

UNIVERSITY OF PORTSMOUTH
SCHOOL OF EARTH & ENVIRONMENTAL SCIENCES

Contaminated Site Reclaimed for Housing Re-use
Site No.3 Contaminant Removal Solution Oil Terminal Site-North-West England

Site location and layout

Adjacent to coast. Bounded by a clean stream and by land still in agricultural use. Site layout shown on Figure 1.

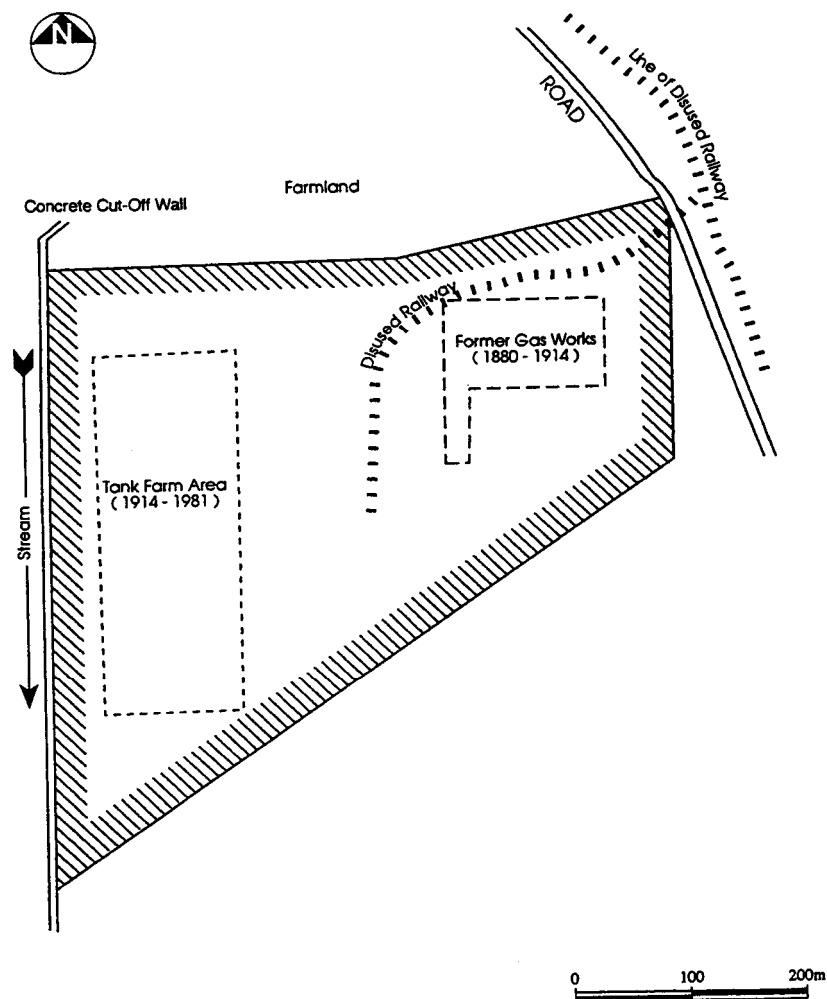


Fig 1. Site No. 3: Former oil terminal (18.8Ha)

Site history

Till 1880	agricultural use.
1880 to 1914	small gas works in eastern central area of the site.
1914 to 1950s	Royal Navy fuel depot.
1950s to 1981	private-sector oil storage depot.
1981	site demolished and levelled.

Site topography (pre-reclamation)

Flat and some 2.0 m higher than the surrounding farmland.

Concrete cut-off wall separates the site from the stream to the west.

Natural geology

Fluvio-glacial sands (up to 3 m thick and water-bearing) overlie massive sandstones.

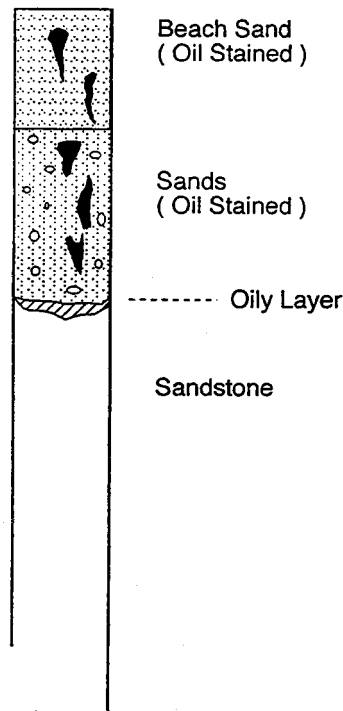


Figure 2. Vertical section through Site No. 3

Site investigation (Summer 1990)

3 m deep trial pits on a 20 m grid.

Ten deeper (20m) boreholes to prove groundwater conditions in the sandstone rock.

Ground radar geophysical survey to map out contact of sands and the underlying sandstone, and identify low spots on the rock surface.

Groundwater occurred in the sands and showed floating oils plus oil emulsions.

Free oil product proved to be thickest (10 to 15 mm thick) where low spots in the sandstone surface existed.

Oil contamination restricted to tank farm area and to the former loading area, adjacent to the rail head.

Sands heavily oil contaminated in these two areas.

Rock surface (especially at low spots) was heavily coated with denser oil fraction.

Oils had penetrated only some 20 mm into the sandstone rock.

Gas works wastes and contaminated groundwaters in fluvio-glacial sands adjacent to the former gas works.

Upper 2.0 m of site composed of imported beach sands. Presumably laid in 1914, since they entirely cover the old gas works.

Chemical analyses of gas works wastes (Table 5).

Chemical analyses of oil-soaked sands (Table 6).

Chemical analyses of benzene air pollution (Table 7).

Site zoning revealed three areas of concern, namely: the former gas works, the tank farm area, and the fuel loading area at the railhead. The remainder of the site proved to be essentially clean.

Groundwater/oil plume proved to move in a south-west direction from the former tank farm area.

Table 5. Chemical composition of gas works wastes

(a) Solid materials (all as mg/kg except pH and calorific value)

pH	5.7 to 8.4
Total cyanide	< 2.4 to 6400
Free cyanide (as CH)	<2.5 to 340
Toluene-extractable content	500 to 18 000
Coal tar derivatives (PAHs)	< 100 to 12 000
Mineral oil	< 500 to 4000
Total phenols	< 2.5 to 8.2
Acid soluble sulphates	600 to 16 000
Sulphides (as H ₂ S)	< 1.4 to 64
Total arsenic	8.6 to 18
Total lead	50 to 430
Total zinc	70 to 410
Calorific value	< 5000 U/kg

(b) Waters (all mg/litre except pH)

pH	3.4 to 8.3
Total cyanide	<0.05 to 10.0
Free cyanides	<0.05 to 0.32
Toluene-extractable content	7 to 33 000
Phenols	<0.05 to 7.1
Sulphates	350 to 5000
Sulphides	<0.02 to 4.4
Total lead	<0.02 to 0.35
Total zinc	<0.02 to 1.9

Table 6. Chemical composition of oil-contaminated areas

(a) Solid materials (all as mg/kg except pHs)

pH	6.7 to 9.1
Total sulphates (acid soluble)	80 to 1260
Total phenols	2 to 186
Toluene-extractable content	4000 to 34 600
Total PAHs	28 to 2200

(b) Liquid samples (all as mg/litre except pHs)

pH	6.1 to 9.2
Total sulphates	340 to 1517
Total phenols	< 0. 1 to 23.7
Toluene-extractable content	46 to 99 500
Total PAHs	<0.1 to 6670

Table 7. Benzene air pollution when 3 m-deep excavations were carried out

Time (minutes)	Excavation depth (m)	Benzene concentration in air (mg/litre)
0	0	0
12	3	137 to 102
15	3	64 to 41
20	3	20 to 12
30	3	10 to >5

Note: Benzene concentrations in air vary with wind condition and are lower in higher winds.

Reference

Carney T (1995) The Re-use of Contaminated Land – A Handbook of Risk Assessment. Wiley.