

3.8 De-watering of East Bay

To allow the hydrocarbon impacted material to be removed from East Bay in a safe and efficient manner, the majority of the standing water was removed before any excavation works commenced.

This was undertaken by the following methods:

- The water level in East Bay was allowed to naturally reduce following the installation of the surface water diversions. Over a period of approximately 2 weeks the water levels reduced sufficiently so that much of the material to the east of the man-made pier was exposed with no standing water.
- A visual assessment of the water levels to the west of the man-made pier found that the water levels were greatly affected by the water level of NSR. Therefore, the identified inlet pipes were blocked when the water levels in the NSR were at their lowest.
- East Bay was divided into three sections during the remediation works and the water was typically pumped from the area undergoing material removal to another section of East Bay, preventing the need to discharge into NSR.
- In order to complete all sections of East Bay a short period of pumping (3 weeks in total) into NSR was required. No physical works were undertaken while this pumping was being undertaken in order to minimise agitation of the underlying sediments. The extracted water was passed through oil/ water separator and sediment trap to ensure that any contamination and/ or suspended solids were removed prior to discharge (Photograph 10).

The OWS was placed within an appropriately sized bund (minimum holding capacity of 110% of the OWS). Photograph 9 shows the type and location of the oil/ water separator.

Photograph 10 – Water Treatment System at East Bay



3.8.1 Surface Water Monitoring

Water samples of the discharge entering NSR were taken on a weekly basis when the pumps were in operation. The samples were collected in laboratory supplied containers and couriered to a UKAS accredited laboratory. The water samples were scheduled for contaminants which matched the consent criteria at the discharge point of the NSR which is approximately 600 m away from the inlet point from East Bay. A summary of the surface water sampling results is presented in Table 3, and full certificates presented in Appendix D1.

An elevated amount of suspended solids were encountered on 05/05/11, however this was taken following a period of heavy rainfall.

Table 3 – Summary of surface water data

Analyte	Date		
	21/03/11	06/04/11	05/05/11
Suspended Solids (mg/l)	120	10	1000*
TPH (Aqueous Phase) (mg/l)	0.36	<0.01	1

** Taken following period of heavy rainfall*

3.9 Removal of Hydrocarbon Impacted Material

Investigations, a visual assessment of the physical properties of the hydrocarbon impacted material and previous experience indicated that the most appropriate technique to remove the material would be mechanical excavation.

Although following the installation of the surface water inlets improved the physical properties of the sediments it was evident the material still required stabilisation to allow it to be safely excavated and transported to the designated treatment pad. The stabilisation material used was recycled wood fines, which were imported to site.

The stabilisation works were undertaken by creating a bund of wood fines that the untreated hydrocarbon impacted sediments were placed (Photograph 11). Wood fines were then slowly added and mixed to the sediment until the physical properties were sufficient to allow safe excavation and transportation to the treatment area.

Photograph 11 – Hydrocarbon Impacted material within mixing bund at eastern section of East Bay



As discussed in Section 3.6.2, a significant inflow of water was observed at numerous locations along the boundary between NSR and East Bay. In order to allow the water inflows to be adequately controlled during the excavation works, East Bay was divided into three sections with each area being completely finished before the next was started. A layout of the sections is shown in Appendix A, Drawing A4.

3.9.1 Section 1

Section 1 encompassed the area to the east of the man-made pier that crossed East Bay. Following the installation of the surface water diversions the material within this area became considerably firmer with minimal standing water, negating the need for further pumping (Photograph 12).

Photograph 12 – Section 1 of East Bay following installation of surface water diversions

The mixing and removal of the hydrocarbon impacted sediment in Section 1 took approximately 4 weeks to complete. Water that collected during the Section 1 works was pumped directly into Section 2. The completed area is shown in Photograph 13.

Photograph 13 – Completed Section 1

The natural base material was typically uniform comprising grey clayey silts. However, an organic band was encountered entering East Bay from the eastern boundary and crossing the central area of the base in an east to west orientation (Photograph 14). The

location of the organic band is highlighted on the post works topographic survey (Appendix A, Drawing 6).

Photograph 14 – Band of organic material encountered at the base of East Bay (highlighted by vegetation growth)



3.9.2 Section 2

Section 2 was located between the man-made pier and NSR. A substantial amount of water remained in this section due to continual inflows from NSR. Therefore, a significant amount of preliminary works were undertaken prior to the removal of hydrocarbon impacted material in order to remove standing water and control inflows.

The inlets and outlets of the low level pipes were sealed using clean material excavated from East Bay. However, a significant inflow remained through the dam matrix which could not be sealed. Therefore, a large wood fines bund was created along the entire length of the dam to allow the water inflow to be adequately reduced and controlled (Photograph 15).

Photograph 15 – Wood fines bund created along dam between NSR and East Bay

Following the completion of the wood fines bund the volume of water in Section 2 significantly reduced. Prior to commencing works a sump was excavated within Section 2 and the standing water pumped into Section 3. Due to the small amounts of water flowing into this area the pumps were only required to be operational for a short period at the start of each working day.

Photograph 16 shows Section 2 of East Bay immediately following de-watering and at the start of the material removal process.

Photograph 16 – Section 2 of East Bay at start of removal process of hydrocarbon impacted material

The amount of water flowing into Section 2 increased as the contaminated sediment removed and the elevation of the base of East Bay was reduced. This caused the sediment to become saturated making it difficult for mechanical excavation. As a result the methodology was modified with a large mixing lagoon being created away from the dam between NSR and East Bay using wood fines (Photograph 17). The contaminated sediment was placed into the lagoon and the relatively permeable nature of the wood fines allowed the sediment to naturally de-water. Once sufficiently de-watered the original methodology was adopted to mix and remove the material.

Photograph 17 – Mixing lagoon within Section 2 of East Bay



The mixing and removal of the hydrocarbon impacted material within Section 2 took approximately 6 weeks to complete. The completed profile is shown on Photograph 18.

Photograph 18 – Section 2 following completion of the removal of hydrocarbon impacted material



3.9.3 Section 3

Section 3 was a relatively small area at the south western corner of East Bay. This area was excavated separately from the rest of East Bay due to two large low level pipes that had significant inflows (Photograph 4).

Due to the high water inflows, Section 3 was divided into two work areas by a low permeability barrier to allow each section to be pumped and completed separately (Photograph 19).

Photograph 19 – Section 3 divided into two work areas, note connecting pipework protruding from the NSR dam



Due to the high pumping rates required to de-water these sections the OWS was not suitable. Therefore, a large lagoon was created at the southern edge of Section 2 to receive the pumped water (Photograph 20). A double bund of wood fines was created within the lagoon to provide a filtration system, preventing the recontamination of Section 2.

Photograph 20 – Settlement lagoon created at southern edge of Section 2



Photograph 21 shows the southern part of Section 3 following de-watering (prior to the removal of hydrocarbon impacted material).

Photograph 21 – Southern area of Section 3 following de-watering but prior to the removal of hydrocarbon impacted material



Photograph 22 – Southern section of Section 3 after the removal of hydrocarbon impacted material



Once the water within the southern part of Section 3 was removed, the hydrocarbon impacted material was removed. However, the material remained saturated so it was placed into a settlement lagoon (Photograph 20) for it to de-water prior to mixing with wood fines. Photograph 22 shows the exposed natural base following the removal of the hydrocarbon impacted material.

On completed of the southern part the pumps were removed and the area was allowed to re-flood. The second section was completed in using the same methodology as the first and Photographs following de-watering and the removal of hydrocarbon impacted material are presented as Photographs 23 and 24, respectively.

Once all of the hydrocarbon impacted material was removed the area was assessed by an Atkins engineer and the Monitor prior to re-flooding, who agreed that all hydrocarbon impacted material had been removed. A very small amount of surface residue remained in areas of significant water inflows, this was discussed with the Atkins Engineer and the Monitor during their assessment who agreed that remaining staining was negligible and no further works required.

Photograph 23 – Northern area of Section 3 following de-watering but prior to complete removal of hydrocarbon impacted material



Photograph 24 – Northern area of Section 3 the removal of hydrocarbon impacted material



The mixing and removal of hydrocarbon impacted material in Section 3 took approximately 4 days.

3.10 Removal of Man-made Pier/ Embankment

On completion of the removal of hydrocarbon impacted material Celtic undertook a visual assessment of the material contained within the central embankment/ causeway that crosses East Bay (Photograph 25).

Photograph 25 – Central pier prior to removal



The assessment indicated that the pier was constructed predominantly of large concrete boulders. Extensive hydrocarbon staining was present on the material within the matrix between the boulders, so the entire pier was removed in order to prevent future leaching of hydrocarbons.

Photograph 26 shows the pier when partially removed, while Photograph 27 shows the area following complete removal.