London Gateway: Marine Archaeology
Monitoring of Exclusion Zones
Commentary on Dredge Monitoring

May 2011 Monitoring Survey

WA Ref: 72437
24 June 2011

Background

Wessex Archaeology (WA) has been commissioned by London Gateway Port Ltd. (LGPL) to provide archaeological services in respect of marine works in the course of developing London Gateway Port and its associated dredged channel.

As part of this work, WA has been asked to review data relating to the monitoring of three exclusion zones intended to protect sites of archaeological interest.

Provision for each Archaeological Exclusion Zones (AEZ) and their monitoring is made in the document *Archaeological Exclusion Zones and Monitoring Regimes: Method Statement* (13/11/08: LG-WSA-ENV-CEP-C7013-RPT-ARC-3012), agreed with the Port of London Authority (PLA) and English Heritage, which is appended to the Detail Dredge Plan. Under the Tidal Works Approval issued by the PLA, the dredging must be carried out in accordance with the Detail Dredge Plan.

The three AEZs protect sites 5020, 5019 and 5029, which were identified as being potentially important in the course of EIA and pre-clearance investigations. The background to each site is presented in their respective Clearance Mitigation Statements (CMSs).

Site 5020 is known as the Iron Bar Wreck. Sites 5019 and 5029 are both parts of the wreck of the London, a second rate ship-of-the line sunk in an explosion in 1665. As well as being subject to exclusion zones, both 5019 and 5029 are protected by Restricted Areas designated under the Protection of Wrecks Act 1973.

All three sites lie to the north of the dredged channel and are, therefore, outside the area of dredging. The exclusion zones offer additional protection, and in all three cases also lie beyond the planned extent of dredging; the dredging does extend beyond the Channel Toe Line to allow for channel side slopes but does not extend into the exclusion zones. The statutory designated areas for 5019 and 5029 are smaller than the exclusion zones and also lie, therefore, beyond the planned extent of dredging.

It has been proposed that the designated area for 5029 will be extended by 25m towards the Channel Toe Line to include material thought to be buried. The exclusion zone for 5029 has already been extended by a corresponding 25m in the navigational software being used by the dredging company.

The relationship between the Restricted Areas, AEZs and the Channel Toe Line is shown in Fig. 1, including the proposed extension to the designated area for 5029.

Recent Survey History

All three sites were subject to high-resolution multibeam bathymetric survey in 2006 as part of pre-clearance investigations and the results included in the relevant CMS.

The three sites were re-surveyed using high-resolution multibeam equipment in February 2010 prior to dredging. A commentary on the pre-dredge monitoring of the AEZs was submitted previously (Wessex Archaeology ref: 72433, December 2010).

Dredging for London Gateway Port commenced in March 2010.

The document *Archaeological Exclusion Zones and Monitoring Regimes: Method Statement* provided for geophysical survey to take place following the first load from a dredger in the vicinity of the AEZs. This provision was varied by the PLA, who regulate the Tidal Works Approval, such that the monitoring survey should be carried out after 10-20% of the proposed dredging had taken place in the zones adjacent to the AEZs.

An interim survey of all three sites corresponding to the completion of approximately 10-20% of dredging in the adjacent dredging zones (zones 27; 28; 29) was carried out in February 2011. A commentary on the February 2011 survey was submitted in April (Wessex Archaeology ref: 72437, April 2011).

A second interim survey was carried out in May 2011 corresponding to the completion of approximately 50% of dredging in the adjacent zones. The results are considered below.

It was agreed at a meeting between LGPL, PLA and English Heritage on 14 June 2011 that two further interim surveys would be carried out corresponding to completion of approximately 75% and 100% of dredging in adjacent zones.

All surveys in (2006; February 2010; February 2011 and May 2011) were conducted by the PLA using a hull-mounted Reson 8125 system. The surveys were conducted as special order surveys (IHO S-44 5th Edition) that can be expected to produce a maximum error of c. 8cm in the water depths encountered at the three sites (10-12m). In each case the data were made available to WA by the PLA as tidally-corrected x,y,z files.

Monitoring Survey, May 2011

The surveys were carried out by the PLA on 9 May 2011 (PLA Report on Hydrographic Survey: Wk_342_79_110509; Wk_343_1_110509; Wk_342_2_110509).

WA has compared the multibeam data from May 2011 with the pre-dredge survey of February 2010. This comparison was carried out in order to assess any cumulative impact on sites 5019, 5020 and 5029 following c. 50% of dredging in adjacent zones.

The datasets were gridded using IVS Fledermaus (v. 7) at a horizontal resolution (i.e. cell size) of 0.5m to produce the surface models. The resulting surfaces were then compared and the surface-difference was calculated to indicate apparent changes in bed levels between February 2010 and May 2011.

For the 2010 pre-dredge report, the surface-difference between 2006 and February 2010 was coloured in bands, with the range +0.15m to -0.15m made transparent to represent neutral change. These values were chosen as the limit at which known archaeological features, whose absolute height is not thought to have changed, are not highlighted by the surface-difference analysis. This range was increased to +0.20m to -0.20m for the report on the February 2011 survey to reduce the influence of data artefacts on interpretation, and has been repeated for the May 2011 survey here.

Results

The surface models for February 2010 and May 2011 are presented for each site in Figures 2-4, with sidescan data indicating the extent of structural material as a background. Oblique views that zoom in on the wreck sites are presented in Figure 5.

The general trend across the survey areas is one of little change with areas of increasing bed level ranging from 0.2m to 0.4m, and localised areas of 0.3m decrease.

For site 5020, the difference between the February 2010 survey and the May 2011 shows some reduction in levels with no obvious increases. At the northwest limit of the Restricted Area, levels have reduced by up to 0.25m over an area covering roughly 6m by 3m. An area of reduced levels can also be identified immediately to the northeast of the wreck mound; the surface difference calculation indicates a reduction in level of 0.3m over an area covering roughly 4.7m by 4.7m. The dredged channel can be easily identified about 60m south of the wreck 5020. There is no evidence for direct impacts from dredging beyond the channel toe line, but there is a reduction in the bed level of about 0.35m extending roughly 14m from the toe line towards 5020 that appears to be an indirect effect of the reduction of bed levels in the channel. At its nearest point, the reduction in bed level beyond the toe line is about 12m from the exclusion zone.

For site 5019, the surface difference analysis between the February 2010 and May 2011 datasets indicates little change. There are several areas where the bed level has increased around the wreck. Around the southern part of the wreck, the bed level has increased by approximately 0.35m to the south and 0.3m to the west. Small localised areas where bed levels have reduced are generally associated with upstanding structure. These tend to comprise isolated patches measuring roughly 0.5m by 0.5m to the east of structural elements with levels reduced by roughly 0.25m. The dredging area appears to extend roughly 4.5m beyond the channel toe line with some indirect reduction in bed level adjacent to the exclusion zone.

The depositional environment around site 5029 varies considerably between the west and east sides of the wreck. To the west there is an area measuring roughly 20m by 4m which shows an increase in levels of as much as 0.4m. To the east, levels have reduced by up to 0.26m from an area measuring roughly 5m by 7.4m. There are also isolated patches where levels have reduced that are associated with upstanding wreck structure. The surface difference calculation shows a reduction of roughly 0.4m for most of these patches with a maximum 0.6m reduction in level at the northern part of the wreck. There has been a reduction of about 0.5m of the bed level extending about 15m beyond the channel toe line, though this is still c. 90m from the original exclusion zone.

In addition to the comparison of datasets, profiles of all three sites have been prepared and are presented in Figure 6. The profiles are presented relative to the channel toe line, AEZ boundaries and Restricted Area boundaries. The direct impact of dredging in the channel is readily apparent in each of the May 2011 profiles, as is the very localised effect of the reduction in levels at and beyond the channel toe line.

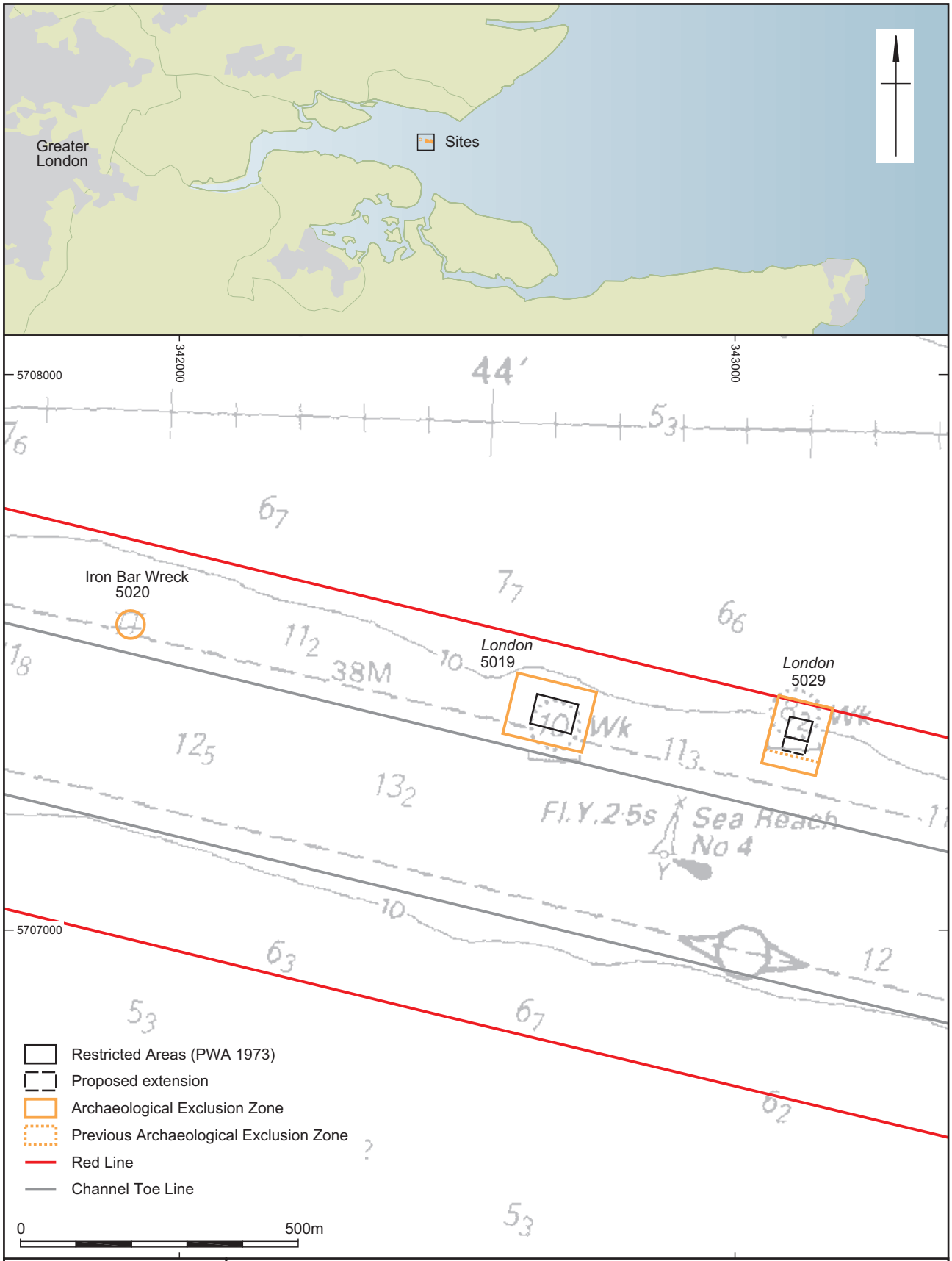
Conclusion

As noted previously, it is clear that all three sites are in a dynamic sedimentary environment and that change – both increases and decreases in bed level – that was apparent prior to dredging has continued to occur. The very localised reductions in bed level with wider increases in bed level seen between February 2010 and May 2011 is very similar to that seen between 2006 and 2010.

At all three sites, the direct impact of dredging within the channel is immediately apparent. However, it is also apparent that the decrease in bed level associated with the draghead tracks is very localised. None of the AEZs have been impacted directly by dredging.

As indicated above, two further monitoring surveys will be undertaken when dredging is c. 75% and 100% complete in the adjacent dredging zones. The survey data will be compared with the datasets reviewed here in due course, and the results reported.

Wessex Archaeology
June 2011



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Wessex Archaeology

Site location

Figure 1

A. February 2010 bathymetry

B. May 2011 bathymetry

C. Surface difference

-7.29
-7.64
-7.99
-8.34
-8.70
-9.05
-9.40
-9.75
-10.10
-10.45
-10.81
-11.16
-11.51
-11.86
-12.21
-12.56
-12.91
-13.27
-13.62
-13.97

0.81
0.40
0.20
0.00
-0.24
-0.40
-1.75

Wessex Archaeology

0 50 Metres

Archaeological Exclusion Zone
Red Line
Channel Toe Line

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5020 Iron Bar Wreck

Figure 2

A. February 2010 bathymetry

B. May 2011 bathymetry

C. Surface difference

-7.29
-7.64
-7.99
-8.34
-8.70
-9.05
-9.40
-9.75
-10.10
-10.45
-10.81
-11.16
-11.51
-11.86
-12.21
-12.56
-12.91
-13.27
-13.62
-13.97
-14.41

0.81
0.40
0.20
0.00
-0.24
-0.40
-1.75

Wessex Archaeology

0 50 Metres

Restricted Areas (PWA 1973)
Archaeological Exclusion Zone
Red Line
Channel Toe Line

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A. February 2010 bathymetry

B. May 2011 bathymetry

C. Surface difference

-7.29
-7.64
-7.99
-8.34
-8.70
-9.05
-9.40
-9.75
-10.10
-10.45
-10.81
-11.16
-11.51
-11.86
-12.21
-12.56
-12.91
-13.27
-13.62
-13.97
-14.41

0.81
0.40
0.20
0.00
-0.24
-0.40
-1.75

Wessex Archaeology

0 50 Metres

Restricted Areas (PWA 1973)
Proposed Extension
Archaeological Exclusion Zone
Previous Archaeological Exclusion Zone
Red Line
Channel Toe Line

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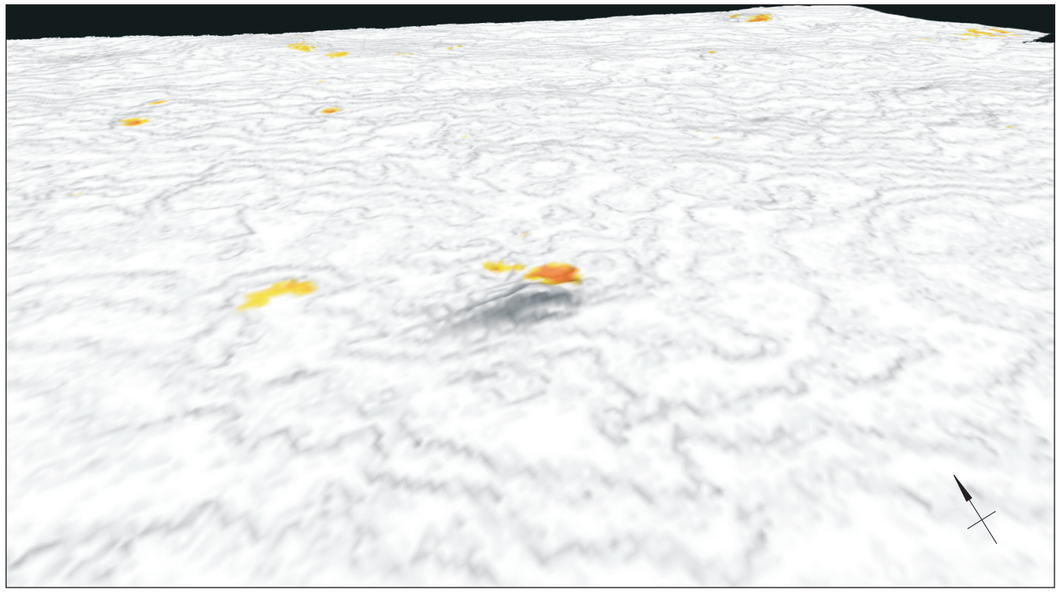
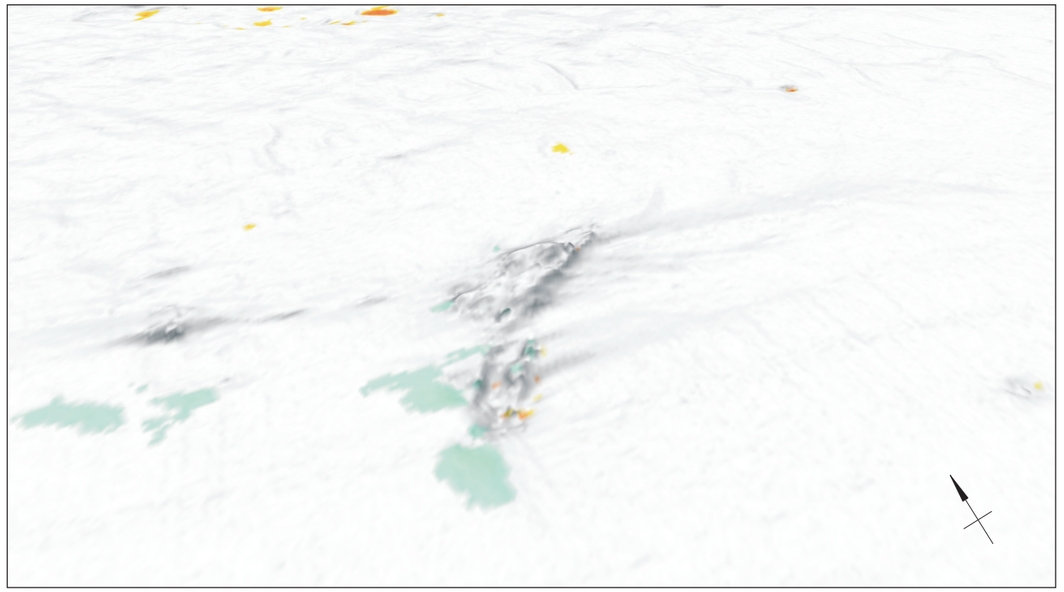
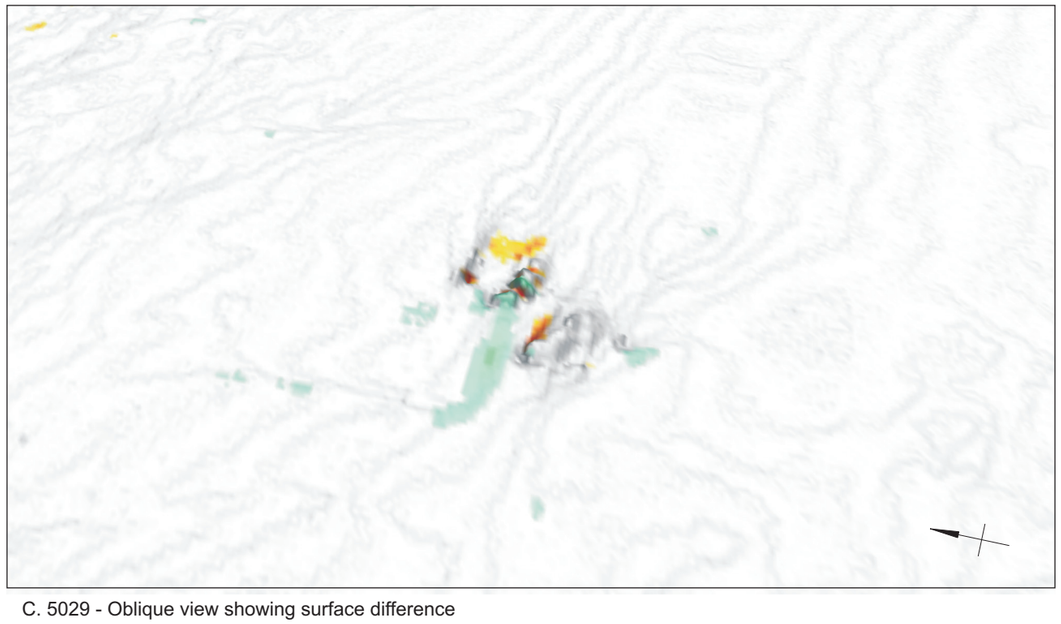
Figure 4



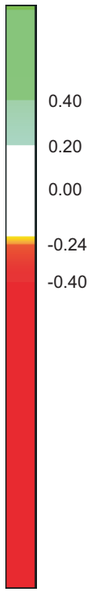
A. 5020 - Oblique view showing surface difference



B. 5019 - Oblique view showing surface difference



C. 5029 - Oblique view showing surface difference



Wessex Archaeology

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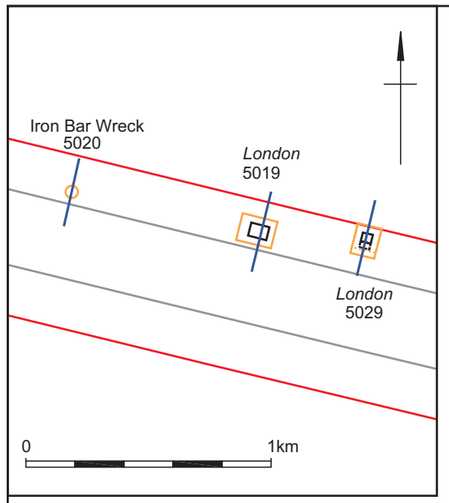
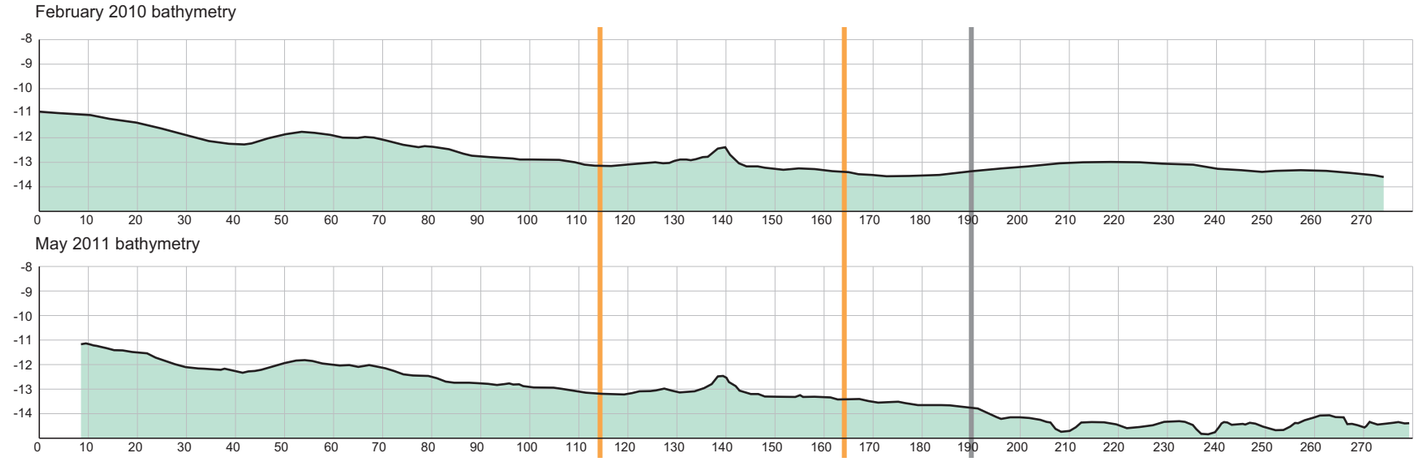
Oblique views showing surface difference

Figure 5



A. Iron Bar Wreck 5020



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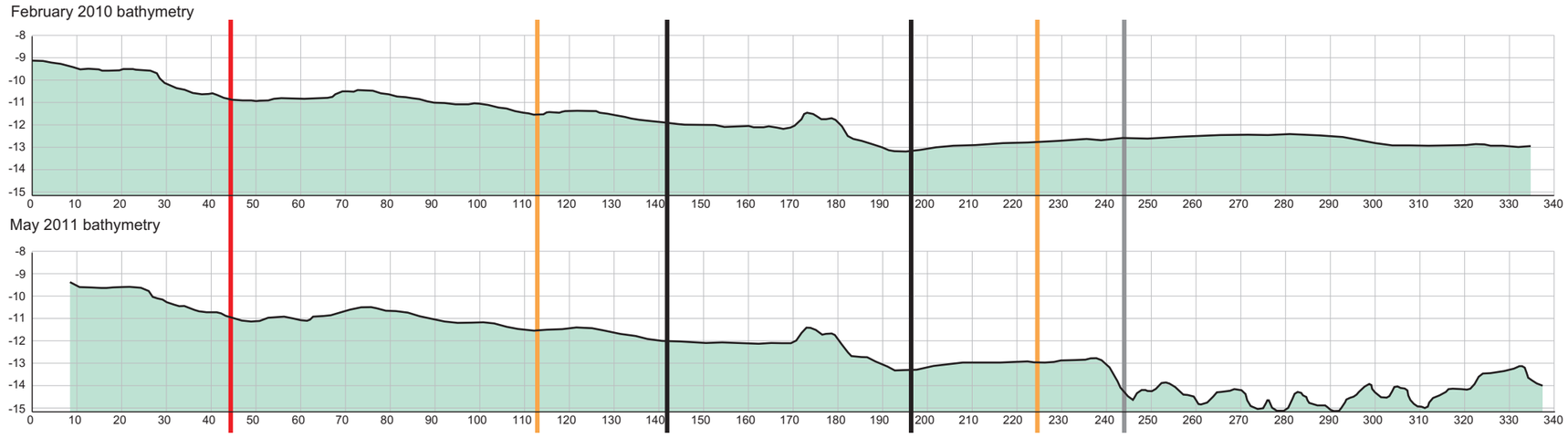
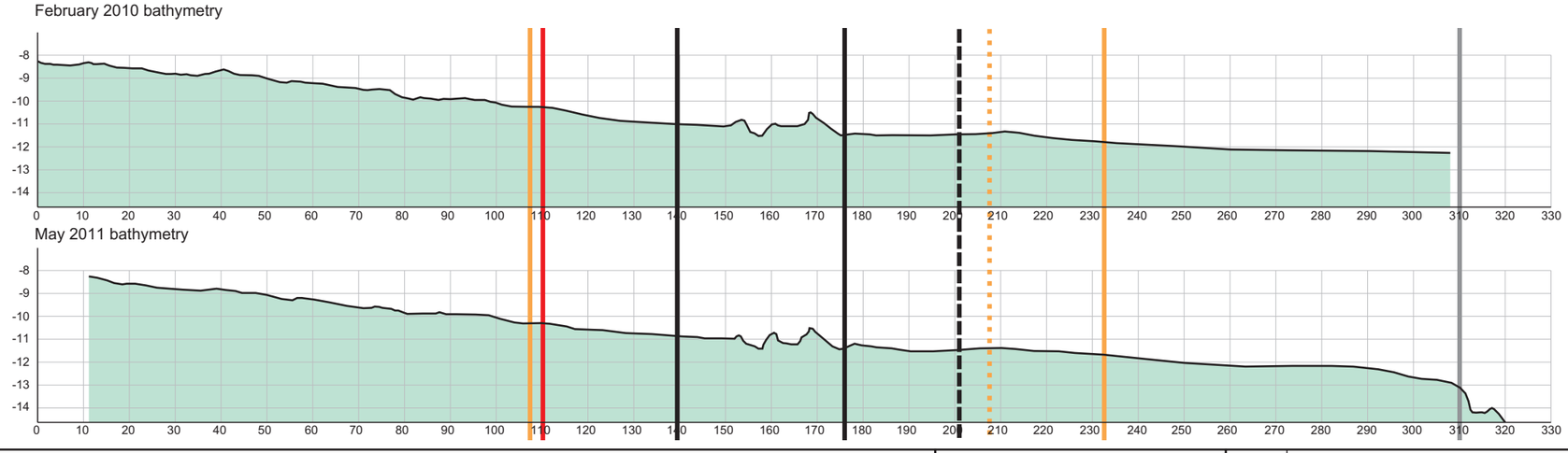


C. *London* 5029



Wessex Archaeology

Restricted Areas (PWA 1973)
Proposed extension
Archaeological Exclusion Zone
Previous Archaeological Exclusion Zone
Red Line
Channel Toe Line
Profile location

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Profiles

Figure 6