APPENDICES 5.10

Appendix 5.10.1

Recorded historical shipwrecks within and immediately adjacent to Dun Laoghaire Harbour

Shipwreck No.	Ship Name	Location	Description	NGR
W01966	Unknown	Dun Laoghaire Harbour, end of east pier	Wreck discovered by Marlin Sub Aqua Club during training dive. Wreck lies exposed on a sandy seabed beside the rocky slope of the east pier foundation in 10-12m of water. Wreck appears to extend into the seabed, with only 3m of wreck visible. Remains consist of 'a few transverse ribs and part of a keel or keelson'. Pieces of iron, including an anchor, lie scattered on the lower slope of the pier	ITM 724817.419 729690.303
W01967	Unknown	Dun Laoghaire Harbour, just inside the entrance	Unknown date: Possible wreck (INSS No. G145) identified during the National Seabed Survey. Wreck measures L.27m, W.5m with a height of 1m off the seabed. It lies in a general sea depth of 8m	ITM 691268.381 590958.352
W01736	Admiral	Dun Laoghaire Harbour - rocks near the west pier	12/05/1870: Trawler of Dublin parted from its moorings	Not available
W01738	Adventurer	Dun Laoghaire - near the coastgaurd station	18/03/1874: Brig laden with coal parted from its anchors during ENE gale. Went ashore on rocks	Not available
W01740	Aghi Apostoli	Dun Laoghaire Harbour	04/03/1858: Greek brig parted from its anchor. Unclear if vessel sank	Not available
W01743	Argyle	Dun Laoghaire Harbour	27/11/1852: Of Cork, broke adrift from anchors and sank	Not available
W01743	Argyle	Dun Laoghaire Harbour	26/12/1852: 79-ton 20 year old schooner from Cork en route from Glasgow to Waterford. Broke from moorings during SSW force 11 wind. Struck the east pier and sank	Not available
W01745	Artemis	Dun Laoghaire Harbour	04/03/1858: Greek brig, parted from its anchor. Unclear if vessel sank	Not available

W01746	Aurora	Dun Laoghaire, east pier	04/12/1823: Sloop of Carnarvon, moored in ballast Anchor broke at shank during hurricane, vessel driven onto the pier, sank	Not available
W01747	Badger	Dun Laoghaire Harbour	29/12/1861: The Leda, steamer en route from Dublin to London, ran into and sank the Badger (Revenue cutter). Crew saved	Not available
W01749	Betsey/Betsy	Dun Laoghaire, outside the eastern pier entrance	13/08/1829: Schooner of Dundalk encountered severe storm, driven towards Bullock harbour. Too dangerous to enter harbour, attempted to reach Dun Laoghaire Harbour. Mast, rudder broke away, vessel struck against east pier and was dashed to pieces. Three crew saved themselves, five drowned in total	Not available
W01751	Betties	Dun Laoghaire	Schooner of Liverpool, sank in an easterly storm	Not available
W01752	Capricorn	Dun Laoghaire Harbour	02/11/1844: Brig wrecked during a gale	Not available
W01753	Caroline	Dun Laoghaire Harbour	09/02/1861: Wrecked during a violent storm en route from Workington	Not available
W01754	Catherine	Dun Laoghaire Harbour	18/03/1844: Sloop of Newry sank	Not available
W01755	Catherine Isabella	Dun Laoghaire Harbour, west pier head	13/08/1846: Struck the west pier head entering Dun Laoghaire Harbour, sank. Crew saved	Not available
W01756	Celerius/ Celeritas	Dun Laoghaire, north side of east pier	03/12/1823: 110-ton Dutch schooner/galliot parted from anchor, forced onto east pier. Became a total wreck. Loss vessel attributed to poor state of its cables	Not available
W01757	Celt	Dun Laoghaire Harbour, alongside the quay	19/12/1883: Trawler of Dublin caught fire at its moorings, sank. No loss of life	Not available
W01759	Charles	Dun Laoghaire	27/12/1814: En route from London to Dublin. Went ashore filled with water	Not available
W01760	Charles	Dun Laoghaire Harbour	24/12/1836: En route from Liverpool to Newcastle. Parted from anchors, drifted onto	Not available

			rocks, capsized, sank	
W01761	Civil Service	Dun Laoghaire Harbour, west pier	23/12/1892: 10-ton, 2 year old wooden lifeboat. Owned by RNLI. Lost during a south-east force 8 gale en route from Dun Laoghaire to Dublin Bay	Not available
W01762	Clans	Dun Laoghaire Harbour	09/02/1861: Wrecked during a violent storm en route from Ayr to Dublin	Not available
W01763	Clyde	Dun Laoghaire Harbour, between Coal Quay and Yacht Club	09/02/1861: 100-/160-ton schooner/brigantine of Runcorn/Bideford, en route to Cork, cargo of salt. Struck against the east pier head. Crew rescued. Following day, driven off pier onto rocks, became a total wreck	Not available
W01764	Collon	Dun Laoghaire, east pier	29/01/1837: En route from Troon to Dublin. Struck the eastern pier, fell over, went to pieces. Three crew drowned	Not available
W01765	Colonel Smith	Dun Laoghaire Harbour	18/03/1844: Sloop of Carnarvon sank	Not available
W01766	Commerce	Dun Laoghaire Harbour	02/11/1844: Sank	Not available
W01767	Cynthia	Dun Laoghaire Harbour, west pier	24/02/1933: 272-ton, 41-year-old paddle-steamer. Operated as a pleasure cruiser around Dublin Bay. Broke adrift during a gale and snow storm, sank. No loss of life	Not available
W01768	Dahlia	Dun Laoghaire	18/12/1853: Smack of Newport, en route from Cork to Wicklow, collided with brig Darnley, sank almost immediately	Not available
W01769	Diligence	Dun Laoghaire	09/11/1873: The Nagpore en route from Calcutta to Liverpool ran into Kingston on fire, collided with the trawler Diligence, which subsequently became wrecked	Not available
W01770	Dolphin	Dun Laoghaire	16/11/1840: En route from Aberystwith to Ayr, driven from anchors, collided with a brig. Crew abandoned vessel. Unclear if vessel sank	Not available
W01772	Dwarf	Dun Laoghaire, east pier	03/03/1824: 203-ton, 14-year old cutter, parted from moorings in a northerly gale,	Not available

			driven against the new wall. Sank with 59 of the 60 crew saved. Payment claimed for raising the wreck though some accounts suggest vessel broke up completely	
W01773	Edith	Dun Laoghaire pier	01/02/1884: 208-ton, 13-year-old brigantine of Swansea. En route from Waterford to Ardrossan in ballast, seven crew. At anchor, parted starboard cable, went ashore on rocks. No lives lost, vessel later sold at auction	Not available
W01774	Elizabeth	Dun Laoghaire Harbour	07/01/1826: Sank en route from Cardiff to Dundalk	Not available
W01775	Elizabeth	Dun Laoghaire Harbour	30/10/1855: Schooner of Belfast, anchored in Kingstown Harbour, cargo of potatoes. Parted from anchors in a violent gale, totally wrecked on a ledge of rocks	Not available
W01776	Eliza Beynon	Dun Laoghaire Harbour	27/10/1880: 34-ton, 33-year-oldwooden ketch of Bridgewater. En route from Bridgewater to Liverpool, three crew, cargo of bricks. Stranded and totally wrecked in an ENE force 9 gale. No loss of life	Not available
W01778	Ellen	Dun Laoghaire Harbour	28/12/1821: En route from Ardrossan to Dublin. Wrecked during a violent storm, crew saved	Not available
W01780	Esperanza	Dun Laoghaire Harbour	05/10/1880: Yacht driven ashore, went to pieces	Not available
W01782	Eva	Dun Laoghaire, pier head, 0.5 mile off	30/12/1886: 33-ton, 32-year-old wooden smack of Dublin. Fishing in ballast from Ringsend. Ran down by *SS* Ulster of Dublin during thick fog, totally wrecked. Crew saved.	Not available
W01783	Express	Dun Laoghaire Harbour	12/11/1901: Schooner laden with coal. En route to new Ross. Became stranded, crew saved	Not available
W01784	Eyr	Dun Laoghaire Harbour, west pier	07/07/1834: Went ashore en route from Dram to Dublin. Vessel capsized, towed into	Not available

			Dun Laoghaire Harbour, sank	
W01785	Falcon	Dun Laoghaire Harbour	02/03/1881: 20-ton, 3-year-old wooden lugger of Peel. En route in ballast from Peel to Kinsale, seven crew. Became stranded, totally wrecked. No loss of life	Not available
W01787	Favourite	Dun Laoghaire Harbour, under coastguard station	14/02/1970: Brig of Whitehaven, laden with coal, parted from its anchor, went onto rocks. Filled with water	Not available
W01789	Flora	Dun Laoghaire Harbour, near coast-guard station	12/11/1901: Coastguard cruiser broke from mooring during a gale, ten crew on board. Driven onto rocks, became totally wrecked. Crew saved	Not available
W01791	Friends	Dun Laoghaire	26/11/1809: Of Irvine, sank en route from Belfast to Dublin	Not available
W01792	Friendship	Dun Laoghaire	07/10/1849: En route from Halifax, N. S. to Liverpool, cargo of coal. Driven ashore during an easterly gale, wrecked	Not available
W01793	Gannet	Dun Laoghaire Harbour	23-ton, 40-year-old wooden cutter of Dublin. Moored in ballast, four crew. Became stranded, totally wrecked in gale. No loss of life	Not available
W01794	Gem	Dun Laoghaire, coastguard station	13/10/1910: 15-ton, 50-year-old wooden cutter of Dublin. Moored at Dun Laoghaire, became stranded, total loss	Not available
W01796	Granuaile	Dun Laoghaire, between the yacht club and the Irish Light works	16/12/1917: 52-ton, 33-year-old wooden fishing ketch of Dublin. Anchored in the harbour in ballast, no crew on board. Broke from moorings during a gale, dashed against the harbour wall, sank	Not available
W01797	Gwendoline	Dun Laoghaire Harbour, entrance to	26/07/1892: 18-ton, 14-year-old wooden steam yacht. En route from Dun Laoghaire to Carnarvon, in ballast, three crew. Became stranded, wrecked in gale	Not available
W01799	Hannah	Dun Laoghaire Old Harbour, entrance to	05/01/1786: Sank en route from Waterford to Liverpool	Not available
W01800	Harmony	Dun Laoghaire	24/01/1838: Collier parted	Not

		Old harbour, entrance to	from anchor, driven ashore. Knocked off rudder, filled with water	available
W01801	Helen	Dun Laoghaire Harbour	09/02/1861: Ran onto rocks when entering the harbour during a storm, became wrecked	Not available
W01802	Helen Irvine	Dun Laoghaire Harbour	09/02/1861: Dragged anchors during a severe storm, broke up against quay wall	Not available
W01803	Helly	Dun Laoghaire Harbour	03/09/1931: Yacht went ashore	Not available
W01804	Hemer	Dun Laoghaire Harbour	16/03/1844: Brig of Maryport, totally wrecked in an easterly storm	Not available
W01805	Hercules	Dun Laoghaire Harbour	04/11/1844: Sank en route from Cardiff to Belfast	Not available
W01806	Hero	Dun Laoghaire, outside the pier	09/02/1827: Totally wrecked en route from Dublin to Preston	Not available
W01807	Hero	Dun Laoghaire Harbour	09/02/1861: Lost en route from Ardrossan	Not available
W01808	Homer	Dun Laoghaire Harbour	18/03/1844: Of Maryport, became wrecked	Not available
W01809	Industry	Dun Laoghaire Harbour	09/02/1861: 56-ton schooner/brig en route from Whitehaven, four crew, cargo of coal. Stranded, totally lost in NE force 10. Two/three crew perished	Not available
W01810	Industry	Dun Laoghaire, outside the pier	12/11/1915: 51-ton, 25-year-old wooden fishing cutter of Dublin. At anchor, four crew on board. Broke from moorings, became wrecked. Crew saved	Not available
W01812	Jane	Dun Laoghaire	12/02/1808: Driven ashore en route from Killough	Not available
W01813	Jane	Dun Laoghaire, coastguard station rocks	12/11/1901: Schooner of Arklow/Dublin broke from moorings during a gale, driven ashore, sank. Crew saved	Not available
W01814	Jane & Frances	Dun Laoghaire Harbour	18/03/1844: Schooner of Wexford sank	Not available
W01815	Jane & Sarah	Dun Laoghaire, old harbour	27/02/1875: Of Beaumaris, en route from Runcorn to Wicklow, cargo of coal. Parted from its anchors, ran aground	Not available
W01816	Jeannette	Dun Laoghaire, near the coastgaurd	27/10/1880: 23-ton trawler at moorings. Driven ashore, smashed on rocks during a	Not available

		station	severe gale. No crew on board	
W01817	Jessie M'Gaskin	Dun Laoghaire Harbour, beside the west pier	11/12/1863: Of Skerries, sank during severe gales. Expected to be refloated	Not available
W01819	June Rose	Dun Laoghaire Harbour	12/11/1915: 83-ton, 38-year-old schooner of Dublin. En route from Dublin to Glasgow, five crew, cargo of steel boardings. Went ashore, became a total wreck. Crew saved	Not available
W01820	King Olive/Olave	Dun Laoghaire Harbour	09/02/1861: Wrecked during a violent storm en route from Drogheda	Not available
W01821	Kitty	Dun Laoghaire	03/03/1820: Sank en route from Killala to Liverpool	Not available
W01822	Kitty	Dun Laoghaire Harbour	29/11/1830: En route from Whitehaven to Swansea/Cardiff. Parted from anchors, struck the west pier, driven ashore	Not available
W01823	Leven	Dun Laoghaire Harbour, near coast guard station	09/02/1861: Collier on Whitehaven, en route from Dundalk, ran onto rocks, broke up	Not available
W01824	Liffey	Dun Laoghaire Harbour, east pier entrance	15/03/1987: 50-ton, 21-year-old wooden smack of Dublin. Fishing in ballast from Kingstown, four crew. Lost in easterly force 2 wind. Crew saved	Not available
W01827	Lively	Dun Laoghaire Harbour	11/02/1861: Lost en route from Newry	Not available
W01829	Louisa	Dun Laoghaire, old harbour	02/03/1858: Of Dublin. Parted from its anchor. Ran onto pier, sank	Not available
W01830	Mabel	Dun Laoghaire Harbour, outside entrance	24/09/1899: 1-ton wooden lugsail. Pleasure cruising, foundered in a squall. One life lost	Not available
W01831	Mabel	Dun Laoghaire Harbour	08/10/1939: 15-ton sailing boat dragged its moorings during a gale, went adrift and sank	Not available
W01832	Manchester	Dun Laoghaire	25/02/1858: Of Liverpool, became stranded en route from Liverpool to Pembrey	Not available
W01833	Margaret	Dun Laoghaire	09/11/1873: The Nagpore en route from Calcutta to Liverpool ran into Kingstown on fire, collided with the	Not available

			schooner Margaret which sank, crew saved	
W01834	Margaret	Dun Laoghaire Harbour	03/09/1931: Yacht went ashore	Not available
W01836	Margaret Elizabeth	Dun Laoghaire Harbour near the coastguard station	12/11/1901: 88-ton, 59-year-old schooner en route from Dundalk to Liverpool, cargo of bog ore. Became stranded on rocks, may have been refloated. Crew saved	Not available
W01837	Maria	Dun Laoghaire, old harbour	20/02/1834: Ran aground en route from Limerick to Liverpool	Not available
W01839	Maria	Dun Laoghaire Harbour	27/01/1842: Of Wexford, moored in the Bay, parted from its anchor, ran ashore	Not available
W01840	Maria	Dun Laoghaire Harbour	18/03/1844: Brig of Whitehaven sank	Not available
W01841	Mariette	Dun Laoghaire Harbour, under coastguard station	21/04/1872: Of Paimboef, en route from Nantes to Londonderry, cargo of barley. Driven against the pier during a north-easterly storm and sank. Crew saved.	Not available
W01842	Mary	Dun Laoghaire	04/12/1823: Sloop loaded with stones sank at anchor during a hurricane. Loss of vessel attributed to not having covered the main hatch with a tarpauline	Not available
W01843	Mary	Dun Laoghaire Harbour	16/03/1844: Brig of Whitehaven wrecked in an easterly storm	Not available
W01846	Mary	Dun Laoghaire Harbour, outside	28/04/1869: Of Newry, sank en route from Clyde to Dublin. Cargo of coal, crew saved	Not available
W01848	Mary Ann	Dun Laoghaire Harbour	08/10/1848: En route from New York to Dublin. Anchored outside harbour, parted from anchor, driven onto pier	Not available
W01849	Mary Ann	Dun Laoghaire, abreast of the coastguard station	13/10/1910: 46-ton, 26-year-old Dublin wooden fishing smack. Anchored in ballast at Dun Laoghaire, became a total wreck	Not available
W01852	Mercator	Dun Laoghaire	12/02/1808: Driven ashore en route from Philadelphia	Not available
W01854	Milbay	Dun Laoghaire Harbour, entrance to coastguard	12/11/1901: Ketch of Plymouth, en route from Kilkeel to Newport. Cargo of	Not available

		depot	potatoes. Became stranded, driven against harbour walls. Vessel sank, total wreck. Crew saved	
W01855	Minerva	Dun Laoghaire Harbour, east pier	05/02/1824: Schooner of Liverpool, sank attempting to lift sloop Providence	Not available
W01856	Mizpah	Dun Laoghaire, under the coastguard station	16/12/1917: 50-ton, 29-year-old wooden fishing smack of Dublin. Anchored near the west pier, became wrecked, four crew saved	Not available
W01857	Molly Bawn	Dun Laoghaire Harbour	19/12/1847: 384-ton sailing vessel, en route from Liverpool to Valparaiso, struck the Kish Bank. Proceeded leaky, attempted to make for Dublin, struck the Bar, attempted to make for Dun Laoghaire Harbour. Sank entering the harbour, crew saved	Not available
W01858	Morning Star	Dun Laoghaire, hen and chicken rocks	12/03/1774: Sloop of Caernarvon ran onto rocks after firing several gun shots as signals of distress. Crew saved	Not available
W01859	Moses	Dun Laoghaire Harbour, yacht club	09/02/1861: Of Troon, en route from Whitehaven, cargo of coal. Driven against pier wall during a severe storm, sank. Crew saved	Not available
W01860	Nelly	Dun Laoghaire	28/04/1809: Of Harrington. Lost en route from Harrington	Not available
W01861	Neptune	Dun Laoghaire	18/10/1765: En route from Petersburg. Sprang a leak in Dublin Bay during a NNE gale, filled with water. Anchor cables broke, driven ashore. Hull was lost, cargo and materials were saved	Not available
W01862	Neptune	Dun Laoghaire Harbour, outside east pier	09/02/1861: 118-ton brig, en route from Workington, six crew, cargo of coal. Struck rocks in a gale. Became stranded, total loss. Five crew drowned, one survived. Six crew off the Ajax, including Captain Boyd drowned attempting to rescue the crew of the industry and the	Not available

			Neptune	
W01863	Octavius/Octopus	Dun Laoghaire	12/11/1901: 71-ton, 23-year-old wooden schooner of Bridgewater. En route from Dublin to Cardiff, five crew, cargo of burnt ore. Broke from mooring during gale. Became stranded, sank. Vessel a total loss, crew saved	Not available
W01864	Olympus	Dun Laoghaire, near	12/02/1808: Brig of New Bedford, en route from Cork to Dublin	Not available
W01865	Onyx	Dun Laoghaire Harbour, eat pier	09/02/1861: Of Falmouth, cargo of salt. Ran onto the east pier when exiting harbour. Two tugs and boats of the HMS Ajax failed to refloat the vessel. Expected to become a wreck	Not available
W01866	Pandora	Dun Laoghaire, Harbour	18/03/1844: Of Whitehaven, sank	Not available
W01871	Providence	Dun Laoghaire Harbour, east pier	94/12/1823: Sloop of Fishguard, in ballast, driven upon the pier, sank. Union (sloop) and Minerva (schooner) both sank trying to raise the Providence	Not available
W01872	Queen Bee	Dun Laoghaire Harbour, 0.5 miles north	05/09/1887: 4-ton, wooden yacht en route from Howth to Dun Laoghaire in ballast, one crew, two passengers. Collided with schooner Waterwitch of Portsmouth in gale. Totally wrecked, one passenger drowned	Not available
W01873	Quita	Dun Laoghaire Harbour	20/08/1934: Sank at its moorings during a storm, the two crew were rescued by the lighthouse-keepers	Not available
W018174	Ranger	Dun Laoghaire	09/02/1861: Wrecked during a violent storm en route from Stranraer	Not available
W01875	Raven	Dun Laoghaire Harbour	27/12/1836: Sank	Not available
W01876	Revivalist	Dun Laoghaire Harbour, entrance to	17/11/1887: 42-tn, 25-year-old wooden cutter of Dartmouth. Fishing in ballast from Ringsend, collided with SS Connaught of Dublin. Totally wrecked, no loss of life	Not available

W01878	Robert and Mary	Dun Laoghaire, outside the east pier	39-ton, 32-year-old, single-decked, single-masted smack/sloop of Dundalk/Whitehaven. En route from Whitehaven to Drogheda/Dunany, cargo of coal. Went ashore during a storm, became a total wreck	Not available
W01879	Rose in June	Dun Laoghaire Harbour, west pier	23/10/1855: Smack of Arklow, en route to Arklow, cargo of sulphur. Struck the west pier, sank immediately. Crew saved	Not available
W01880	Royal Sovereign	Dun Laoghaire Harbour, near	09/02/1861: En route from Portaferry. Wrecked during violent storm	Not available
W01881	St. Michael	Dun Laoghaire	12/02/1808: Driven ashore en route from Wexford	Not available
W01882	Sally Ann	Dun Laoghaire Harbour	21/04/1872: Of Beaumaris laden with slates. En route from Porthmadog to Londonderry, parted from its anchors, went ashore, became a total wreck. Master drowned, remainder of crew saved	Not available
W01884	Sarah Rooke/Rourke	Dun Laoghaire, new quay	12/11/1901: 51-ton, 23-year-old wooden fishing smack	Not available
W01885	Sarah Rourke	Dun Laoghaire Harbour	25/08/1891: Trawler of Dublin. Collided with the trawler Granuwaile of Dublin. The Sarah Rourke sank in the harbour	Not available
W01886	Seek	Dun Laoghaire Harbour, west pier	21/02/1892: 19-ton, 30-year-old wooden fishing lugger. En route from Port St Mary to Glandore, Co. Cork, two crew. Stranded during wind, totally lost. Crew saved.	Not available
W01888	Swallow	Dun Laoghaire	26/04/1800: Cutter of Killybegs was wrecked	Not available
W01889	Sylph	Dun Laoghaire Harbour	09/02/1861: Schooner en route from Bordeaux, wrecked during a violent storm, crew saved. Vessel may have been raised	Not available
W01890	Telegraph	Dun Laoghaire Harbour, back end of the west pier	26/01/1872: Of Newry, en route from Dundrum to Bristol, cargo of potatoes. Driven onto rocks exiting the harbour, expected to become a total	Not available

			wreck. Coast-guards stripped the vessel, saved the cargo.	
W01891	Tindal	Dun Laoghaire, chicken rocks	05/11/1774: Brig of Maryport, en route from Whitehaven, master was Martin Potts. Driven onto a reef of rocks, sank during a violent gale. Crew saved using their lifeboat	Not available
W01892	Tom	Dun Laoghaire Harbour	16/03/1844: Of Whitehaven, sank during a storm	Not available
W01893	Union	Dun Laoghaire, east pier	05/02/1824: Sloop of Aberystwith, sank while attempting to raise the sloop Providence. Schooner Minerva also sank	Not available
W01894	Victoria	Dun Laoghaire Harbour, entrance to	18/12/1853: Schooner of Cardigan, en route from Gloucester to Dublin. Sank after collision with collier William. Crew survived	Not available
W01896	Vigo	Dun Laoghaire	06/06/1910: 4-ton, unregistered wooden cutter. Moored at Dun Laoghaire, no one on board. Broke from moorings, became wrecked	Not available
W01897	Virtue	Dun Laoghaire Harbour	15/03/1856: Schooner of Cardigan run down and sunk by steamer Resolute	Not available
W01898	Wanderer	Dun Laoghaire Harbour, off	09/02/1861: 300-ton collier/brig of Swansea, en route from Whitehaven to Dublin, cargo of coal. Struck the pier, sank. Wreckage swept into the harbour	Not available
W01899	Wanderer	Dun Laoghaire	09/02/1861: Schooner of Swansea, en route from Whitehaven, became wrecked during a violent storm	Not available
W01900	Willoughby	Dun Laoghaire	31/10/1752: Lost en route from Liverpool to Cork to Jamaica, most of the crew drowned	Not available
W01903	Unknown	Dun Laoghaire	02/01/1726: Sloop en route from Skerries, lost during a storm	Not available
W01904	Unknown	Dun Laoghaire	05/10/1765: Large vessel driven ashore during a violent wind, crew saved	Not available
W01905	Unknown	Dun Laoghaire, near the quay	05/10/1773: Boat overset during a storm, one man drowned	Not available

W01908	Unknown	Dun Laoghaire	23/11/1787: Became wrecked, one body washed ashore	Not available
W01909	Unknown	Dun Laoghaire Harbour	12/01/1789: Scottish vessel laden with sugars entered Dun Laoghaire Harbour in distress. Subsequently filled with water, sank	Not available
W01910	Unknown	Dun Laoghaire Harbour	21/11/1791: Portuguese brig went ashore en route from Oporto to Dublin. Most of the cargo expected to be saved	Not available
W01911	Unknown	Dun Laoghaire, near the pier	Cumberland collier ran aground, became wrecked. Crew saved	Not available
W01913	Unknown	Dun Laoghaire, 0.75 miles from centre of entrance	Oct 1823: Stone hacker sank. Initially masthead was visible above water, danger to navigation. Dun Laoghaire Minutes Book records requests by the Harbour Commissioners to Ballast Office for removal of wreck. Not stated if vessel was removed	Not available
W01914	Unknown	'Old Dunleary Harbour'	11/10/1824: Wrecked during a gale	Not available
W01915	Unknown	'Old Dunleary Harbour'	11/10/1824: Wrecked during a gale	Not available
W01916	Unknown	Dun Laoghaire Harbour	20/08/1828: A boat became entangled in the paddle wheel of the steam packet Shamrock, entering Dun Laoghaire Harbour. Boat broke up, one man died	Not available
W01920	Unknown	Dun Laoghaire Harbour	14/08/1829: Brig en route from Maryport to Dublin, fourteen on board, cargo of coal. Wrecked near the site of the wreck of the Betsey	Not available
W01923	Unknown	Dun Laoghaire Harbour	27/12/1836: Small vessel sank	Not available
W01924	Unknown	Dun Laoghaire, near Mr Fagan's shipyard	16/03/1844: One of three brigs driven onto rocks, all became total wrecks	Not available
W01925	Unknown	Dun Laoghaire, near Mr Fagan's shipyard	16/03/1844: One of three brigs driven onto rocks, all became total wrecks	Not available
W01926	Unknown	Dun Laoghaire, near Mr Fagan's shipyard	16/03/1844: One of three brigs driven onto rocks, all became total wrecks	Not available

W01927	Unknown	Dun Laoghaire, near Mr Fagan's shipyard	16/03/1844: One of two schooners driven onto rocks, all became total wrecks	Not available
W01928	Unknown	Dun Laoghaire, near Mr Fagan's shipyard	16/03/1844: One of two schooners driven onto rocks, all became total wrecks	Not available
W01929	Unknown	Dun Laoghaire Harbour	16/03/1844: Several colliers and coasters were driven into Dun Laoghaire Harbour, soon expected to become total wrecks	Not available
W01931	Unknown	Dun Laoghaire Harbour	25/12/1852: Schooner sank during a collision with another schooner	Not available
W01932	Unknown	Dun Laoghaire Harbour, western entrance	18/12/1853: Sloop, cargo of corn, collided with brig. Sloop sank	Not available
W01933	Unknown	Dun Laoghaire, north of	03/02/1855: Timber-laden vessel went ashore	Not available
W01935	Unknown	Dun Laoghaire Harbour, near the coal quay	09/02/1861: One of two smacks wrecked during a violent storm en route from Portaferry to Dublin, cargo of potatoes. Crews saved	Not available
W01936	Unknown	Dun Laoghaire Harbour, near the coal quay	09/02/1861: One of two smacks wrecked during a violent storm en route from Portaferry to Dublin, cargo of potatoes. Crews saved	Not available
W01937	Unknown	Dun Laoghaire Harbour, outside east pier	09/02/1861: One of two vessels wrecked during a violent storm. Crews perished	Not available
W01938	Unknown	Dun Laoghaire Harbour, outside east pier	09/02/1861: One of two vessels wrecked during a violent storm. Crews perished	Not available
W01946	Unknown	Dun Laoghaire Harbour	09/02/1861: One of four small vessels wrecked during a violent storm. Cargoes of grain and potatoes	Not available
W01947	Unknown	Dun Laoghaire Harbour	09/02/1861: One of four small vessels wrecked during a violent storm. Cargoes of grain and potatoes	Not available
W01948	Unknown	Dun Laoghaire Harbour	09/02/1861: One of four small vessels wrecked during a violent storm. Cargoes of grain and potatoes	Not available
W01949	Unknown	Dun Laoghaire Harbour	09/02/1861: One of four small vessels wrecked during a violent storm. Cargoes of grain	Not available

			and potatoes	
W01955	Unknown	Dun Laoghaire Harbour, end of east pier	22/01/1900: First-class sailing trawler became stranded on rocks and was badly damaged	Not available
W01956	Unknown	Dun Laoghaire Harbour	12/11/1901: First-class vessel wrecked during a gale	Not available
W01957	Unknown	Dun Laoghaire Harbour	12/11/1901: Second-class vessel wrecked during a gale	Not available
W01958	Unknown	Dun Laoghaire Harbour	12/11/1901: Third-class vessel wrecked during a gale	Not available
W01960	Unknown	Dun Laoghaire Harbour, beside coastguard station	Pre-1908: One of three wrecks marked on a chart of Dun Laoghaire Harbour as surveyed in 1902	ITM 723991.486 729071.990
W01961	Unknown	Dun Laoghaire Harbour, beside coastguard station	Pre-1908: One of three wrecks marked on a chart of Dun Laoghaire Harbour as surveyed in 1902	ITM 723974.918 729089.247
W01962	Unknown	Dun Laoghaire Harbour, beside coastguard station	Pre-1908: One of three wrecks marked on a chart of Dun Laoghaire Harbour as surveyed in 1902	ITM 723974.918 729089.247
W01963	Unknown	Dun Laoghaire Harbour, alongside the east pier	20/08/1934: One of three yachts that sank during a gale	Not available
W01964	Unknown	Dun Laoghaire Harbour, alongside the east pier	20/08/1934: One of three yachts that sank during a gale	Not available
W01965	Unknown	Dun Laoghaire Harbour, alongside the east pier	20/08/1934: One of three yachts that sank during a gale	Not available

Appendix 5.10.2

Recorded monuments within 500m of the Proposed Development Area

RMP No.:	DU023-052001/3
Townland:	Dunleary
Parish:	Monkstown
Barony:	Rathdown
Proximity to Site:	20m north
Classification:	Site of Promontory Fort and Martello Tower
Description:	A fortified site is recorded immediately SE of the old harbour opposite the junction of Clarence St and Dunleary Road. The railway cut through the site. No visible trace. Stokes (1893) gives the position of the 'Dun' of Dun Laoghaire as to the left of the old pier. A Martello tower was built in the middle of it. Marked on Rocque's map of Co. Dublin 1765 as a circular mound on the highest peak of high ground by the harbour. This high ground has been levelled to make way for the railway c. 1834. The material from the dismantled earthwork was used to level the ground and form the foundation for the road.
Reference:	SMR file

Appendix 5.10.3

Topographical Files

Information on artefact finds from the proposed development area in Dublin has been recorded by the National Museum of Ireland since the late 18th century. Location information relating to these finds is important in establishing prehistoric and historic activity in the proposed development area.

Museum No:	NMI L1932 17, A, B, 18
Townland:	Dunleary
Find:	Two decorated stones, one with ogham script
Find place:	Found in 36A Clarinda Park West during digging a garden.
Description:	i) Small stone of granite, vaguely conical shape and triangular section. One face is damaged. One is plain and the remaining face is decorated. The decoration consists of two sets of dot-in circle motifs joined by two parallel lines. A further pair of lines project from the lower set of circles. On either side of each pair of parallel lines project a further set of lines at an angle of 45 degrees. On the damaged face are two short arcs of concentric circles. ii) A small stone of similar shape and section to the above but it has been broken in two. Two faces of the surviving fragment are decorated. On one corner is a part of an ogham-like inscription. The decoration on one face consists of concentric circles from which emerge some short wavy lines at two points. The decoration on one face consists of concentric circles from which emerge some short wavy lines at two points. The decorated face consists of an abstract layout of vaguely zig zag lines, arcs of circles and groups of strokes. The ogham is as follows: C, L (?), A (?), R, U, S.

Museum No:	NMI 1955:0108
Townland:	Dunleary
Find:	Stone Axe
Find place:	Found in 36A Clarinda Park West during digging a garden.
Description:	Stone Axe - Porcellanite

Museum No:	NMI 1955:0109
Townland:	Dunleary
Find:	Stone Axe

Find place:	Found in 36A Clarinda Park West during digging a garden.
Description:	Stone Axe - Porcellanite

Museum No:	NMI 1955:0110
Townland:	Dunleary
Find:	Stone Axe
Find place:	Found in 36A Clarinda Park West during digging a garden.
Description:	Stone Axe - Gabbro

Museum No:	NMI 1955:0111
Townland:	Dunleary
Find:	Stone Axe
Find place:	Found in 36A Clarinda Park West during digging a garden.
Description:	Stone Axe - Schist

Appendix 5.10.4

Marine Geophysical Survey Report

Geomara Ltd May 2014

Report of Geophysical Survey

Dun Laoghaire Cruise Project

At Dun Laoghaire Harbour, Co. Dublin

Licence Number: 13R73

Prepared by: Conall O'Malley and Eoghan Kieran

Date: 30/06/2014

Project No.G14017

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1 Introduction

Geomara was commissioned by Irish Archaeological Consultancy Ltd to undertake a programme of marine geophysical survey at Dun Laoghaire Harbour, Co. Dublin. The survey was carried out on 22nd May 2014 and comprised a side scan sonar, sub bottom profiler and marine magnetometer survey under licence number 13R73.

The aim of the survey was to investigate an area associated with the Dun Laoghaire Cruise Project to form part of an archaeological environmental impact assessment, designed to identify the presence of both natural and man-made obstacles and obstructions which may impede potential development in the area. The area in question comprised a sea access navigation channel, a turning circle outside of the harbour mouth and the associated channel within the harbour limits.

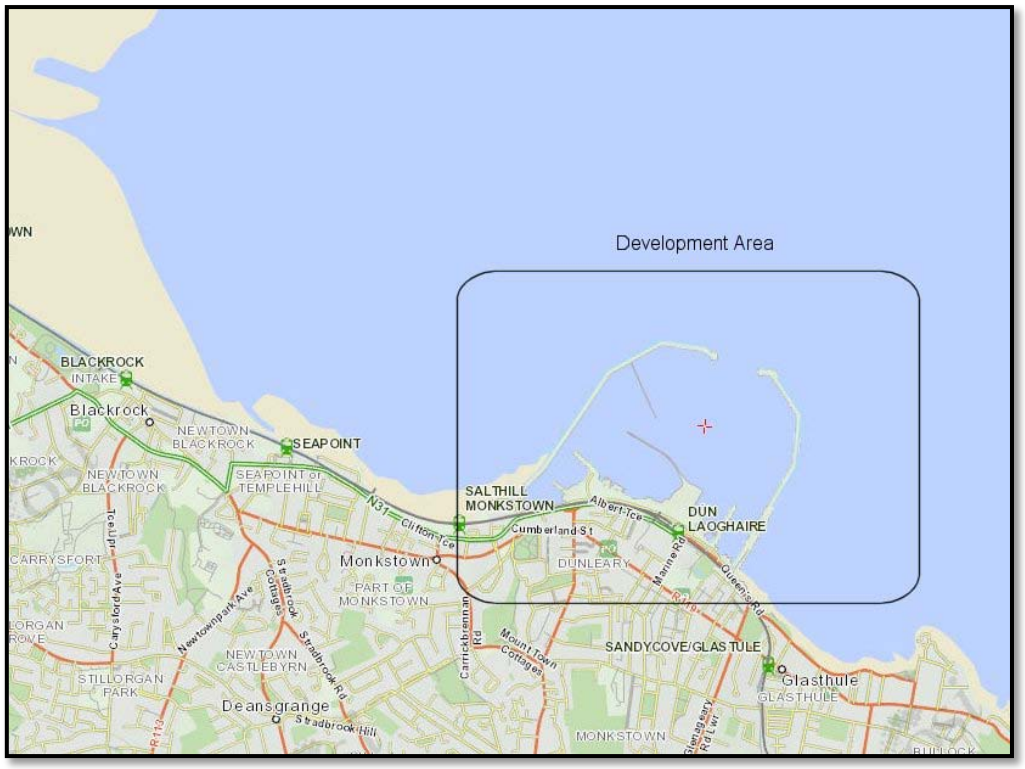


Figure 1. Development Location

2 Development Characteristics

The proposed development will consist of the removal or reuse of the current Stena Line Berth 5 at Dun Laoghaire Harbour and the construction of a new berth and mooring dolphins in that same general area which will be able to facilitate the docking of larger scale cruise ships. Associated channel dredging within the harbour will be required, along with a dredged turning circle outside of the harbour mouth; a dredged sea access navigation channel will be formed to ensure that access and egress of large scale cruise ship with the harbour can be accommodated at the various tide states. Geological investigations are required in order to precisely define the extent of the bed area to be deepened within the interior and exterior of the harbour, ie within and outside the Harbour

Limits Line, and to define relationships with existing quay structures. Strengthening of these existing quay structures could be required, including the provision of protection structures to the existing East and West Pier roundheads which form the Harbour mouth. A series of navigational aids such as mooring buoys and lights tethered to the bottom will be provided to help delineate the navigation channel limits.

It is possible that material that is dredged from the development area may be permanently deposited at sea.

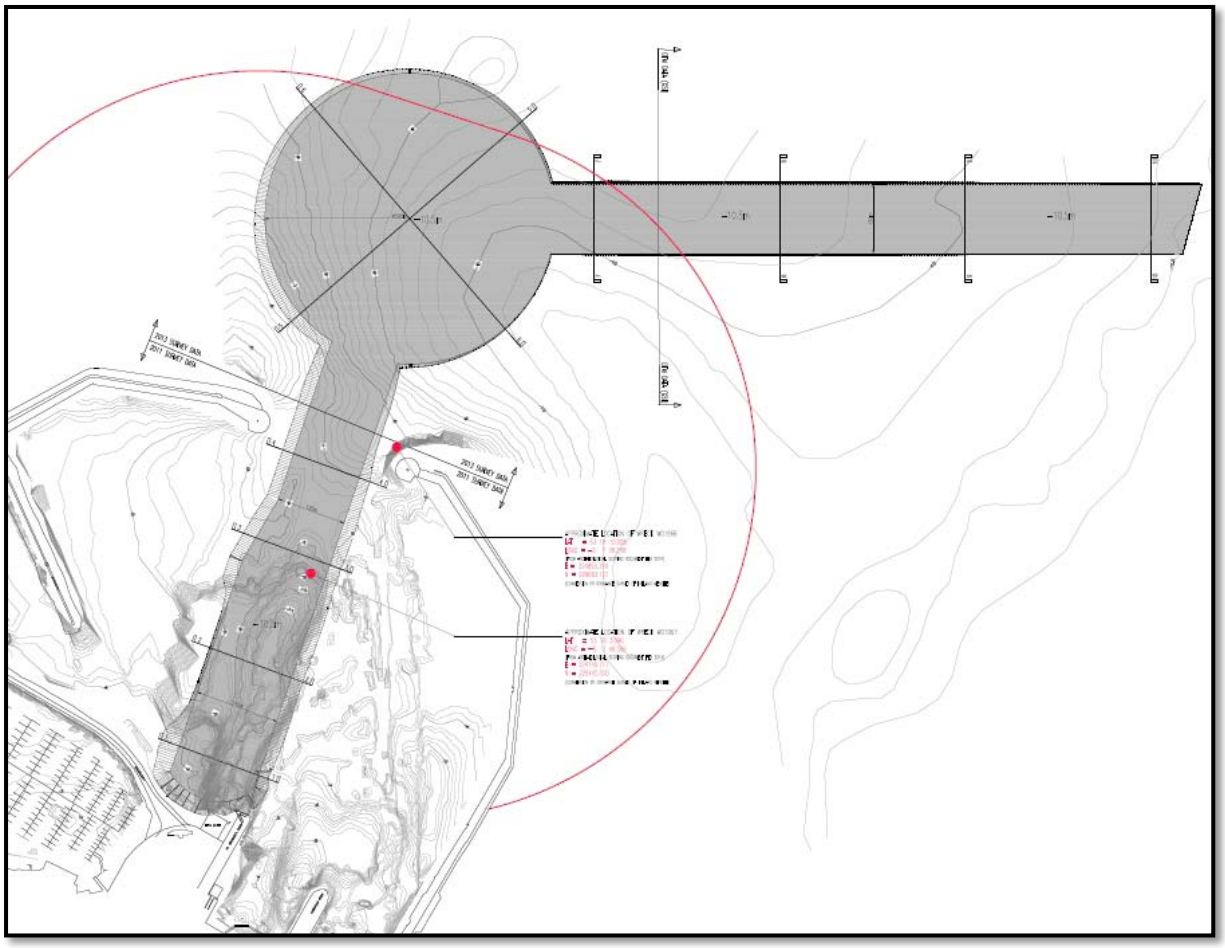


Figure 2. Development Details

3 Brief Archaeological Background

The most sensitive archaeological resource associated with the proposed development area is that of marine archaeological remains, which for the most part, consist of the wrecks of ships. There are c. 70 ships recorded as sinking in Dun Laoghaire harbour that do not have a recorded location. There are additional recorded ship wrecks in Dublin Bay, with no reference to the harbour but which may be within vicinity of turning circle and channel.

There are 18 ships recorded as sinking at the entrance to the harbour or close to the piers or heads of the piers. Locational information is not precise. There are two wrecks within the harbour that possess location references, which are either within or in close proximity to the proposed channel

and turning circle. These consist of Wreck W01966 –discovered by Marlin Sub Aqua Club in harbour entrance at 53 18 10.006 N/ 006 07 38.298 W and Wreck W01967 identified during national sea bed survey inside of harbour entrance at 53 18 03.096 N/ 06 07 46.596 W. Both potential wreck sites should be considered as key archaeological constraints.

There are no recorded archaeological sites listed within the Site and Monuments Record in proximity of the proposed development area. Furthermore, no stray archaeological artefacts have been retrieved from in or within the vicinity of the proposed development area (National Museum of Ireland: Topographical Files).

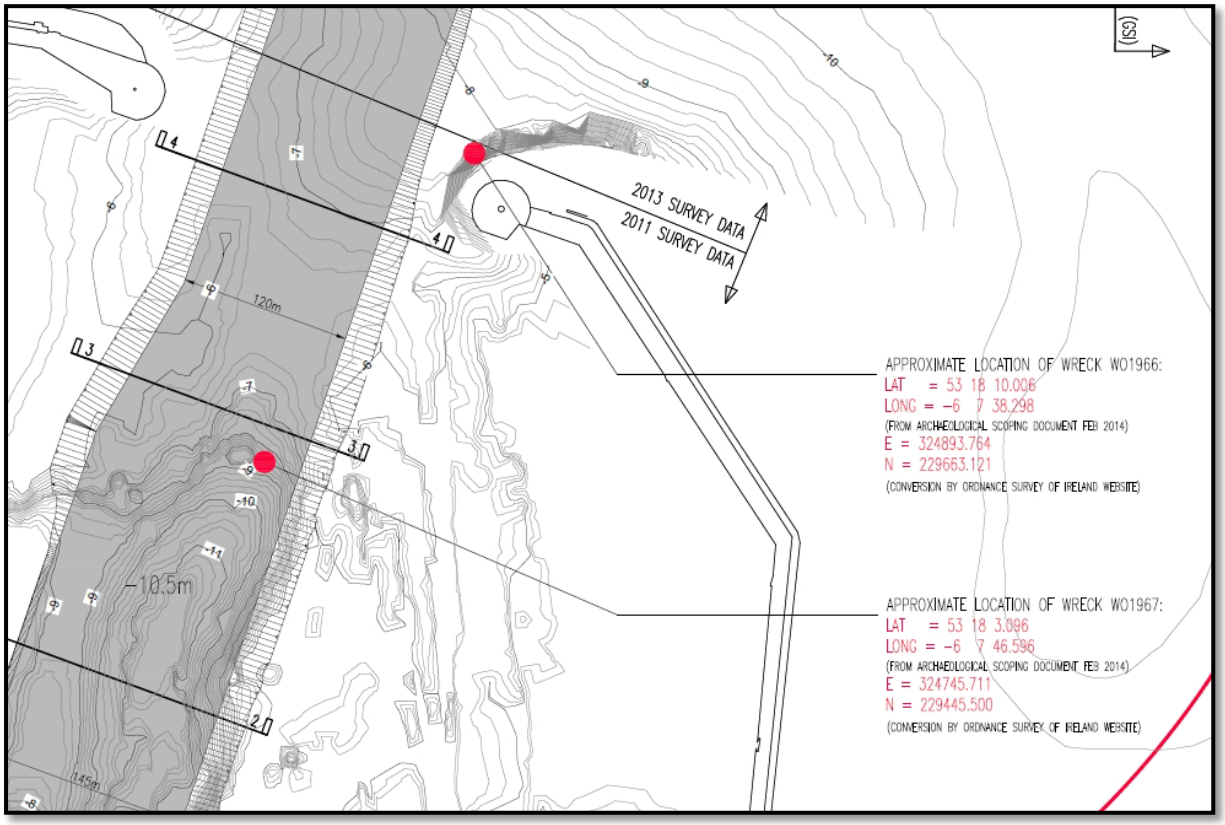


Figure 3. Known Wreck Locations

4 Geophysical Survey

The survey was carried out on 22nd May 2014 under licence number 13R73. The objective was:

1. To carry out a high resolution marine geophysical survey. This survey used marine geophysical survey techniques to investigate the seafloor for the presence of potential archaeological and cultural heritage remains.

High resolution marine geophysical equipment, namely side scan sonar, sub bottom profiler and marine magnetometer were used to survey the development area. This ensured that the specific area of seafloor to be impacted was comprehensively surveyed and that any potential cultural heritage therein would be identified.

4.1 High resolution Geophysical survey

The following techniques were used for archaeological investigation of the areas of seafloor to be impacted by the development.

- Side Scan Sonar
- Sub Bottom Profiler
- Marine Magnetometer

The marine survey was carried out in compliance with;

- The *Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish Waters and,*
- *The General Requirements for a Geophysical Survey for Archaeological Purposes*.

Equipment Type	Frequency	Line Spacing	Overlap
Sidescan Sonar Klein 3900	445 KHz	50m	100%
Marine Magnetometer Geometrics 882 marine magnetometer	Passive	50m	Detection sensitivity of 0.004nT
SyQwest Stratabox	3-12 kHz	50m	Vertical profile

Table 1. Equipment frequencies, line spacing and overlap

4.1.1 Side Scan Sonar

The Klein 3900 was the side scan system used for the survey. It is a full spectrum chirp dual frequency side scan sonar. It simultaneously transmits linearly swept FM pulses centred at two discrete frequencies. The two recordable frequencies were 100 and 445 kHz, all data was recorded at both 100 and 445 kHz. The normal operating range was 100m each side of the centreline. This was the optimum combination of range and resolution.

The side scan sonar images the seabed with amplitude returns dependent on the nature of the seabed sediments or objects / debris on the seafloor. It was capable of imaging small objects of less than 0.20 m and the QC geophysicist were able to map these and any changes in sediment. Full coverage in excess of 200% including the nadir of adjacent lines was required. The position of the Klein integrated sonar tow-fish was determined using a cable counter. The speed of the survey vessel did not exceed 5 Knots. Throughout the survey, the tow-fish was flown at a height above the sea floor, of approximately 10% of the range used.

Data was recorded to XTF digital format via Klein's own proprietary software Sonar Pro. The digital data could then be played back on board the vessel for QC purposes, on completion of data acquisition. All the data are transmitted to the surface on Klein TPU digital link via an Ethernet tow cable.

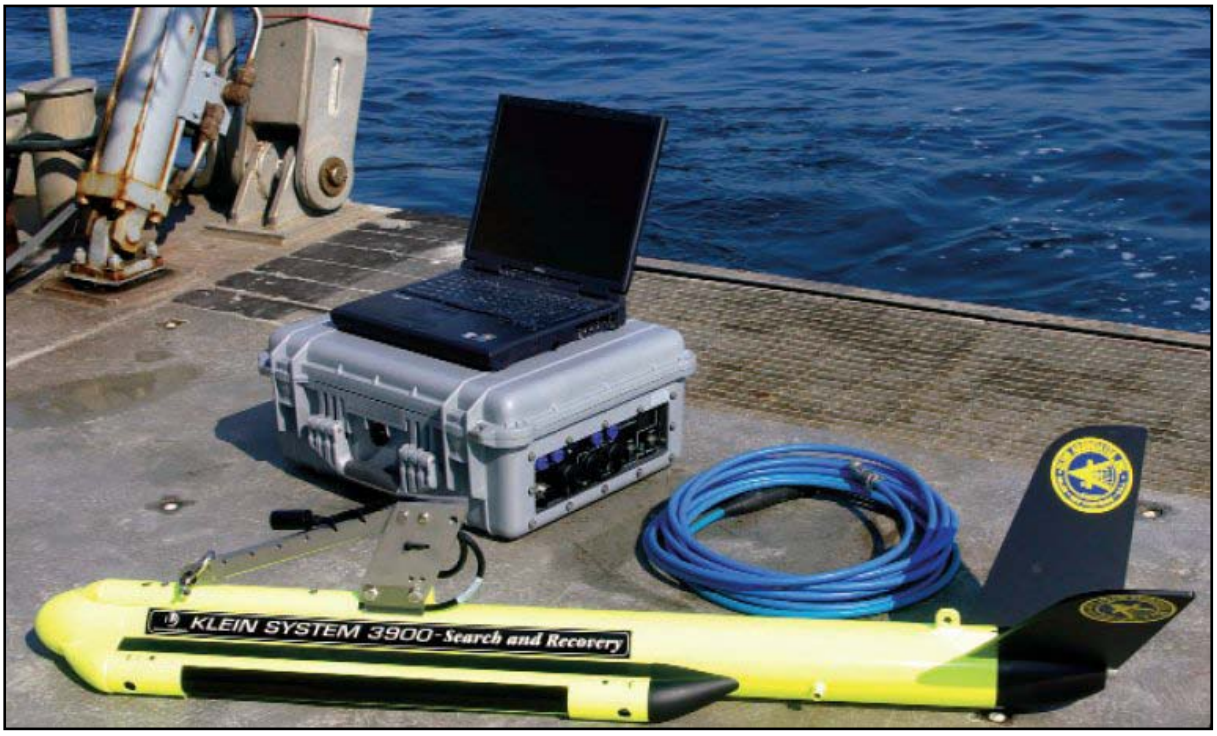


Plate 1. Side Scan Sonar

4.1.2 Sub Bottom Profiler

Geomara chose their Stratabox as the sub bottom profiler for this survey. It is a portable high-resolution marine sediment imaging instrument capable of delivering 12 cm of marine sediment strata resolution with bottom penetration of up to 40 meters. It is designed exclusively for inshore and coastal geophysical marine survey up to 150 meters of water depth.

It was pole mounted from the side of the survey vessel with the GPS antenna mounted on top. As such there were no X and Y offsets required. All data was recorded in Seg-Y format using the Stratabox proprietary software. The data was alter processed using SonarWiz.

Plate 2. Syqwest Strata box

4.1.3 Marine Magnetometer

Geomara used a geometrics 882 caesium magnetometer for the survey. It has a detection sensitivity of 0.004nT. The magnetometer was operated at a cycle rate of 10hz and towed at a distance of 35m

off the starboard aft quarter of the survey vessel. This distance ensured that the sensor was not impacted by the magnetic signature of the survey vessel allowing for better data.

Plate 3. Geometrics 882 Marine Magnetometer

4.1.4 Positioning

Vessel and equipment positioning was provide by a Trimble 132 AgDGPS. This, survey grade, GPS used EGNOS and WAAS corrections to provide sub metre accuracy at all stages of the survey. A receiver antenna was mounted on the roof of the survey vessel, with a receiver processor being situated in the survey lab. Layback was calculated from the antenna to each of the respective survey components. These calculations were inputted into the relevant softwares thus providing each unit with a real time position.

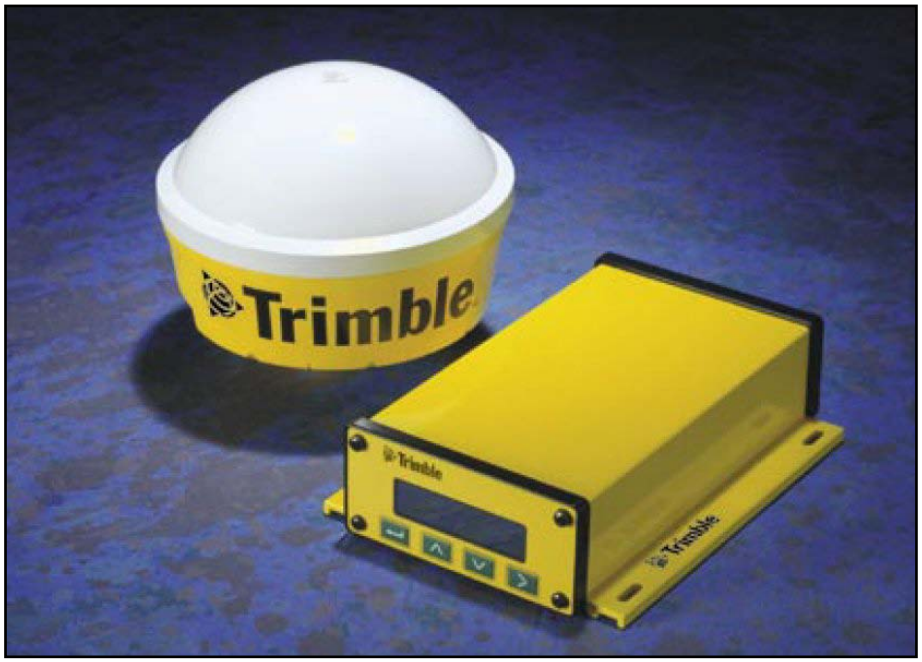


Plate 4. Trimble 132 DGPS

4.1.5 Navigation

Vessel navigation was provided by Hypack 2014. Hypack is the most widely used hydrographic software package in the world. It enables users to create and follow pre-determined and pre-configured survey lines. It uses GPS input to calculate navigation errors and provides the helmsman with cross track and off track measurements.

4.1.6 Survey Vessel

The survey of the main navigation channel was carried out from a 6.5m rigid hulled vessel. It was fitted with two no. Mariner 115 horsepower outboard engines and has a centre control console. The equipment configuration was such that the vessel navigation control point was located in the centre of the vessel. The side scan sonar was deployed off the stern port side, the sub bottom profiler was pole mounted on the starboard side and with the magnetometer being deployed off the stern starboard side.

Plate 5. View of survey vessel

5. Data Processing

A variety of software packages were used during data acquisition and subsequent processing. These included the following:

5.1 Hypack 2013

Hypack 2013 is the world's most popular a hydrographic survey software. It enables users to create and follow pre-determined and pre-configured survey lines. It uses GPS input to calculate navigation errors and provides the helmsman with cross track and off track measurements. It also allows users to post processing single beam bathymetric and magnetometer data, allowing for the input of diurnal variation calculations as well as positional corrections. The software can also be used for the export of processed data in various formats including XYZ and 3D contour styles.

5.2 Sonar Pro

Sonar pro is Klein's proprietary side scan sonar acquisition software. It allows the user to determine ping rate and transmit frequency and also provides valuable real time sensor information such as sonar signal intensity, sonar trace waterfall imagery and positional location. The software was used for data acquisition but it has no post processing capabilities.

5.3 Sonarwiz

Sonarwiz 5 was the side scan sonar, sub bottom profiler and magnetometer data processing software used for the survey. It allows for side scan, sub bottom profiler (Seg-Y) and magnetometer data interrogation. It enables the user to geo-locate and describe potential targets of potential interest. It permits the creation of side scan sonar mosaics and also allows for cross reference of side scan sonar, sub bottom profiler and even magnetometer anomaly locations. The software allows the user to export processed data in various forms such as geo-tiff and shapefile.

5.4 Maglog

Maglog is the proprietary data acquisition software of Geometrics. It was used for data acquisition of the Geometrics 882 data. Magpick is the proprietary data processing software of Geometrics. The Magpick software allows for saved data to be exported in a number of-processed and un-processed formats such as XYZ and ASCII. ASCII was the chosen export format of the survey.

5.5 Stratabox

Stratabox is the proprietary data acquisition software of the Syqwest stratabox. It allows for collection of GPS tagged ODEC and SEG –Y sub bottom profiler data. It also allows for amplitude and gain changes, thus varying the output signal based on the substrate type.

6. Survey results

6.1 Side scan sonar

A total of 10.125 linear kilometres of seabed was ensonified during the survey, comprising 16 separate lines. The quality of the side scan sonar data was generally good although there were some roll and pitch artefacts recorded in the sonar traces. These were as a result of environmental conditions at the time of survey. The side scan sonar was operated at two frequencies, 100 kHz and 445 kHz, with the range set to 100m this ensured that there was 100% overlap on all lines. A total of 16 contacts were noted in the survey area. All side scan sonar anomalies were identified with the prefix **DL CH**, followed by a sequential number. A complete detailed report on each anomaly is contained in the contact report section of the appendix.

The survey data analysis identified a number of potential features in the survey area. These included 4 pilings associated with the Stena Ferry docking Dolphins (**DL CH 01-04**), a navigation marker (**DL CH**

16), the potential sites of the two previously recorded shipwrecks (**DL CH 07-10 & DL CH 12**) and a number of ancillary contacts which could represent additional cultural heritage deposits.

The southernmost contacts recorded were **DL CH 01 – 04**. These clearly represented pilings associated with the existing HSS Ferry berthing Dolphins.

A cluster of contacts located in the central navigation channel, namely; **DL CH 07 – 10** appeared to be related to the known wreck WO1967 (See figure 4). Separate survey lines ensonified different the seafloor at different grazing angles, thus imaging exposed remains at different levels. The sonar data indicates that the feature does not appear to comprise a single isolated body. Additionally, as can be expected with shipwrecks, the exposed remains appear to be extended or scattered over a section of seafloor measuring 30m in length. This is not unusual as, over time, remains can become disarticulated from the main wreck body, they can be washed out by vessel movements and other sections can be buried beneath the seabed.

There is one contact located in the central channel (**DL CH 12**) at the entrance to the harbour which may be associated with the known wreck WO1966, although the known location of this wreck is to the east of this location.

The WO1967 AND WO1966 wreck site locations (as seen in figure 3) are recorded in the SMR. It should be noted that there is a degree of uncertainty as to the accuracy of these locations. There is some correlation between the reported wreck locations and the sonar contact locations which were noted during the geophysical survey. The contacts may represent exposed or washed out debris associated with these wrecks.

Approximately 270m north of the Harbour entrance another contact was ensonified. It was termed, **DL CH 13**. It was difficult to classify this contact and it may or may not be associated debris from the previously identified wreck sites. The area outside the harbour walls, the ‘turning circle’, does not show any contacts on the sonar traces.

Contact **DL CH 14**, located along the outside navigation channel appears to represent a mooring with chain or rope attached. This is likely to be related to the navigation marker which is represented by **DL CH 16**. The feature recorded as **DL CH 15** most likely is propeller wash from a passing vessel, however caution should be exercised in this interpretation.

Target Name	Latitude	Longitude	Description
DL CH 01	53.29716077	-6.13090181	Piling
DL CH 02	53.29780749	-6.131115872	Piling
DL CH 03	53.2978488	-6.130834441	Piling
DL CH 04	53.29744511	-6.131352506	Piling
DL CH 05	53.29883854	-6.13016258	Unknown undulation on seafloor. Image appears to indicate slight seafloor depression
DL CH 06	53.2995445	-6.1300203	Unknown seafloor conical shaped depression
DL CH 07	53.30066669	-6.130785742	Possible area of scattered remains of Shipwreck WO1967
DL CH 08	53.30061363	-6.131186334	Small linear feature possibly associated with Shipwreck WO1967
DL CH 09	53.30083094	-6.13179001	Possible remains associated with wreck WO1967
DL CH 10	53.30103336	-6.130102223	Possible wreck remains associated with WO1967
DL CH 11	53.30171223	-6.129738787	Unknown seafloor anomaly
DL CH 12	53.30287533	-6.1287984	Unknown seafloor anomaly
DL CH 13	53.30483525	-6.126377301	Unknown anomaly
DL CH 14	53.3063906	-6.112120233	Anchor and chain
DL CH 14	53.3063906	-6.112120233	Anchor and chain
DL CH 15	53.30610495	-6.107131529	Unknown linear seafloor feature possible prop wash
DL CH 16	53.30673618	-6.106379873	Navigation marker

Table 2. Table of Side Scan Sonar Anomalies

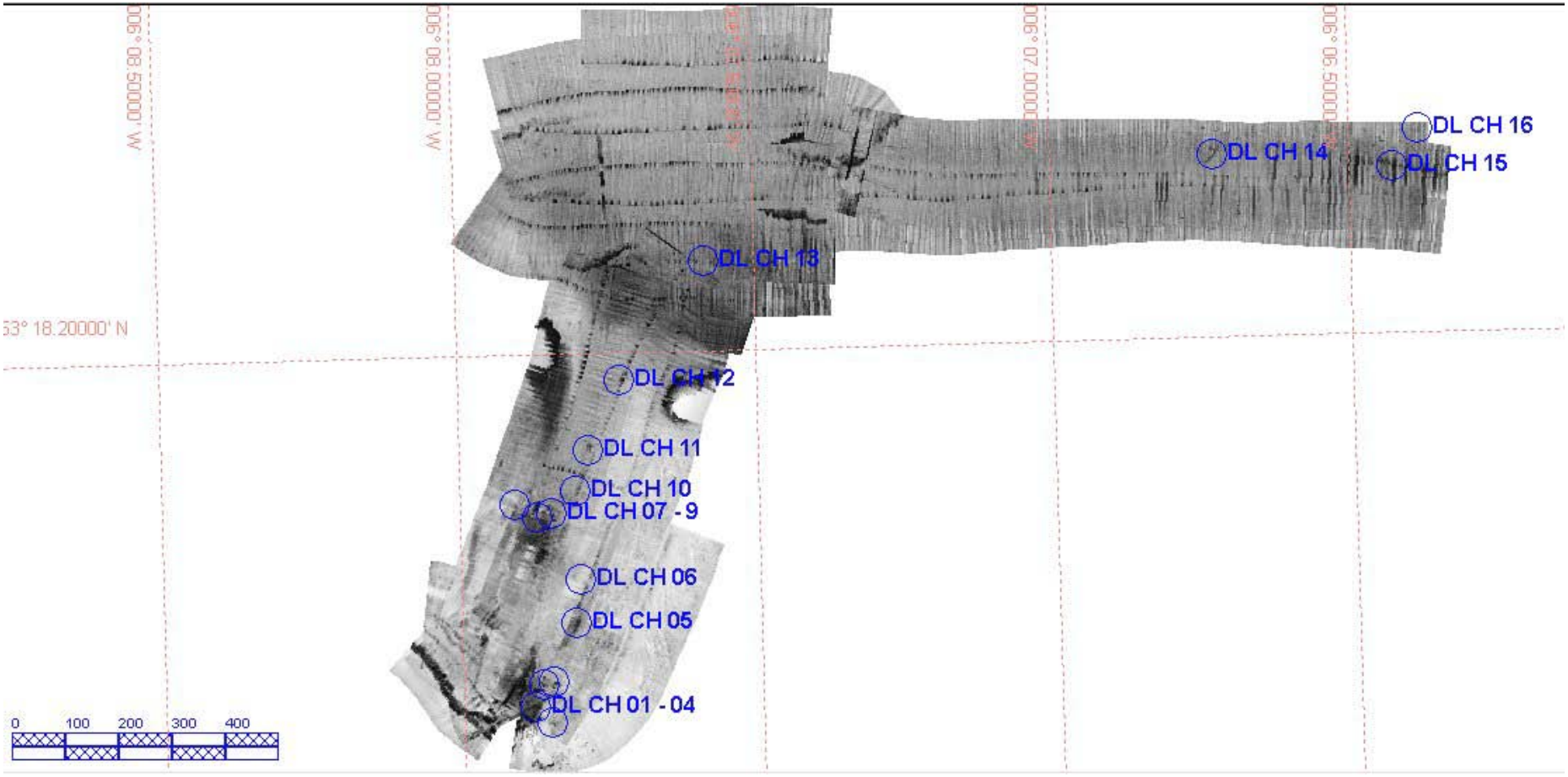


Figure 4. Side Scan Sonar Contacts

6.2 Magnetometer

A similar survey regime was undertaken for the marine magnetometer survey. A total of 16 lines of magnetometer data were collected, similarly measuring 10.125 linear kilometres. The magnetometer data around the existing berth in the southernmost section of the survey area shows high fluctuations in signal which are clearly related to the existing berthing Dolphin structures and possible wreck remains of shipwreck WO 1967, both of which are situated in that area.

An additional high signal fluctuation was recorded in the north-western corner of the survey area. This correlated to the location of a marker buoy and associated chain and anchor. There were also slight deviations in the magnetometer data over the area associated with WO1966.

When cross referenced with the side scan sonar data, the following table can be deduced:

Magnetometer Anomaly No	Corresponding Side Scan Sonar Anomaly No.
Mag 1	DL CH 01-10
Mag 2	DL CH 12
Mag 3	DL CH 14-16

Table 3. Table of magnetometer contacts with corresponding side scan sonar contacts

Figure 5. Magnetometer Data showing location of the three main anomalies.

6.3 Sub Bottom Profiler

A total of 16 lines or 10.125 linear kilometres of sub bottom profiler data were collected across the survey area. The quality of the acquired data varied due to the varying bedform densities. In the areas of soft sediment such as the harbour, penetration and resolution was good, however in the outer areas where sediment appeared to be more compact, resolution and penetration was reduced.

In the main harbour area, the sub bottom profiler indicated the presence of a strong surface reflector with a possible sub horizon noted 2.5-3.2m below. This sub horizon was generally noted as a uniform horizon throughout much of the inner harbour survey area, however it did ascend and descend in places. The horizon appeared to mask the current bed level in many places but it was noted to undulate in certain areas, thus indicating that it was not a multiple reflector. No evidence of the recorded shipwreck WO1967 was noted in the sub bottom profiler record. The absence of evidence for the wreck remains can be attributed to a number of reasons:

- Density similarities between wreck remains and surrounding substrate
- Reflective co-efficient similarities
- Failure to pass directly over large buried sections

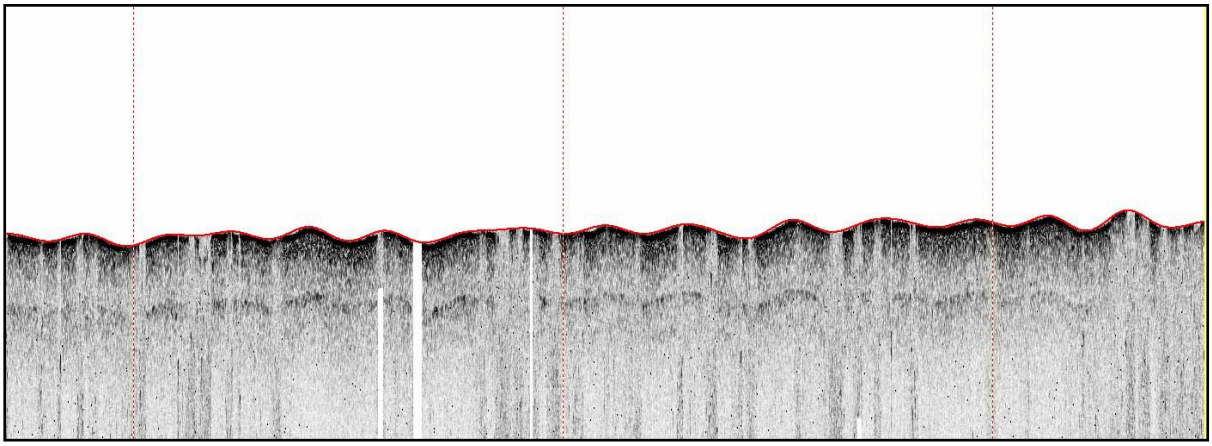


Plate 6. Sub Bottom Profiler section through harbour area

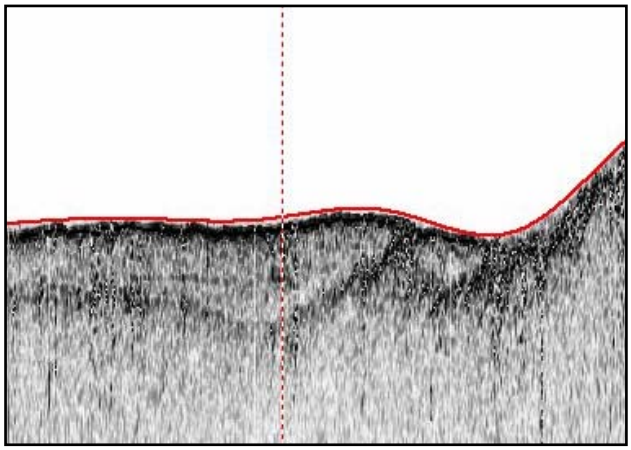


Plate 7. Sub Bottom Profiler section showing undulating seafloor substrate

In the outside harbour area, the substrate appeared to be more compact, thus making penetration more difficult. The survey did not manage to record bedrock depths as it was not designed as a low frequency, low resolution survey. It did however manage to record some data from this area. It recorded that a possible substrate horizon was noted 2.2 – 3.6m below the current bed level, throughout the outer survey area. The sub bottom profiler survey of the outer harbour area, did not appear to record the presence of any potential archaeological material.

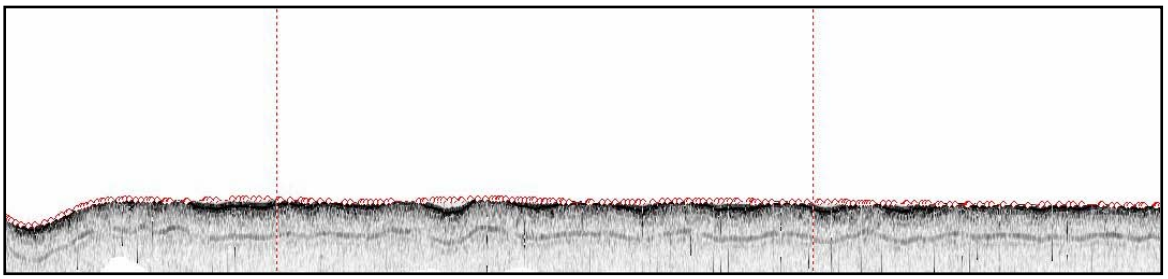


Plate 8. Central Sub Bottom Profiler line

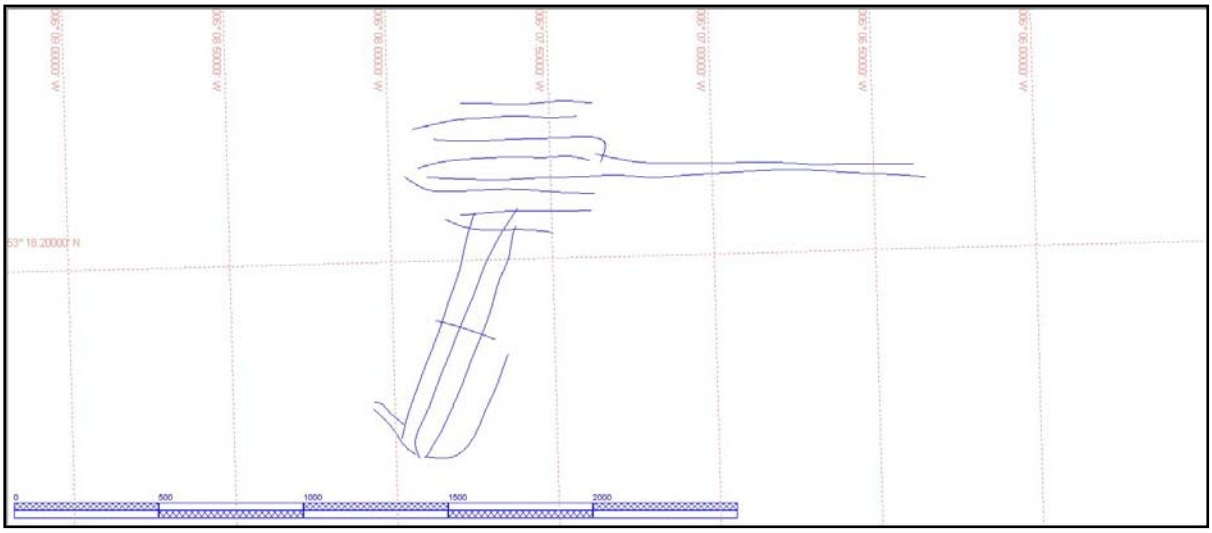


Plate 9. Sub Bottom Profiler Line Chart

7. Conclusions and Recommendations

The survey was carried out on the 22nd of May 2014 under licence number 13R73. It recorded 10.125 linear kilometres of sidescan, sub bottom profiler and magnetometer data, consisting of 16 lines.

The side scan sonar survey recorded the presence of 16 anomalies, four of which were the mooring dolphins associated with the HSS Ferry (**DL CH 01-04**), another series represented a navigation marker and anchor (**DL CH 14 & 16**), with the remainder being unknown. Of the remaining eleven anomalies, four appear to be clustered around the site of a known shipwreck, that of recorded shipwrecks WO1967 (**DL CH 07-10**). A detailed list of all side scan sonar contacts is contained in the appendices.

The magnetometer survey recorded the evidence of 3 no. significant anomalies. These are:

Mag 1. The area surrounding contacts associated with the existing mooring dolphins and known wreck WO1967 in the main channel. It corresponded with side scan sonar anomalies **DL CH 01-10**

Mag 2. The anomalies close to the mouth of the harbour and just inside the mouth of the harbour. It corresponded with side scan sonar anomaly **DL CH 12**

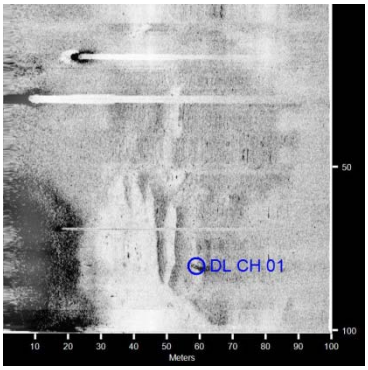
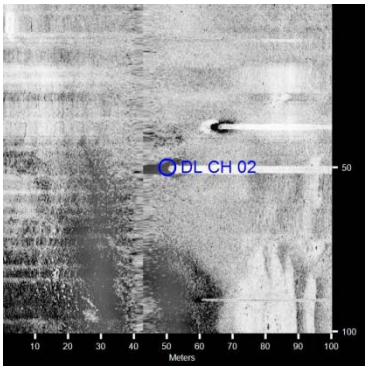
Mag 3. The anomaly close to the navigation marker at the entrance to the approach navigation channel. It corresponded with side scan sonar anomalies **DL CH 14-16**

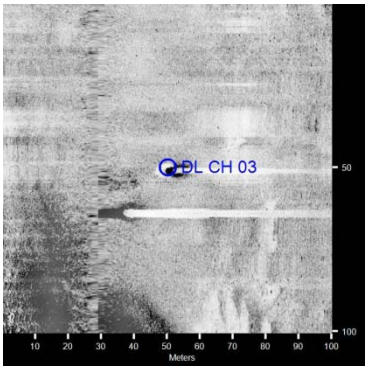
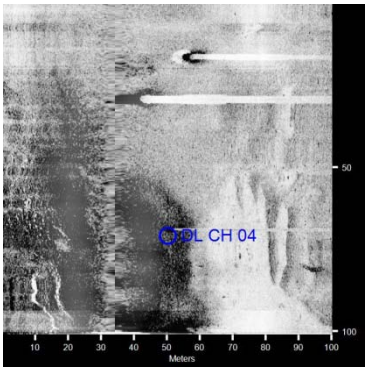
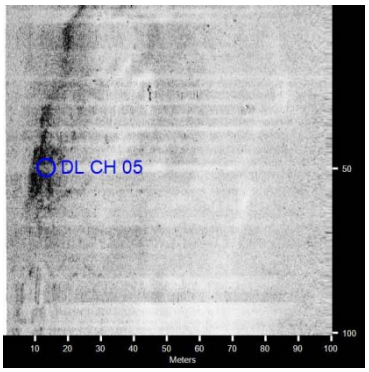
The sub bottom profiler recorded substrate variations but did not appear to record the presence of any potential archaeological material.

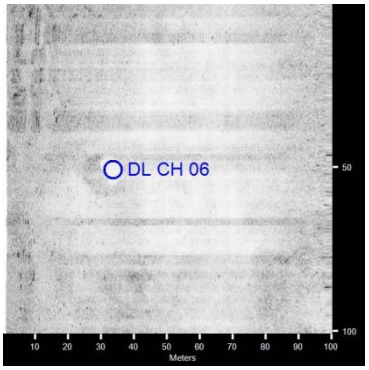
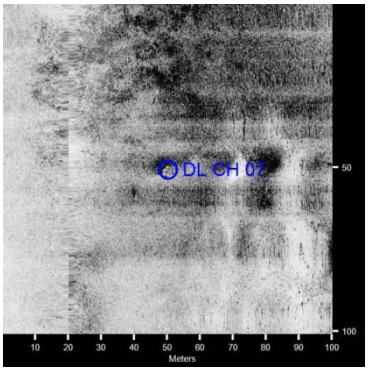
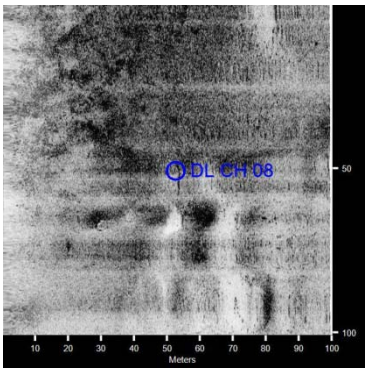
It is subsequently recommended that the magnetic anomalies and the side scan sonar contacts are investigated to determine their nature, age and extent. This should be undertaken by a team of archaeological divers, subject to the approval of the Department of Arts, Heritage and Gaeltacht.

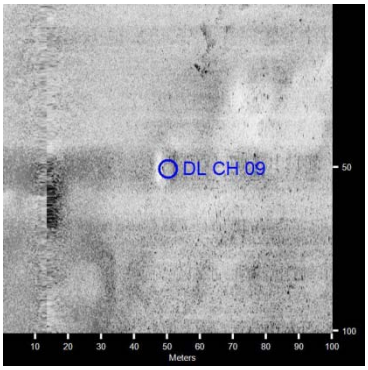
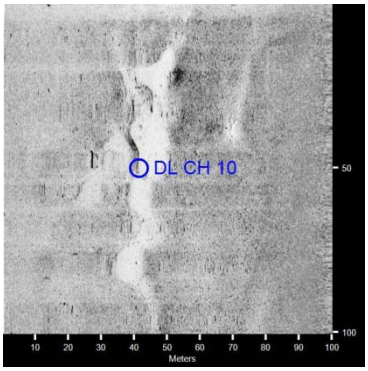
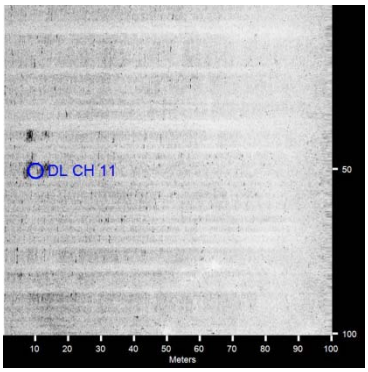
Appendix 1 Contact Report

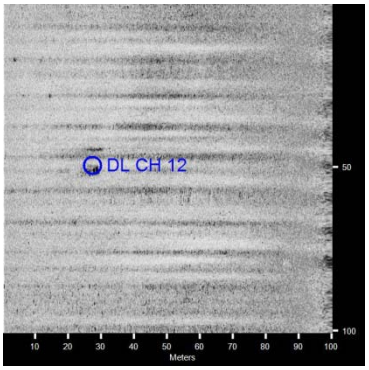
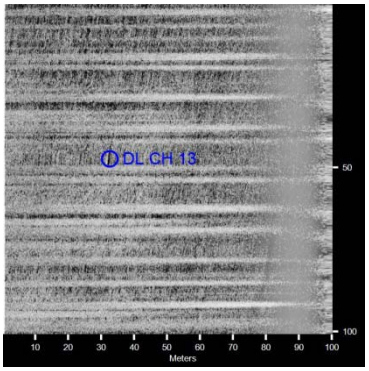
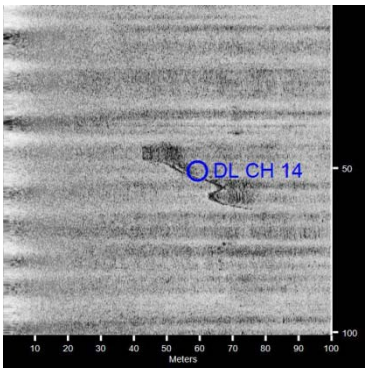
Dun Laoghaire Contact Report

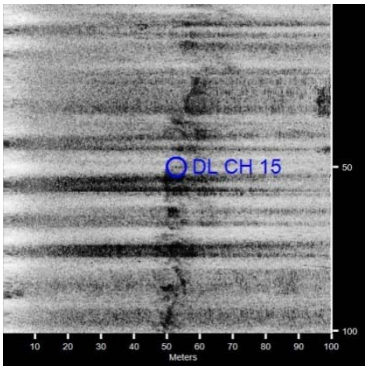
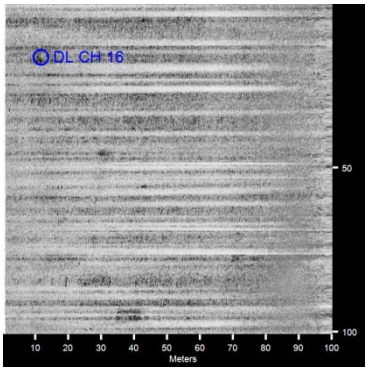
Target Image	Target Info	User Entered Info
	**DL CH 01** • Sonar Time at Target: 5/22/2014 12:49:23 PM • Click Position 53.2971607666 -6.1309018096 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2971607666 -6.1309018096 (LocalLL) (X) 724594.07 (Y) 729058.92 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 35819 • Range to target: 58.59 Meters • Fish Height: 12.99 Meters • Heading: 46.890 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 5.34 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Piling • Classification2: • Area: • Block: • Description: Piling
	**DL CH 02** • Sonar Time at Target: 5/22/2014 12:49:45 PM • Click Position 53.2978074885 -6.1311158715 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2978074885 -6.1311158715 (LocalLL) (X) 724577.92 (Y) 729130.50 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 35977 • Range to target: 7.42 Meters • Fish Height: 13.28 Meters • Heading: 59.890 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Piling • Classification2: • Area: • Block: • Description: Piling

	**DL CH 03** • Sonar Time at Target: 5/22/2014 12:49:51 PM • Click Position 53.2978487951 -6.1308344414 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2978487951 -6.1308344414 (LocalLL) (X) 724596.56 (Y) 729135.58 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 36018 • Range to target: 21.09 Meters • Fish Height: 14.65 Meters • Heading: 51.890 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Piling • Classification2: • Area: • Block: • Description: Piling
	**DL CH 04** • Sonar Time at Target: 5/22/2014 12:49:27 PM • Click Position 53.2974451108 -6.1313525058 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2974451108 -6.1313525058 (LocalLL) (X) 724563.20 (Y) 729089.77 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 35848 • Range to target: 16.01 Meters • Fish Height: 12.69 Meters • Heading: 52.390 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Piling • Classification2: • Area: • Block: • Description: Piling
	**DL CH 05** • Sonar Time at Target: 5/22/2014 12:47:29 PM • Click Position 53.2988385418 -6.1301625805 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2988385418 -6.1301625805 (LocalLL) (X) 724638.45 (Y) 729246.87 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124252.jsf • Ping Number: 35016 • Range to target: 86.91 Meters • Fish Height: 13.09 Meters • Heading: 181.790 Degrees • Event Number: 0 • Line Name: 20140522124252 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 60.93 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown undualtion on seafloor. Image appears to indicate slight seafloor depression

	**DL CH 06** • Sonar Time at Target: 5/22/2014 12:46:58 PM • Click Position 53.2995445018 -6.1300202997 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2995445018 -6.1300202997 (LocalLL) (X) 724645.88 (Y) 729325.66 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124252.jsf • Ping Number: 34792 • Range to target: 66.60 Meters • Fish Height: 14.35 Meters • Heading: 179.290 Degrees • Event Number: 0 • Line Name: 20140522124252 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 6.70 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown seafloor concical shaped depression
	**DL CH 07** • Sonar Time at Target: 5/22/2014 12:46:20 PM • Click Position 53.3006666875 -6.1307857419 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3006666875 -6.1307857419 (LocalLL) (X) 724591.60 (Y) 729449.17 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124252.jsf • Ping Number: 34527 • Range to target: 30.08 Meters • Fish Height: 11.91 Meters • Heading: 177.200 Degrees • Event Number: 0 • Line Name: 20140522124252 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Possible wreck • Classification2: • Area: • Block: • Description: Possible area of scattered remains of Shipwreck WO1967
	**DL CH 08** • Sonar Time at Target: 5/22/2014 12:46:27 PM • Click Position 53.3006136323 -6.1311863342 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3006136323 -6.1311863342 (LocalLL) (X) 724565.05 (Y) 729442.57 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124252.jsf • Ping Number: 34572 • Range to target: 52.34 Meters • Fish Height: 12.79 Meters • Heading: 181.290 Degrees • Event Number: 0 • Line Name: 20140522124252 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 8.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Linear Feature • Classification2: • Area: • Block: • Description: Small linear feature possibly associated with Shipwreck WO1967

	**DL CH 09** • Sonar Time at Target: 5/22/2014 1:00:15 PM • Click Position 53.3008309355 -6.1317900100 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3008309355 -6.1317900100 (LocalLL) (X) 724524.19 (Y) 729465.69 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522125659.jsf • Ping Number: 40442 • Range to target: 36.72 Meters • Fish Height: 7.91 Meters • Heading: 178.500 Degrees • Event Number: 0 • Line Name: 20140522125659 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Possible wreck • Classification2: • Area: • Block: • Description: Possible remains associated with Wreck WO1967
	**DL CH 10** • Sonar Time at Target: 5/22/2014 12:59:51 PM • Click Position 53.3010333641 -6.1301022225 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3010333641 -6.1301022225 (LocalLL) (X) 724636.09 (Y) 729491.16 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522125659.jsf • Ping Number: 40267 • Range to target: 58.79 Meters • Fish Height: 7.13 Meters • Heading: 181.390 Degrees • Event Number: 0 • Line Name: 20140522125659 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 46.67 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Possible wreck • Classification2: • Area: • Block: • Description: Possible wreck remains associated with WO1967
	**DL CH 11** • Sonar Time at Target: 5/22/2014 12:53:04 PM • Click Position 53.3017122297 -6.1297387873 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3017122297 -6.1297387873 (LocalLL) (X) 724658.33 (Y) 729567.32 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 37385 • Range to target: 90.03 Meters • Fish Height: 7.81 Meters • Heading: 49.390 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 5.79 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown seafloor anomaly

	**DL CH 12** • Sonar Time at Target: 5/22/2014 12:58:21 PM • Click Position 53.3029671753 -6.1287160279 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3029671753 -6.1287160279 (LocalLL) (X) 724722.84 (Y) 729708.72 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522125659.jsf • Ping Number: 39632 • Range to target: 72.75 Meters • Fish Height: 6.74 Meters • Heading: 161.000 Degrees • Event Number: 0 • Line Name: 20140522125659 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 3.47 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown Anomaly • Classification2: • Area: • Block: • Description: Unknown Anomaly
	**DL CH 13** • Sonar Time at Target: 5/22/2014 12:40:21 PM • Click Position 53.3048352500 -6.1263773015 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3048352500 -6.1263773015 (LocalLL) (X) 724873.25 (Y) 729920.64 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522123816.jsf • Ping Number: 31983 • Range to target: 67.57 Meters • Fish Height: 9.86 Meters • Heading: 100.200 Degrees • Event Number: 0 • Line Name: 20140522123816 • Water Depth: 0.77 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown anomaly
	**DL CH 14** • Sonar Time at Target: 5/22/2014 12:01:48 PM • Click Position 53.3063906032 -6.1121202333 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3063906032 -6.1121202333 (LocalLL) (X) 725818.78 (Y) 730118.70 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522115910.jsf • Ping Number: 15596 • Range to target: 58.98 Meters • Fish Height: 10.45 Meters • Heading: 260.590 Degrees • Event Number: 0 • Line Name: 20140522115910 • Water Depth: 0.77 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Anchor and chain • Classification2: • Area: • Block: • Description: Anchor and chain

	**DL CH 15** • Sonar Time at Target: 5/22/2014 11:59:47 AM • Click Position 53.3061049463 -6.1071315286 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3061049463 -6.1071315286 (LocalLL) (X) 726152.06 (Y) 730095.72 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522115910.jsf • Ping Number: 14740 • Range to target: 52.54 Meters • Fish Height: 10.64 Meters • Heading: 229.900 Degrees • Event Number: 0 • Line Name: 20140522115910 • Water Depth: 0.77 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 93.46 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown linear seafloor feature, possible prop wash
	**DL CH 16** • Sonar Time at Target: 5/22/2014 11:58:09 AM • Click Position 53.3067361799 -6.1063798733 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3067361799 -6.1063798733 (LocalLL) (X) 726200.29 (Y) 730167.27 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522115006.jsf • Ping Number: 14046 • Range to target: 88.47 Meters • Fish Height: 11.33 Meters • Heading: 99.500 Degrees • Event Number: 0 • Line Name: 20140522115006 • Water Depth: 0.77 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Navigation marker • Classification2: • Area: • Block: • Description: Navigation marker

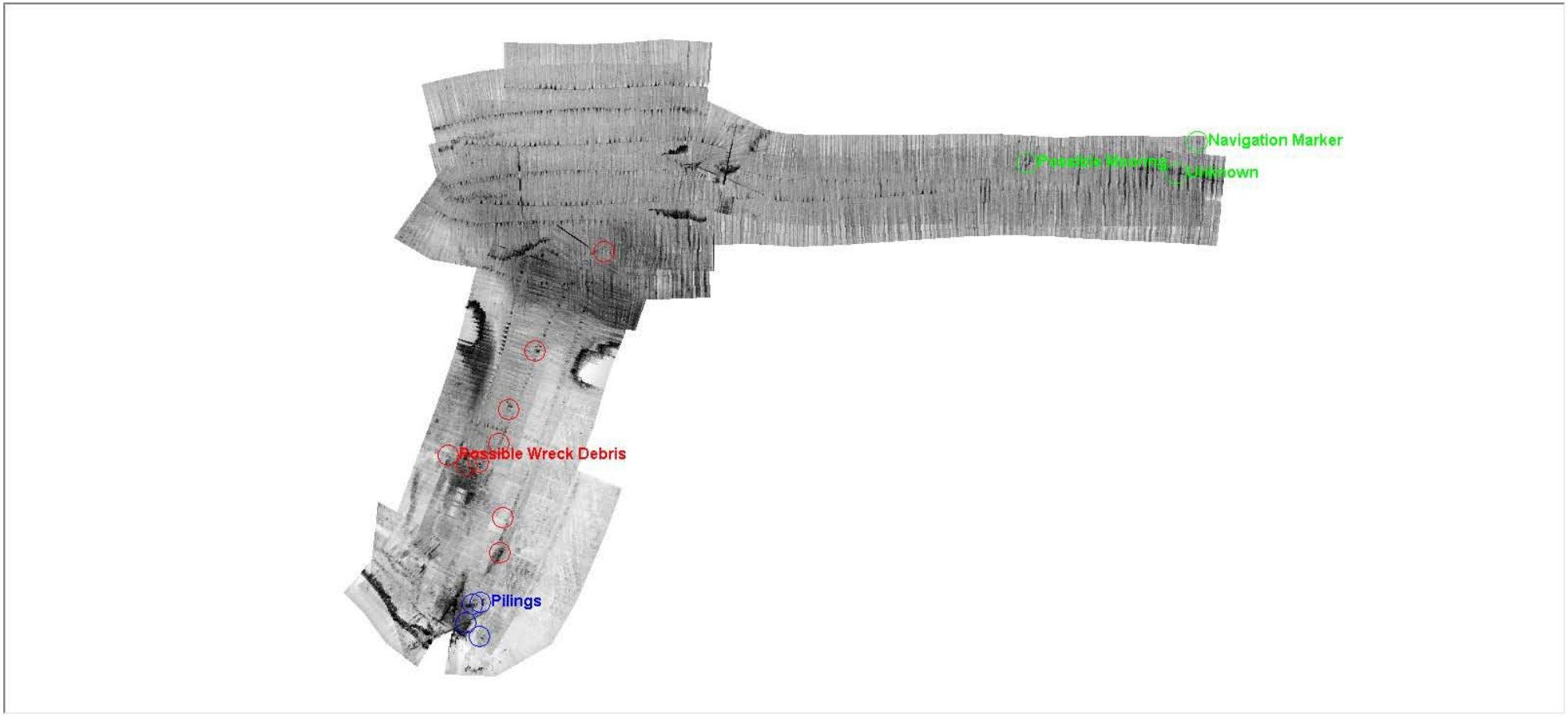


Figure 6. Side Scan Sonar Contacts

Appendix 2 Side Scan Coverage Report

File Name	Area Covered (m) sq	Perimeter (m)	Line Length (m)	Pct of Total Coverage
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522131052.jsf	43,400.6	834.0	216.7	4.5
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522120953.jsf	119,979.2	1,599.9	595.1	12.4
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522121503.jsf	132,832.5	1,926.5	582.2	13.8
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522121946.jsf	113,565.5	1,535.7	565.2	11.8
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522122503.jsf	91,565.3	1,315.7	457.1	9.5
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522123001.jsf	133,946.7	1,739.7	659.2	13.9
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522123534.jsf	91,368.3	1,313.7	456.5	9.5
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522123816.jsf	75,858.8	1,159.3	375.4	7.9
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522124252.jsf	187,854.2	2,300.7	922.3	19.5
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522124914.jsf	171,560.4	2,115.9	854.1	17.8
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522125659.jsf	164,290.3	2,043.0	820.4	17.0
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522130339.jsf	27,276.0	754.5	132.9	2.8
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522130453.jsf	43,735.5	837.4	216.6	4.5
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522130637.jsf	101,912.4	1,426.8	456.0	10.6
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522115006.jsf	219,853.8	2,598.7	1,096.7	22.8
E:\Dunleary Sidescan and MagData\Dunleary Sidescan\20140522115910.jsf	344,218.0	3,842.6	1,718.7	35.7

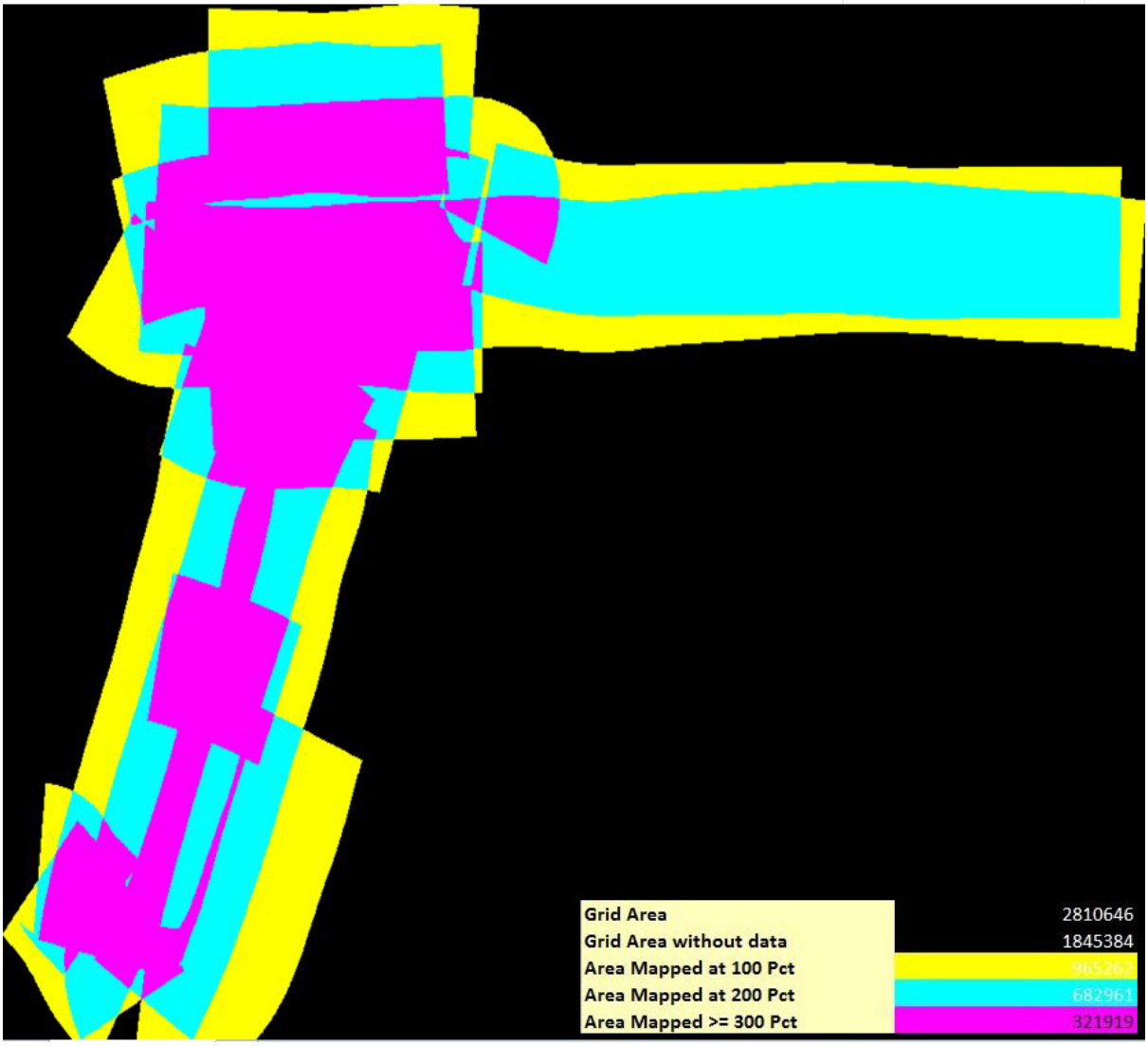


Figure 7. Side Scan Sonar Coverage Map

Report prepared by: 

Conall O'Malley

Report reviewed by: 

Finn Delaney

Date: 30 June 2014

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Web: www.geo-mara.com

Appendix 5.10.5

Dive Inspection Report

Geomara Ltd September 2014

REPORT ON ARCHAEOLOGICAL DIVE INSPECTION

GEOPHYSICAL ANOMALIES IDENTIFIED AT

DUN LAOGHAIRE HARBOUR

CO. DUBLIN

Geomara Ltd

Job Number: G14017

Authors:EoghanKieran

Dive Survey Licence no. 14D0014

Date: September 2014

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Non Technical Summary

Geomara was commissioned by Irish Archaeological Consultancy to carry out an archaeological dive inspection of a number of potential archaeological anomalies identified at Dun Laoghaire, Co. Dublin. This report details the results of the dive inspection which was carried out 3 September 2014.

The proposed development will consist of the removal or reuse of the current Stena Line Berth 5 at Dun Laoghaire Harbour and the construction of a new berth and mooring dolphins in that same general area which will be able to facilitate the docking of larger scale cruise ships. Associated channel dredging within the harbour will be required, along with a dredged turning circle outside of the harbour mouth

The proposed development area is contained in an area of rich archaeological and historical significance. A previously conducted archaeo-geophysical survey (13R73) recorded the presence of sixteen seafloor anomalies, two of which were anomaly feature clusters.

A dive inspection (14D14) was carried out on these anomalies to confirm their nature. The dive inspections recorded that all other anomalies, with the exception of one cluster, were either modern or seafloor features or else acoustic artefacts.

Although lying outside the survey area, the wreck remains most likely associated with recorded wreck WO1966 were recorded at location 53 18 10.006 N/ 006 07 38.298 W. Whilst these remains were contained outside the immediate development zone, dredging of the nearby area has the potential to:

1. Impact remains of recorded wreck WO1966 which may be contained within the development zone through site dredging operations.
2. Uncover further remains of recorded wreck WO1966 which may be in the vicinity of the current site through erosion and/or boat wash

Wreck remains most likely associated with recorded wreck WO1967 were recorded at location 53 18 10.006 N/ 006 07 38.298 W, in the centre of the proposed development. Dredging of the area has the potential to:

1. Impact remains of recorded wreck WO1967 contained within the development zone through site dredging operations.
2. Uncover/impact further remains of recorded wreck WO1967 which may be in the vicinity of the current site through dredging and or secondary erosion caused by boat wash.

Both sites do not appear to be well contained small sites but rather scatters of wreck remains, with only sections of the wreck remains were visible on the surface. There is potential for further wreck remains be present in the adjacent seafloor substrate.

In situ preservation is the preferred mitigation measure for the site. Small design amendments and a monitoring regime may allow for such mitigation measures to be effected. As such, the presence of WO1967 in the centre of the development and WO1966 immediately outside the development zone does not preclude development.

In order to effect this mitigation, a staged approach is recommended. This approach should include:

1. Determination of age and extend of Wreck Sites WO1966 and WO1967 through archaeological test trenching.
2. Project Design modification based on results of above (no.1) to allow for in situ preservation.

The staged mitigation should be undertaken, in conjunction with the Department of Arts Heritage and the Gaeltacht, and the National Museum of Ireland.

1 SCOPE OF WORKS

1.1 Introduction

Geomara was commissioned by Irish Archaeological Consultancy to carry out an archaeological dive inspection of sixteen number potential archaeological anomalies at Dun Laoghaire, Co. Dublin (see figure 1). The work was carried out as preliminary work associated with a proposed cruise liner berthing project at Dun Laoghaire harbour.

The sixteen potential archaeological anomalies were identified during analysis of data acquired from a previously conducted high resolution marine archaeo-geophysical survey of the area. The techniques used during the survey were side scan sonar, sub bottom profiler and marine magnetometer.

The identified anomalies comprised two feature clusters and eight individual anomalies. The subsequent dive inspection survey was carried out on 3rd September 2014 under dive licence no. 14D0014. It investigated all the identified anomalies as well as the site of recorded wreck WO1966. The aim of the inspection was to attempt to identify the nature of the anomalies and determine if they were archaeological in nature.

Figure 1. Site Location

1.2 Purpose of the Assessment

The principle aim of assessment is to anticipate and avoid impacts on the archaeological resource. Archaeological assessment may be required as part of the planning process "in response to developments which may be located in the vicinity of archaeological monuments" (The Heritage Council, 2000).

Assessment has been described as "the overall process of assessing the impact of a development" (DAHGI, 1999). It can comprise of mitigatory measures including documentary research, examination of aerial photographs etc. and more intrusive measures including testing and/or full excavation.

The purpose of the underwater archaeological assessment was to:

- The character, condition and extent of any archaeological area, features or objects likely to be affected by the proposed works, including any associated temporary works and to ascertain the potential impact of the works on archaeological remains outside the immediate area of the proposed works as these may be vulnerable to impacts arising from consequent changes in hydrology and sediment formation
- Describe same and discuss their likely provenance
- Ascertain the potential impact of the proposed works on these remains
- Recommend appropriate measures for the avoidance of these remains or, where this cannot be achieved, to recommend measures to mitigate the impact of the works
- Accurately locate the archaeological area, features and objects and present the findings in map form
- Incorporate all the above into a report

The site survey investigated the ten potential archaeological anomalies and their immediate surroundings. It achieved this through a combination of direct diver visual survey and metal detection.

2 CHARACTERISTICS OF THE PROJECT

2.1 Proposed development

The proposed development will consist of the removal or reuse of the current Stena Line Berth 5 at Dun Laoghaire Harbour and the construction of a new berth and mooring dolphins in that same general area which will be able to facilitate the docking of larger scale cruise ships. Associated channel dredging within the harbour will be required, along with a dredged turning circle outside of the harbour mouth; a dredged sea access navigation channel will be formed to ensure that access and egress of large scale cruise ship with the harbour can be accommodated at the various tide states. Geological investigations are required in order to precisely define the extent of the bed area to be deepened within the interior

and exterior of the harbour, ie. within and outside the Harbour Limits Line, and to define relationships with existing quay structures. Strengthening of these existing quay structures could be required, including the provision of protection structures to the existing East and West Pier roundheads which form the Harbour mouth. A series of navigational aids such as mooring buoys and lights tethered to the bottom will be provided to help delineate the navigation channel limits.

It is possible that material that is dredged from the development area may be permanently deposited at sea.

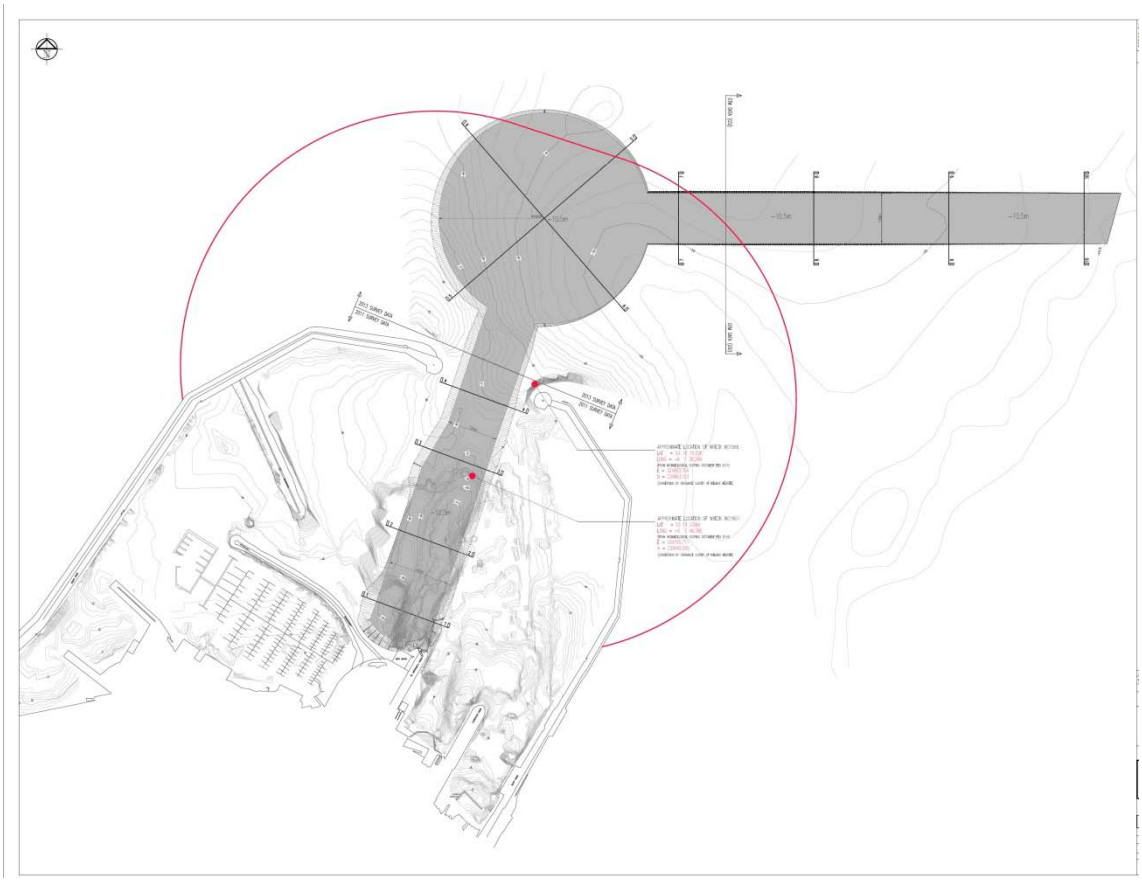


Figure 2. Development Proposal

3. BRIEF ARCHAEOLOGICAL BACKGROUND

This dive inspection resulted from the recommendations of a previously conducted archaeo-geophysical survey. The side scan sonar, sub bottom profiler and marine magnetometer survey was carried out under licence no. 13R73. It was designed to investigate the subject site for the presence of previously unrecorded potential archaeological material. The archaeo-geophysical survey recorded the presence of sixteen potential anomalies, potentially comprising two feature clusters and eight individual anomalies. Investigation of these anomalies was the objective of the dive inspection.

The most sensitive archaeological resource associated with the proposed development area is that of marine archaeological remains, which for the most part, consist of the wrecks of ships. The Shipwreck Inventory of Ireland, records that there are c. 70 ships recorded as sinking in Dun Laoghaire harbour that do not have a recorded location. It also records that there are additional recorded ship wrecks in Dublin Bay, with no reference to the harbour but which may be within vicinity of turning circle and channel.

Of the 70 shipwrecks recorded for Dun Laoghaire, 18 are recorded as sinking at the entrance to the harbour or close to the piers or heads of the piers. Although the locational information for these 18 wrecks are not precise, there are two wrecks within the harbour that possess location references.

These two wrecks plus an additional potential archaeological anomaly, situated at the northeastern end of the turning circle, were identified during a previously undertaken pre-development archaeo-geophysical survey.

4. SITE SURVEY

4.1 Site Survey Methodology

The aim of the survey was to investigate the potential archaeological anomalies and their immediate surroundings. The diver survey involved the deployment of a weighted buoyed line at the site of the anomaly. A diver then descended the weighted buoyed line to the seafloor. Upon arriving at the seafloor the diver then searched the area for the anomaly. This was achieved through the use of the circular search technique using a graduated line. Upon identification of the feature, the diver would then describe the nature and extent of the feature.

The anomalies to be dived comprised ten sites; two feature clusters (Pilings, **DL CH 01-04** & Possible Wreck WO1967 site, **DL CH 07-10**). As these clustered features were located close by they were each investigated under one dive. The remainder of the anomalies were investigated under individual dives.

The following figure indicates the location of all anomalies to be dived:

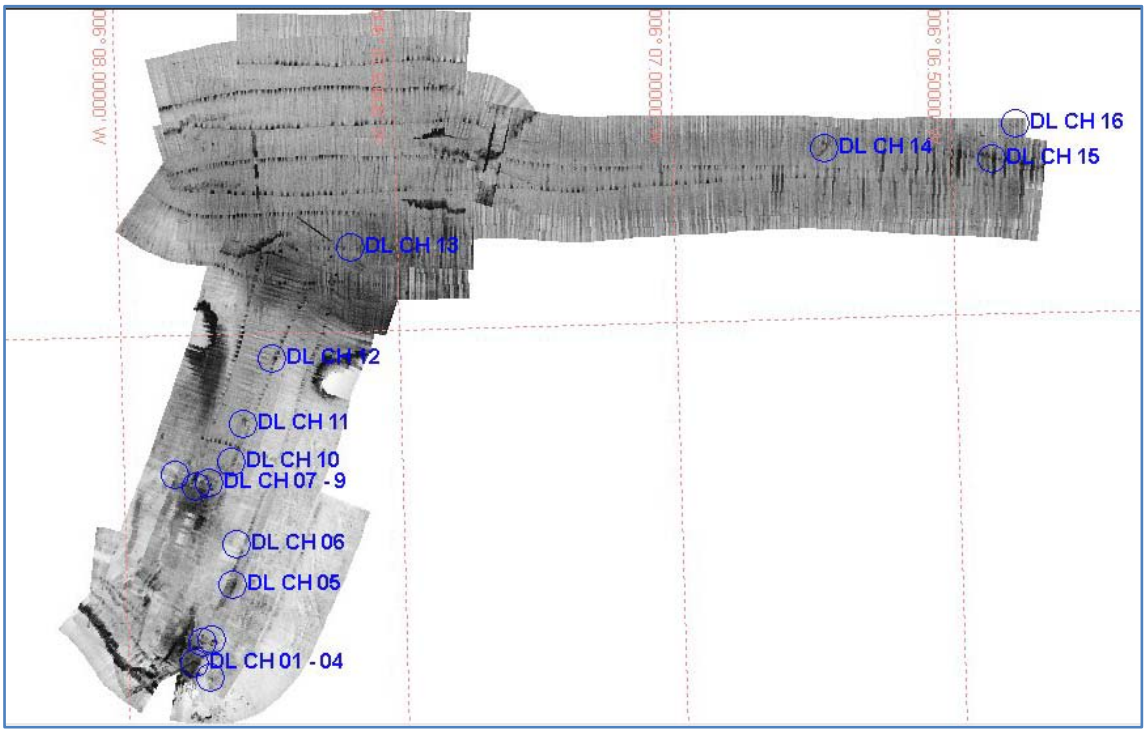


Figure 3. Anomalies to be dived

4.2 Site Survey Findings

4.2.1 DL CH 01-04

Anomalies DL CH 01 – 04 were mooring dolphins associated with the Stena HSS ferry berth. They were not archaeological

4.2.2 DL CH 05

This anomaly was situated to the east of the Stena HSS ferry berth and consisted of a 63m long linear feature of variated width. A 50m circular search was carried out in this area and it identified the seafloor anomaly as most likely being a seafloor scar. The dive did not record the presence of any cultural heritage feature in this area.

4.2.3 DL CH 06

This anomaly was also located to the east of the Stena HSS ferry berth. The side scan sonar image indicated that this was a 3.7m diameter seafloor hollow. Again, a 50m circular search was carried out in this area. The survey recorded seafloor variations but there was no visible trace of any cultural heritage features. It is most likely that this was an acoustic artefact and not a physical anomaly.

4.2.3 DL CH 07-10

This feature was positively identified as possible shipwreck remains consistent with the location of recorded Wreck WO1967. The scattered site lay directly in the centre of the channel inside the mouth of

the harbour. The remains appeared to comprise the scattered remains of a shipwreck orientated in a roughly N-S direction and contained within the silty gravel upper horizon of the harbour bed. The Dive Inspection recorded that the wreck remains appeared to be scattered over a 25m (N-S) x 15m (E-W) area. They comprised outer structural members and some internal fittings. An exposed section of what appeared to be a section of gunwale measured 8.2m in length and was exposed to a depth of 0.2m. There was no obvious signs of internal cargo, however visibility at the time of the survey was poor (c.2-3m).

Dating of the site was not possible. The Maritime Sites and Monuments Record does not provide a name or date of loss for the wreck recorded as WO1967. The dive survey did not record the presence of any obviously datable material on the site.

The dive inspection recorded that the feature was a shipwreck located in the centre of the navigation channel into the harbour. The development proposes to dredge this area. Dredging of this area and the removal of sediment from this area has the potential to permanently negatively impact these remains. Further remains associated with wreck WO1967 may be buried in the vicinity of the identified remains. Determination of the full extent of the site was not possible during the dive inspection survey. This would only be possible through the excavation of pre-development archaeological test trenches.

4.2.4 DL CH 11

This anomaly was located inside the harbour mouth and comprised a series of two parallel acoustic shadows, each measuring 3.7m in length and 0.8m apart. A 50m circular search survey was carried out on this area. The survey recorded seafloor variations but there was no visible trace of any cultural heritage features. It is most likely that this was an acoustic artefact and not a physical anomaly.

4.2.5 DL CH 12

This anomaly was located in the centre of the two roundheads. It comprised a roughly circular anomaly that measured 3.7m in diameter. A 50m circular search survey was carried out on this area and no anomaly was noted. It is most likely that this anomaly was an acoustic artefact and not a physical anomaly.

4.2.6 DL CH 13

This anomaly was located outside the harbour mouth. It comprised a single linear acoustic shadow, measuring 4.6m in length and 0.3m in width. A 50m circular search survey was carried out on this area and no anomaly was noted. It is most likely that this anomaly was an acoustic artefact and not a physical anomaly.

4.2.7 DL CH 14

This anomaly was located outside the harbour at the eastern end of the navigation approach channel. The diver survey on this site did not record the presence of any feature at the location. A mooring chain and anchor associated with a nearby navigation buoy was identified to the north of the location. It is most likely that this feature may be the ensonified anomaly. This mooring chain and anchor were clearly not of archaeological significance.

4.2.8 DL CH 15

This anomaly was located to the south of the previous mooring chain, on the eastern end of the proposed outer harbour approach channel. The side scan sonar image indicated that this was a 95.3m long undulating seafloor anomaly. A 50m circular search survey was carried out on this area. The survey recorded seafloor variations but there was no visible trace of any cultural heritage features. Further review of the feature based on the results of the dive survey indicates that this may have propeller wash caused by a passing vessel. Consequently, it is most likely that this was an acoustic artefact and not a physical anomaly.

4.2.9 DL CH 16

This anomaly was positively identified as a navigation marker. It had a chain descending to the seafloor and a buried anchor.

4.2.10 Wreck W01966 at 53 18 10.006 N/ 006 07 38.298 W

This feature lay to the east of the immediate impact zone of the development and was not ensonified during the archaeo-geophysical survey. It was however located immediately adjacent to the proposed site and there was potential that remains may be buried within the development site. The dive survey concluded that it comprised a series of disarticulated metal beams, girders and plates, with no discernible complete hull structure noticeable. The metallic remains were noted adjacent to, interspersed with and overlying the stone of the east Pier. The remains appeared to be scattered over an area of 28m on the gravel seafloor and the angular rock. However, no definitive hull outline was identifiable.

These wreck remains were located at the position of recorded Wreck WO1966. Although there were no materials directly identifying the site as that of WO1966, the recording of the wreck remains in the immediate vicinity of the known wreck site appears to indicate that this was the site.

The remains noted at the location of WO1966 appear to be those of recorded shipwreck remains. As such they should be afforded protection. Although the surface expression of the wreck is low, there is potential that further more intact remains and associated materials may be contained beneath the

sediment. These remains may extend from the know wreck site into the proposed development zone, however confirmation of this was not possible during the dive inspection survey.

The development proposal indicates that the site of WO1966 is situated to the east of the main harbour channel. The proposal also indicates that this channel is due to be dredged. Dredging of this channel has the potential to impact or damage remains of Wreck WO1966 through both primary impact or secondary impact.

Primary impact of the remains would most likely be through dredging operations impacting the remains. Secondary impact would be encountered through exposure due to boat wash and any erosion caused by vessel activities.

Determination of the full extent of the wreck site and whether sections of the wreck WO1966 extend into the development zone was not possible during the dive inspection survey. It would only be possible through the excavation of pre-development archaeological test trenches.

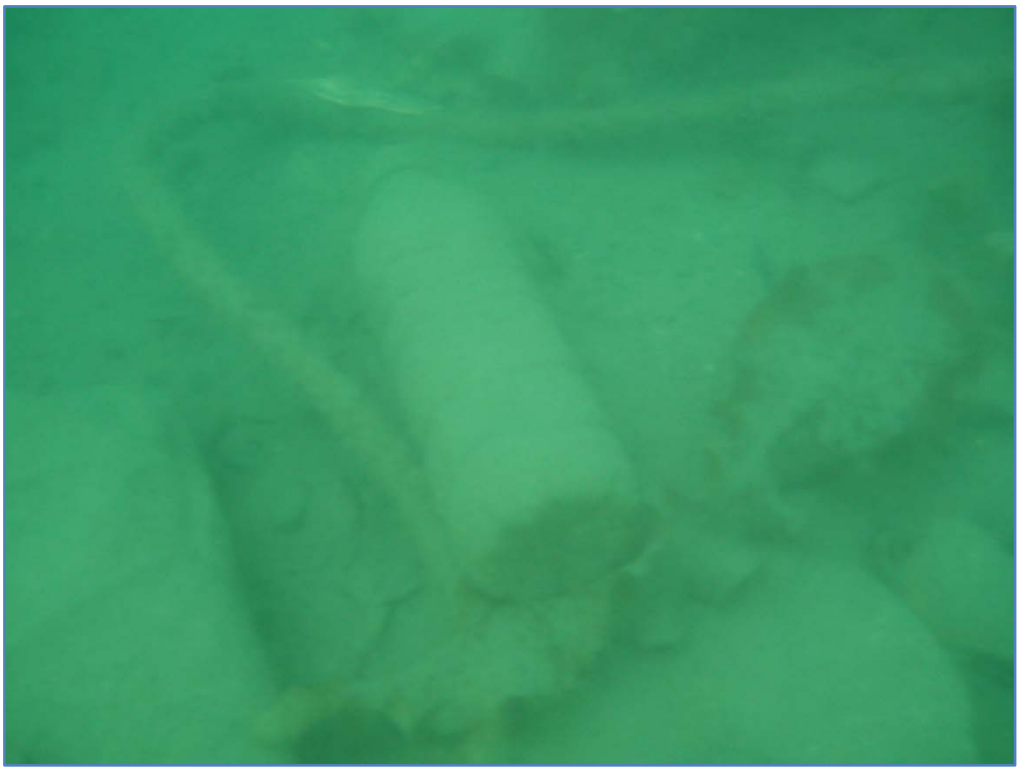


Plate 1. Large Bottle with Twisted metal at site of wreck WO1966

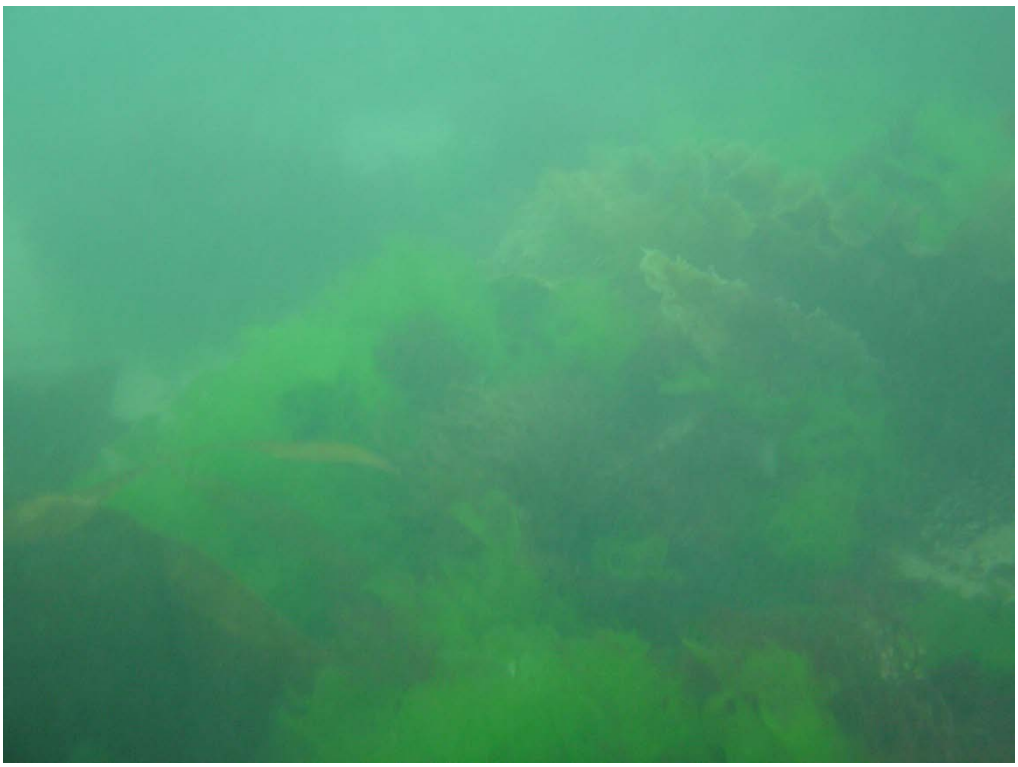


Plate 2. Weed encrusted metallic bars at site of wreck WO1966

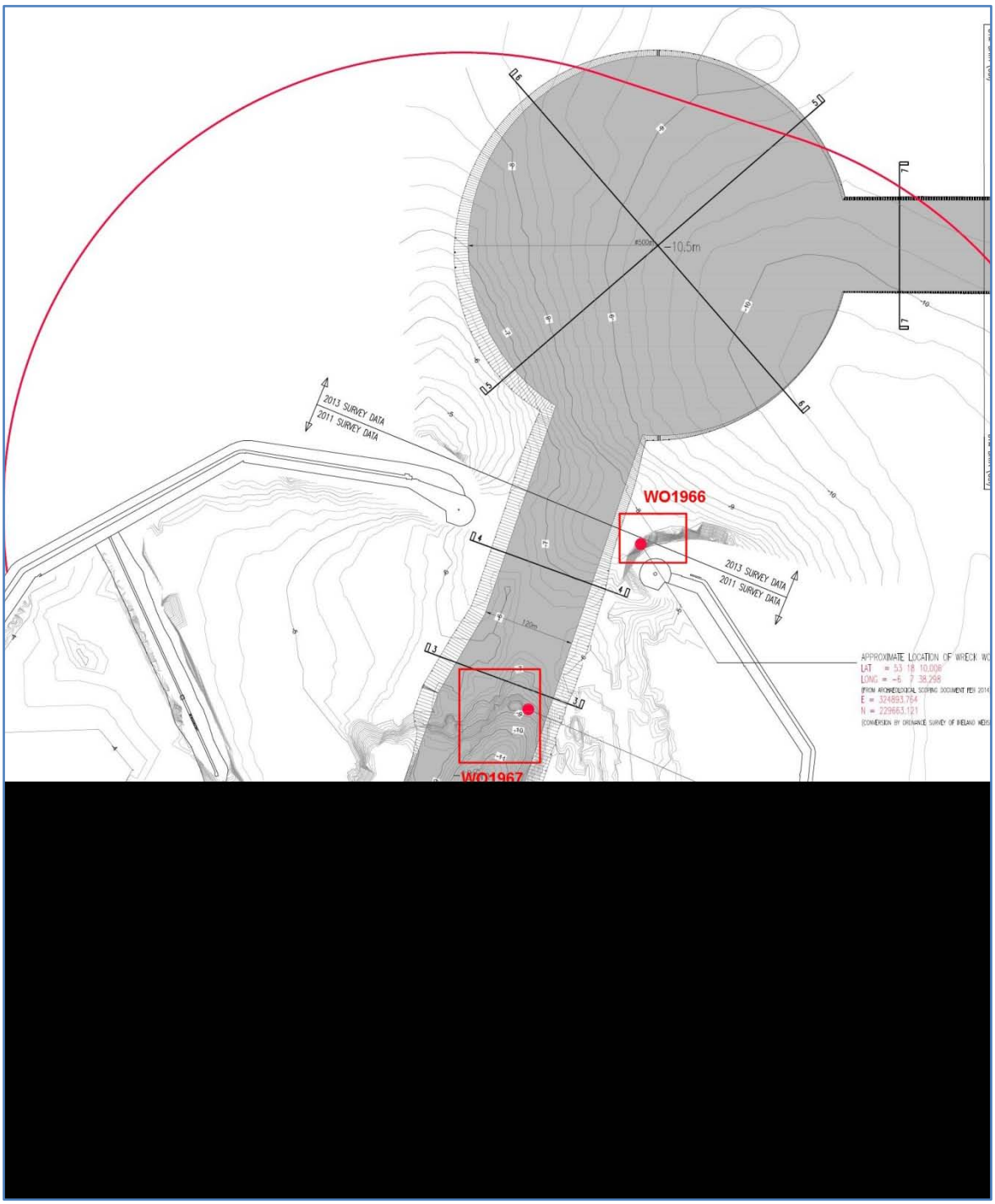


Figure 4. Wreck Locations

5. SUMMARY AND CONCLUSION

5.1 Summary

The proposed development area is contained in an area of rich archaeological and historical significance. A previously conducted archaeo-geophysical survey (13R73) recorded the presence of sixteen seafloor anomalies.

A dive inspection was carried out under licence no. 14D14. The aim of the dives were to confirm the nature of the anomalies. The dive inspections recorded that the two know wreck site were present and that all other anomalies were either modern or seafloor features or else acoustic artefacts.

The dive survey recorded that wreck remains, most likely associated with recorded wreck WO1966 were recorded at location 53 18 10.006 N/ 006 07 38.298 W. Whilst these remains were contained outside the immediate development zone, dredging of the nearby area has the potential to:

3. Impact remains of recorded wreck WO1966 which may be contained within the development zone through site dredging operations.

4. Uncover further remains of recorded wreck WO1966 which may be in the vicinity of the current site through erosion and/or boat wash

Wreck remains most likely associated with recorded wreck WO1967 were recorded at location 53 18 10.006 N/ 006 07 38.298 W, in the centre of the proposed development. Dredging of the area has the potential to:

3. Impact remains of recorded wreck WO1967 contained within the development zone through site dredging operations.

4. Uncover/impact further remains of recorded wreck WO1967 which may be in the vicinity of the current site through dredging and or secondary erosion caused by boat wash.

5.2 Conclusion

The sites of the two wreck remains (WO1966, WO1967) appear to be scattered wreck sites. Wreck remains WO1967 is contained within the development zone, whilst wreck remains WO1966 are contained adjacent to the development zone. Both sites are recorded shipwrecks, as such; the wreck, its remains and any associated material is protected by the National Monuments Act.

Both sites do not appear to be well contained small sites but rather scatters of wreck remains, with only sections of the wreck remains were visible on the surface. There is potential for further wreck remains be present in the adjacent seafloor substrate.

In situ preservation is the preferred mitigation measure for the site. Small design amendments and a monitoring regime may allow for such mitigation measures to be effected. As such, the presence of WO1967 in the centre of the development and WO1966 immediately outside the development zone does not preclude development.

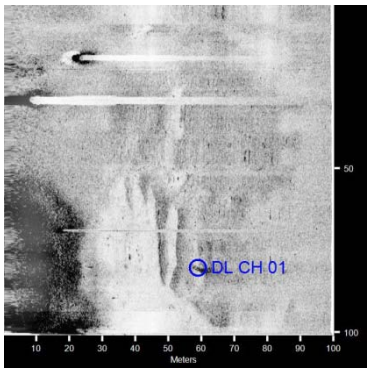
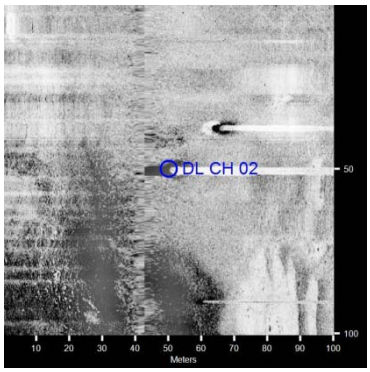
In order to effect this mitigation, a staged approach is recommended. This approach should include:

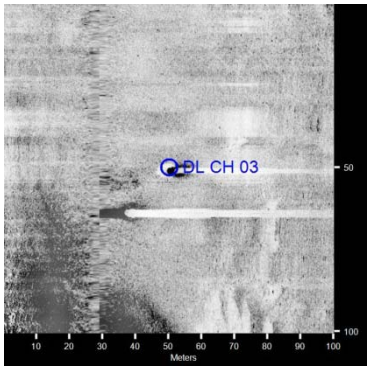
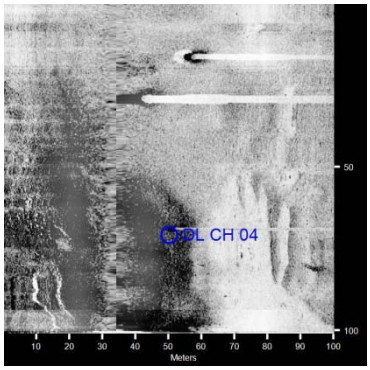
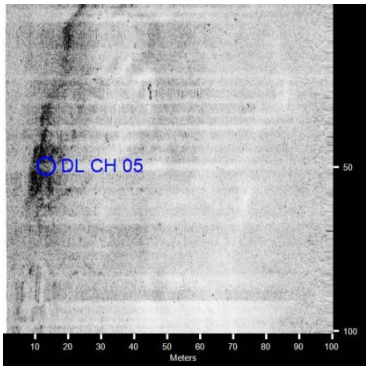
3. Determination of age and extend of Wreck Sites WO1966 and WO1967 through archaeological test trenching.

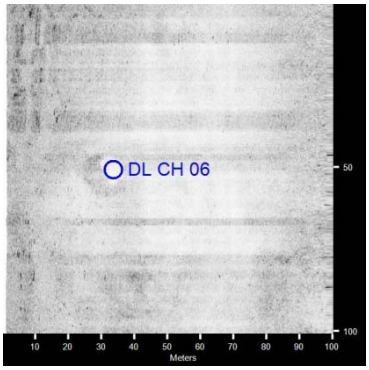
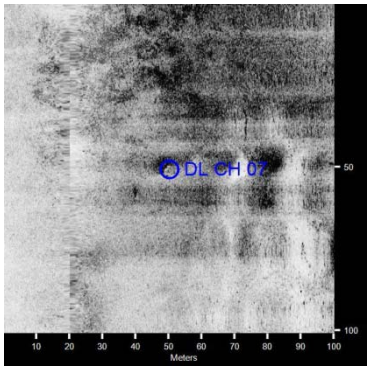
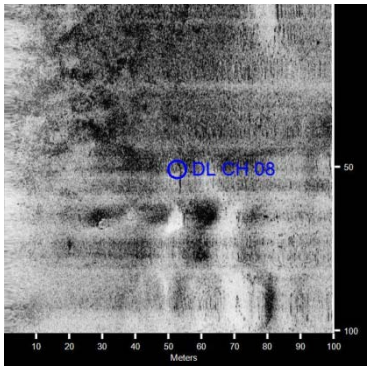
4. Project Design modification based on results of above (no.1) to allow for in situ preservation.

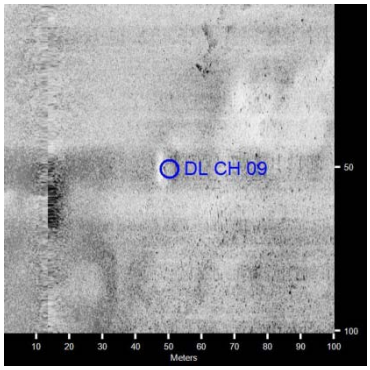
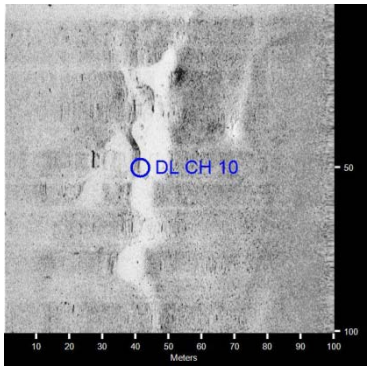
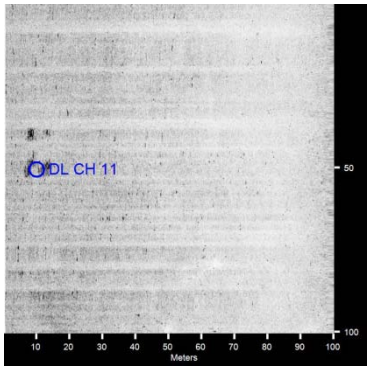
The staged mitigation should be undertaken, in conjunction with the Department of Arts Heritage and the Gaeltacht, and the National Museum of Ireland.

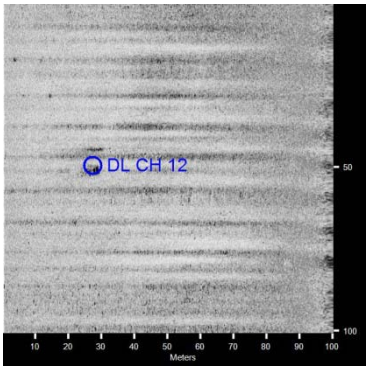
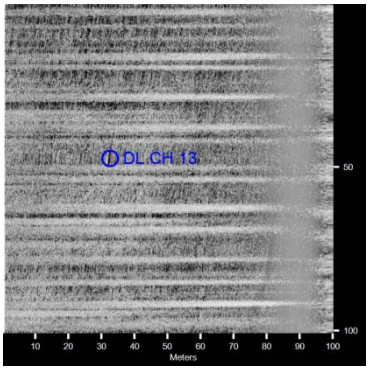
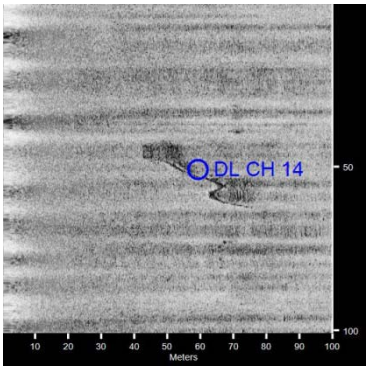
APPENDIX 1. SIDE SCAN SONAR ANOMALY DESCRIPTION

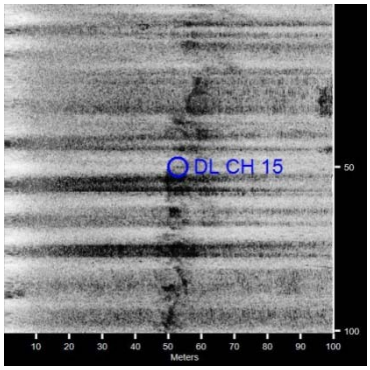
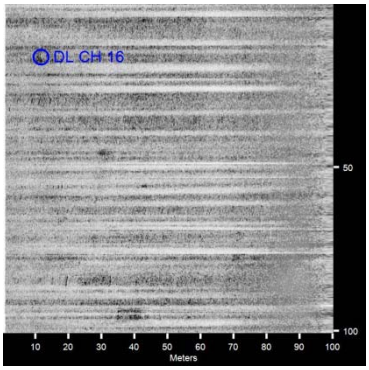
Target Image	Target Info	User Entered Info
	DL CH 01 • Sonar Time at Target: 5/22/2014 12:49:23 PM • Click Position 53.2971607666 -6.1309018096 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2971607666 -6.1309018096 (LocalLL) (X) 724594.07 (Y) 729058.92 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 35819 • Range to target: 58.59 Meters • Fish Height: 12.99 Meters • Heading: 46.890 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	Dimensions and attributes • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 5.34 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Piling • Classification2: • Area: • Block: • Description: Piling
	DL CH 02 • Sonar Time at Target: 5/22/2014 12:49:45 PM • Click Position 53.2978074885 -6.1311158715 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2978074885 -6.1311158715 (LocalLL) (X) 724577.92 (Y) 729130.50 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 35977 • Range to target: 7.42 Meters • Fish Height: 13.28 Meters • Heading: 59.890 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	Dimensions and attributes • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Piling • Classification2: • Area: • Block: • Description: Piling

	**DL CH 03** • Sonar Time at Target: 5/22/2014 12:49:51 PM • Click Position 53.2978487951 -6.1308344414 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2978487951 -6.1308344414 (LocalLL) (X) 724596.56 (Y) 729135.58 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 36018 • Range to target: 21.09 Meters • Fish Height: 14.65 Meters • Heading: 51.890 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Piling • Classification2: • Area: • Block: • Description: Piling
	**DL CH 04** • Sonar Time at Target: 5/22/2014 12:49:27 PM • Click Position 53.2974451108 -6.1313525058 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2974451108 -6.1313525058 (LocalLL) (X) 724563.20 (Y) 729089.77 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 35848 • Range to target: 16.01 Meters • Fish Height: 12.69 Meters • Heading: 52.390 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Piling • Classification2: • Area: • Block: • Description: Piling
	**DL CH 05** • Sonar Time at Target: 5/22/2014 12:47:29 PM • Click Position 53.2988385418 -6.1301625805 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2988385418 -6.1301625805 (LocalLL) (X) 724638.45 (Y) 729246.87 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124252.jsf • Ping Number: 35016 • Range to target: 86.91 Meters • Fish Height: 13.09 Meters • Heading: 181.790 Degrees • Event Number: 0 • Line Name: 20140522124252 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 60.93 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown undualtion on seafloor. Image appears to indicate slight seafloor depression

	**DL CH 06** • Sonar Time at Target: 5/22/2014 12:46:58 PM • Click Position 53.2995445018 -6.1300202997 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.2995445018 -6.1300202997 (LocalLL) (X) 724645.88 (Y) 729325.66 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124252.jsf • Ping Number: 34792 • Range to target: 66.60 Meters • Fish Height: 14.35 Meters • Heading: 179.290 Degrees • Event Number: 0 • Line Name: 20140522124252 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 6.70 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown seafloor concical shaped depression
	**DL CH 07** • Sonar Time at Target: 5/22/2014 12:46:20 PM • Click Position 53.3006666875 -6.1307857419 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3006666875 -6.1307857419 (LocalLL) (X) 724591.60 (Y) 729449.17 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124252.jsf • Ping Number: 34527 • Range to target: 30.08 Meters • Fish Height: 11.91 Meters • Heading: 177.200 Degrees • Event Number: 0 • Line Name: 20140522124252 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Possible wreck • Classification2: • Area: • Block: • Description: Possible area of scattered remains of Shipwreck WO1967
	**DL CH 08** • Sonar Time at Target: 5/22/2014 12:46:27 PM • Click Position 53.3006136323 -6.1311863342 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3006136323 -6.1311863342 (LocalLL) (X) 724565.05 (Y) 729442.57 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124252.jsf • Ping Number: 34572 • Range to target: 52.34 Meters • Fish Height: 12.79 Meters • Heading: 181.290 Degrees • Event Number: 0 • Line Name: 20140522124252 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 8.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Linear Feature • Classification2: • Area: • Block: • Description: Small linear feature possibly associated with Shipwreck WO1967

	**DL CH 09** • Sonar Time at Target: 5/22/2014 1:00:15 PM • Click Position 53.3008309355 -6.1317900100 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3008309355 -6.1317900100 (LocalLL) (X) 724524.19 (Y) 729465.69 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522125659.jsf • Ping Number: 40442 • Range to target: 36.72 Meters • Fish Height: 7.91 Meters • Heading: 178.500 Degrees • Event Number: 0 • Line Name: 20140522125659 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Possible wreck • Classification2: • Area: • Block: • Description: Possible remains associated with Wreck WO1967
	**DL CH 10** • Sonar Time at Target: 5/22/2014 12:59:51 PM • Click Position 53.3010333641 -6.1301022225 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3010333641 -6.1301022225 (LocalLL) (X) 724636.09 (Y) 729491.16 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522125659.jsf • Ping Number: 40267 • Range to target: 58.79 Meters • Fish Height: 7.13 Meters • Heading: 181.390 Degrees • Event Number: 0 • Line Name: 20140522125659 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 46.67 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Possible wreck • Classification2: • Area: • Block: • Description: Possible wreck remains associated with WO1967
	**DL CH 11** • Sonar Time at Target: 5/22/2014 12:53:04 PM • Click Position 53.3017122297 -6.1297387873 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3017122297 -6.1297387873 (LocalLL) (X) 724658.33 (Y) 729567.32 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522124914.jsf • Ping Number: 37385 • Range to target: 90.03 Meters • Fish Height: 7.81 Meters • Heading: 49.390 Degrees • Event Number: 0 • Line Name: 20140522124914 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 5.79 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown seafloor anomaly

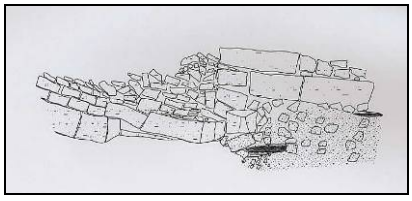
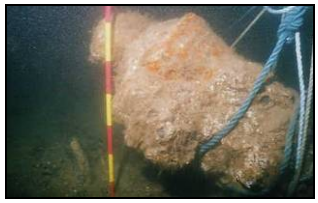
	**DL CH 12** • Sonar Time at Target: 5/22/2014 12:58:21 PM • Click Position 53.3029671753 -6.1287160279 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3029671753 -6.1287160279 (LocalLL) (X) 724722.84 (Y) 729708.72 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522125659.jsf • Ping Number: 39632 • Range to target: 72.75 Meters • Fish Height: 6.74 Meters • Heading: 161.000 Degrees • Event Number: 0 • Line Name: 20140522125659 • Water Depth: 0.78 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 3.47 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown Anomaly • Classification2: • Area: • Block: • Description: Unknown Anomaly
	**DL CH 13** • Sonar Time at Target: 5/22/2014 12:40:21 PM • Click Position 53.3048352500 -6.1263773015 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3048352500 -6.1263773015 (LocalLL) (X) 724873.25 (Y) 729920.64 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522123816.jsf • Ping Number: 31983 • Range to target: 67.57 Meters • Fish Height: 9.86 Meters • Heading: 100.200 Degrees • Event Number: 0 • Line Name: 20140522123816 • Water Depth: 0.77 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown anomaly
	**DL CH 14** • Sonar Time at Target: 5/22/2014 12:01:48 PM • Click Position 53.3063906032 -6.1121202333 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3063906032 -6.1121202333 (LocalLL) (X) 725818.78 (Y) 730118.70 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522115910.jsf • Ping Number: 15596 • Range to target: 58.98 Meters • Fish Height: 10.45 Meters • Heading: 260.590 Degrees • Event Number: 0 • Line Name: 20140522115910 • Water Depth: 0.77 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Anchor and chain • Classification2: • Area: • Block: • Description: Anchor and chain

	**DL CH 15** • Sonar Time at Target: 5/22/2014 11:59:47 AM • Click Position 53.3061049463 -6.1071315286 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3061049463 -6.1071315286 (LocalLL) (X) 726152.06 (Y) 730095.72 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522115910.jsf • Ping Number: 14740 • Range to target: 52.54 Meters • Fish Height: 10.64 Meters • Heading: 229.900 Degrees • Event Number: 0 • Line Name: 20140522115910 • Water Depth: 0.77 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 93.46 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Unknown • Classification2: • Area: • Block: • Description: Unknown linear seafloor feature, possible prop wash
	**DL CH 16** • Sonar Time at Target: 5/22/2014 11:58:09 AM • Click Position 53.3067361799 -6.1063798733 (WGS84) 0.0000000000 0.0000000000 (NAD27LL) 53.3067361799 -6.1063798733 (LocalLL) (X) 726200.29 (Y) 730167.27 (Projected Coordinates) • Map Projection: IRENET95.IrishTM • Acoustic Source File: E:\Dunleary Sidescan and MagData\DunlearySidescan\20140522115006.jsf • Ping Number: 14046 • Range to target: 88.47 Meters • Fish Height: 11.33 Meters • Heading: 99.500 Degrees • Event Number: 0 • Line Name: 20140522115006 • Water Depth: 0.77 Meters	**Dimensions and attributes** • Target Width: 0.00 Meters • Target Height: 0.00 Meters • Target Length: 0.00 Meters • Target Shadow: 0.00 Meters • Mag Anomaly: • Avoidance Area: • Classification1: Navigation marker • Classification2: • Area: • Block: • Description: Navigation marker

Appendix 5.10.6

Marine Archaeological Survey & testing Report

ADCO Ltd November 2014

DUN LAOGHAIRE CRUISE DEVELOPMENT PROJECT

ARCHAEOLOGICAL INVESTIGATIONS 14E0441, 14D0045, 14R0130

THE ARCHAEOLOGICAL DIVING COMPANY LTD.

DUN LAOGHAIRE CRUISE DEVELOPMENT PROJECT

UNDERWATER INVESTIGATIONS 14E0441, 14D0045, 14R0130

DRAFT 06 January 2015

Project Director **Dr. Niall Brady**

Brehon House, Kilkenny Road, Castlecomer, Co. Kilkenny info@adco-ie.com

THE ARCHAEOLOGICAL DIVING COMPANY LTD.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ADCO	The Archaeological Diving Company Ltd
DAHG	Department of Arts, Heritage and the Gaeltacht
DLHC	Dun Laoghaire Harbour Company Ltd
E	Easting
EIS	Environmental Impact Statement
GSI	Geological Survey of Ireland
IAC	Irish Archaeological Consultancy Ltd
N	Northing
NGR	National Grid Reference
NMI	National Museum of Ireland
OPW	Office of Public Works
RIB	Rigid Inflatable Boat
RMP	Record of Monuments and Places
RPS	Record of Protected Structures
UTM	Universal Transverse Mercator

NON TECHNICAL SUMMARY

Requirement and Background

The Archaeological Diving Company Ltd (ADCO) was appointed to conduct underwater investigations at the charted locations of one known shipwreck site and one possible shipwreck site in Dun Laoghaire Harbour, Co. Dublin.

The two wrecksites are included in the published Shipwreck Inventory of Ireland, as wrecksites W01966 and W01967. The former site's location is charted at the harbour mouth against the East Pier and is a known shipwreck based on a dive report from 1996. The latter site's location is charted within the main harbour and is a possible shipwreck based on an anomaly detected by the Irish National Seabed Survey.

Both locations are within potential impact zones associated with the proposed dredging of an approach channel into the harbour to facilitate future cruise ship movements.

Marine geophysical survey conducted for the overall project in May 2014 under licence 13R073 concluded that there was some correlation between the reported wrecksite locations and side-scan sonar contact locations, which seemed to represent debris associated with the wrecks. It also observed slight deviations in the magnetometer data over the areas associated with both wrecksites.

Subsequent underwater inspection in September 2014 at the two charted wrecksite locations concluded that there was wreck remains at both locations, which represented scattered remains with only sections of wreckage visible on the surface.

At the request of the DAHG, underwater investigation of both wrecksite locations was required to further inform the nature and extent of the two sites. This work was to include detailed mapping where possible and the cutting of investigation trenches across both sites, to indicate stratigraphic depth; complexity of wreckage remains and the potential for dating each site.

Observations

ADCO was appointed to the project at this stage, and carried out a seven-day investigation project between 25th November and 4th December 2014 to meet the Department's requirements. The work anticipated the presence of wrecks at both locations. However there was no wreckage located at either of the charted coordinates for W01966 or W01967. These observations were

concluded following an extensive search and both probing and dredging at each location.

The search of a wide area beside both locations located wrecksite W01966, some 85m east of the charted location. Two pieces of exposed ironwork lay within metres of timberwork that was substantially buried. Two investigation trenches cut at the site revealed a composite array of ships' timbers lying close against the foot of the East Pier's rock armour. The remains are largely buried in the covering sands, and appear to be the hull section of a large wooden vessel orientated northwest-southeast. The remains are wedged against the foot of the rock armour and run north of it in a sloping fashion. It was not possible to expose the full depth of the remains or their full extent. The removal of covering sands around one of two iron pieces lying beside the wreck revealed the presence of boulders underneath the iron. A scaled drawing has been made of the remains.

No remains were located that might be associated with W01967. Investigation at the charted location revealed an encrusted fish box that was partially exposed above the covering soft silts. Metal-detection survey did not highlight the presence of any anomalies. Consideration should be given to the possibility of changes in the seabed levels since the original record of a possible wreck was made. At that point in time, seabed levels were noted to be 8m depth. Today, seabed levels in this location are 10-11m deep.

Impact assessment

The actual location of W01966 lies 87m from potential impact of the proposed dredging works. Although it is likely that still-buried remains of the wreck await discovery, it is unlikely that sections of articulated remains would extend to within the proposed impact area.

The present work did not locate wreckage associated with the record for W01967. Following the work completed at the charted location, it may be concluded that there will be no impact on wreckage here, as no remains exist.

A question does remain in relation to W01967 given that the observations of the present work are at variance with the record of inspection conducted in September 2014.

Mitigation

The following archaeological mitigation measures are recommended in relation to further works associated with the proposed dredging scheme:

The charted location for wrecksite W01966 should be revised and updated to reposition the wreck to its actual location.

There is no archaeological reason for the dredging programme not to proceed in this area.

The results of any additional bore-holes, seabed sampling or other geo-technical data to be acquired as part of the development project should be reviewed and assessed by a competent marine archaeologist.

An exclusion zone should be established around the known location of W0-1966, within which all works temporary and permanent must be prohibited, to protect the wrecksite from any unwarranted impacts. The nature and extent of such an exclusion zone should be defined in consultation with the National Monuments Section at the Department of Arts Heritage and the Gaeltacht, but one can anticipate it would not be less than 80m in all directions.

The principal mitigation during the implementation phase of the project will be archaeological monitoring. This would apply to all ground and seabed disturbance activities, including dredging works. It will require full-time monitoring of the dredging activity, with the ability to recover any material deemed to be of interest that may become exposed during the dredging works.

A finds retrieval protocol would be required in line with the requirements of the National Museum of Ireland.

The exposure of archaeological material during dredging would require new seabed inspection to determine the nature and extent of such remains.

Recommendations are subject to the approval of the National Monuments Section at the Department of Arts, Heritage and the Gaeltacht.

LIST OF FIGURES

1.0 INTRODUCTION

1.1 General

The Archaeological Diving Company Ltd (ADCO) was appointed by Irish Archaeological Consultancy Ltd on behalf of Waterman Moylan, consulting engineers to Dun Laoghaire Harbour Company Ltd, to conduct underwater investigations at the charted locations of one known shipwreck site and one possible shipwreck site in Dun Laoghaire Harbour, Co. Dublin.

The two wrecksites are included in the published Shipwreck Inventory of Ireland, as wrecksites W01966 and W01967.[1] The former site's location is charted at the harbour mouth against the East Pier and is a known shipwreck based on a dive report from 1996. The latter site's location is charted within the main harbour and is a possible shipwreck based on an anomaly detected by the Irish National Seabed Survey.

Both locations are within potential impact zones associated with the proposed dredging of an approach channel into the harbour to facilitate future ship movements.

A series of archaeological studies carried out in 2014 led to the requirement for the present work. Marine geophysical survey conducted for the overall project in May 2014 under licence 13R073 concluded that there was some correlation between the reported wrecksite locations and side-scan sonar contact locations, which seemed to represent debris associated with the wrecks.[2] It also observed slight deviations in the magnetometer data over the areas associated with both wrecksites.

Subsequent underwater inspection in September 2014 at the two charted wrecksite locations concluded that there was wreck remains at both locations, which represented scattered remains with only sections of wreckage visible on the surface.[3]

The Department of Arts, Heritage and the Gaeltacht requested a programme of underwater investigation of both wrecksite locations to inform further the nature and extent of the two sites. This work was to include detailed mapping where possible and

[1] Karl Brady, *Shipwreck inventory of Ireland. Louth, Meath, Dublin and Wicklow* (Stationary Office, Dublin, 2008), p. 368.
[2] Conall O'Malley and Eoghan Kieran, 'Report of geophysical survey, Dun Laoghaire Cruise Project at Dun Laoghaire Harbour, Co. Dublin. Licence 13DR73', unpublished report by Geomara, 2014, revision 1.
[3] Eoghan Kieran, 'Report on archaeological dive inspection, 3 no. anomalies, Dun Laoghaire Harbour, Co. Dublin. Licence 14D00014', unpublished report by Geomara 2014, v3.

the cutting of investigation trenches across both sites, to indicate stratigraphic depth; complexity of wreckage remains and the potential for dating each site.

ADCO was appointed to the project at this stage, and carried out a seven-day investigation project between 25th November and 4th December 2014 to meet the Department's requirements.

1.2 Location

The coordinates presented for the investigations are those recorded in the *Shipwreck Inventory*, summarized in Table 1.

Reference	Latitude	Longitude	ING E	ING N	UTM 29N E	UTM 29N N
W01966	58 18 10.006N	006 07 38.298W	324893	229663	691412	5909801
W01967	58 18 03.096N	006 07 46.596W	324745	229446	691268	5909582

Table 1: Coordinates of wrecksite locations based on WGS data and projected in Irish National Grid (ING) and Universal Transverse Mercator 29 North (UTM 29N), with conversions based on OSi converter <http://osi.ie/calculators/converter_index.asp>.

The coordinates position W01966 on the terminus of the East Pier at the harbour entrance and W01967 within the central area of the harbour approximately 240m south of the entrance and 350m east of the east pier (Figures 1-3). Wrecksite W01966 lies just outside the proposed footprint for dredging by 30m, while W01967 lies within the dredging footprint.

1.3 Method

In preparation for site work, ADCO acquired a geo-referenced copy of the multi-beam contour tile that shows the seabed levels within Dun Laoghaire Harbour (Figure 4).

ADCO applied for the following archaeological licenses to carry the work: Excavation Licence, Detection Device Licence, Dive Survey Licence. ADCO completed a Health and Safety Risk Assessment. Both sets of documents were reviewed by the client's representatives.

Site work was conducted using an archaeological dive team comprising four experienced and certified personnel, operating Surface Supplied Diving Equipment, supported by adequate boat cover and working within the Diving at Work regulations to ensure safety in the work place. The dive team members comprised Dr. Niall

Brady, project leader; Aisling Collins, archaeological diver; Kyle McCoy, diver; and Brian MacAllister, dive supervisor.

Dive support was provided by the Geological Survey of Ireland's (GSI) survey vessel, the *RV Keary*, captained by Sean Cullen. The GSI's rib *Geo* was also used during one day.

The programme sought to commence site work with a pre-disturbance survey of each wrecksite location, mapping the visible remains.

This was to include the laying of a measured baseline to assist with accurate recording, and the locations of fix points being recorded using the *Keary's* DGPS systems.

Where visibility permitted, a comprehensive photographic record would be made.

Investigation trenches would ideally be cut across each wrecksite to determine the buried extent of each site. The trenches would be located where it was determined to return the greatest level of information in terms of clarifying the construction and extent of each wreck site, and to determine the articulated integrity of each site.

It was anticipated that two trenches would be cut across each site, in a linear fashion that would be somewhat wider than the intact remains. In the case of W01967 the record indicated it to be 5m wide, and so the trenches would each be *c.* 6m long. The details for W01966 were not clear in advance of site work commencing.

Excavation would be conducted manually with the assistance of a suction-dredge, where the diver operates and directs the dredge-head and spoil is pumped through a 5mm mesh. This method allows the recovery of any small artefacts or organic material disturbed by the excavation work that is not immediately recovered by the diver.

Any objects or remains recovered as a result of the investigation works would be subject to conservation as determined by the National Museum of Ireland.

The project report would set out the observations made in a clear and concise manner.

The results would be assessed from the perspective of the known and likely impacts from the proposed dredging programme.

The project archive would contain copies of field notes and constraints mapping used, where appropriate.

2.0 OBSERVATIONS, W01966

2.1 Background observations

The published entry for wrecksite W01966 reads:

> Wreck discovered by Marlin Sub Aqua Club during training dive. Wreck lies exposed on a sandy seabed beside the rocky slope of the East Pier foundation in 10-12m of water. Wreck appears to extend into the seabed, with only 3m of wreck visible. Remains consist 'of a few transverse ribs and part of a keel or keelson'. Pieces of iron, including an anchor, lie scattered on the slower slope of the pier'.[4]

A correspondence file of the original report has been lodged in the National Museum of Ireland and includes the following additional information:

> Lies on a sandy seabed coming off the rocky slope of the pier foundation and consists of a few transverse ribs and part of a keel or keelson, in addition there are some pieces of iron lying about and a little further up the rocky slope there is an anchor lodged. The remains appear to have the same age and the size of the anchor would be consistent with that of a small schooner or ketch … the overall extent is only about three metres long although there seems to be more beneath the sand.[5]

The 2014 marine geophysical survey report observed:

> The WO1967 and WO1966 wreck site locations … are recorded in the SMR. It should be noted that it is uncertain how accurate the locations of these wrecks are. There is some correlation between the reported wreck locations and the sonar contact locations which were noted during the geophysical survey. The contacts seem to represent debris associated with these wrecks. [In addition t]here were also slight deviations in the magnetometer data over the areas associated with WO1966 and WO1967.[6]

The September 2014 underwater inspection report observed:

> This feature lay to the east of the immediate impact zone of the development. It comprised a series of disarticulated metal beams, girders and plates, with no discernible complete hull structure noticeable. The metallic remains were noted adjacent to, interspersed with and overlying the rock armour of the east Pier. The remains appeared to be scattered over an area of 28m on the gravel seafloor and the angular rock armour. However, no definitive hull outline was identifiable.
>
> These wreck remains were located at the position of recorded Wreck WO1966. Although there were no materials directly identifying the site as that of WO1966, the recording of the wreck remains in the immediate vicinity of the known wreck site appears to indicate that this was the site.[7]

[4] Brady, *Shipwreck inventory of* Ireland, p. 368.
[5] Report prepared by Cormac Lowth, dated 29/12/1996 and sent with cover note to NMI, reference NMI IA/262/1996. Accessed 15/12/2014.
[6] O'Malley and Kieran, 'Report of geophysical survey, Dun Laoghaire Cruise Project at Dun Laoghaire Harbour, Co. Dublin. Licence 13DR73', pp 11-12, 16.
[7] Kieran, 'Report on archaeological dive inspection, 3 no. anomalies, Dun Laoghaire Harbour, Co. Dublin. Licence 14D00014', p. 5.

2.2 Site assessment

Appendix 1 presents the dive log of work completed during the underwater investigations carried out by ADCO, which includes underwater photographs. On 26/11/2014, dive work commenced to locate the wrecksite by positioning the dive boat over the charted location of W01966. A series of circular searches on the seabed were undertaken (Dives 4-7). These extended across the East Pier's rock armour and the adjacent area of seabed, reaching 90m west across the harbour mouth, 40m north out to sea, and 70m east. The inspections also extended south around the pier head, to consider an area of disturbance highlighted in the multi-beam data. In the absence of any clear indication of wreckage, a trench was excavated at the charted location (Dive 12). The conclusion reached is that there is no indication of wreckage at the charted location, within its immediate vicinity at the pier head, or within the eastern half of the harbour's entrance.

2.3 Identification of the wrecksite

Wrecksite W01966 was discovered by extending the search area eastwards (Dives 15-20).[8] The wrecksite was identified by observing two pieces of corroded iron lying at the base of the East Pier's rock armour, and within metres of a small exposed section of timber, all of which is centered on 691495E 5906822N (UTM 29N) / 324975E 229681N ING, some 85m east of the charted location for the wrecksite.

There was no observation of the anchor that was mentioned in the discovery of this wrecksite in 1996, or of metal beams, girders or plates noted in September 2014. Investigation of the surrounding sands revealed an intact section of a vessel lying largely buried in the sands at the foot of the rock armour. The section exposed during the investigations was revealed in an area extending 2.5m northwards from the rock armour on a northwest-southeast alignment. The potential for further sections to be present remains.

The rock armour protection at the terminus to the East Pier commences with a steeply sloped glacis that extends from the wall-top above the High Water Mark, to a point below mean Low Water, where there is a distinct edge to the feature (Dive 15). The stonework on the glacis is made from cut granite blocks designed to present a smooth surface, with little opportunity for gaps to form. A linear breakwater is built across the glacis, running north-south. The breakwater is four courses of stonework

[8] We are grateful for a direct communication with Cormac Lowth on this matter, who first discovered the site in 1996.

high and has a stepped appearance on its west side. It terminates abruptly at the outer edge of the glacis. The breakwater provides a useful key to positioning the wrecksite, which is located close to it at the base of the rock armour. A more random arrangement of granite blocks occurs below the glacis. At first there is general tumble of small and medium-sized rock that extends seawards, but this falls away in a series of very large boulders that measure over 2m in size and fall 3-4 metres further before the present seabed is reached, at depths of 10-12m. The boulders provide many gaps and voids and are ideal entrapment features for mobile artefacts, but there was no indication of the anchor noted in 1996.

The line of rock armour where it meets the seabed is irregular, and boulders extend onto the seabed proper as well as being retained within the line of the armour. The seabed comprises of stiff coarse sand, filled with razor clam and other shell types. Underwater visibility was generally good at approximately 1m, and the absence of extensive layers of silt ensured that such visibility was not dramatically reduced when the sediment was disturbed.

The two pieces of ironwork identified were both lying directly against the rock armour. One piece retains a flattened cross-section with a rounded edge and is broadly curved at one end, measuring 130cm long, 13cm wide and 4cm thick. It represents the most easterly element of the exposed wreck. The second metal piece lies 70cm to its west. It is a long straight piece and is round in section, measuring 125cm long and 4.5cm in diameter. Removal of the sediment around this piece revealed its full surviving length. It lies loose on the seabed and rests on a series of smaller boulders that lie 30cm underneath the covering sands. The boulders were not disturbed. A larger boulder associated with the rock armour lies beside the second iron piece. The first sight of timbers occurred 3.5m further west. The top of two timbers were observed; one of which ran parallel with the rock armour, while the other lay at right angles to it.

Two small excavation trenches were opened along a 6m-long baseline that extended from the round-sectioned iron piece to the timbers (Trenches 1-2, Figure 5). A combination of dredging and manual excavation opened trenches that were approximately 1.8m long, 2m wide and 50cm deep. These were aligned east-west and north-south respectively. It was not possible to excavate one continuous trench due to the intrusion of rock at this location. The sediment was filled with seashell which darkened in colour at depth, compromising the results of photography. It was however possible to plan the results and to take an initial video record from which stills images are captured (Figure 5, see photographs in Appendix 1, Dive 17).

Several position fixes were taken along the baseline by extending a shot-line vertically from the baseline to the surface, where positioning was made by manoeuvering the *Keary* overhead.

The two iron pieces can be assumed to be associated with the wreck but are not integral to its structure; they may be characterized as part of the ship's furniture or former cargo. The structural information lies in the timbers. A line of seven framing timbers was exposed at the west side (Trench 2). They are square in section and measure 20cm in width and depth. The framing timbers are aligned east-west and are sandwiched between two sets of planks (outer planks and ceiling planks) that run at right angles to the framing timbers (north-south). This composite structure was exposed over a 2.4m long by 50cm wide area, aligned north-south. A second area of timbering was exposed to the east, and comprised a series of three planks running east-west that intersect with a single plank at right angles, which measures 17cm in width (Trench 1). The single plank was exposed over a length of 1.3m, to a depth of 5cm. The planking lying to its west runs up to and abuts the long plank; there was no indication that one overlay the other.

It remains unclear what the direct relationship of the two elements of timber structure are to each other. The first element appears to be a piece of hull structure, where the framing timbers lay between the external hull planks and below the internal, ceiling, planks of the lower deck. The second element may represent part of a keelson, but too little was exposed to be clear. In neither section of timbering was there any clear indication of the use of metal fastenings. A single dowel hole was observed towards the terminus of one planking timber, as indicated on Figure 5. The absence of metal pins supports the notion that this is a fully timber wreck.

The two elements of timberwork and the round-sectioned piece of ironwork all retain a gentle slope northwards. While the timberwork was exposed across the width of the 2m-wide trench, it was clear that further elements lay to the north outside the trench extent. Despite a robust search-and-probe of the seabed using a slender stainless steel spike to trace the seaward extension of wreckage, no indication of such was possible because the sediment proved resilient to probing below 20cm.

No objects were recovered during the investigations.

2.4 Conclusions

The presence of a wreck at W01966 is not in question, but its location is some 85m east of the charted position. Limited investigation conducted on the site indicates that

substantial remains lie buried close against the toe of the East Pier's rock armour. It was not possible to confirm the northern extension of wreckage. The wreck is that of a timber vessel of considerable size.

There are records of several shipwrecking events at the mouth of Dun Laoghaire harbour close to the East Pier, but perhaps the most dramatic was that of the *Neptune*, which was lost along with several ships during a ferocious storm on the 9th February 1861. The *Neptune* was a 118-ton brig with a cargo of coal that struck rocks in a Northeast Gale Force wind and was stranded. Attempts to rescue her crew are illustrated on an engraving that was published in the *Illustrated London News*, showing Captain Boyd of *HMS Ajax* and some of his crew extending a lifeline from the shore to the stricken *Neptune* (Figure 6).[9] Boyd and five of his crew, along with five of the six-man crew of the *Neptune* died in the event. The harbour was newly built at the time, the East and West Piers being completed in 1842, but the size of the harbour's entrance was larger than had been advised and left vessels vulnerable to northeasterly storms.[10]

[9] Brady, *Shipwreck inventory of* Ireland, pp 352-353.
[10] Shaffrey Associates, *Dun Laoghaire Harbour. Inventory of structures, buildings and elements* (Dun Laoghaire Harbour Company, Dun Laoghaire, 2007), p. 9.

3.0 OBSERVATIONS, W01967

3.1 Background observations

The published entry for wrecksite W01966 reads:

> Possible wreck (INSS No. G145) identified during the National Seabed Survey. Wreck measures L 27m, W 5m with a height of 1m off the seabed. It lies in a general sea depth of 8m.[11]

The original INSS databased record is based on survey data taken in 2004, and reads:

> Possible wreck. Elongate [anomaly] but rough like rock and funny shape at one end. Length 26.5m, Width 4.5m, average Height 1.257m, average depth 7.705m.[12]

The 2014 marine geophysical survey report observed that there was some correlation between the reported wreck location and the sonar contact. It also positioned the wrecksite 80m west-southwest of the charted location, at 691190E 5909557N (UTM 29N).[13]

The September 2014 underwater inspection report observed:

> This feature was positively identified as shipwreck remains consistent with the location of recorded Wreck WO1967. The scattered site lay directly in the centre of the channel inside the mouth of the harbour. The remains appeared to comprise the scattered remains of a shipwreck orientated in a roughly N-S direction and contained within the silty gravel upper horizon of the harbour bed. The Dive Inspection recorded that the wreck remains appeared to be scattered over a 25m (N-S) x 15m (E-W) area. They comprised outer structural members and some internal fittings. An exposed section of what appeared to be a section of gunwale measured 8.2m in length and was exposed to a depth of 0.2m. There was no obvious signs of internal cargo, however visibility at the time of the survey was poor (c.2-3m).[14]

3.2 Site assessment

Appendix 1 presents the dive log of work completed during the underwater investigations carried out by ADCO. On 25/11/2014, dive work commenced to locate the wrecksite by positioning the dive boat over the location of W01967 recorded in

[11] Brady, *Shipwreck inventory of* Ireland, p. 368.
[12] INSS Record G145, provided by Sean Cullen, courtesy of the Geological Survey of Ireland, 15/12/2014.
[13] O'Malley and Kieran, 'Report of geophysical survey, Dun Laoghaire Cruise Project at Dun Laoghaire Harbour, Co. Dublin. Licence 13DR73', p. 25. The UTM 29N coordinate is based on conversion from the WGS84 coordinate provided in the report: 53.3029762615 Latitude -6.1261560344 Longitude.
[14] Kieran, 'Report on archaeological dive inspection, 3 no. anomalies, Dun Laoghaire Harbour, Co. Dublin. Licence 14D00014', p. 7.

Geomara's marine geophysical survey report. A circular search on the seabed was undertaken, extending out 15m from the target location (Dive 1) (Figure 7, W01967: Geomara location). No wreckage was identified. The seabed was observed to be generally flat with a low undulation and with a surface level of silt that blankets a harder gravel some 20cm below.

The search area for W01967 was repositioned to the charted location as recorded by the INSS in 2004 (Dives 2, 3, 8-11, 21) (Figure 7, W01967: Charted location). The seabed was more undulating and a slight hollow was encountered to the west of the target location. One encrusted feature was observed, while probing located a hard buried object. This work was followed by two investigation trenches being cut, but neither feature was archaeological in nature; the former being an abandoned fish box, the latter an isolated boulder. A metal-detector survey also failed to return any anomalies (Dive 21). Additional inspections of the seabed were made, extending the search area in all directions, and including the location of a wrecksite that is recorded on the Admiralty Chart 60m east-southeast of W01967 (Dive 13). No evidence for wreckage was observed during these additional searches.

Appendix 2 presents the results of two further approaches used to locate an anomaly at this location. Firstly it was possible to use the *Keary's* onboard sonar, but the sonar imaging indicated that the nature of the seabed would not generate a coherent image. No features were observed from this work that indicated wreckage. Secondly, a grapple survey was conducted from the surface. The grapple survey covered a much greater area but focused on the charted location, with the purpose of snagging any feature and diving the snag to determine its origin. However this approach also failed to identify any material.

3.5 Conclusion

The dive and prospection work completed for this report at the site and area associated with W01967 failed to observe any features associated with shipwreck on the seabed. The recovery of an abandoned and encrusted fish box from the site that was almost completely buried indicates the disturbed nature of the seabed at this location. The entire area is blanketed in a light silt that is at least 20cm deep, and is deeper still in defined hollows.

The original record in 2004 referred to a possible wreck, which was based on a marine geophysical anomaly detected remotely by multi-beam data. The multi-beam data derived in 2004 clearly shows evidence of dredging to the north of the HSS terminal and to a lesser degree north of the Carlisle Pier. The 2004 record also refers

to seabed levels being in the order of 8m, which is substantially shallower than the levels experienced today, at 10-12m.

Archaeological monitoring of dredging work within the harbour was reported at this time, which was carried out during dredging works and bed levelling/ploughing activities within the harbour, east of the marina and in the vicinity of the HSS ferry terminal. The work was undertaken to reduce siltation and achieve a design dredge depth of 6.1m.[15] It is not clear whether this work occurred before or after the multi-beam image was acquired. A large amount of modern material was observed in the monitoring, but nothing of archaeological significance was recovered. It does appear that seabed levels have been reduced in the area since 2004.

The archaeological result of the 2014 investigations conducted in November-December is at odds with the result arising from the 2014 inspections conducted in September, which confirmed the presence of wreckage at the charted location. This disparity cannot be explained based on current knowledge.

[15] O'Connor, D., 'Dun Laoghaire Harbour, Monkstown', in Isabel Bennett (ed.) *Excavations 2003* (Dublin 2006), 173-4.645. O'Connor, D. 'Archaeological monitoring of dredgings at Dun Laoghaire Harbour, 03E1190', unpublished report, CRDS 2003.

4.0 IMPACT ASSESSMENT

The actual location of W01966 lies 87m from potential impact associated with the proposed dredging works, which is associated with the top of the proposed dredge slope. Although it is likely that still-buried remains of the wreck await discovery, it is unlikely that sections of articulated remains would extend to within the proposed impact area.

The present work did not locate wreckage associated with the record for W01967. Following the work completed at the charted location, it may be concluded that there will be no impact on wreckage here, as no remains exist.

A question does remain in relation to W01967. The present work did not locate material at the charted location, and this is at variance with the record of inspection conducted in September 2014.

5.0 MITIGATION MEASURES

5.1 Pre-construction Measures

The following archaeological mitigation measures are recommended in relation to further works associated with the proposed dredging scheme:

The charted location for wrecksite W01966 should be revised and updated to reposition the wreck to its actual location.

There is no archaeological reason for the dredging programme not to proceed.

The results of any additional bore-holes, seabed sampling or other geo-technical data to be acquired as part of the development project should be reviewed and assessed by a competent marine archaeologist.

An exclusion zone should be established around the known location of W01966, within which all works temporary and permanent must be prohibited, to protect the wrecksite from any unwarranted impacts. The nature and extent of such an exclusion zone should be decided in consultation with the National Monuments Section at the Department of Arts Heritage and the Gaeltacht, but one can anticipate it would not be less than 80m in all directions.

5.2 Construction Phase Measures

Archaeological monitoring of all dredging activities will be carried out during the implementation phase, with the provision to resolve fully any material of archaeological significance observed at that point.

5.3 Archaeological Management Measures

RETAINING AN ARCHAEOLOGIST/S. An archaeologist specialised and experienced in maritime archaeology will be retained for the duration of the relevant works.

ARCHAEOLOGICAL LICENCES will be required to conduct the on-site archaeological works. Licence applications require the inclusion of detailed method statements, which outline the rationale for the works and the means by which the works will be resolved. Licence applications take a MINIMUM OF THREE WEEKS to process through the Department, and advance planning is required to ensure that the necessary permits are in place before site works commence. One can anticipate that the following licence types will be required: Excavation, to cover monitoring and

investigations works; Detection, to cover the use of metal-detectors; and Dive Survey, to cover the possibility of having to conduct underwater inspections and investigations.

ARCHAEOLOGICAL MONITORING will be carried out by suitably qualified and experienced maritime archaeological personnel licensed by the Department of Arts, Heritage and the Gaeltacht. Archaeological monitoring is conducted during all terrestrial, inter-tidal/foreshore and seabed disturbances associated with the development.

The monitoring will be undertaken in a safe working environment that will facilitate archaeological observation and the retrieval of objects that may be observed and that require consideration during the course of the works.

The monitoring will include a finds retrieval strategy that is in compliance with the requirements of the National Museum of Ireland.

THE TIME SCALE for the construction phase will be made available to the archaeologist, with information on where and when ground disturbances will take place.

DISCOVERY OF ARCHAEOLOGICAL MATERIAL. In the event of archaeologically significant features or material being uncovered during the construction phase, machine work will cease in the immediate area to allow the archaeologist/s to inspect any such material.

ARCHAEOLOGICAL MATERIAL. Once the presence of archaeologically significant material is established, full archaeological recording of such material will be recommended. If it is not possible for the construction works to avoid the material, full excavation will be recommended. The extent and duration of excavation will be a matter for discussion between the client and the licensing authorities. Final resolution of any such feature would be by record, with any artefacts or structural members recovered for permanent storage and/or conservation, in accordance with best practice and the requirements of the National Museum of Ireland.

ARCHAEOLOGICAL TEAM. It is recommended that the core of a suitable archaeological team be on standby to deal with any such rescue excavation. This would be complimented in the event of a full excavation.

ARCHAEOLOGICAL DIVE TEAM. It is recommended that an archaeological dive team is retained on standby for the duration of any in-water disturbance works on the basis of a twenty-four or forty-eight hour call-out response schedule, to deal with any

archaeologically significant/potential material that is identified in the course of the seabed disturbance activities.

A SITE OFFICE and facilities will be provided by Dun Laoghaire Harbour Company on site for use by archaeologists.

SECURE WET STORAGE facilities will be provided on site by the Dun Laoghaire Company to facilitate the temporary storage of artefacts that may be recorded during the course of the site work.

BOUYING/FENCING of any such areas of discovery will be necessary if discovered and during excavation.

MACHINERY TRAFFIC during construction will be restricted to avoid any identified archaeological site/s and their environs.

SPOIL will not be dumped on any of the selected sites or their environs.

POST-CONSTRUCTION PROJECT REPORT AND ARCHIVE. It is a condition of archaeological licensing that a detailed project report is lodged with the DAHG within 12 months of completion of site works. The report should be to publication standard and should include a full account, suitably illustrated, of all archaeological features, finds and stratigraphy, along with a discussion and specialist reports. Artefacts recovered during the works need to meet the requirements of the National Museum of Ireland.

PLEASE NOTE: the above recommendations are subject to the approval of the National Monuments Section at the Department of Arts, Heritage and the Gaeltacht.

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ADCO's team included: Niall Brady, project and site leader and report author; Aisling Collins, site archaeologist; Kyle McCoy, diver; Brian MacAllister, dive supervisor; Rex Bangerter, draughtsman, and Cameron Brady, Transition Year experience.

APPENDIX 1: DAY AND DIVE LOG

Date	25/11/2014
Team	Niall Brady (NB); Brian MacAllister (BMcA); Aisling Collins (AC); Kyle McCoy (KMcC); Sean Cullen (SC), Skipper *RV Keary*
Start time	08:30
End time	17:00
Activity	Mobilization, including loading kit onto *Keary* at Marina and at Coal Harbour Dives 1-3
Observations	None

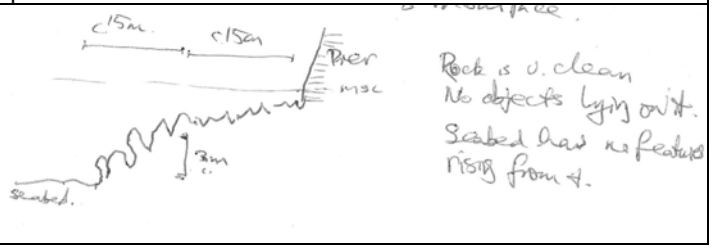
Dive No.	1
Date	25/11/2014
Location	W01967, Geomara
Shotline coordinates	691190E 5909558N UTM 29N; 324666E 229422N ING
Dive Supervisor	BMcA
Diver	NB
Time in	13:36
Time out	14:31
Sea state	Calm
Dive depth	12m
Observations	The purpose of the dive was to clarify the dive location in terms of W01967, as Geomara's geophysical survey report highlighted this as the location for the wrecksite. Underwater visibility was at 30-40cm. There was no indication of cultural material at the base of the shotline. A circular search was commenced, which extended out the 15m length of search line, and followed a full 360º sweep. The seabed is generally flat with some slight undulation. The surface sediment is a soft silt, with sand content. Once disturbed, visibility is reduced. No cultural material or indicator of wreckage or debris was observed.

Dive No.	2
Date	25/11/2014
Location	W01967
Shotline coordinates	691268E 5909582N UTM 29N; 324745E 229446N ING
Dive Supervisor	BMcA
Diver	NB
Time in	13:50
Time out	15:30
Sea state	Calm
Dive depth	12m
Observations	The purpose of the dive was to consider the charted location of W01967. Underwater visibility was at 30-40cm, reducing to 2cm when surface silt was disturbed. There was no indication of cultural material at the base of the shotline. A linear hollow lies to the west of the shotline, with soft mud blanketing its surface and providing easy penetration to *c*. 1m depth. The hollow appears to be shallow, and loose kelp occupies its base. The hollow appears to measure 5-6m long by 3m wide. A broken piece of marine plastic lay in the hollow.

	To the east of the shotline, an encrusted object was observed, measuring 1.5m long with part of a corner exposed, and standing c. 2cm from the seabed. The remainder of the dive considered the area to the east of the shotline, extending out the 15m length of search line, and following a full 180º sweep. The seabed is generally flat with some slight undulation. The surface sediment is a soft silt, with sand content. No other cultural material or indicator of wreckage or debris was observed.

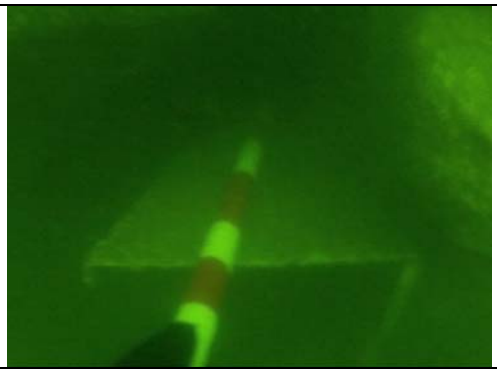
Dive No.	3
Date	25/11/2014
Location	W01967
Shotline coordinates	691268E 5909582N UTM 29N; 324745E 229446N ING
Dive Supervisor	BMcA
Diver	KMcC
Time in	15:45
Time out	16:45
Sea state	Calm
Dive depth	12m
Observations	The purpose of the dive was to consider the area to the west of charted location of W01967. Visual inspection proceeded out the 15m length of search line, and following a full 180º sweep. Inspection was accompanied by probing the seabed with a 1.54m-long stainless steel pin, designed to penetrate soft overburden and locate hard material or buried debris. No cultural material or indicator of wreckage or debris was observed.

Date	26/11/2014
Team	Niall Brady (NB); Brian MacAllister (BMcA); Aisling Collins (AC); Kyle McCoy (KMcC); Sean Cullen (SC), Skipper *RV Keary*
Start time	08:30
End time	17:00
Activity	• Work commenced using the *Keary's* onboard multi-beam sonar over the locations for W01967 (see Appendix 2) • A calm sea-state at the harbour's mouth directed attention at W10966 • Dives 4-5
Observations	None

Dive No.	4
Date	26/11/2014
Location	W01966
Shotline coordinates	691412E 5909801N UTM 29N; 324893E 229663N ING
Dive Supervisor	BMcA
Diver	NB
Time in	10:35
Time out	12:56
Sea state	Calm
Dive depth	10m
Observations	The purpose of the dive was to locate W01966 at the charted location. Underwater visibility was very good at 1-1.5m. There was no indication of cultural material at the base of the shotline. A circular search was commenced to the west and the southwest of the shotline, moving into the harbour entrance, which extended out beyond the 15m length of search line, to 30m. The seabed is generally flat with a clean coarse sand mixed with sea shell, and would have a very good holding content for objects. The search area included portion of the rock armour associated with the pier. The armour is made of granite blocks, some of which retain drill holes associated with their quarrying. The rocks form a tumbled mass, creating a haphazard surface that would serve to sap the energy of aggressive waves. Two ranges of rock exists, with an upper platform of smaller rock (70cm and less) that lies close against the pier wall. At *c.* 15m from the pier, this platform gives way to a steep slope occupied by coulders, which drop *c.* 3m in depth to the current sea floor, over a horizontal distance of *c.* 15m. The rock armour is quite 'clean', and does not have obvious artefacts lying exposed on it. The seabed has no features exposed on it.
Images Sketch section of rock armour at base of East Pier, recorded on dive log	

View looking South onto the East Pier terminus. The slightly battered walls of the bastion are girdled with a sequence of rock armout protection underwater that extends seawards to the white buoy, which is more or less on the charted location of W01966.	

Dive No.	5
Date	26/11/2014
Location	W01966
Shotline coordinates	691412E 5909801N UTM 29N; 324893E 229663N ING
Dive Supervisor	BMcA
Diver	NB
Time in	13:25
Time out	16:20
Sea state	Calm
Dive depth	10m
Observations	The purpose of the dive was to locate W01966 at the charted location. Underwater visibility remained very good at 1-1.5m. Underwater search proceeded into the centre of the harbour entrance and also northwest, extending 80m in this direction from the shotline to cover the extended area. The *Keary* was repositioned to facilitate this work to the west of the shotline. The multi-beam data of 2004 shows an anomaly in the centre of the harbour entrance, and this became a focus of attention for the dive work. It is located at 691315E 5909810N UTM 29N / 324795E 229672N ING. The feature is only a localized hollow, and does not have any features exposed within it or apparent through probing. The zone northwest of the shotline has no features exposed on the seabed. The search area included elements of the rock armour, and two modern objects were identified lying among its boulders: an aluminum paddle and a steel box. No material of archaeological interest was identified.
Ìmage Photograph of handle of modern aluminum paddle, with tip of scale bar showing	

Ìmage Photograph of modern metal box, lodged between rock armour	

Date	27/11/2014
Team	Niall Brady (NB); Brian MacAllister (BMcA); Aisling Collins (AC); Kyle McCoy (KMcC); Sean Cullen (SC), Skipper *RV Keary*
Start time	08:30
End time	17:00
Activity	• Work continued at the harbour's mouth looking for W10966. • Dives 4-5 • Grapple survey (see Appendix 2)
Observations	Faith Bailey, IAC visited the operation

Dive No.	6
Date	27/11/2014
Location	W01966
Shotline coordinates	691412E 5909801N UTM 29N; 324893E 229663N ING
Dive Supervisor	BMcA
Diver	NB
Time in	10:00
Time out	12:30
Sea state	Calm
Dive depth	10m
Observations	The purpose of the dive was consider the seabed to the east of the charted location for W01966. Underwater visibility was very good at 1.5m. The focus of attention was the edge of the rock armour, a 20m-wide band of seabed close to the rock armour, and the rock armour extending into shore. This brought the search area 70m east of the charted location. No material of archaeological significance was noted.

Dive No.	7
Date	27/11/2014
Location	W01966
Shotline coordinates	691413E 5909738N UTM 29N; 324892E 229599N ING
Dive Supervisor	BMcA
Diver	AC
Time in	14:00
Time out	15:00
Sea state	Calm
Dive depth	9m
Observations	The purpose of the dive was consider the seabed to the south of the charted location for W01966. An anomaly is located inside the

	harbour directly beneath the East Pier terminus, east of the proposed dredging corridor, and was the focus of the dive. Local fisherman's knowledge suggests that there is a wreck located inside the harbour close to this location. Underwater visibility was very good at 1.5m. The dive recorded the nature of the foundation to the East Pier terminus beneath the Soldier's Quarters building. Rock armour protection extends around the pier head but stops short of the buildings on the south side. In its place, the vertical granite wall is supported on a three-tiered plinth that is 1.5m high, with no armour protection on its seaward side. The plinth steps out in three courses of stonework, each of which is 50cm high. The anomaly lies on the west end of the Soldier's Quarters. It is not a shipwreck but rather a dump of granite blocks and 4" cast-iron drainage pipes lost from the buildings above.

Date	28/11/2014
Team	Niall Brady (NB); Brian MacAllister (BMcA); Aisling Collins (AC); Kyle McCoy (KMcC); Sean Cullen (SC), Skipper *RV Keary*
Start time	08:30
End time	17:00
Activity	• Work returned to charted location of W10967 • Dives 8-11
Observations	None

Dive No.	8
Date	28/11/2014
Location	W01967
Shotline coordinates	691268E 5909582N UTM 29N; 324745E 229446N ING
Dive Supervisor	BMcA
Diver	NB
Time in	09:58
Time out	10:50
Sea state	Calm
Dive depth	10m
Observations	The purpose of the dive was probe again the seabed at charted location for W01967. Probing commenced to the west of the shotline. The silt overburden was consistently 20cm thick, over a stiff gravel that was not penetrable using the steel spike. A hard object was located to the northwest of the shotline, at 691260E 5909593N UTM 29N / 324737E 229456N ING. Limited clearance observed the object to be buried by 10cm of overburden and it appeared to be fixed to the seabed. It was located 14m from the shotline, on the northern edge of the hollow. The dive was terminated to prepare the dredge for further investigation.

Dive No.	9
Date	28/11/2014
Location	W01967

Dive coordinates	691260E 5909593N UTM 29N / 324737E 229456N ING
Dive Supervisor	BMcA
Diver	KMcC
Time in	11:28
Time out	13:30
Sea state	Calm
Dive depth	10m
Observations	Dredging work excavated a c. 2m x 2m sized hole centered on the anomaly. The dredge spoil was directed into a mesh bag, which was inspected and emptied when full. The anomaly turned out to be an isolated rock, measuring 1m long by 30cm wide. It was not associated with other pieces. Further dredging in this location was terminated. Dive work returned to a search-and-probe survey, working to the north and east of the shotline. The encrusted feature observed on Dive 2 was relocated, and a trench opened around it, to facilitate dredging.
Images Picture sequence showing the recovery of the dredged spoil within its sealed mesh sack (top left); the contents removed for sorting (top right); contents with silt and sand removed after water hosing (bottom left); final selection of objects recovered from the spoil, which in this instance are all modern pieces and were not retained (bottom right). Scale bar 15cm long.	   

Dive No.	10
Date	28/11/2014
Location	W01967
Dive coordinates	691268E 5909582N UTM 29N; 324745E 229446N ING
Dive Supervisor	BMcA
Diver	KMcC
Time in	14:30
Time out	16:00
Sea state	Calm
Dive depth	10m
Observations	Dredging continued to expose the encrusted feature, cutting a large and deep hole in zero-visibility. The object was firmly fixed to the seabed throughout the work.

Dive No.	11
Date	28/11/2014
Location	W01967
Dive coordinates	691268E 5909582N UTM 29N; 324745E 229446N ING
Dive Supervisor	BMcA
Diver	NB
Time in	16:15
Time out	16:45
Sea state	Calm

Dive depth	10m
Observations	Inspection dive at end of dredging observed that the object was no longer fixed to the seabed. On inspection and recovery to the surface, it was seen to be an abandoned fishbox. The depth of its burial in the silt and underlying gravel and sand indicates the disturbed nature of this substrate, which has continued to provide no indication of wreckage.
Image Encrusted fishbox recovered to the surface that was buried and only partially exposed at the charted location of W01967.	

Date	02/12/2014
Team	Niall Brady (NB); Brian MacAllister (BMcA); Aisling Collins (AC); Kyle McCoy (KMcC); Sean Cullen (SC), Skipper *RV Keary*
Start time	08:30
End time	17:00
Activity	• Work returned to charted location of W10966 and moved inside the harbour in the afternoon due of unsteady sea state • Dives 12-14
Observations	None

Dive No.	12
Date	02/12/2014
Location	W01966
Shotline coordinates	691412E 5909801N UTM 29N; 324893E 229663N ING
Dive Supervisor	BMcA
Diver	KMcC
Time in	09:55
Time out	10:58
Sea state	Slight chop with developing westerly airstream
Dive depth	10m
Observations	The purpose of the dive was open an investigation trench at the charted location of the wrecksite, to clarify whether remains lie buried there. A 5m-long, 1m-wide and 80cm-deep trench was opened, exposing shell and sand, coming down to a hard compact gravel that could not be penetrated. There was no indication of archaeological remains.

Images Nature of the seabed deposits as dredged and prior to cleaning down with water hose. The absence of silt in contrast to its presence inside the harbour is noticeable.	
Single sherd of modern bottle glass observed and not retained.	

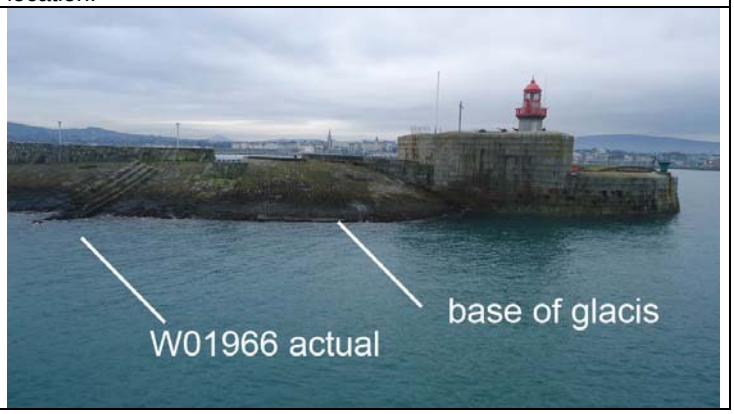
Dive No.	13
Date	02/12/2014
Location	Wrecksite indicated on Admiralty Chart
Shotline coordinates	691333E 5909554N UTM 29N; 324809E 229416N ING
Dive Supervisor	BMcA
Diver	KMcC
Time in	12:07
Time out	13:00
Sea state	Calm
Dive depth	8-10m
Observations	The purpose of the dive was to extend the search area around the charted location of W01967. The new area lies 60m to the east-southeast, and is the location of a wrecksite marked on the Admiralty Chart, indicating wreckage at 6.5m. The location is also highlighted also in the multi-beam tile and the project drawing contours as a localized hollow. The dive conducted a 15m-radius circular search from the base of the shotline, which was positioned at the centre of the feature. Soft mud blanketed the area, concealing a 2m-deep hollow, the sides of which were clearly defined underneath the covering sediment. No wreckage was however present. It is concluded that the wreck must have been removed, and this would explain the hollow that lies there today. The dive then proceeded eastwards, to cover the space between here and W01967. No archaeological features were observed.

Image Screen-grab from on-0board navigation chart showing the plotted wrecksite, to the south of the black icon showing the actual location of the *Keary*. The yellow lines relate to vessel tracklines, which are focused around the charted W01967 location.	

Dive No.	14
Date	02/12/2014
Location	W01967
Shotline coordinates	691268E 5909582N UTM 29N; 324745E 229446N ING
Dive Supervisor	BMcA
Diver	AC
Time in	14:00
Time out	16:00
Sea state	Calm
Dive depth	10m
Observations	The purpose of the dive was to focus on the metal-detector survey at the charted location of W01967. The dive conducted a 15m-radius circular search from the base of the shotline, moving slowly across the seabed. It also extended further to the north and to the south. Not a single metallic return was noted.

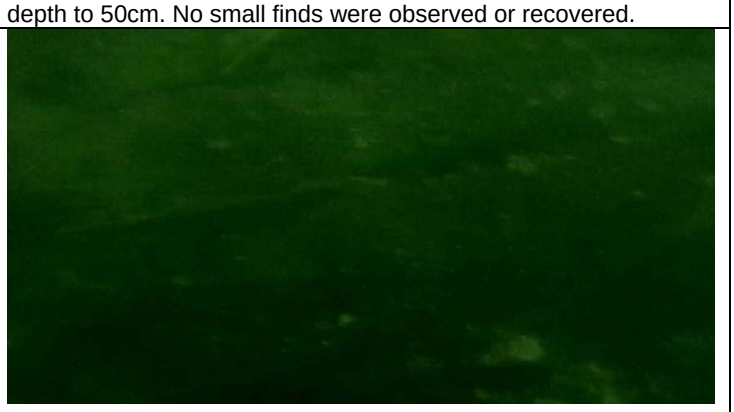
Date	03/12/2014
Team	Niall Brady (NB); Brian MacAllister (BMcA); Aisling Collins (AC); Kyle McCoy (KMcC); Sean Cullen (SC), Skipper *RV Keary*
Start time	08:30
End time	17:00
Activity	• Work extended search area for W10966 eastwards and located wreckage • Dives 15-17 • Dive 15 used *Geo* as support vessel • Dives 16-17 used *Keary* as support vessel
Observations	Faith Bailey, IAC visited the operation

Dive No.	15
Date	03/12/2014
Location	W01966
Shotline coordinates	691501E 5909817N UTM 29N; 324982E 229677N ING
Dive Supervisor	BMcA
Divers	KMcC and NB
Time in	09:55
Time out	10:58

Sea state	Slight chop becoming calm
Dive depth	10m
Observations	The purpose of the dive was to extend the search area for W1966 eastwards. It had become possible to contact the original finder of the wrecksite in 1996, which gave confidence to extending the search area in this direction. A two-person dive team progressed on a grid-line search aligned North-South and progressing westwards against a strong ebb tide. Underwater visibility was good at 1.5-2m. A series of sweeps extend 30m from the base of the rock armour, progressing west at 2m increments. The work included searches within the rock armour, reaching the base of the glacis at the LWM. Wreckage was identified close against the base of the rock armour. It consisted of two iron pieces lying 70cm apart. A marker buoy was fixed to one of the metal pieces, to clearly identify the location.
Image View looking Southeast, showing the base of the glacis, and the general location of wrecksite W01966.	

Dive No.	16
Date	03/12/2014
Location	W01966
Shotline coordinates	691501E 5909817N UTM 29N; 324982E 229677N ING
Dive Supervisor	BMcA
Diver	AC
Time in	12:58
Time out	14:00
Sea state	Slight chop becoming calm
Dive depth	10m
Observations	The purpose of the dive was to extend the search area around the find location for W1966. Underwater visibility was good at 1.5-2m. A section of timber was located some meters away from the two iron pieces, and also lay at the base of the rock armour. All three elements were partly exposed above the sand and largely buried. Smaller rock and boulder lay in the space between the metal pieces and the timber.

Dive No.	17
Date	03/12/2014
Location	W01966
Shotline coordinates	691501E 5909817N UTM 29N; 324982E 229677N ING
Dive Supervisor	BMcA
Divers	KMcC (dredging) and NB (video survey)
Time in	14:30
Time out	16:30
Sea state	Calm

Dive depth	10m
Observations	The purpose of the dive was to commence dredging at the find location for W1966. Underwater visibility was good at 1.5-2m. A trench was opened around the timber, revealing a series of three planks and a smaller fragment of a fourth plank aligned at right angles to a single long plank, aligned northwest-southeast. The relationship of the timbers to each other was not clear but they represent piece of an articulated whole that continues northwards into the unexcavated portion. Excavation extended in depth to 50cm. No small finds were observed or recovered.
Images Stills from video capture, showing three images of the timber planking that lies to the west of the west of the metal pieces. The planking is clearly conjoined as an articulated piece. The absence of encrustation on the timbers in the upper picture reflects their buried state beneath the covering sands. The bottom image shows an acute angle on one end (east end) of the timber, resulting from erosion.	  

Date	04/12/2014
Team	Niall Brady (NB); Brian MacAllister (BMcA); Aisling Collins (AC); Kyle McCoy (KMcC); Cameron Brady (CB), Sean Cullen (SC),

	Skipper *RV Keary*
Start time	08:30
End time	17:00
Activity	• Strong tide running at start-up, had to wait for it to dissipate • Work concluded investigation and recording on W01966, and included a final effort to locate W01987 • Dives 18-22 • Project demobilization
Observations	None

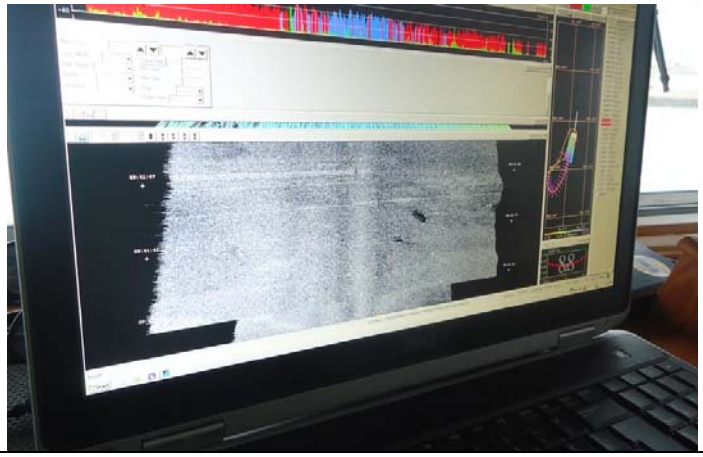
Dive No.	18
Date	04/12/2014
Location	W01966
Shotline coordinates	691501E 5909817N UTM 29N; 324982E 229677N ING
Dive Supervisor	BMcA
Divers	KMcC
Time in	10:00
Time out	11:00
Sea state	Ebb tide running hard
Dive depth	10m
Observations	Dredging was not possible due to the fast tide, which was pulling the device off site. Excavation was completed manually, and focused on the area beside the iron pieces. The work exposed a new area of buried timbers, comprising a seven framing timbers with planking above and below.

Dive No.	19
Date	04/12/2014
Location	W01966
Shotline coordinates	691501E 5909817N UTM 29N; 324982E 229677N ING
Dive Supervisor	BMcA
Divers	AC
Time in	11:30
Time out	13:00
Sea state	Calm, approaching slack water
Dive depth	10m
Observations	Archaeological planning of exposed elements at end of investigation phase. Scale 1:20.

Dive No.	20
Date	04/12/2014
Location	W01966
Shotline coordinates	691501E 5909817N UTM 29N; 324982E 229677N ING
Dive Supervisor	BMcA
Divers	NB
Time in	13:30
Time out	15:00
Sea state	Calm
Dive depth	10m
Observations	Final survey conducted on the seaward side of W01966, going 20m out from base of rock armour, probing seabed in search of indicators for wreckage. The surface is quite firm and resists probing. Without doubt further wreckage associated with W01988 exists here and close inshore, but its presence remains buried. Baseline coordinates taken and site de-mobilized.
Dive No.	21
Date	04/12/2014
Location	W01967
Shotline coordinates	691274E 5909564N UTM 29N; 324982E 229677N ING

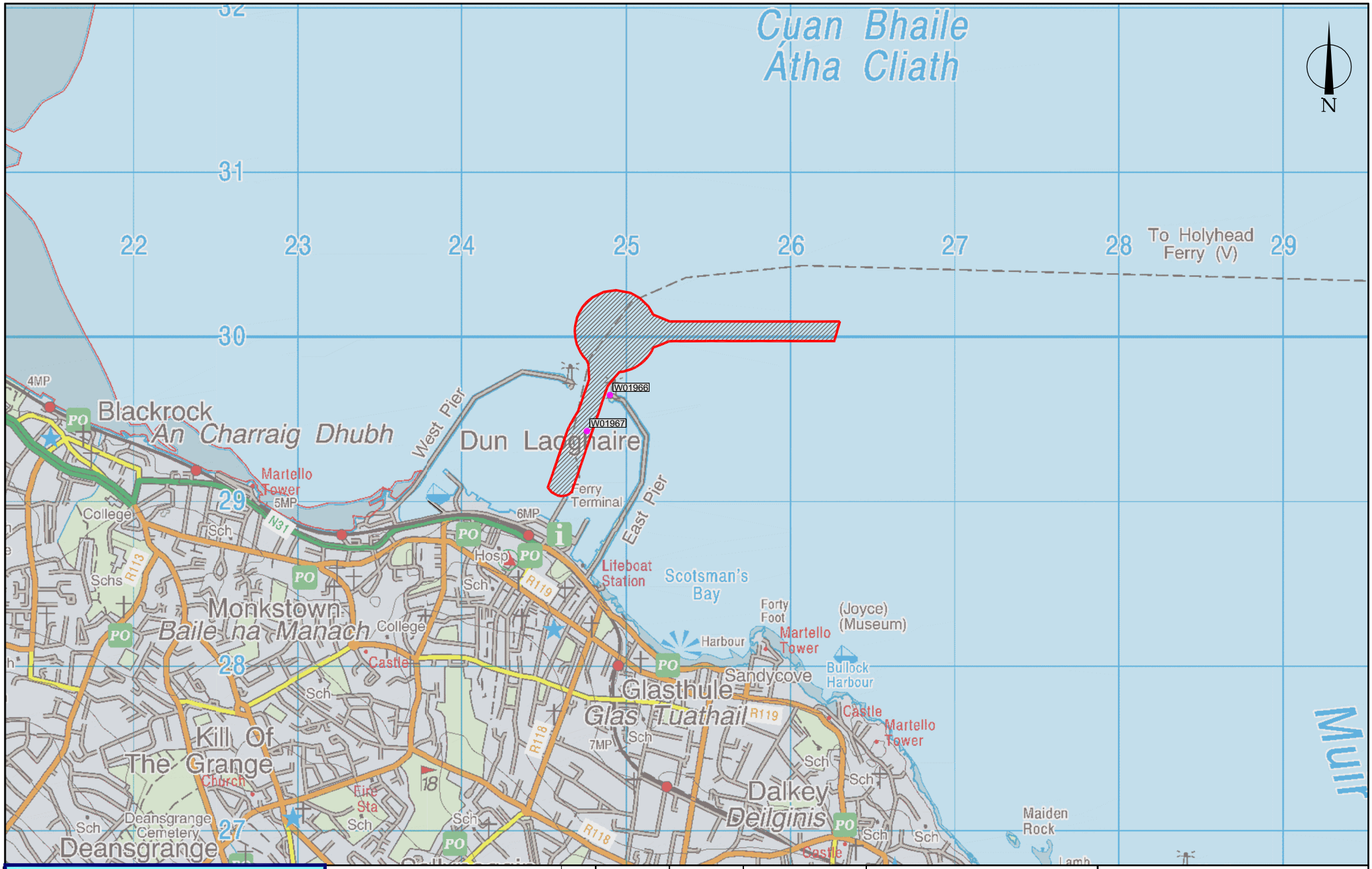
Dive Supervisor	BMcA
Divers	NB
Time in	15:30
Time out	16:00
Sea state	Calm
Dive depth	10m
Observations	Final attempt to locate W01967 by conducting a seabed search to the south of the charted location. No features were observed exposed on the seabed.

APPENDIX 2: GEOPHYSICAL SURVEY AND GRAPPLE SURVEY

Date	26/11/2014
Activity	Geophysical Survey
Observations	The *RV Keary* is equipped with a variety of onboard marine geophysical survey devices. Given the difficulty in locating wreckage at the charted locations, it was agreed to run the vessel's multi-beam sonar over the harbour area in an effort to locate W01967. The intention was to verify the nature of the seabed and observe any defined hard points, which could then be plotted and returned to for diving. The data produced was 'live feed' and not subject to post-processing. A selection of screen-grab images is presented below. A series of localized soft deposits or hollows were observed, as were already known, but no features of obvious archaeological potential were observed.
Images Screen-grab images of multi-beam monitor. The upper image shows to localized hard points as black dots, and these refer to piling posts within the marina. The lower images shows the seabed at the charted location of W01967. The dark patches refer to hollows rather than hard points, and were inspected as part of the dive work.	 

Date	27/11/2014
Activity	Grapple Survey
Observations	Grapple survey is a direct method of locating wreckage and underwater snags. It deploys a pronged device that is weighted to lie at seabed level, and is then pulled gently through the water

	column and will snag any substantial obstruction or object on the seabed. Tension is maintained on the line by hand, where slight variations can be detected easily. As the image below shows, a series of runs were completed across the harbour area, focusing on the charted location of W01967, but also extending large distances away from it. Not features of snags were observed.
Image Screen-grab showing navigation monitor recording vessel tracklines following during grapple survey. The locus point is the charted location of W01967.	



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Notes
Source: OSi
Extent of proposed Dredge Channel

A4

Job/Exc No.	Compiled by	CAD reference	Client
14E00441	R.Bangerter	Dun_Laoghaire2014	IAC Ltd. for Dun Laoghaire Harbour Company
Date	**Scale**	**Drawing No.**	**Project**
18.12.14	1:7000	Figure 1	Dun Laoghaire Development Project- Archaeological Investigations.

Title
Figure 1- Extract from OS Discovery Series mapping showing location of proposed development and charted locations of W01966 & W01967 at Dun Laoghaire Harbour.

N

-10.5m

-10.5m

-10.5m

2013 SURVEY DATA
2011 SURVEY DATA

2013 SURVEY DATA
2011 SURVEY DATA

Approximate Location of wreck W01966:
LAT = 53 18 10.006
LONG= -6 7 38.298
[From Archaeological Scoping Document Feb 2014]
East = 324893.764
North = 229663.121
[Conversion by Ordnance Survey of Ireland Website]

Approximate Location of wreck W01967:
LAT = 53 18 3.096
LONG= -6 7 46.596
[From Archaeological Scoping Document Feb 2014]
East = 324745.711
North = 229445.500
[Conversion by Ordnance Survey of Ireland Website]

KEY:

- Limit of DLHC Authority
- Extent of proposed Dredge Channel
- 1:5 batter to dredge slope

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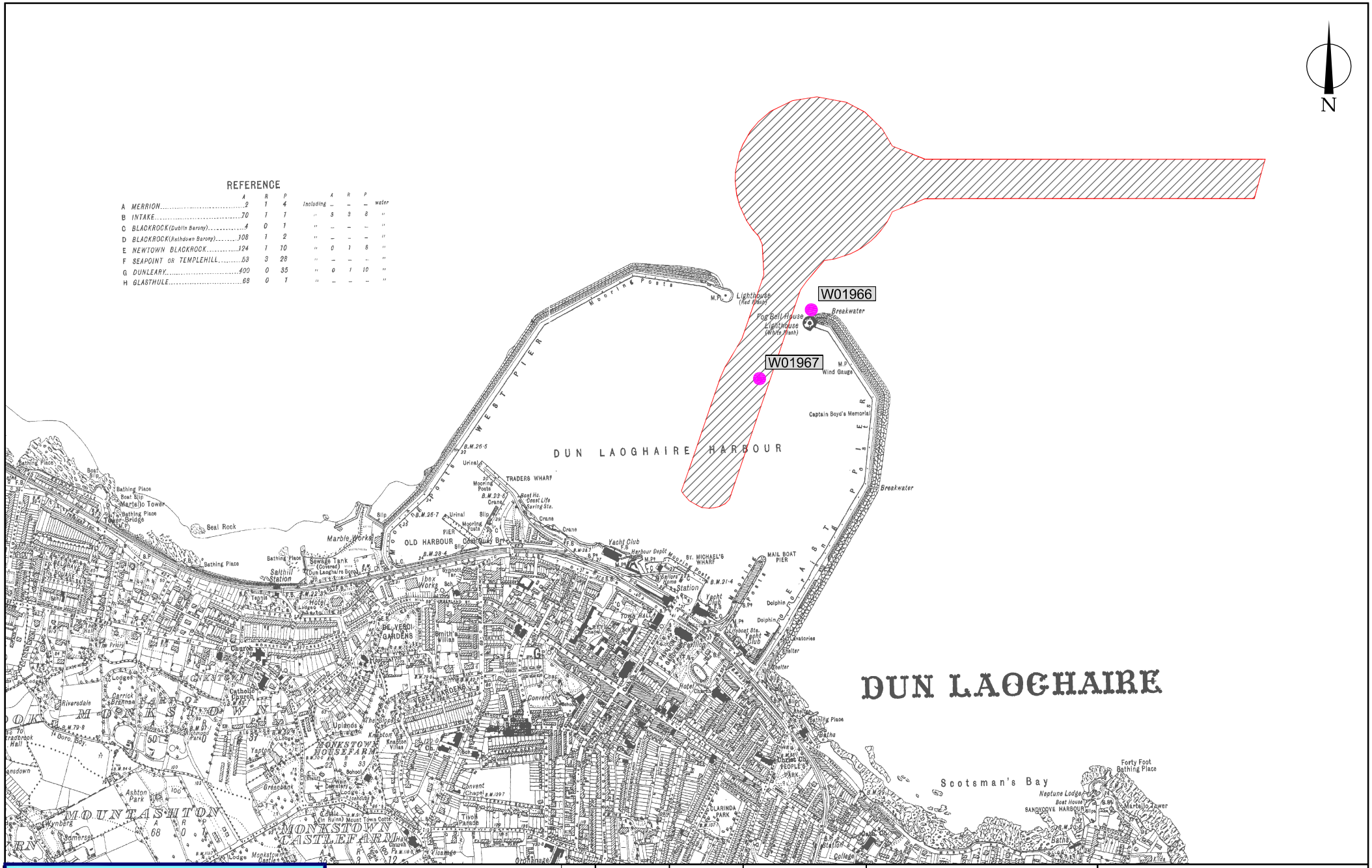
Notes
--- Figure adapted from Project Drawing No. CIV-14969-sa-ns-option3a supplied by Client.

A3

Job/Exc No.	Compiled by	CAD reference	Client	Title
14E00441	R.Bangerter	Dun_Laoghaire2014	IAC Ltd. for Dun Laoghaire Harbour Company	Figure 2- Project drawing showing proposed dredging footprint and charted locations of W01966 and W01967.
Date 17.12.2014	**Scale** 1:7,500	**Drawing No.** Figure 2	**Project** Dun Laoghaire Harbour Development Project- archaeological Investigations	



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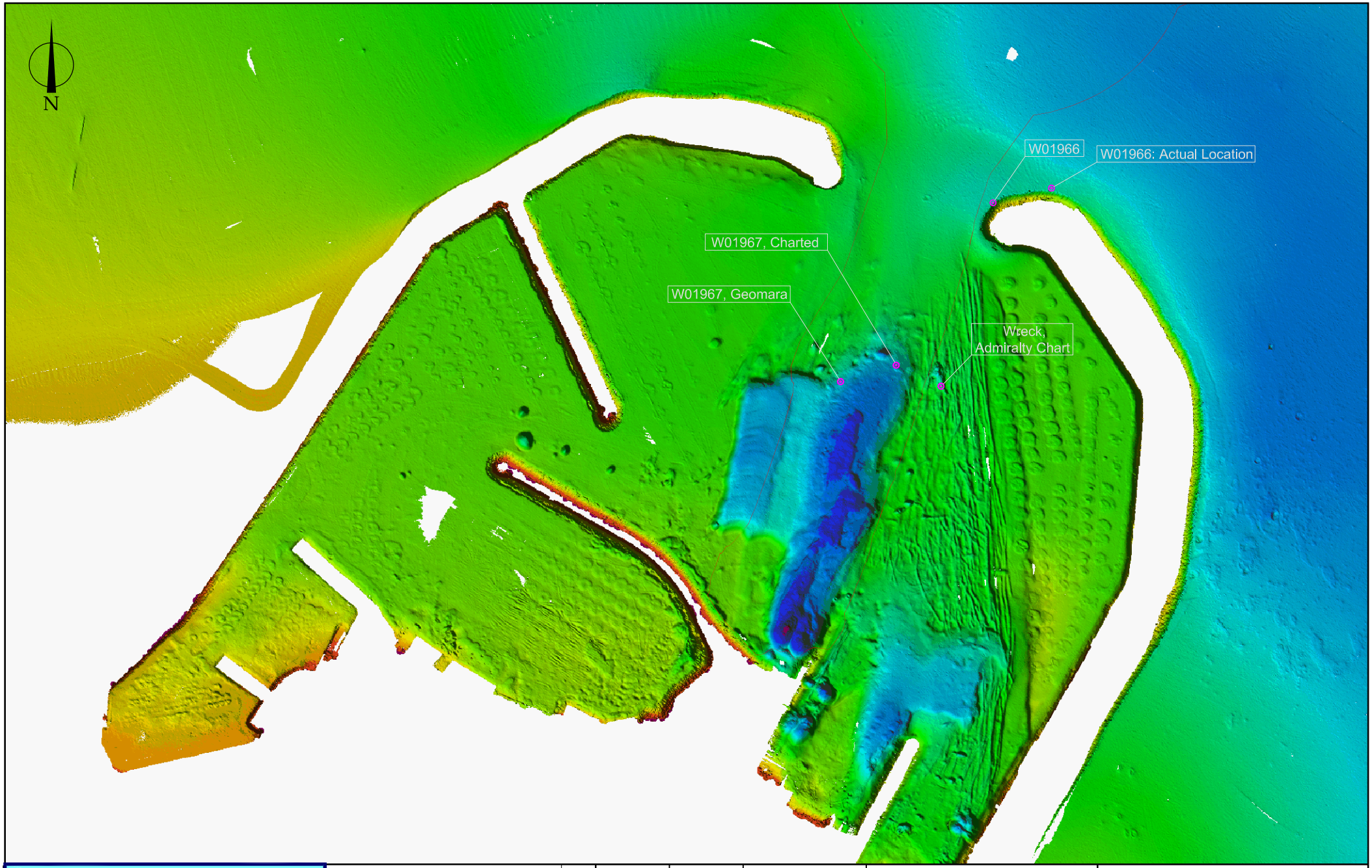
Notes
Source: OSI
Extent of proposed Dredge Channel

A4	Job/Exc No. 14E00441	Compiled by R.Bangerter	CAD reference Dun_Laoghaire2014	Client IAC Ltd. for Dun Laoghaire Harbour Company	Title
	Date 18.12.14	Scale 1:10,000	Drawing No. Figure 3	Project Dun Laoghaire Development Project- Archaeological Investigations.	

Figure 3- Extract from OS Third Edition mapping showing location of proposed development at Dun Laoghaire Harbour. Note: charted location of W01966 & W0197 highlighted.



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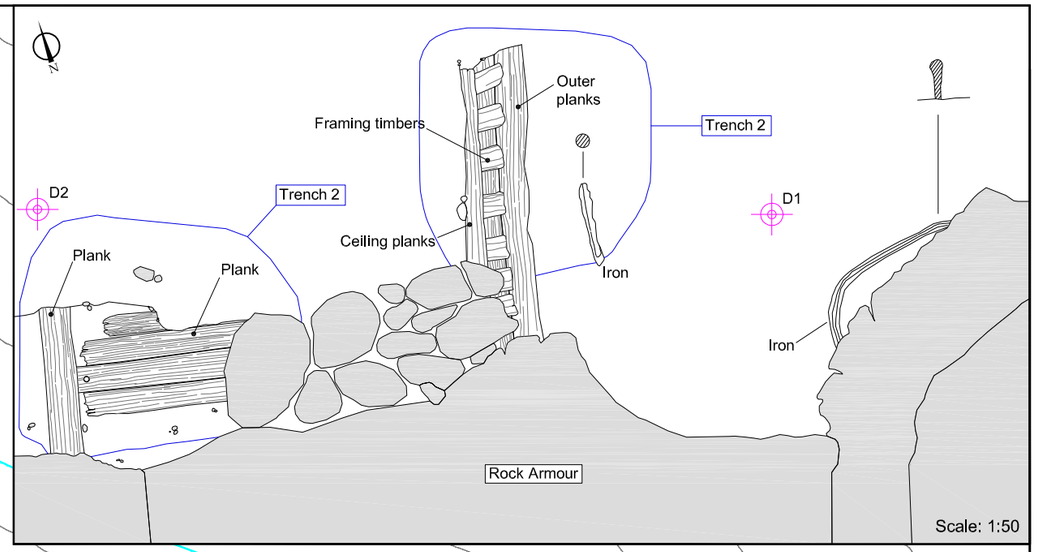
Notes
Source: GSI [data gathered 2004]
Extent of proposed Dredge Channel

A4

Job/Exc No.	Compiled by	CAD reference	Client
14E00441	R.Bangerter	Dun_Laoghaire2014	IAC Ltd. for Dun Laoghaire Harbour Company
Date	**Scale**	**Drawing No.**	**Project**
17.12.14	1:7000	Figure 4	Dun Laoghaire Development Project- Archaeological Investigations

Title
Figure 4- Multi-beam tile showing underwater terrain model of seabed, with recorded and known shipwreck locations highlighted.



W01966: Actual Location

D2

D1

Investigation Trench

W01966: Charted

-8

-7

-5

KEY:

D1
Datum 1: 324970E, 229684N

D2
Datum 2: 324965E, 229681N

Extent of ADCO underwater survey

Extent of investigation trenches at W01966 [actual location]

Investigation trench measuring 5m x 1m at W01966 [charted]

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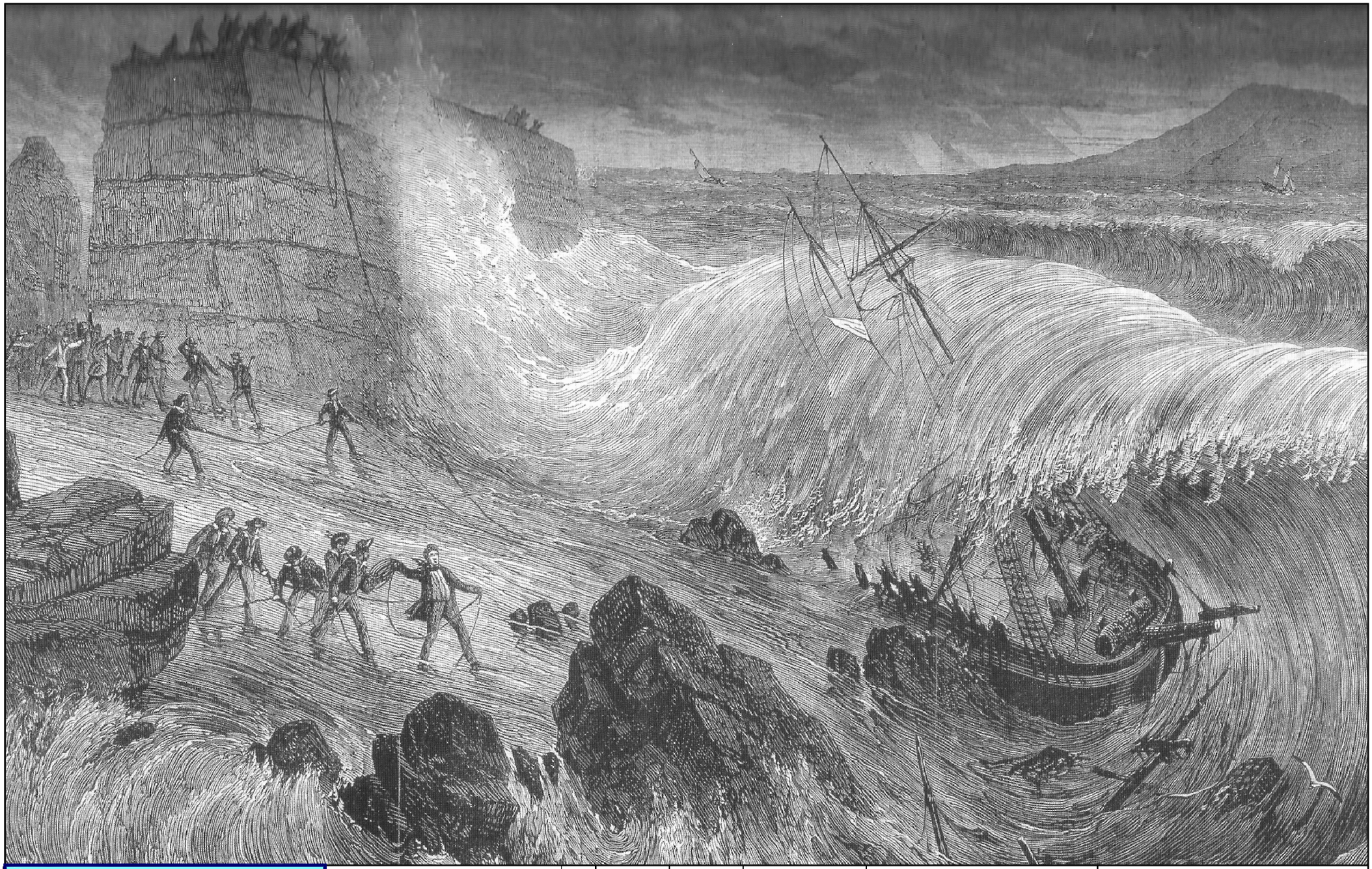
Notes

--- Figure adapted from Project Drawing No. CIV-14969-sa-ns-option3a supplied by Client.

--- Data gathered for site plan by A. Collins.

A3

Job/Exc No. 14E00441	**Compiled by** R.Bangerter	**CAD reference** Dun_Laoghaire2014	**Client** IAC Ltd. for Dun Laoghaire Harbour Company	**Title** Figure 5- Detail of Project Drawing with actual location of W01966 overlaid, and plan of wrecksite (inset) following investigations.
Date 17.12.2014	**Scale** 1:1000/ 1:50	**Drawing No.** Figure 5	**Project** Dun Laoghaire Harbour Development Project- Archaeological Investigations	



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Notes
Source: Karl Brady, Shipwreck Inventory of Ireland, Louth, Meath, Dublin & Wicklow, pp.352-353 [Illustrated London Times 1861].

A4

Job/Exc No.	Compiled by	CAD reference	Client
14E00441	R.Bangerter	Dun_Laoghaire2014	IAC Ltd. for Dun Laoghaire Harbour Company
Date	**Scale**	**Drawing No.**	**Project**
18.12.14	NTS	Figure 6	Dun Laoghaire Development Project- Archaeological Investigations

Title
Figure 6- Engraving of the attempts to rescue the crew of the *Neptune* (118-ton brig) wrecked in 1861, as depicted in the Illustrated London News.

N

-7

-6

Top of dredge slope

Investigation Trench

W01967: Charted location

Investigation Trench

W01967: Geomara location

-9

-10

Wreck, Admiralty Chart

-11

-10.5m

-9

KEY

location of 2m x 2m trenches at W01967 [Charted location]

Extent of ADCO survey area at each location

1:5 batter to dredge slope

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Notes

--- Figure adapted from Project Drawing No. CIV-14969-sa-ns-option3a supplied by Client.

A3

Job/Exc No.	Compiled by	CAD reference	Client
14E00441	R.Bangerter	Dun_Laoghaire2014	IAC Ltd./ Dun Laoghaire Harbour Company Ltd.
Date	**Scale**	**Drawing No.**	**Project**
18.12.2014	1:750	Figure 7	Dun Laoghaire Harbour Development Project- Archaeological Investigations

Title

Figure 7- Detail of Project Drawing showing W01967 (Charted), W01967 (Geomara), & Wreck (Admiralty Chart) and extent of ADCO Underwater Survey at same.

Appendix 5.10.7

Marine Geophysical Survey Report (Phase 2)

Geomara Ltd January 2015

Report of Geophysical Survey

Dun Laoghaire Cruise Project

At Dun Laoghaire Harbour, Co. Dublin

Licence Number: 14R0049

Prepared by: Kevin Whyte and Eoghan Kieran

Date: 06/02/2014

Project No.G14017

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1 Introduction

Geomara was commissioned by Irish Archaeological Consultancy Ltd to undertake a programme of marine geophysical survey at Dun Laoghaire Harbour, Co. Dublin. The survey was carried out on 2nd February 2015 and comprised a side scan sonar survey under licence number 14R0049.

A previously conducted programme of geophysical survey identified the presence of a number of potential archaeological anomalies within the defined project area. Subsequent dive surveys confirmed that a number of the possible archaeological anomalies were either modern materials or acoustic artefacts. The survey did positively identify one of the anomalies as the remains of Wreck W01966. Additional possible wreck remains (WO1967) were noted in the survey area. An initial diver investigation recorded the presence of a potential ships timber in this area. Subsequent more detailed diver investigations recorded that the previously recorded timber was no longer present. These investigations carried out detailed surveys and excavations in the area, but failed to record the presence of any archaeological material. In order to ensure that there were no further potential archaeological materials in the area, a second geophysical survey was conducted. The aim of the survey was to compare the seafloor topography and form with that recorded in previous survey of May 2014 and to ensure that there were no further archaeological materials present in the area.

Figure 1. Development Location

2 Development Characteristics

The proposed development will consist of the removal or reuse of the current Stena Line Berth 5 at Dun Laoghaire Harbour and the construction of a new berth and mooring dolphins in that same

general area which will be able to facilitate the docking of larger scale cruise ships. Associated channel dredging within the harbour will be required, along with a dredged turning circle outside of the harbour mouth; a dredged sea access navigation channel will be formed to ensure that access and egress of large scale cruise ship with the harbour can be accommodated at the various tide states. Geological investigations are required in order to precisely define the extent of the bed area to be deepened within the interior and exterior of the harbour, ie within and outside the Harbour Limits Line, and to define relationships with existing quay structures. Strengthening of these existing quay structures could be required, including the provision of protection structures to the existing East and West Pier roundheads which form the Harbour mouth. A series of navigational aids such as mooring buoys and lights tethered to the bottom will be provided to help delineate the navigation channel limits.

It is possible that material that is dredged from the development area may be permanently deposited at sea.

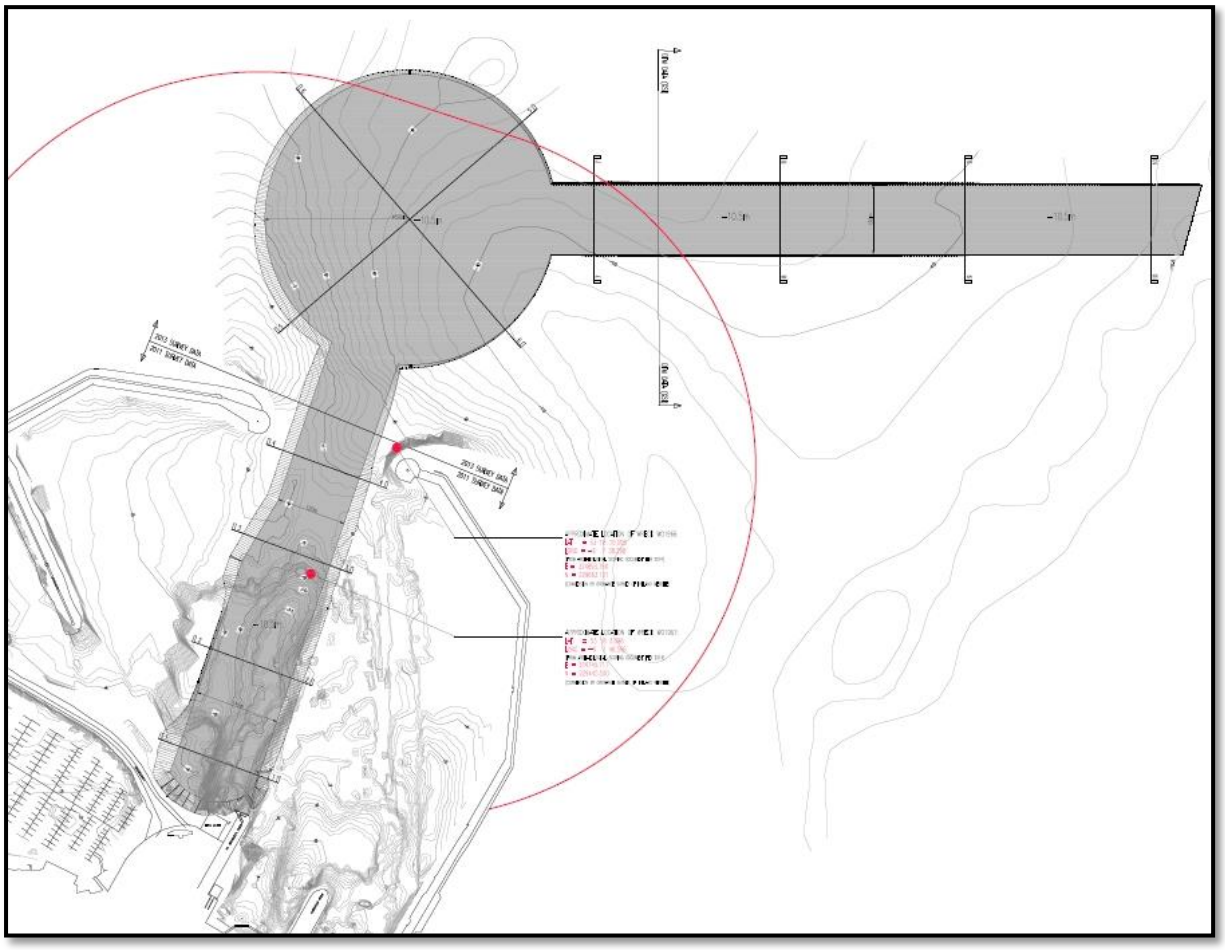

Figure 2. Development Details

3 Brief Archaeological Background

The most sensitive archaeological resource associated with the proposed development area is that of marine archaeological remains, which for the most part, consist of the wrecks of ships. There are

c. 70 ships recorded as sinking in Dun Laoghaire harbour that do not have a recorded location. There are additional recorded ship wrecks in Dublin Bay, with no reference to the harbour but which may be within vicinity of turning circle and channel.

There are 18 ships recorded as sinking at the entrance to the harbour or close to the piers or heads of the piers. Locational information is not precise. There are two possible wrecks within the harbour that possess location references, which are either within or in close proximity to the proposed channel and turning circle. These consist of Wreck W01966 –discovered by Marlin Sub Aqua Club in harbour entrance at 53 18 10.006 N/ 006 07 38.298 W and Wreck W01967 identified during national sea bed survey inside of harbour entrance at 53 18 03.096 N/ 06 07 46.596 W.

In May 2014, a programme of side scan sonar, sub bottom profiler and magnetometer survey was undertaken on across the proposed development area. It recorded sixteen potential archaeological anomalies. A short program of dive inspection was then undertaken in September 2014 to determine the nature of these anomalies. It confirmed that 14 of the possible archaeological anomalies were either modern materials or acoustic artefacts. It confirmed the existence of potential wreckage remains close to the site of recorded wreck WO1966. It also noted the presence of the remains of a potential vessel timber at the site of DL CH 08 & 09 or wreck site WO1967.

Subsequent to this, further underwater archaeological investigations were undertaken in November 2014. These investigations recorded further details relating to wreck site WO1966. They did not however record the presence of any vessel remains at the site of wreck WO1967.

Target Name	Latitude	Longitude	Description
DL CH 01	53.29716	-6.1309	Piling
DL CH 02	53.29781	-6.13112	Piling
DL CH 03	53.29785	-6.13083	Piling
DL CH 04	53.29745	-6.13135	Piling
DL CH 05	53.29884	-6.13016	Unknown
DL CH 06	53.29954	-6.13002	Unknown
DL CH 07	53.30067	-6.13079	Possible wreck
DL CH 08	53.30061	-6.13119	Linear Feature
DL CH 09	53.30083	-6.13179	Possible wreck
DL CH 10	53.30103	-6.1301	Possible wreck
DL CH 11	53.30171	-6.12974	Unknown
DL CH 12	53.30297	-6.12872	Unknown

			Anomaly
DL CH 13	53.30484	-6.12638	Unknown
DL CH 14	53.30639	-6.11212	Anchor and chain
DL CH 15	53.3061	-6.10713	Unknown
DL CH 16	53.30674	-6.10638	Navigation marker

Table 1. Table of initial anomalies noted

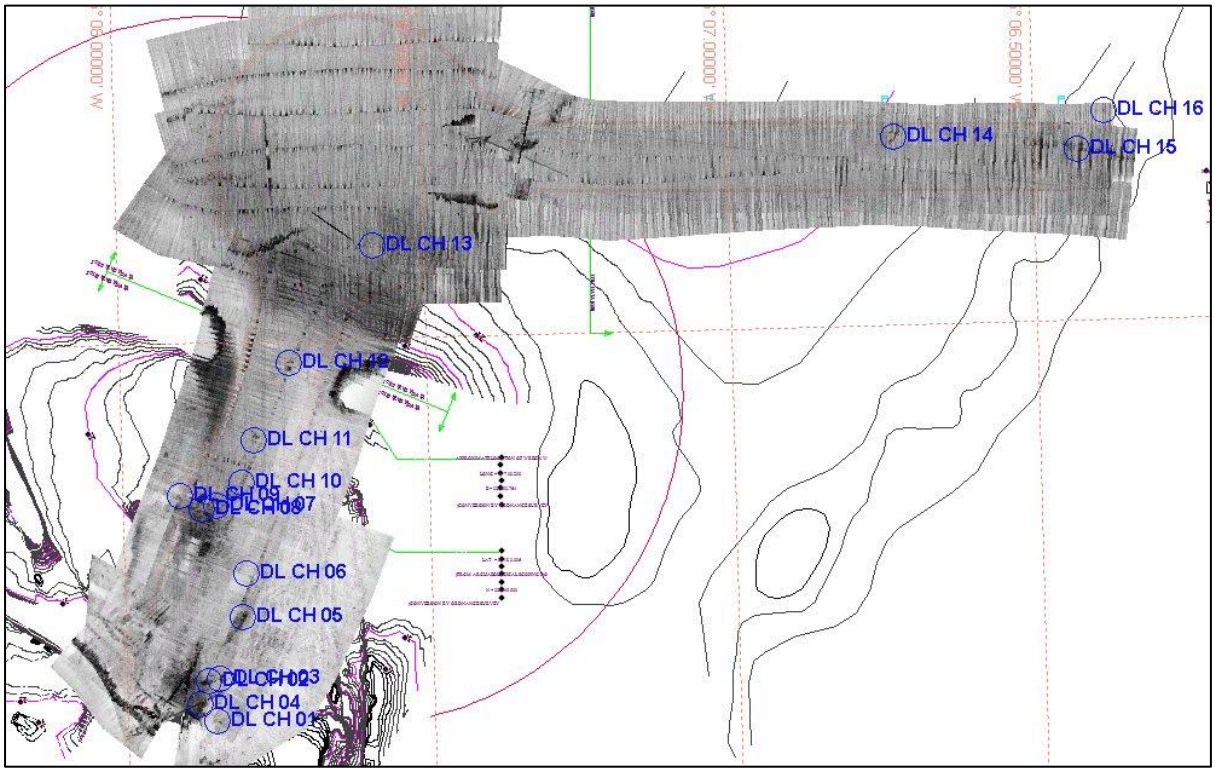

Figure 3. Initial anomaly locations

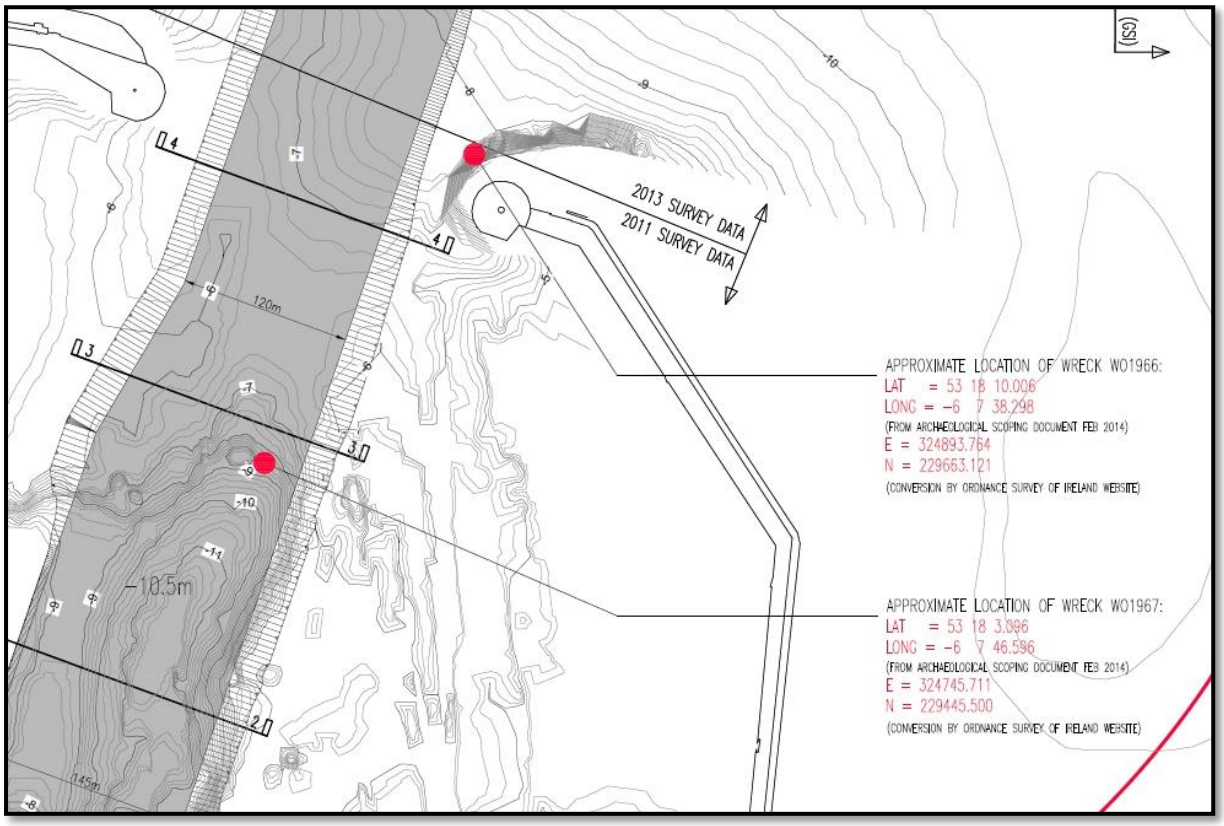

Figure 4. Known Wreck Locations

4 Geophysical Survey

The survey was carried out on 2nd February 2015 under licence number 14R0049. The objective was:

1. The aim of the survey was to compare the seafloor topography and form with that recorded in May 2014
2. To ensure that there were no further archaeological materials present in the area.

High resolution marine geophysical equipment, namely a Klein 3000 side scan sonar used to survey the development area. This ensured that the specific area of seafloor to be impacted was comprehensively surveyed and that any potential cultural heritage therein would be identified.

4.1 High resolution Geophysical survey

The following techniques were used for archaeological investigation of the areas of seafloor to be impacted by the development.

- Side Scan Sonar

The marine survey was carried out in compliance with;

- The *Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish Waters and,*

- *The General Requirements for a Geophysical Survey for Archaeological Purposes*.

Equipment Type	Frequency	Line Spacing	Overlap
Sidescan Sonar Klein 3000	445 KHz	100m	100%

Table 2. Equipment frequencies, line spacing and overlap

4.1.1 Side Scan Sonar

The Klein 3000 was the side scan system used for the survey. It is a full spectrum chirp dual frequency side scan sonar. It simultaneously transmits linearly swept FM pulses centred at two discrete frequencies. The two recordable frequencies were 100 and 445 kHz, all data was recorded at both 100 and 445 kHz. The normal operating range was 100m each side of the centreline. This was the optimum combination of range and resolution.

The side scan sonar images the seabed with amplitude returns dependent on the nature of the seabed sediments or objects / debris on the seafloor. It was capable of imaging small objects of less than 0.20 m and the QC geophysicist were able to map these and any changes in sediment. Full coverage in excess of 200% including the nadir of adjacent lines was required. The position of the Klein integrated sonar tow-fish was determined using a cable counter. The speed of the survey vessel did not exceed 5 Knots. Throughout the survey, the tow-fish was flown at a height above the sea floor, of approximately 10% of the range used.

Data was recorded to XTF digital format via Klein's own proprietary software Sonar Pro. The digital data could then be played back on board the vessel for QC purposes, on completion of data acquisition. All the data are transmitted to the surface on Klein TPU digital link via an Ethernet tow cable.

Plate 1. Klein 3000 Side Scan Sonar System

4.1.2 Positioning

Vessel and equipment positioning was provide by a Trimble 132 AgDGPS. This, survey grade, GPS used EGNOS and WAAS corrections to provide sub metre accuracy at all stages of the survey. A

receiver antenna was mounted on the roof of the survey vessel, with a receiver processor being situated in the survey lab. Layback was calculated from the antenna to each of the respective survey components. These calculations were inputted into the relevant softwares thus providing each unit with a real time position.

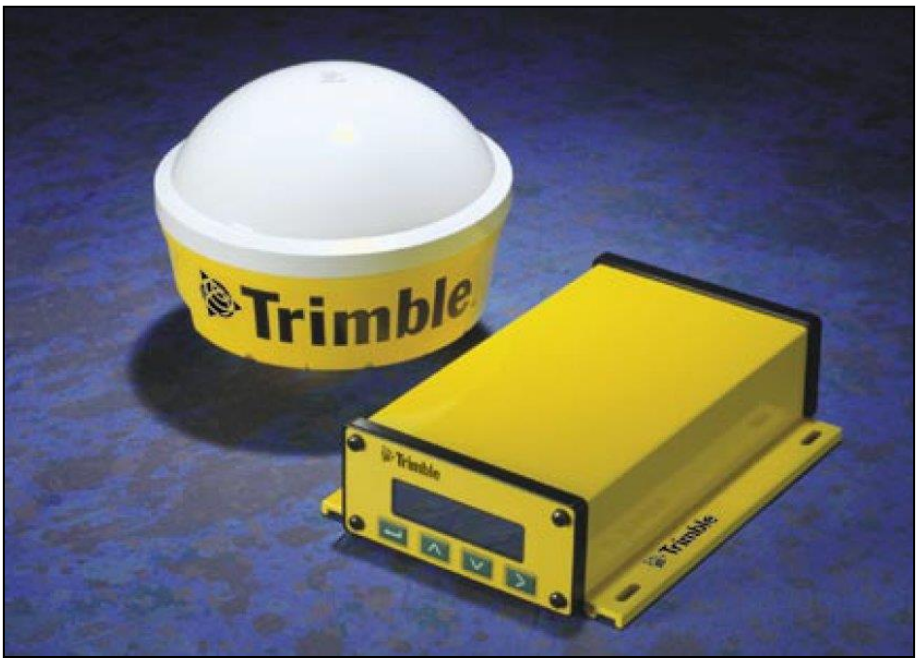

Plate 2. Trimble 132 DGPS

4.1.5 Navigation

Vessel navigation was provided by Hypack 2014. Hypack is the most widely used hydrographic software package in the world. It enables users to create and follow pre-determined and pre-configured survey lines. It uses GPS input to calculate navigation errors and provides the helmsman with cross track and off track measurements.

4.1.6 Survey Vessel

The survey of the main navigation channel was carried out from a 6.5m rigid hulled vessel. It was fitted with two no. Mariner 115 horsepower outboard engines and has a centre control console. The equipment configuration was such that the vessel navigation control point was located in the centre of the vessel. The side scan sonar was deployed off the stern port side, the sub bottom profiler was pole mounted on the starboard side and with the magnetometer being deployed off the stern starboard side.

Plate 3. View of survey vessel

5. Data Processing

A variety of software packages were used during data acquisition and subsequent processing. These included the following:

5.1 Hypack 2014

Hypack 2014 is the world's most popular a hydrographic survey software. It enables users to create and follow pre-determined and pre-configured survey lines. It uses GPS input to calculate navigation errors and provides the helmsman with cross track and off track measurements. It also allows users to post processing single beam bathymetric and magnetometer data, allowing for the input of diurnal variation calculations as well as positional corrections. The software can also be used for the export of processed data in various formats including XYZ and 3D contour styles.

5.2 Sonar Pro

Sonar pro is Klein's proprietary side scan sonar acquisition software. It allows the user to determine ping rate and transmit frequency and also provides valuable real time sensor information such as sonar signal intensity, sonar trace waterfall imagery and positional location. The software was used for data acquisition but it has no post processing capabilities.

5.3 Sonarwiz

Sonarwiz 5 was the side scan sonar, sub bottom profiler and magnetometer data processing software used for the survey. It allows for side scan, sub bottom profiler (Seg-Y) and magnetometer

data interrogation. It enables the user to geo-locate and describe potential targets of potential interest. It permits the creation of side scan sonar mosaics and also allows for cross reference of side scan sonar, sub bottom profiler and even magnetometer anomaly locations. The software allows the user to export processed data in various forms such as geo-tiff and shapefile.

6. Survey results

6.1 Side scan sonar

A total of 3.193 linear kilometres of seabed was ensonified during the survey, comprising 8 no. separate lines (see figure 7). The quality of the side scan sonar data was generally good although there was propeller wash noted in some of the sonar traces (see plate 5). The data also indicated the presence of a number of water column features such as a shoal of fish (plate 5) and trawl marks on the seafloor (plate 4).

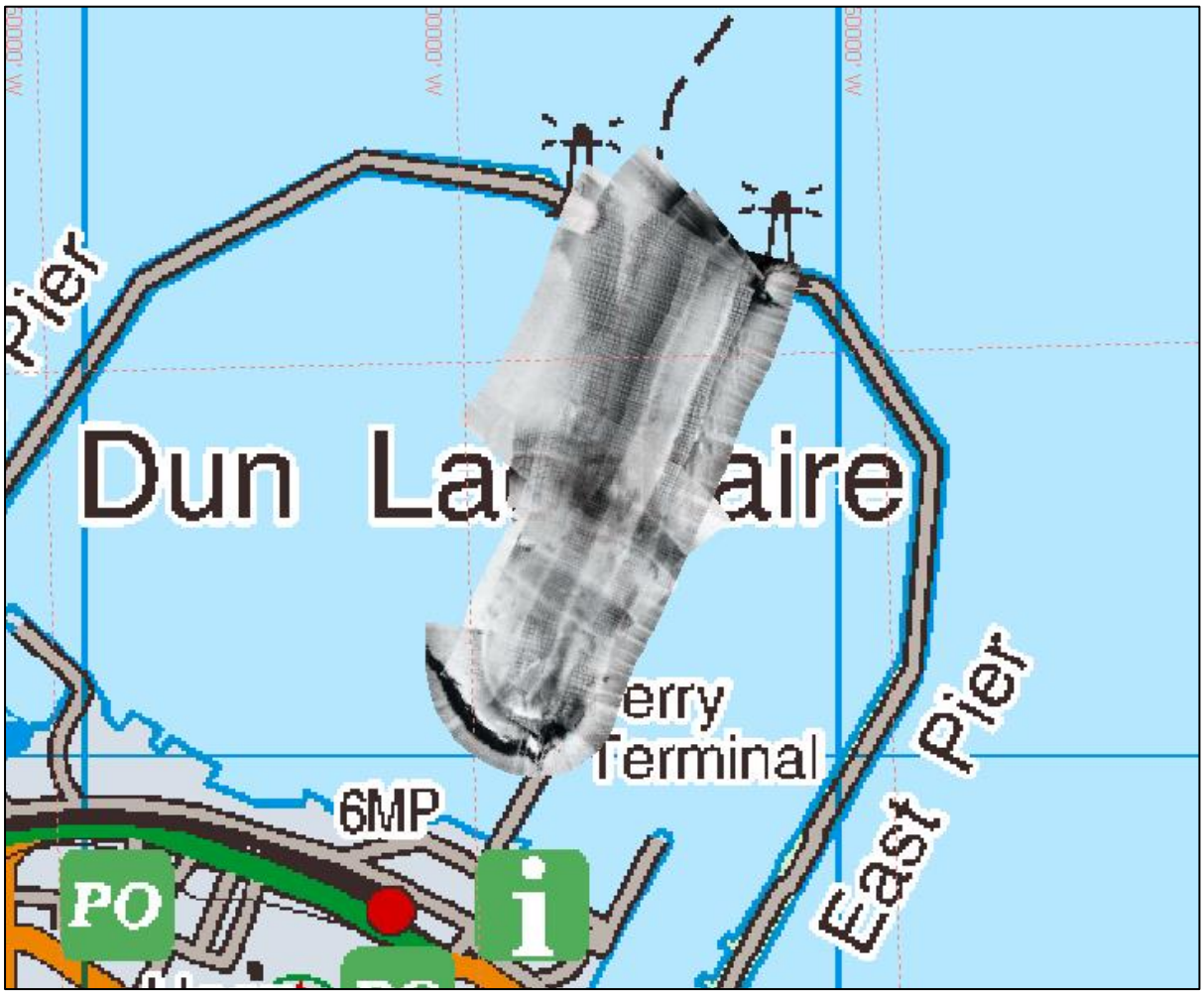

Figure 5 . Mosaic of sidescan sonar data with OS map background.

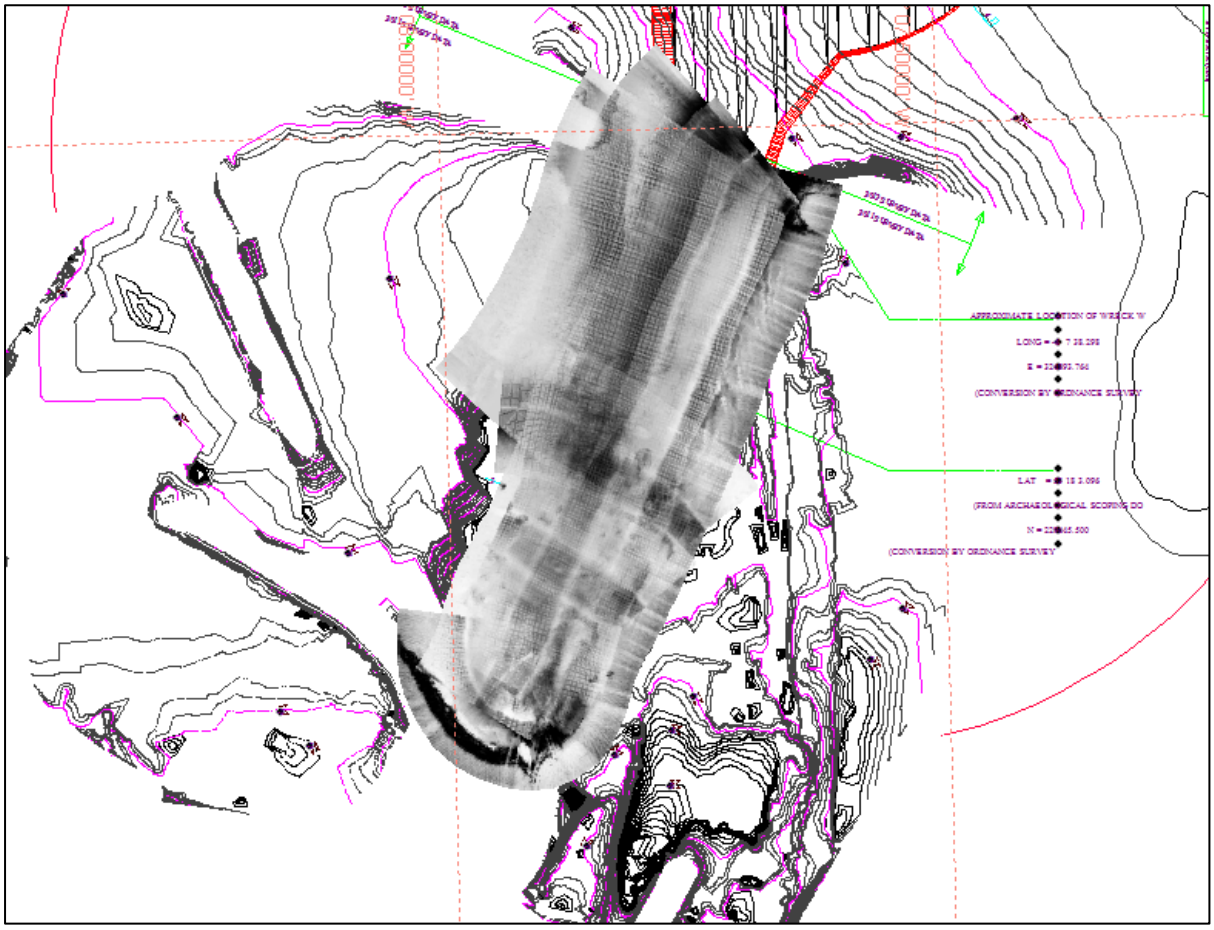

Figure 6. Sidescan data mosaic overlying development plan drawing.

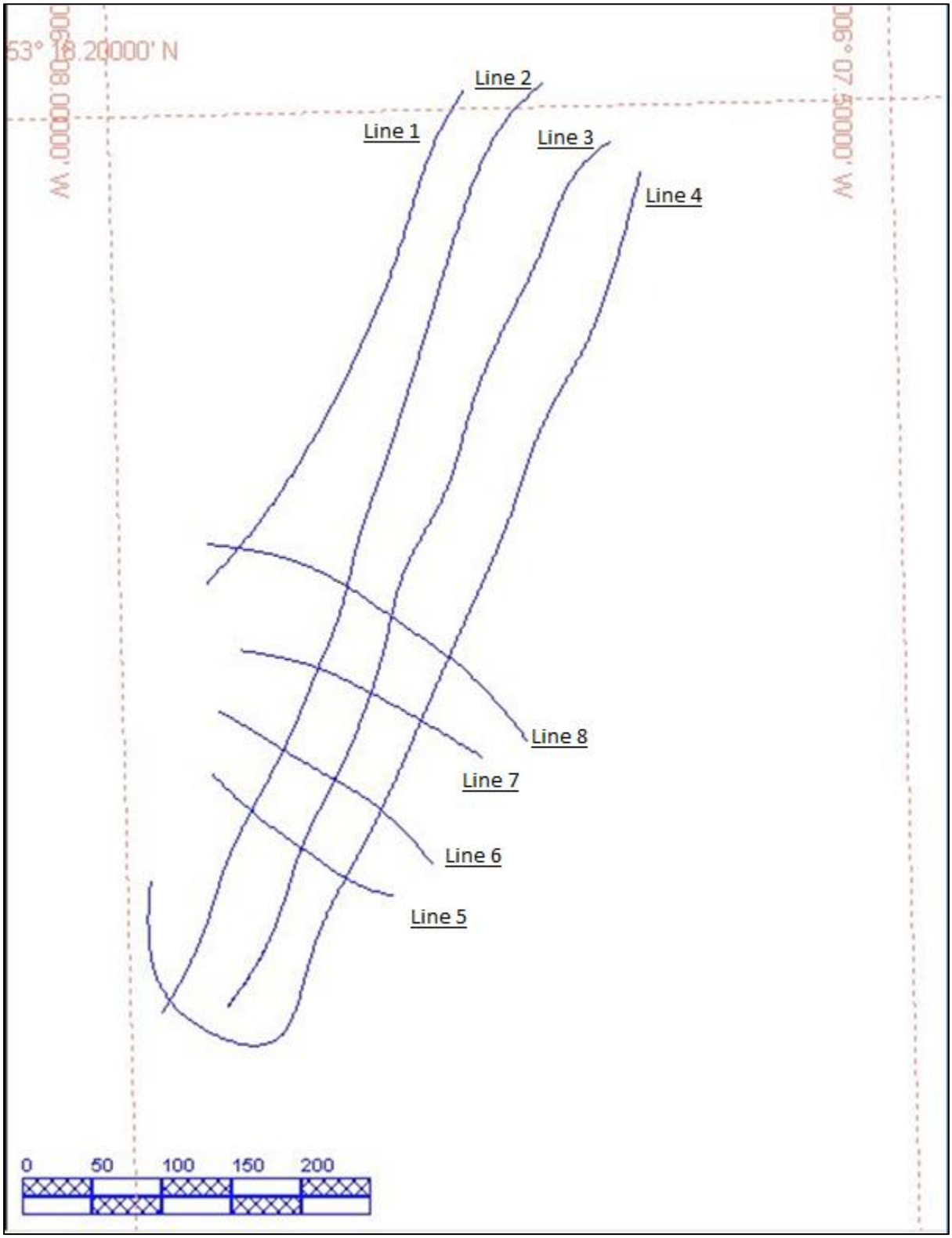

Figure 7. Survey Lines.

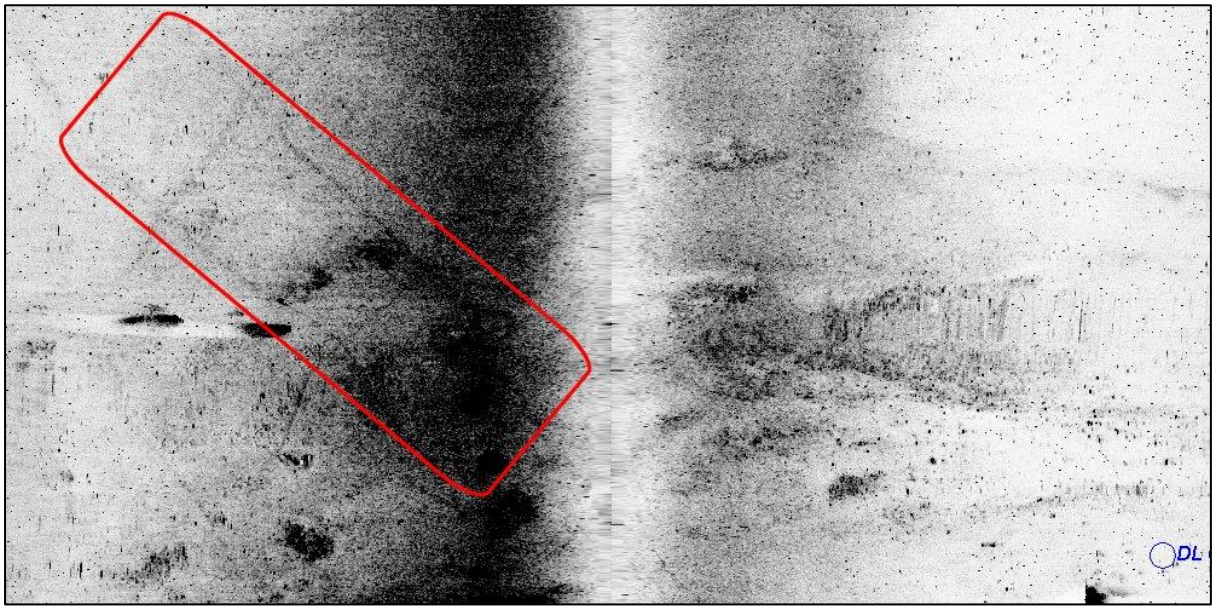

Plate 4. Extract from Survey line 3 showing trawl lines

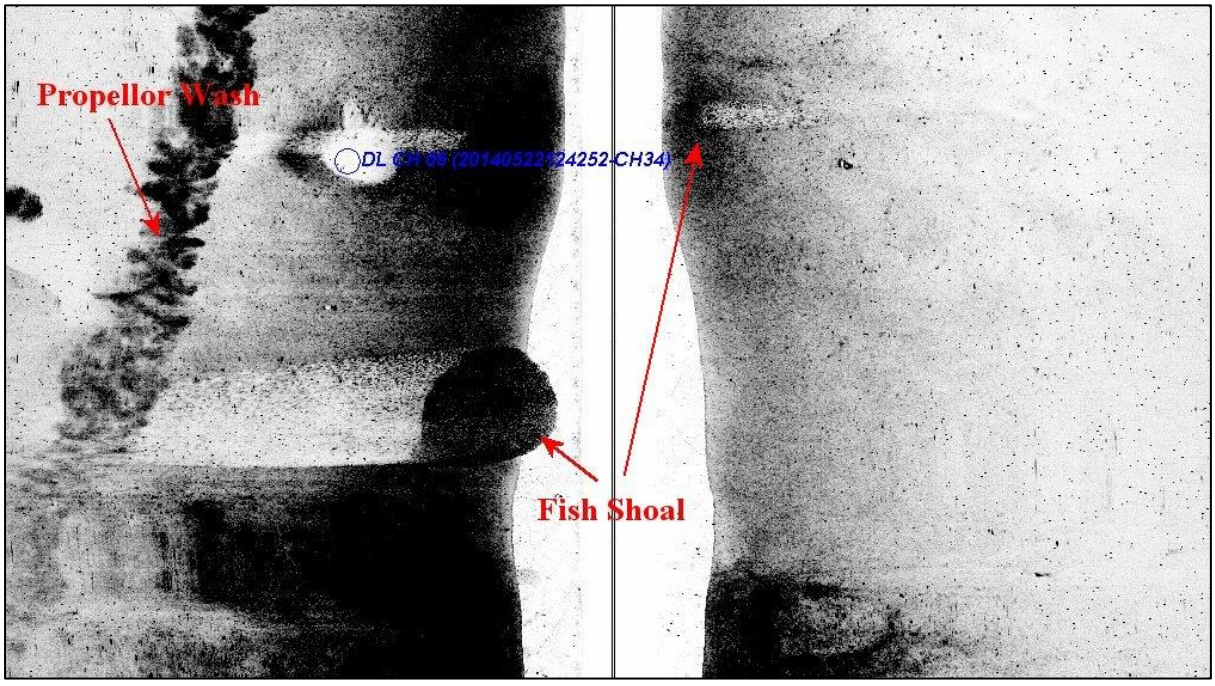

Plate 5. Extract from Line 8 showing Feature DL CH 06 plus natural features

The side scan sonar was operated at two frequencies, 100 kHz and 445 kHz, with the range set to 100m, this ensured that there was 100% overlap on all lines.

The survey data indicated that the area surrounding the site of potential wreck WO1967 (anomalies DL CH 07-10) had changed considerably since the first geophysical survey was carried out in May 2014 (see plates 6 & 7).

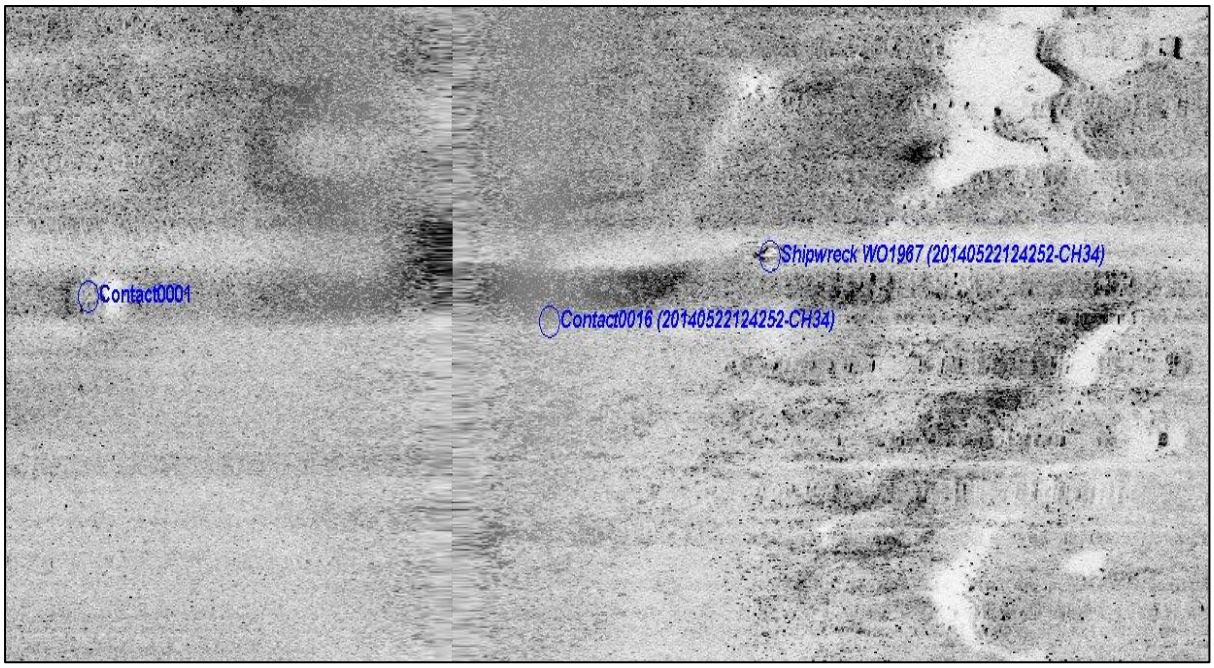

Plate 6. Contacts thought to be related to WO1967 from first geophysical survey, seabed shows notable scouring in this area.

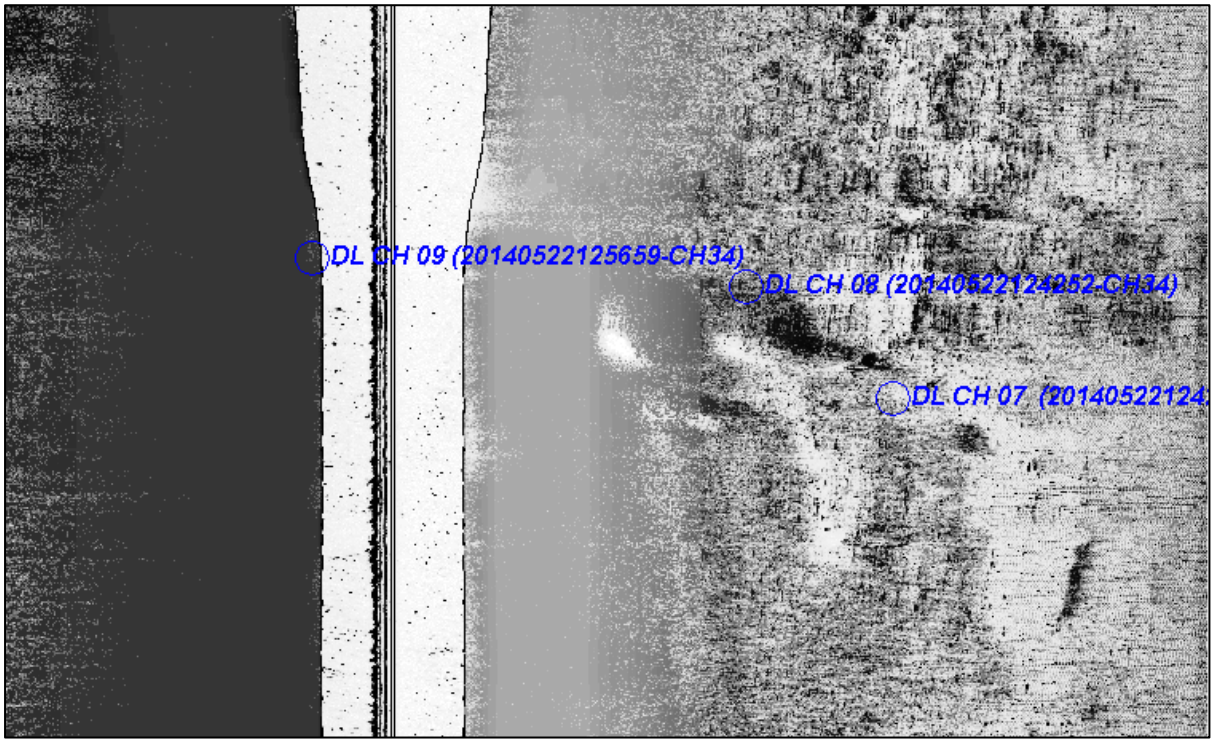

Plate 7. Sonar contacts DL CH 07 – DL CH 09, in same location as contacts from previous geophysical survey, note less scouring of see bed.

The most significant aspect of this change was the flat nature of the seafloor, where it had previously been scoured. A number of the seafloor anomalies noted in this area were still present (see figures 9 & 10). These were recorded during diver investigations as modern debris and small seafloor undulations and not of archaeological significance.

The previously recorded undulating seafloor typified by scour ridges was no longer present. These undulations appear to have been caused by ferry traffic. As ferry transits had ceased from the time of the geophysical survey to the time of the investigations, the seafloor has subsequently naturally silted in the areas of scour.

With regard to the previously recorded timber, it is most likely that it has been relocated. At the time of the survey, the provenance of this partially buried timber was indeterminable. Its subsequent disappearance appears to indicate that it may have been a piece of transient timber or flotsam, which has since been relocated, most likely as a result of shipping movements.

The previously undertaken archaeological investigations have shown that there were not any in situ archaeological features in this area. Consequently, the timber is not related to any archaeological features in this area and no remains of the possible wreck WO1967 are present.

The side scan sonar survey indicates that there are no new seafloor anomalies in this area which may indicate the presence of archaeological features or material.

7. Conclusions

A total of 3.193 linear kilometres of seabed was ensonified during the survey, comprising 8 no. separate lines. The quality of the side scan sonar data was generally good although there were some propeller wash noted in some of the sonar traces. The data also indicated the presence of a number of water column features such as a shoal of fish and trawl marks on the seafloor.

The survey data indicated that the survey area surrounding the site of potential wreck WO1967 (anomalies DL CH 07-10) had changed considerably since the first geophysical survey which took place during May 2014. The most significant aspect of this change was the flat nature of the seafloor, where it had previously been scoured (see plates 8 & 9). A number of the seafloor anomalies noted in this area were still present (see figure 10). These were recorded during diver investigations as modern debris and small seafloor undulations and not of archaeological significance.

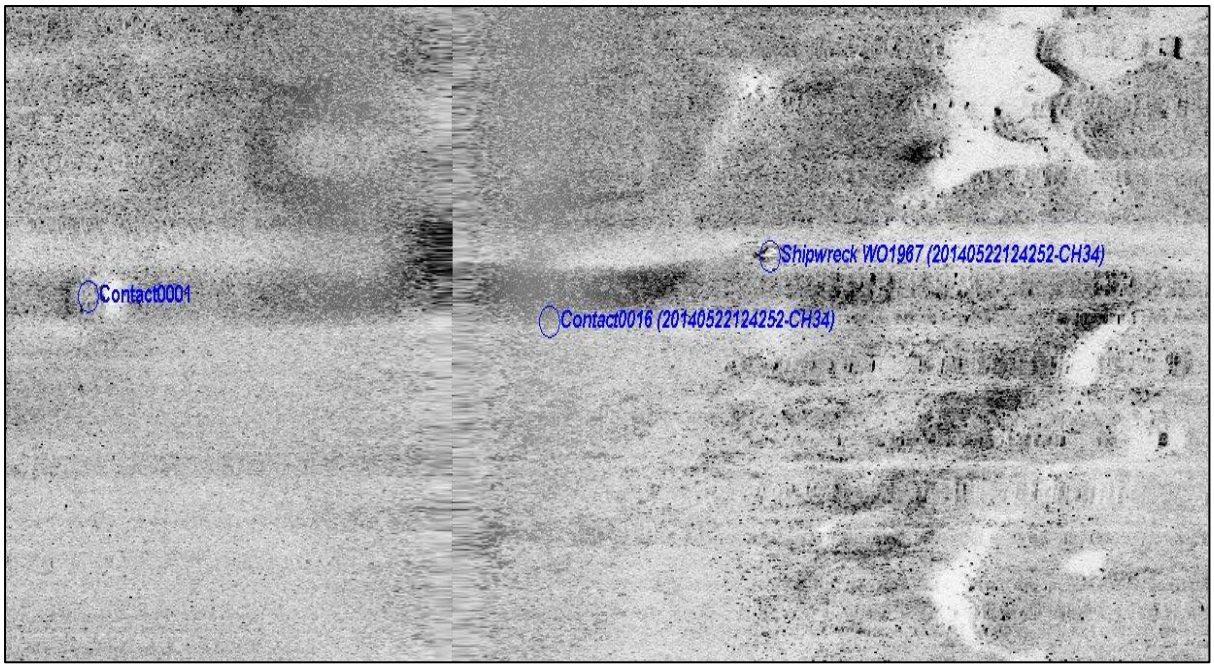

Plate 8. **Contacts thought to be related to WO1967 wreck site, geophysical survey No.1.**

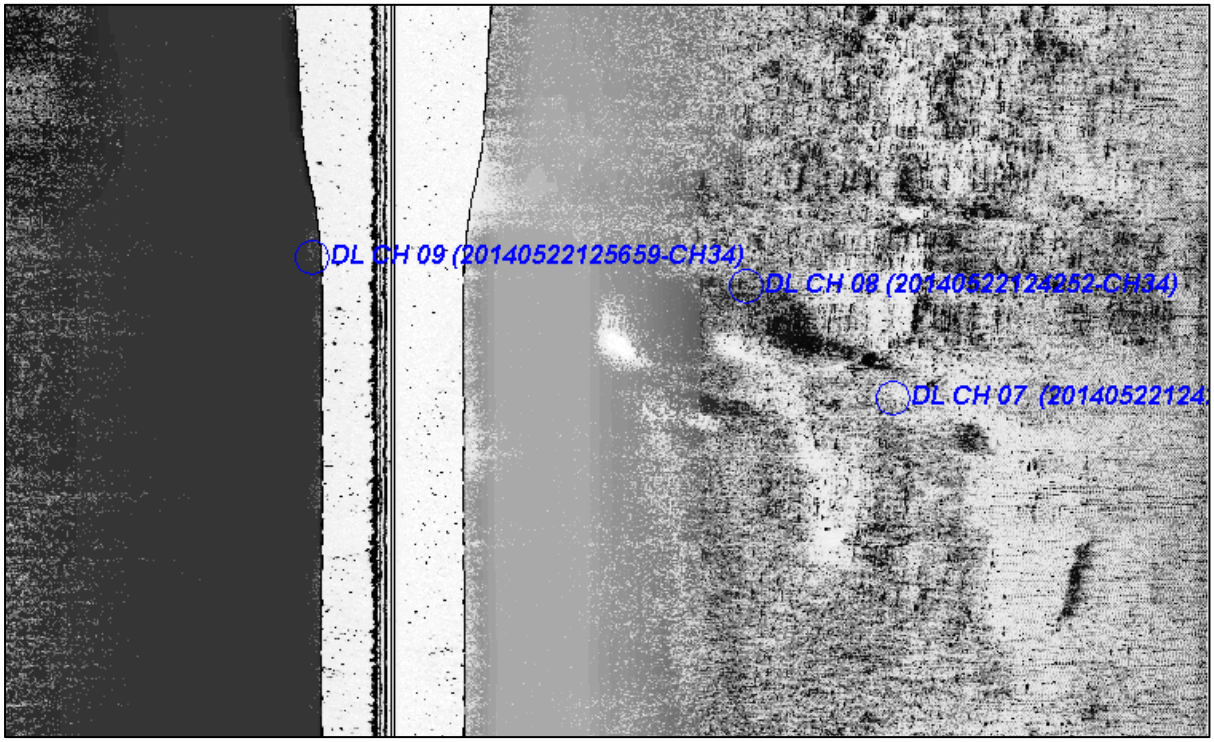

Plate 9. Same contacts as seen in plate 8, geophysical Survey No.2.

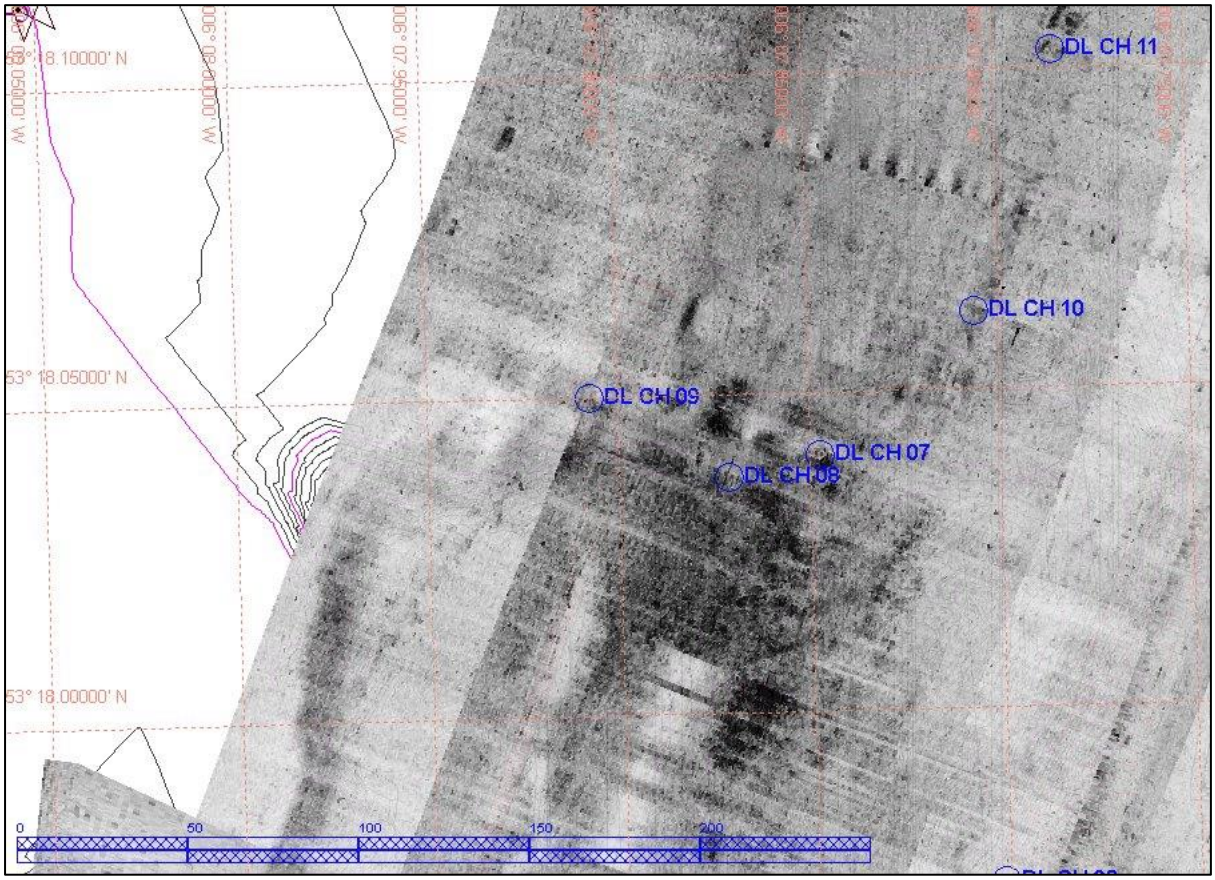

Figure 8. Anomalies DL CH 07-10 after 1st survey

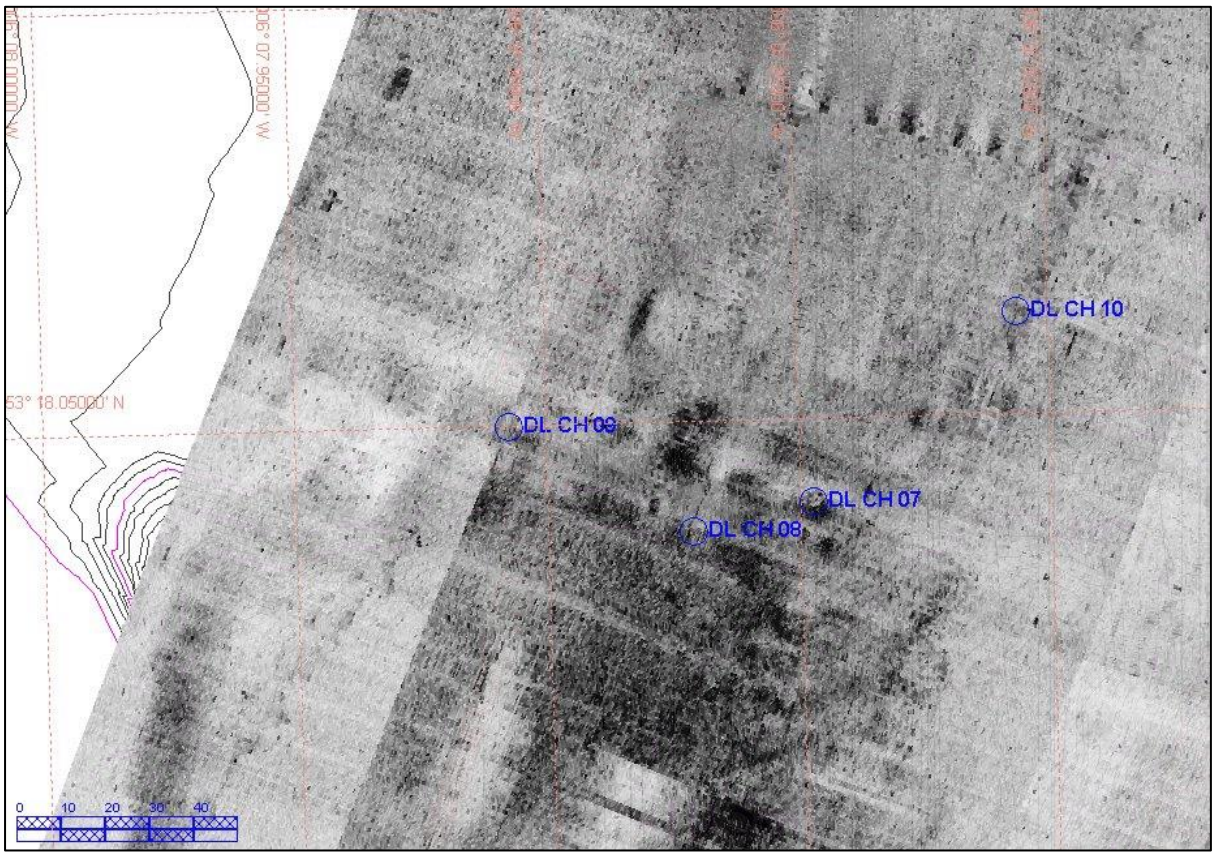

Figure 9. Anomalies DLCH 07-10 after 2nd survey

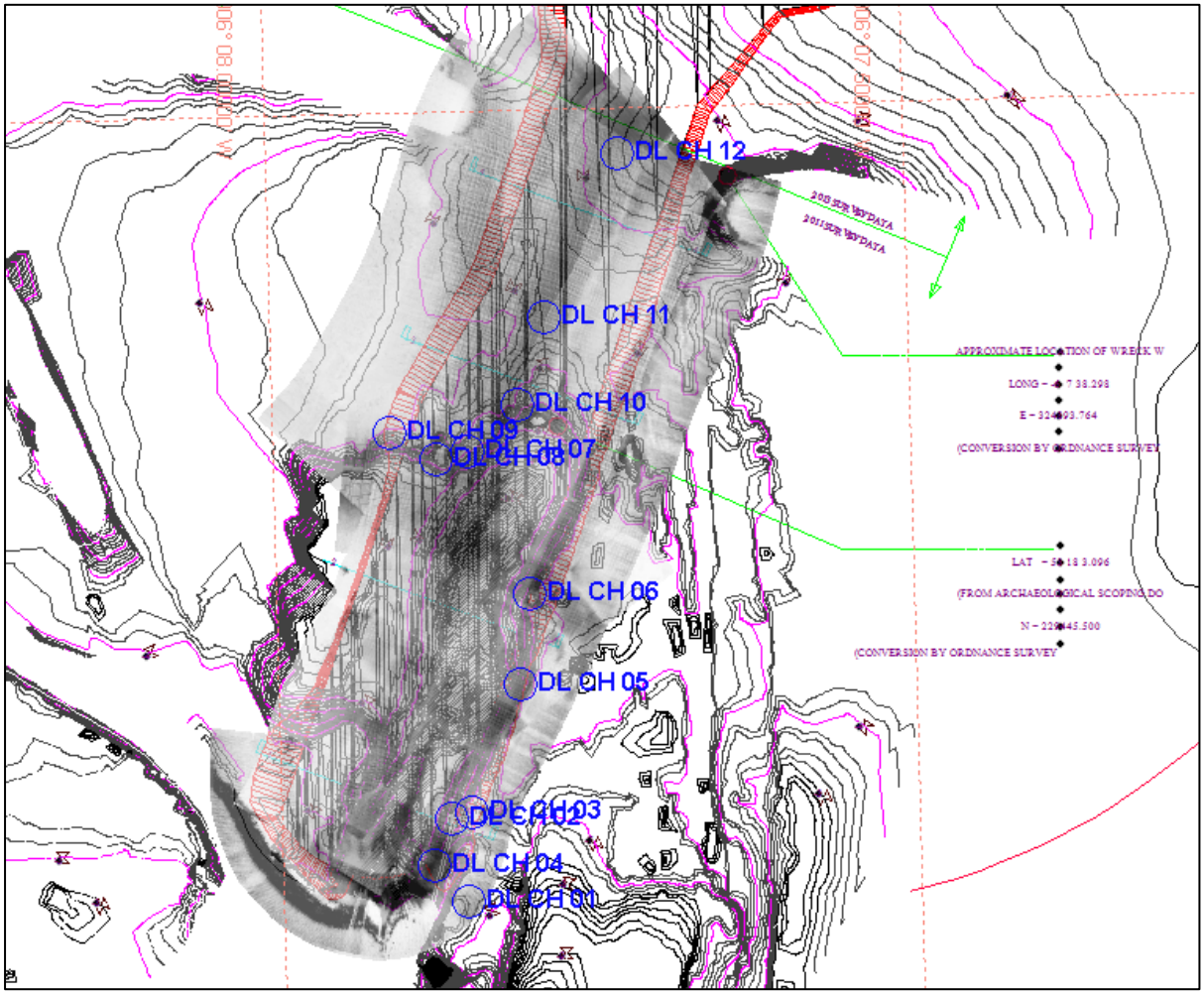

Figure 10. Side Scan Sonar mosaic overlying proposed development plan.

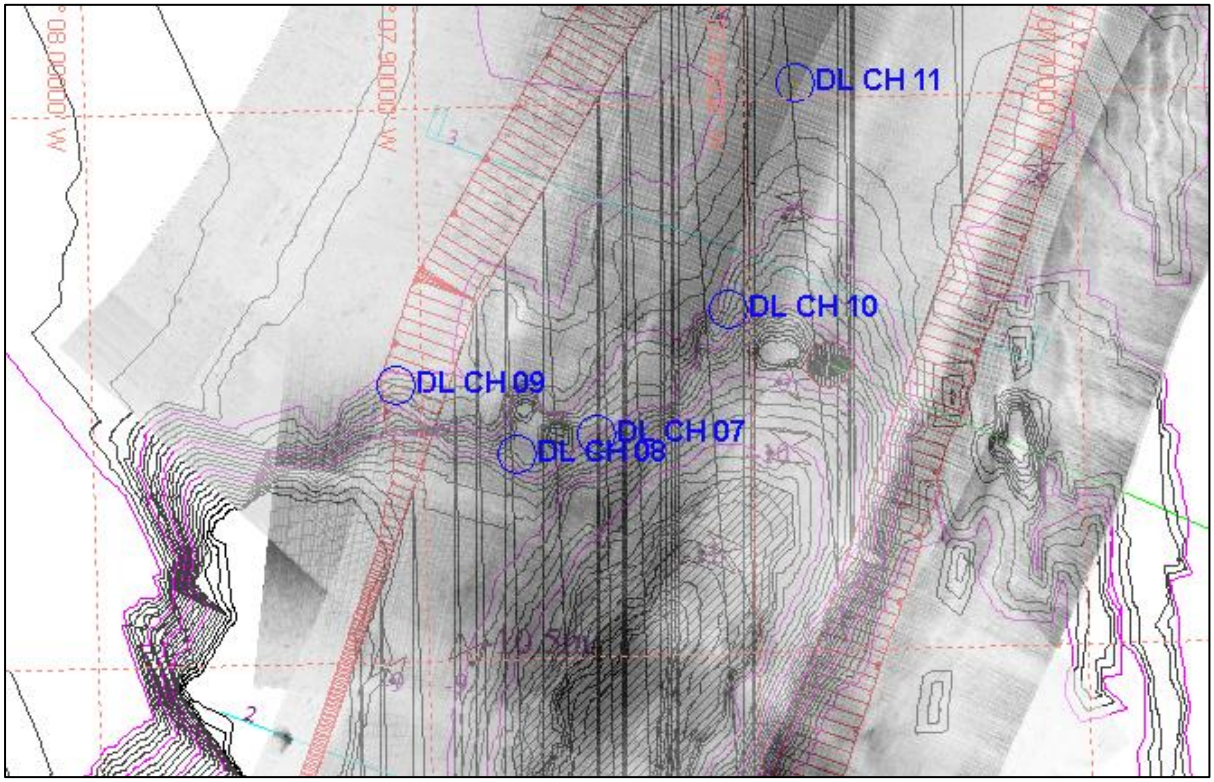

Figure 11. Contacts within proposed development area.

With regard to the previously recorded timber, it is most likely that it has been relocated. At the time of the survey, the provenance of this partially buried timber was indeterminable. Its subsequent disappearance appears to indicate that it may have been a piece of transient timber or flotsam, which has since been relocated, most likely as a result of ship movements.

The previously undertaken archaeological investigations have shown that there were not any in situ archaeological features in this area. Consequently, the timber is not related to any archaeological features in this area.

The side scan sonar survey indicates that there are no new seafloor anomalies in this area which would suggest the presence of archaeological features or material. The contacts located within the proposed development area are not considered to be of any archaeological importance.

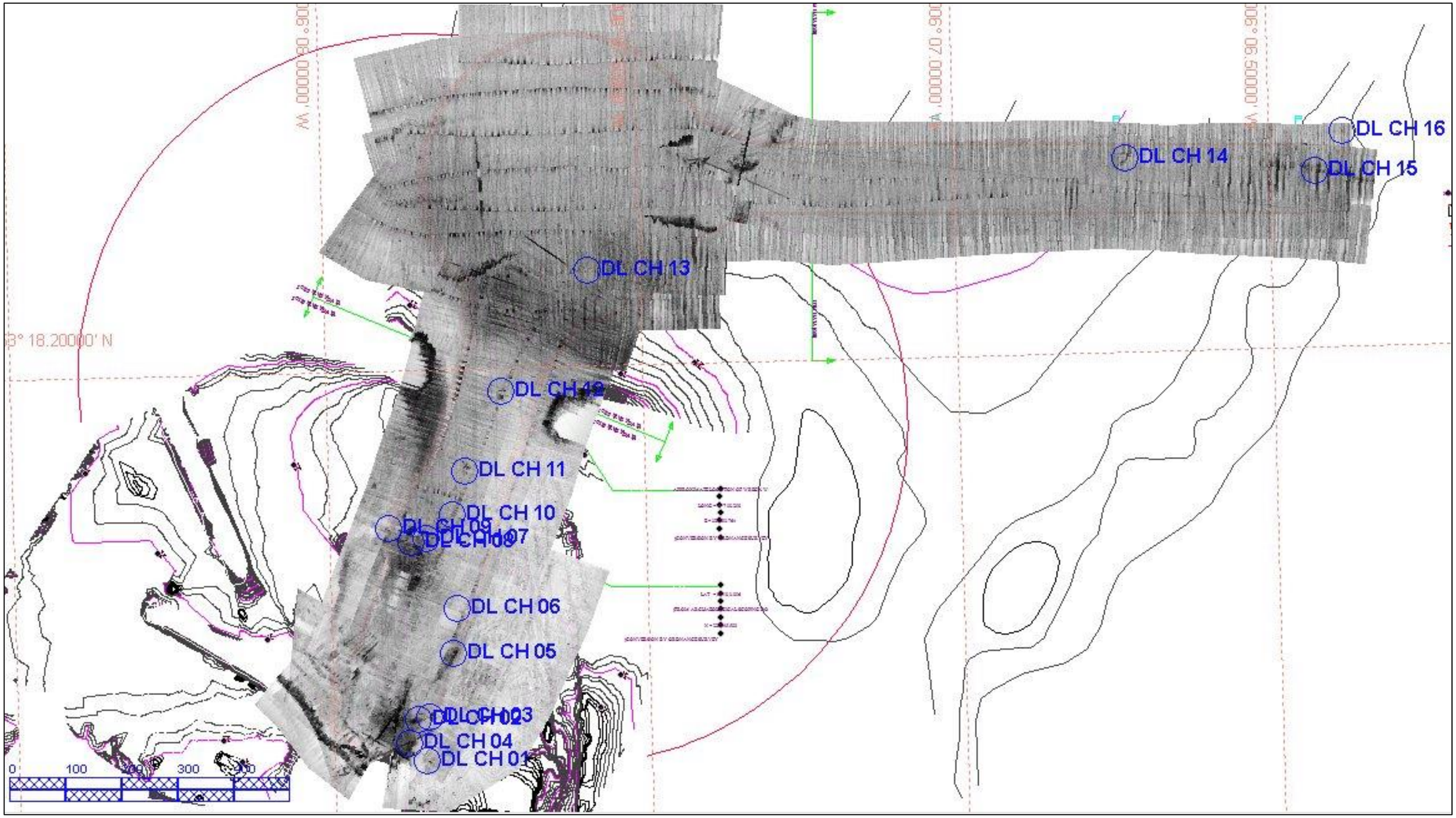

Figure 12. **Anomaly locations as per first survey**

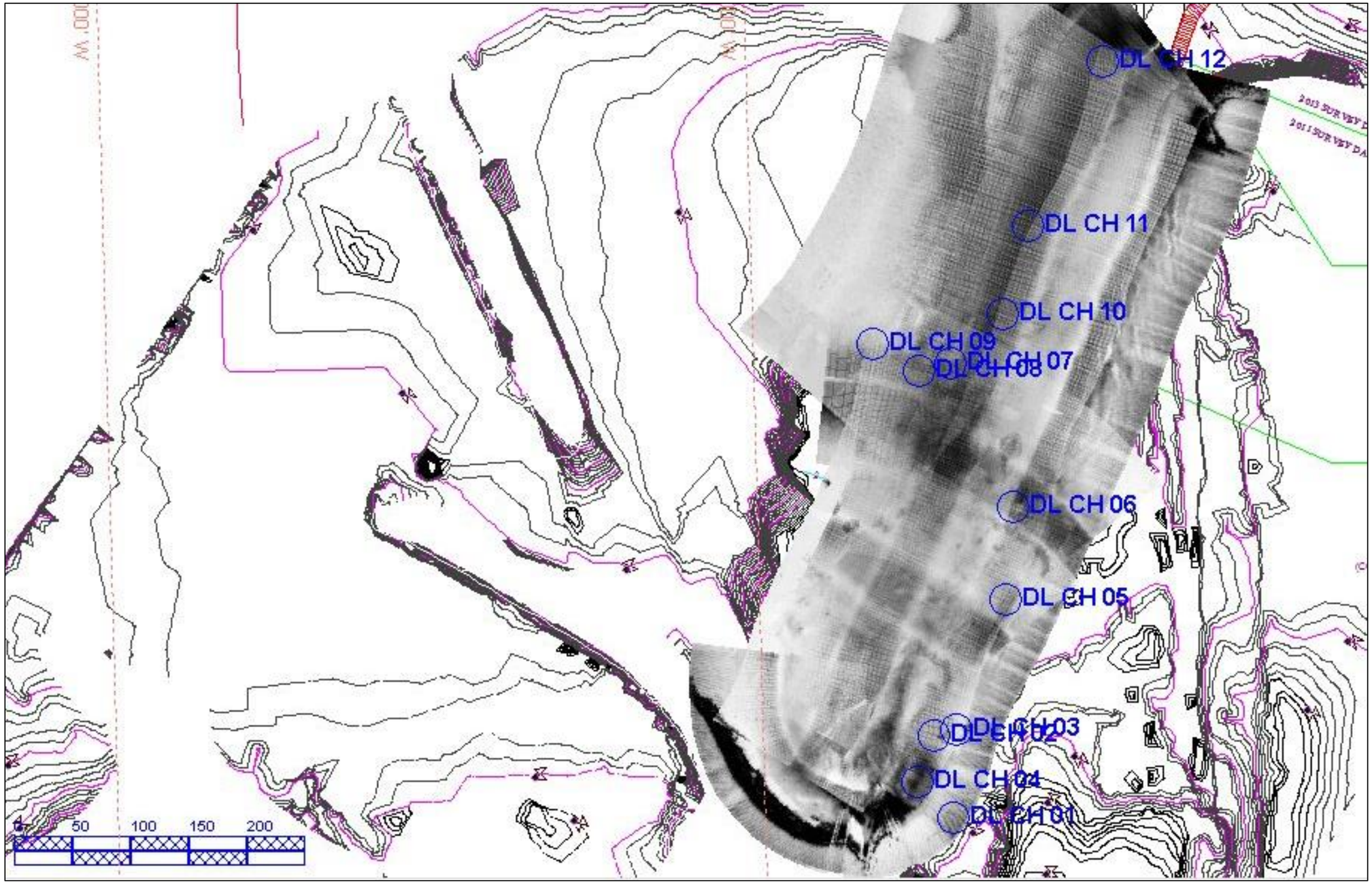

Figure 13. Anomaly locations as per 2nd survey

Appendix 5.10.8

Legislative Framework Protecting the archaeological Resource

Protection of Cultural Heritage

The cultural heritage in Ireland is safeguarded through national and international policy designed to secure the protection of the cultural heritage resource to the fullest possible extent (Department of Arts, Heritage, Gaeltacht and the Islands 1999, 35). This is undertaken in accordance with the provisions of the *European Convention on the Protection of the Archaeological Heritage* (Valletta Convention), ratified by Ireland in 1997.

The Archaeological Resource

The *National Monuments Act 1930 to 2004* and relevant provisions of the *National Cultural Institutions Act 1997* are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. A National Monument is described as 'a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto' (National Monuments Act 1930 Section 2).

A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places, and the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

Ownership and Guardianship of National Monuments

The Minister may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Register of Historic Monuments

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the register is illegal without the permission of the Minister. Two months notice in writing is required prior to any work being undertaken on or in the vicinity of a registered monument. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Preservation Orders and Temporary Preservation Orders

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the

vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Record of Monuments and Places
Section 12(1) of the 1994 Act requires the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for the Environment, Heritage and Local Government) to establish and maintain a record of monuments and places where the Minister believes that such monuments exist. The record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the state. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994. All recorded monuments on the proposed development site are represented on the accompanying maps.

Section 12(3) of the 1994 Act provides that 'where the owner or occupier (other than the Minister for Arts, Heritage, Gaeltacht and the Islands) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage, Gaeltacht and the Islands to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the work until two months after the giving of notice'.

Under the National Monuments (Amendment) Act 2004, anyone who demolishes or in any way interferes with a recorded site is liable to a fine not exceeding €3,000 or imprisonment for up to 6 months. On summary conviction and on conviction of indictment, a fine not exceeding €10,000 or imprisonment for up to 5 years is the penalty. In addition they are liable for costs for the repair of the damage caused.

In addition to this, under the *European Communities (Environmental Impact Assessment) Regulations 1989,* Environmental Impact Statements (EIS) are required for various classes and sizes of development project to assess the impact the proposed development will have on the existing environment, which includes the cultural, archaeological and built heritage resources. These document's recommendations are typically incorporated into the conditions under which the proposed development must proceed, and thus offer an additional layer of protection for monuments which have not been listed on the RMP.

The Planning and Development Act 2000
Under planning legislation, each local authority is obliged to draw up a Development Plan setting out their aims and policies with regard to the growth of the area over a five-year period. They cover a range of issues including archaeology and built heritage, setting out their policies and objectives with regard to the protection and enhancement of both. These policies can vary from county to county. The Planning and Development Act 2000 recognises that proper planning and sustainable development includes the protection of the archaeological heritage. Conditions relating to archaeology may be attached to individual planning permissions.

Dun Laoghaire Rathdown Development Plan 2010-2016

Policy AH1: Protection of Archaeological Heritage

It is Council policy to protect archaeological sites, National Monuments (and their setting), which have been identified in the Record of Monuments and Places (RMP), whilst at the same time reviewing and assessing the feasibility of improving public accessibility to sites and monuments under the direct ownership or control of the Council or of the state.

Policy AH2: Protection of Archaeological Material In Situ

It is Council policy to seek the preservation in-situ (or, as a minimum, preservation by record) of all archaeological monuments included in the Record of Monuments and Places, and of previously unknown sites, features and objects of archaeological interest that become revealed through development activity. In respect of decision making on development proposals affecting sites listed in the Record of Monuments and Places, the Council will have regard to the advice and/or recommendations of the Department of the Environment, Heritage and Local Government.

Policy AH3: Protection of Historic Towns

It is Council policy to protect the Historic Town of Dalkey as identified by the Department of Environment, Heritage and Local Government.

Policy AH4: Designation of Archaeological Landscapes

It is Council policy to identify, designate and protect Archaeological Landscapes in co-operation with relevant government departments.

Policy AH5: Historic Burial Grounds

It is Council policy to protect historic burial grounds within the County and encourage their maintenance in accordance with good conservation practice.

Policy AH6: Underwater Archaeology

It is Council policy for all developments, which have the potential to impact on riverine, inter-tidal and sub-tidal environments to require an archaeological assessment prior to works being carried out.

Appendix 5.10.8

Impact Assessment and the Cultural Heritage Resource

Potential Impacts on Archaeological and Historical Remains

Impacts are defined as 'the degree of change in an environment resulting from a development' (Environmental Protection Agency 2003: 31). They are described as profound, significant or slight impacts on archaeological remains. They may be negative, positive or neutral, direct, indirect or cumulative, temporary or permanent.

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological and historical resources potentially affected. Development can affect the archaeological and historical resource of a given landscape in a number of ways.

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape.

- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery; disturbance by vehicles working in unsuitable conditions; or burial of sites, limiting accessibility for future archaeological investigation.

- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or longer-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits.

- Visual impacts on the historic landscape sometimes arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic monuments and historic landscape elements as well as their visual amenity value.

- Landscape measures such as tree planting can damage sub-surface archaeological features, due to topsoil stripping and through the root action of trees and shrubs as they grow.

- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluviums or peat deposits.

- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, and service trenches.

Although not widely appreciated, positive impacts can accrue from developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments, and the increased level of knowledge of a site or historic landscape as a result of archaeological assessment and fieldwork.

Predicted Impacts

The severity of a given level of land-take or visual intrusion varies with the type of monument, site or landscape features and its existing environment. Severity of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;

- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected;

- Assessment of the levels of noise, visual and hydrological impacts, either in general or site specific terms, as may be provided by other specialists.

Appendix 5.10.9

Mitigation Measures and the Cultural Heritage Resource

Potential Mitigation Strategies for Cultural Heritage Remains

Mitigation is defined as features of the design or other measures of the proposed development that can be adopted to avoid, prevent, reduce or offset negative effects.

The best opportunities for avoiding damage to archaeological remains or intrusion on their setting and amenity arise when the site options for the development are being considered. Damage to the archaeological resource immediately adjacent to developments may be prevented by the selection of appropriate construction methods. Reducing adverse effects can be achieved by good design, for example by screening historic buildings or upstanding archaeological monuments or by burying archaeological sites undisturbed rather than destroying them. Offsetting adverse effects is probably best illustrated by the full investigation and recording of archaeological sites that cannot be preserved *in situ*.

Definition of Mitigation Strategies

Archaeological Resource

The ideal mitigation for all archaeological sites is preservation *in situ*. This is not always a practical solution, however. Therefore a series of recommendations are offered to provide ameliorative measures where avoidance and preservation *in situ* are not possible.

Full Archaeological Excavation can be defined as 'a programme of controlled, intrusive fieldwork with defined research objectives which examines, records and interprets archaeological deposits, features and structures and, as appropriate, retrieves artefacts, ecofacts and other remains within a specified area or site on land, inter-tidal zone or underwater. The records made and objects gathered during fieldwork are studied and the results of that study published in detail appropriate to the project design' (IFA 2008).

Archaeological Test Trenching can be defined as 'a limited programme of intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site on land, inter-tidal zone or underwater. If such archaeological remains are present field evaluation defines their character, extent, quality and preservation, and enables an assessment of their worth in a local, regional, national or international context as appropriate' (IFA 2009).

Archaeological Monitoring can be defined as 'a formal programme of observation and investigation conducted during any operation carried out for non-archaeological reasons. This will be within a specified area or site on land, inter-tidal zone or underwater, where there is a possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive (IFA 2008).

Underwater Archaeological Assessment consists of a programme of works carried out by a specialist underwater archaeologist, which can involve wade surveys, metal

detection surveys and the excavation of test pits within the sea or riverbed. These assessments are able to access and assess the potential of an underwater environment to a much higher degree than terrestrial based assessments.