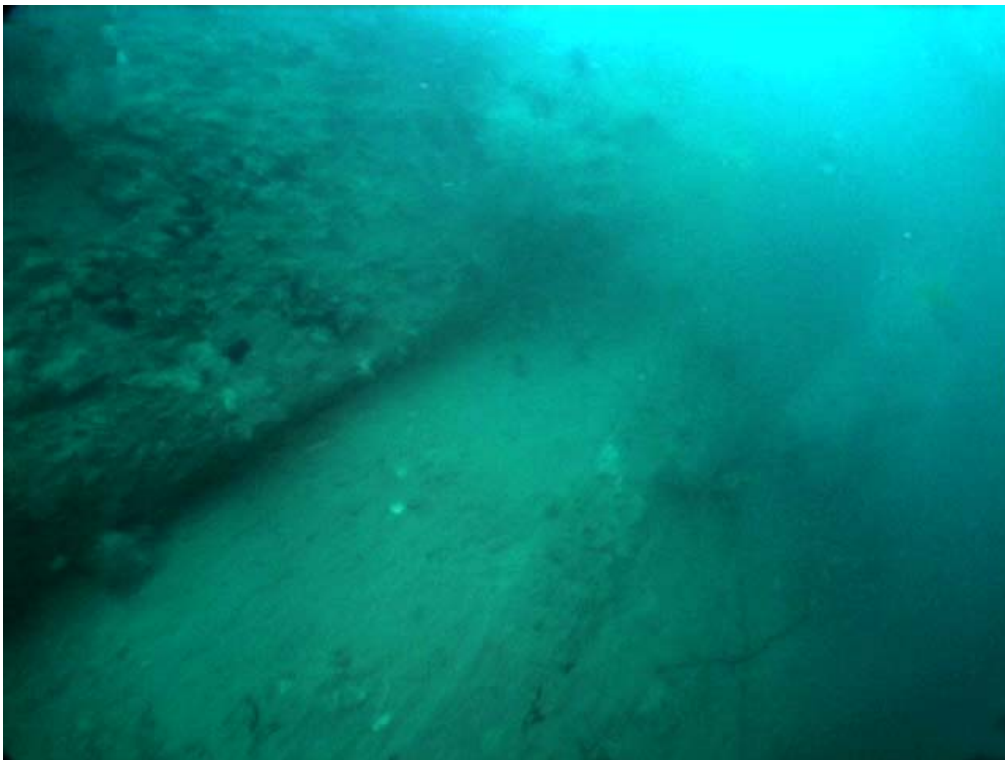
Continuing aft.

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 17
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Continuing further aft.



Continuing further aft.

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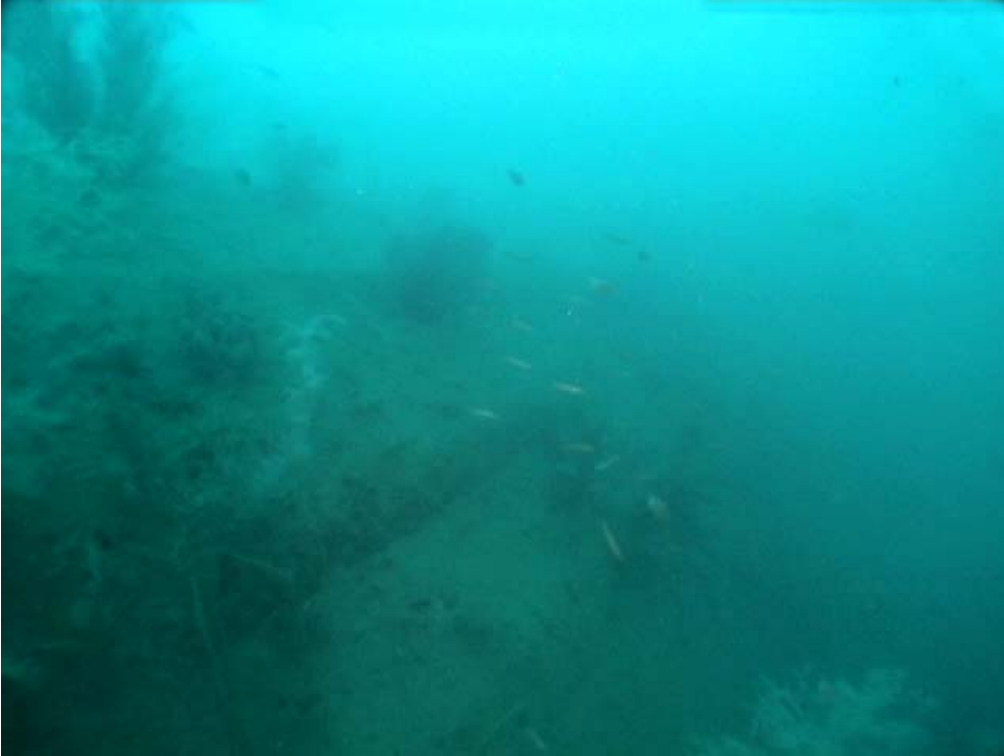


Continuing further aft.



Continuing even further aft. Actual bottom of hull can be seen curving away upper left.

DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 19
ON THE WRECK OF HMS *PRINCE OF WALES* (P1 – 20)



Slightly further aft, just forward of where outer propeller shaft exits the hull at the gland. The step or indentation has now *almost* blended back into the normal shape of the hull.



The raised shape on the hull where it covers the Starboard outer propeller shaft stern tube, just prior to the shaft exiting at the gland, can just be seen center of image running left to right. The hull is now *almost* completely back to normal shape.

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DESCRIPTION OF LOWER HULL INDENTATION DAMAGE 20
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Outer prop shaft can just be seen exiting hull at the stern tube gland lower right. Although not visible in image, the Starboard hull (lower-lower right) is back to 'normal' shape now.



Diver Propulsion Vehicle with video camera and lights 'swivel' mounted for survey work.

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