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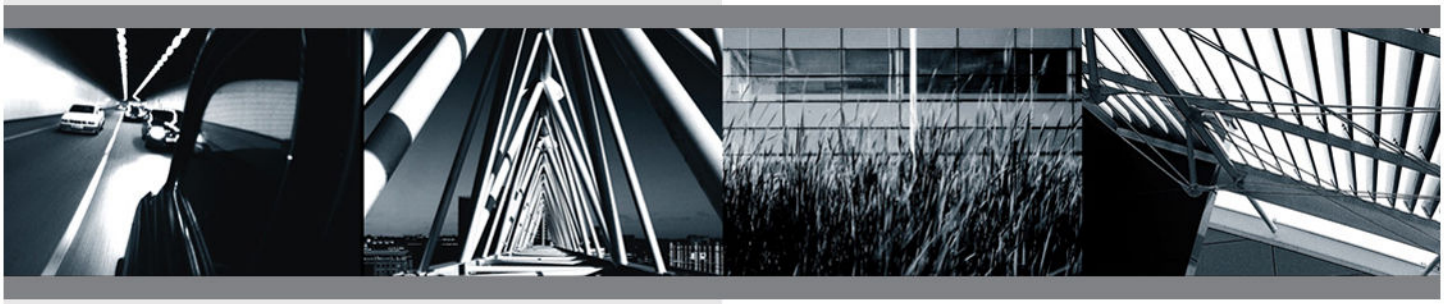
# Daedalus, Lee-on-the-Solent

# Land Quality Statement



For

SEEDA
SOUTH EAST ENGLAND DEVELOPMENT AGENCY
*Working for England's World Class Region*

Project No:

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## SUMMARY OF ACTIONS

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| **HUMAN HEALTH** | Further site investigation should be undertaken to substantially increase the site coverage in areas of the development plots and areas of proposed residential gardens / landscaping. Currently, where localised elevated soil contamination corresponds with these areas, it is recommended that a minimum depth of 'validated' soil cover is placed over a separating proprietary geomembrane.<br><br>The final design should be subject to EHO approval and cognisant of any landscape gardening requirements and detailed and prescribed via a *Groundworks Specification*. This specification should be agreed / approved by the Local Authority and included within groundworks tender documentation.<br><br>The potential risk to the human health of future residents and occupiers from VOCs (tetrachloroethene and BTEX) in groundwaters should be considered further by risk assessment or gas protection measures.<br><br>In relation to radioactive contamination, remediation of localised point sources has been recommended by removing all material having an activity concentration greater than 0.34Bq/g above background. A remediation strategy should be developed and consultation with the regulators undertaken. |
| **CONTROLLED WATERS** | Further groundwater monitoring investigation and Detailed Quantitative Risk Assessment (DQRA) is recommended. |
| **BUILDINGS AND STRUCTURES/ SERVICES** | Gas monitoring to date is likely to be considered insufficient to ascertain whether specific protection measures in buildings will be necessary and additional monitoring is recommended.<br><br>In relation to buried services (i.e. pipework carrying potable water supply), elevated levels of hydrocarbons (BTEX) and tetrachloroethene have been encountered (in addition to localised lead elevations, which may present a secondary risk). As such, liaison with the service provider is required during the selection of appropriate service pipework material and requirements for suitable material in services trenches in accordance with |
| **SITE WORK CONTROLS** | A Contractor Health & Safety Plan and associated risk assessments and method statements should consider the potential for: unforeseen contamination (including asbestos within soils), and, UXO risk. A *Watching Brief* is required throughout groundworks. Should any gross contamination (significantly stained and/or odorous soils) be identified, the advice of an environmental scientist should be sought. Appropriate provision for site welfare facilities and PPE should be provided to protect groundworkers based on these assessments.<br><br>The requirement for these assessments and protocols should unforeseen contamination be encountered should be controlled via a 'Groundworks Specification' and CEMP to be provided at Tender stage of works. |
| **REGULATORY APPROVAL** | The approval of contaminated land assessments is an iterative process. Submission of this report to the Local Planning Authority is required in order to address planning conditions associated with Land Contamination. Specific approval is required from the Environmental Health Officer of the conclusion and recommendations presented herein. Further reporting / verification may be required to enable final discharge of any Land Quality planning conditions. |
| **WASTE** | The LQS does not address the classification of waste soils. The soil results can however be utilised as a basis for such assessments, although additional testing may be required. It is noted that such assessments are required to accord with the Environmental Permitting and Planning Legislation and also to control costs during development. |
| **OTHER** | In relation to UXO, consultation with the Defence Logistics Organisation Ordnance Group is required to ascertain the status of the explosive ordnance clearance certification that was withdrawn in 2005. The risks associated with UXO should be fully recognised within the Health & Safety risk assessments for below ground works, provision of a watching brief and contingency plans should |

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| | be prepared.<br><br>Areas affected by Japanese Knotweed identified on the site should be cordoned off and access to these areas prohibited until the area can be treated by Japanese Knotweed Specialists. |
| **DOCUMENTATION** | Production and agreement of Control Documents and Engineer's Specifications as detailed above.<br><br>Additional documentation is likely to require either a revised Land Quality Statement for the site as a whole incorporating data from the further phases of investigation or separate assessments documents for each development plot in due course. In addition, detailed assessments of human health and controlled waters risks should be reported in a Detailed Quantitative Risk Assessment report for these issues. Should a specific remediation be required, it will be necessary to produce a Remediation Strategy, Specifications and Verification Report. |

## EXECUTIVE SUMMARY

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| **SITE LOCATION** | Daedalus is situated to the west of the built up areas of Lee-on-the-Solent, south of Fareham, and to the east of Hill Head and Stubbington and centred at a National Grid Reference of SU560020 (456002E, 102050N). The nearest Post Code is PO13 9FL. |
| **ENVIRONMENTAL SETTING** | The overall environmental sensitivity of the site is considered '**Medium**' based upon the following:<br><br>**Hydrology (Medium Sensitivity)**: The Solent is present 30m to the southwest of the site.<br><br>**Hydrogeology (Medium Sensitivity)**: The site is underlain by a Secondary A Aquifer but does not fall within an Environment Agency Source Protection Zone.<br><br>**Radon (Low Sensitivity)**: The site is not situated within an area where basic or full radon protection measures are required by default.<br><br>**Sensitive Land Uses / Ecological Receptors (High Sensitivity)**: The site is located in close proximity to international, national and local level ecological designations comprising Ramsar, SSSI, SPA, and LNR associated with The Solent. |
| **CURRENT USE AND HISTORY** | The site was first established as a seaplane base (RNAS Lee-on-Solent) in 1917 and later became the main seaplane training establishment for the RAF before transferring back to the Fleet Air Arm. The site expanded with the acquisition of additional land, construction of the aerodrome, barracks blocks, administration and technical buildings. Following closure of the base, site ownership was split in 2006 with the central areas including the runways transferring to the Maritime and Coastguard Agency (MCA) and surrounding areas by SEEDA. Hampshire Constabulary's fixed wing aircraft continue to use the airfield. The SEEDA areas comprise numerous tenanted commercial activity within the workshops of the Waterfront zone and light aircraft use from hangars around the airfield. |
| **CONTAMINATION ISSUES** | With regards to **Human Health**, contaminants were generally not observed to be in excess of the screening values with the exception of several localised occurrences of elevated heavy metals and hydrocarbons above adopted screening thresholds in each development zone. In addition, elevated VOCs comprising tetrachloroethene and BTEX have been detected in groundwaters<br>As such, the risk to the human health of future occupiers and users in each development area are:<br><br>*Areas 1 and 8a Drake Gardens, Seaplane Square Residential* – **MEDIUM-HIGH**<br>*Areas 4 and 5b Wykeham Hall, Barracks Square Residential* – **LOW-MEDIUM**<br>*Areas 5a, 6 and 7b Barracks Square / Unicorn Triangle / Westcliffe Seafront Mixed* – **MEDIUM-HIGH**<br>*Areas 2, 3, 7a and 8b Airport Park, Marine Business Park, Unicorn Triangle and Seaplane Square Commercial* – **LOW-MEDIUM**<br>*Hangars West Allotments* – **MEDIUM-HIGH**<br>*Hangars West Commercial* – **LOW**<br>*Hangars East Commercial* - **LOW**<br><br>In relation to **Controlled Waters**, the distribution of chlorinated solvents beneath the Waterfront zone is likely to be in close proximity to the site boundary with The Solent and its ecological designations. As such, the risk to the underlying groundwater (classified as a Secondary A Aquifer) has been assessed as **MEDIUM- HIGH**. A small number of marginal exceedences were also recorded in relation to copper, nickel and zinc, however these are considered to be unlikely to result in a significant risk.<br><br>**Ground gas** monitoring to date indicates a CIRIA Characteristic Situation 1 regime to prevail (i.e. low risk), although this is based upon a limited monitoring points from a single visit. |

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|---|---|
| | In terms of radioactive contamination, several areas of elevated levels of radioactive contamination have been identified suggesting a low risk to current end users of the site and a moderate risk to potential future site users such as for a residential development.<br><br>In terms of unexploded ordnance and munitions a residual risk remains for the occurrence of unexploded ordnance or discovery of unrecorded wartime burial of munitions.<br><br>Japanese Knotweed has been recorded within the site boundary identified adjacent to Building 166. Japanese Knotweed has been noted just outside of the site boundary to the south of Building 142 and near to Building 301 adjacent in Hangars East. |
| **ENVIRONMENTAL RECOMMENDATIONS** | **Site Investigation and DQRA:** Further monitoring and Detailed Quantitative Risk Assessment (DQRA) of contaminant levels identified within groundwater will be required in order to demonstrate the absence of risk via the inhalation of vapours by end user residents and potential impact upon nearby Controlled Waters receptors which may otherwise indicate requirements for a specific remediation.<br><br>Furthermore, additional site investigation is required to fully characterise development plots and delineate localised areas or hotspots of soil contamination.<br><br>**Remediation:** Outline remedial requirements comprise a validated soil layer in areas of private residential gardens or communal soft landscaping overlying a proprietary separating geomembrane layer. In addition, point sources of radioactive contamination should also be the removed. The final design of the remedial requirements should be made in consultation with the landscape architect's specification and Environmental Health Officer.<br><br>The final design, including protocols for validation, chemical limiting values, geotechnical backfilling requirements and watching briefs for 'unforeseen contamination' should be compiled within a *Groundworks Specification*. The specification will require agreement with the Environmental Health Officer and should comprise part of the tender information for groundworks.<br><br>**Asbestos:** Asbestos containing materials (ACMs) have been identified on site. Whilst hardstanding across the site will negate any contact between end users and potentially impacted soils, there is considered to be a risk to groundworkers and other personnel who may come into contact with such soils. In addition, excavation of soils should be carefully controlled in order to prevent the dispersal of dusts and fibres.<br><br>**Waste:** A waste classification has not been undertaken as part of this report. Should materials be disposed offsite, a waste classification will need to be prepared in order to assign the appropriate EWC code and identify an appropriate landfill. Analytical data, including a Waste Acceptance Criteria (WAC) analysis is appended to this report and maybe used within the waste classification as appropriate. |

## 1.0 INTRODUCTION

1.1. This report has been produced by Campbell Reith Hill LLP (CampbellReith) on behalf of the South East England Development Agency (SEEDA) to summarise environmental information relating to Daedalus, Lee-on-the-Solent (hereafter referred to as 'the site' or by respective subdivided development zones). The references and limitations associated with this report follow the main text. Figures showing the location of the site and the development proposals are presented in Appendix A and photographs in Appendix B.

**Scope**

1.2. This report has been produced in general accordance with the technical procedures for site investigation, interpretation and reporting set out in DEFRA Contaminated Land Report (CLR)11[1] and BS 5930[2] (as amended). The objective of the report is to collate and interpret Phase 1 Desk Study information and Phase 2 exploratory data in order to provide a:

a) conceptual site model for the site ground conditions (soil, water and gas);
b) generic quantitative risk assessment for human health and controlled waters;
c) qualitative risk assessment for buildings and buried services; and,
d) environmental recommendations including outline recommendations for future site investigation works.

1.3. The contamination appraisal is intended to identify the likely remedial requirements necessary to permit the redevelopment of the site as a residential, mixed-use and commercial end use in accordance with Policy Planning Statements (PPS) 1[3] and 23[4]. It should be recognised that further appraisals, investigations, specification and validation will be required to accord with the recommendations stated herein.

1.4. It is noted that this report does not contain appraisals that consider wider development issues with cost implications, such as geotechnical assessment or waste classification, which lie beyond the remit of the brief. Furthermore, whilst a review of unexploded ordnance and radioactive contamination has been carried out and a summary of previous findings and recommendations for remediation presented herein, no specialist reassessment has been undertaken.

[1] Department for Environment, Food and Rural Affairs (Defra) & Environment Agency, *Contaminated Land Report (CLR) 11: Model Procedures for the Management of Land Contamination*, 2004.

[2] British Standards Institution, *The code of practice for site investigations*, 1999 (as amended).

[3] Communities & Local Government, *Planning Policy Statement (PPS) 1: Delivering Sustainable Development*, 2005.

[4] Communities & Local Government, *Planning Policy Statement (PPS) 23: Planning and Pollution Control*, 2004.

**Icarus Database**

1.5. This report is intended to be cross-referenced with the ICARUS database, which has been created by CampbellReith using MapInfo GIS and has been made available to SEEDA through the use of freely available software. ICARUS contains copies of all of the previous studies that are considered relevant to the future redevelopment of the Daedalus site. Information on the ICARUS database, how it can be accessed and how it is referenced within this report can be provided upon request.

**Previous Studies**

1.6. This report is based upon a summary of the previous studies of the site, (including [2] Landmark Envirocheck Report, dated 9 November 2004, Ref: 7167001-1-2, included within the Entec Phase One Report) and a review of readily available information as referenced. The desk study information is presented in Appendix C. In addition, data provided by the most recent site investigations has also been reappraised in view of the current Masterplan proposals. The site investigation reports produced by Entec / Halcrow in 2006 and 2007 respectively are contained in Appendix D.

1.7. It is noted that several reports have not been provided for inclusion within this report, although they have been referred to by previous studies that are available, such as those mentioned by the Entec (2007) report:

- WSP Phase Two Land Quality Assessment, 1996;
- Mineral Reserve Assessment, Proof of Evidence, reference 778/002 by Rust Environmental, August 1995 - reported by Entec but not available for this review; and,
- Land Contamination Assessments, Institute of Naval Medicine, June 1996.

1.8. In addition, CampbellReith have previously produced Site Appraisal Reports [10 – 13] for the site covering the following topics:

- Buildings;
- Highways;
- Drainage and Services Infrastructure;
- Flood Risk and Marine Issues; and
- Ecology.

1.9. A full list of technical references is presented at the rear of the report.

## 2.0 SITE DESCRIPTION

### Site Location

2.1. The site location is presented in Figure 1. Daedalus is located on the Gosport peninsula, situated to the west of the built up areas of Lee-on-the-Solent, south of Fareham, and to the east of Hill Head and Stubbington and centred at a National Grid Reference of SU560020 (456002E, 102050N). The nearest Post Code is PO13 9FL. The site is currently accessed via Chark Lane, which is in turn accessed from the B3385 Broom Way.

2.2. The site lies within the jurisdiction of both Gosport Borough Council (GBC) and Fareham Borough Council (FBC) and the boundaries between the two are shown on Figure 1.

### Existing Site Layout

2.3. The site covers a total area of 75.8 hectares and is formed by the former operational areas surrounding the airfield, which is currently operated by the Maritime and Coastal Agency (MCA). Annotated site layout plans showing current buildings are presented as Figures 2-4.

#### *Development Zones*

2.4. The site has historically been divided into three distinct zones comprising:

- Waterfront Zone;
- Hangars West; and,
- Hangars East.

2.5. A site visit was made on 27th April 2010 and an abridged description of the above zones is presented in the following text.

#### *Waterfront Zone*

2.6. The Waterfront zone covers approximately 24.7 hectares (excluding junction and slipway areas) and lies between the seafront, the residential area of Lee-on-the-Solent and the airfield to the north. This area is by far the most developed part of the Daedalus site and has direct access to The Solent via a slipway.

2.7. The Waterfront zone lies between approximately 7 – 11 metres Above Ordnance Datum (m AOD) and is generally flat, with nominal gradients (<0.5%) rising towards the east of the site.

2.8. It comprises a combination of brick-faced former MoD offices and barracks buildings alongside large-scale industrial/hangar buildings. Due to the size and complexity of this zone, it is necessary to further subdivide it into the following: 'Waterfront – Commercial' and 'Waterfront – Conservation'.

***Waterfront – Commercial***

2.9. The Waterfront – Commercial site covers an area of 16.7 hectares and lies between the seafront and the airfield. The majority of this zone lies within the jurisdiction of Gosport Borough Council (GBC), although some of the northern-most areas lie within the jurisdiction of Fareham Borough Council (FBC).

2.10. This development zone is characterised by a total of 44 buildings primarily made up airfield hangars and workshops. Notable buildings within this zone are the four large hangars adjacent to the airfield (Dunning, Swann, Esmonde and Overlord Hanger), the new boiler house and four hangars at the slipway. A comprehensive list is provided in Table 2.1 and their locations are shown on Figure 2.

**TABLE 2.1: EXISTING BUILDINGS WITHIN WATERFRONT – COMMERCIAL**

| Building No. | Building Name |
|---|---|
| 3 | E&T Block |
| 4 | E&T Power House |
| 6 | Explosive Store |
| 7 | Air & Gas Bottle Store |
| 14 | Kingston Villa |
| 15 | Crash Tender Bay |
| 18 | Explosive Store |
| 20 | Explosive Store |
| 22 | RN School of Photography |
| 23 | RN School of Photography Annexe |
| 26 | MPBW Store and Garage |
| 27 | Substation |
| 31 | Boat Hanger (Type J Hanger) |
| 33 | Winch House |
| 40 | HTU Hanger (Type G Hanger) |

| Building No. | Building Name |
|---|---|
| 41 | MPBW Store |
| 51 | Station Fitters' Workshop |
| 52 | Boiler |
| 55 | Refrigeration Room |
| 60 | Air Raid Shelter |
| 61 | Victualling Store |
| 62 | Mess Trap Store (Paint Store) |
| 64 | Scrap Metal Compound |
| 67 | Esmonde Hanger |
| 68 | Swann Hanger |
| 69 | Swann Toilet Block |
| 70 | Air Craft Recovery Store |
| 71 | Naval Stores |
| 73 | Dunning Hanger |
| 74 | Central Boiler House |
| 78 | Hetwell Bungalow (NAMDU) |
| 84 | Oil Store |
| 148 | Kepple Block A |
| 149 | Kepple Block B |
| 150 | Kepple Block C |
| 153 | NAMDU & NAIRU Offices and Workshop |
| 154 | Overlord Hanger (No. 5 Bellman) |
| 155 | Overlord Hanger & Attached Workshops and Offices |
| 158 | Tailor's Shop |
| 159 | MPBW (E) Workshop & Store |
| 160 | NAAFI Bookstall |
| 374 | MASU Toilet Block |
| 389 | Store |
| 390 | currently unknown |

***Waterfront – Conservation***

2.11. The Waterfront – Conservation site covers an area of approximately 8 hectares and is primarily within the jurisdiction of Gosport Borough Council (GBC), although some of the northern-most areas lie within the jurisdiction of Fareham Borough Council (FBC).

2.12. The Waterfront – Conservation site contains a total of 47 buildings associated with the former barracks element of the former HMS Daedalus site and a list of these is shown in Table 2.2.

**TABLE 2.2: EXISTING BUILDINGS WITHIN WATERFRONT – CONSERVATION**

| Building No. | Building Name |
|---|---|
| 34 | MT Oil Store (former Winch House) |
| 35 | MT Hanger (Type J Hanger) |
| 37 | MT Hanger (Type J Hanger) |
| 38 | CAO's Office |
| 39 | MT Workshops (Type G Hanger) |
| 56 | MT Offices & Toilets |
| 87 | Norbury House |
| 88 | Bedding Store |
| 89 | Vegetable Store |
| 91 | Dining Room and Cook House (Triumph Galley and Boiler House) |
| 92 | Anson Barracks |
| 94 | Air Raid Shelter |
| 96 | Power House |
| 97 | Blake Barracks |
| 100 | Staff Garages & EO's Offices |
| 101 | EVT Section |
| 105 | Wardroom Annexe Boiler House |
| 107 | Ward Room Annexe |
| 111 | Westcliffe Lodge |
| 115 | Police Search |
| 116 | Eagle Block |
| 117 | Squash Court |
| 118 | The Ward Room and Officers' Mess |
| 119 | Westcliffe House |
| 121 | Exmouth Block |
| 128 | Eagle Club (NAAFI Club) |
| 129 | NAAFI Store |
| 130 | NAAFI Shop |
| 131 | Main Gate Guard Room |
| 132 | Fire Station and Police Rest Room |
| 133 | Fire Pump House (later Police Station) and adjacent Boiler House |
| 134 | Trailer Pump House |
| 135 | NAAFI Barber's Shop and Shoe Repair |
| 137 | Duncan Barracks |
| 139 | Cunnigham Barracks |
| 141 | Ambulance Bay and Sub Station |

| Building No. | Building Name |
|---|---|
| 142 | Frobisher Block |
| 144 | Store |
| 145 | X-Ray Department |
| 146 | Sick Bay |
| 147 | Grenville Block |
| 162 | Hawke Block |
| 164 | Printing Shop |
| 165 | Wykeham Hall |
| 166 | Keith Cottages (Dental Dept.) |
| 375 | currently unknown |
| 387 | NBCD |

***Hangars West***

2.13. Hangars West covers an area of 14.4 hectares and comprises three linked triangles of land, which form a 'saw-tooth' shaped boundary with adjacent Stubbington to the west.

2.14. This development zone is a large area to the west of the airfield at between approximately 5.5m - 12m AOD with nominal gradients. It includes a section of runway, two large Bellman Hangars and various light aircraft hangers. This area also features large areas of managed grass and scrub.

2.15. At present, this parcel of land has no direct access with vehicles having to cross the MCA airfield and main runway from Hangars East. There is a currently unused access to Hangars West on the B3334 Gosport Road.

2.16. The Hangars West site contains a total of 15 buildings and these are listed in Table 2.3 and their locations are shown on Figure 3.

**TABLE: 2.3: EXISTING BUILDINGS WITHIN HANGARS WEST**

| Building No. | Building Name |
|---|---|
| 332 | Hangar U – (outside current development boundary) |
| 339 | Hangar T |
| 340 | Substation – (outside current development boundary) |
| 343 | Hangar R |
| 344 | Hangar P |
| 345 | AIU Toilet Block |

| Building No. | Building Name |
|---|---|
| 346 | AIU Offices |
| 348 | Hangar Q |
| 350 | Fleetlands Store |
| 351 | Fleetlands Test Flight Offices |
| 352 | Fleetlands ARS Offices and Rest Rooms |
| 356 | No. 4 Bellman |
| 358 | No. 1 Bellman |
| 360 | Toilet Block |
| 361 | Substation |

***Hangars East***

2.17. Hangers East (36.7 hectares) is located on the east side of the airfield and is accessed from Broom Way. It consists of a large area at between approximately 5.5 - 12m AOD with nominal gradients. The central and southern areas exhibit areas of hardstanding with a group of loosely clustered aircraft hangers and numerous interconnecting taxi-ways. The site includes a substantial area of undeveloped land to the north, which comprises scrub, grass, hedges and trees.

2.18. The Hangars East site contains a total of 18 buildings. These are listed in Table 2.4 and their locations are shown on Figure 4.

**TABLE 2.4: EXISTING BUILDINGS WITHIN HANGARS EAST**

| Building No. | Building Name |
|---|---|
| 286 | Hangar A |
| 287 | Hangar C |
| 289 | Hangar D |
| 290 | Hangar E |
| 291 | Hangar F |
| 292 | Hangar B |
| 296 | Hangar G |
| 299 | Hangar O |
| 300 | Transformer Pen |
| 301 | Hangar N |
| 302 | Guided Weapons Building |
| 303 | Hangar M |
| 304 | Hangar L |
| 305 | Hangar K |

| Building No. | Building Name |
|---|---|
| 306 | Hangar J |
| 307 | Hangar H |
| 322 | Stand-by Set House |
| Unknown (Near B307) | Currently unknown building |

**Surrounding Land-Use**

2.19. Land uses bordering the site are described as follows:

- North – B3334 Gosport Road, two schools (Crofton and Baycroft), agricultural land and Peel Common sewage works;
- East of the airfield – primarily agricultural land and Lee-on-Solent Golf Club;
- East of the Waterfront zone. A recent housing redevelopment of eastern parts of HMS Daedalus and pre-existing residential areas of Kings Road, Lee-on-Solent; and,
- South east of the Waterfront zone – Residential housing with gardens along Richmond Road and Marine Parade West / Solent;
- South west of the Waterfront zone – Marine Way and the seafront;
- West – Residential areas associated with Stubbington Lane and Kingsmead Avenue.

2.20. Residential housing is located in all directions surrounding the site but most notably adjacent to Marine Way, south east of the Waterfront and to the west of Hangars West. The close proximity of large numbers of residential properties offsite, in addition to proposed residential usage as shown in the Masterplan, indicates areas of High sensitivity.

***Airfield***

2.21. The airfield covers approximately 108 hectares and is currently under the ownership of the Maritime and Coastguard Agency (MCA). It is located outside of the current development zones, although surrounded by them, being bounded to the north by the B3334 Gosport Road, to the west by Hangars West, to the east by Hangars East and to the south by the Waterfront zone. The airfield contains one operational runway and is used by a variety of organisations including the MCA Search and Rescue, the Solent Microlight Group and the Lee Flying Association.

**Site After-Use Proposals**

2.22. The proposed site redevelopment is shown in [8] Proposed Development Masterplan, LDA Design LDA Design Dwg No. REV8 2780_078_Masterplan Whole Site_REV_FEB_2011 and [9] Design & Access Statement, which are shown within Figures 5 and 6.

2.23. It is understood that the proposed redevelopment of the Daedalus site will be subject to two planning applications submitted to Gosport Borough Council (GBC) and Fareham Borough Council (FBC).

***Planning Application to Gosport Borough Council***

2.24. Mixed-use development comprising a change of use and conversion of existing buildings, and demolition and erection of new buildings, for commercial floorspace of use class (B1, B2, B8, D1 & D2), retail space (A1, A3 & A4), up to 200 residential units (C3), a hotel (C1), public and private open space and car and cycle parking, together with landscaping and associating servicing, including new main access from Broom Way and secondary access from Stubbington Lane, together with internal access roads.

***Planning Application to Fareham Borough Council***

2.25. Mixed-use development around the airfield comprising change of use and conversion of existing buildings, as well as demolition and erection of new buildings, for commercial use class (B1, B2, B8, D1 & D2), and residential units (C3), public open space and car and cycle parking, together with landscaping and associating servicing, including new main access from Broom Way and secondary access from Gosport Road, together with internal access roads.

***Waterfront***

2.26. The Waterfront zone is proposed for a variety of land uses and in summary, these comprise:

- Commercial use in Airport Park, Marine Business Park, part of Unicorn Square and Seaplane Square;
- Residential use in Drake Gardens, (including part of Seaplane Square), up to 2-4 storeys;
- Residential use housing at Wykeham Hall (up to 2-storeys), and part of Barracks Square;
- Mixed-Use development (comprising sheltered accommodation, community hall and leisure facilities) at Barracks Square and adjacent Westcliffe Seafront, (although it is proposed to retain number of the existing buildings in this area).

2.27. In addition, the Masterplan provides for up to 3.32 hectares of public open space within Waterfront split between five areas: Barracks Square, Seaplane Square, Westcliffe House / The Wardroom Gardens, Ross House Par and Wykeham Hall Green Link.

2.28. Whilst the site has traditionally been described in terms of the Waterfront, Hangars West and Hangars East, prior to the emergence of a clear development plan, the Design & Access Statement also presents the current Masterplan in terms of specific 'Character Areas' as listed in Table 2.5 and shown on Figure 7.

**TABLE 2.5: MASTERPLAN CHARACTER AREAS**

| Zone | Proposed Land Use | Area Reference No. |
|---|---|---|
| Drake Gardens | Residential | 1 |
| Airport Park | Commercial | 2 |
| Marine Business Park | Commercial | 3 |
| Wykeham Hall | Residential | 4 |
| Barracks Square | Mixed-use (sheltered accommodation, community and some commercial use) | 5a |
| | Residential | 5b |
| Westcliffe Seafront | Mixed-use (residential flats and leisure use) | 6 |
| Unicorn Triangle | Commercial | 7a |
| | Mixed-use (residential flats and retail) | 7b |
| Seaplane Square | Residential | 8a |
| | Commercial | 8b |

2.29. The above list of Character Areas have been referred to in the assessment of human health risk to future end users of the development based upon the sensitivity of the proposed land use.

***Hangars West***

2.30. It is proposed to develop this zone as predominantly commercial use with 1 hectare of allotments as shown in Figure 5.

***Hangars East***

2.31. It is proposed to develop this zone as predominantly commercial use as shown in Figure 5.

2.32. A total of 13.9 hectares of public open space is also proposed in the low-grade arable fields to the north of Hangars East. In addition, one hectare of allotments is also proposed within Hangars West.

## 3.0 ENVIRONMENTAL SETTING

### Geology

3.1. The site geology is summarised in Table 3.1 and the associated references are presented at the rear of the report.

**TABLE 3.1: SUMMARY OF GEOLOGY**

| Type | Description | Reference |
|---|---|---|
| Made Ground | A veneer of Made Ground is anticipated due to the presence of historical development at the site. | [14] [16-20] |
| Superficial Deposits | River Terrace Deposits and Aeolian deposits (Brickearth - windborne dust reworked by river action). The site is primarily underlain by 'Brickearth', although these deposits may be absent in areas where the Plateau and Terrace Gravels outcrop at the surface (generally beneath the central parts of Hangars). | [1] [2] [14] [16-20] |
| | Plateau Gravels (fluvial sands and gravels). The areas of gravels appear to be related to tributaries of the River Alver floodplain to the east of the site (WSP refer to this as possible 'buried river valleys'). | [1] [2] [14] [16-20] |
| Solid Deposits | Reference to the BGS geological map indicates the solid geology to be outcropping bands from the Bracklesham Group (sands, silts and clays), in parallel with the coastline on a northwest to southeast alignment and gently dipping towards the south.<br><br>The north eastern parts of the Daedalus site and most of Hangars East are directly underlain by the Wittering Formation. This is typically described as a brownish grey laminated clay; sand with clay bands; clayey sands and beds of glauconitic sands.<br><br>Earnley Sand and the Marsh Farm Formation underlie most of the airfield and adjacent hangar areas. The Earnley Sand is a sandy clay formation which overlies the Marsh Farm formation and is primarily a greyish brown, laminated sandy clay.<br><br>Selsey Sands (green, glauconitic, shelly sands) are shown to predominantly underlie the Waterfront zone. | [1] [2] [14] [16-20] |
| Other | | |
| Geotechnical Hazards | The Envirocheck Report indicates that the site is not in an area affected by coal mining, ground dissolution features or gulls and cambering.<br>However, there is a High compressible ground subsidence hazard, Moderate risk of swelling clay subsidence and a Low risk of landslip on site. It is noted that a high risk of swelling clay subsidence is indicated approximately 260m to the northeast. | [4] |

**Hydrogeology**

3.2. The site hydrogeology is summarised in Table 3.2 and the associated references presented at the rear of the report.

**TABLE 3.2: SUMMARY OF HYDROGEOLOGY**

| Type | Distance | Description | Reference |
|---|---|---|---|
| 'Secondary A' Aquifer (Superficial geology) | On Site | Secondary 'A' Aquifer[1]. The River Terrace Deposits (Brickearth) and Plateau Gravels indicate permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. | [2] [4] |
| 'Secondary A' Aquifer (Solid geology) | On Site | Secondary 'A' Aquifer[1] associated with the Bracklesham Beds. | [2] [4] |
| Soil Leaching Potential | On Site | The overlying soils have been classified as having a 'High (U)' leaching potential. Soil information for urban areas is generally based on fewer observations. | [4] |
| **Other** | | | |
| Source Protection Zones | >1km | There are no source protection zones within 1km of the site. | [2] [4] |
| Nearest Drinking Water (Potable) Abstraction | 240m West | Private water supply operated by Hampshire County Council at Stubbington Study Centre. 629m$^3$ of groundwater per year from tertiary deposits. | [4] |
| Nearest Non-Potable Water Abstraction. | 14m West<br>24m West<br>236m West | All three records are for I Hamond & Son for agricultural use at 'The Nurseries', Stubbington Lane. | [4] |

**Notes**: [1]Secondary A Aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases form an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.

3.3. Groundwater is of **Medium** sensitivity given the presence of Secondary A Aquifer at the site and records of local groundwater abstractions. The Plateau and River Terrace Gravel are likely to be of high permeability that will facilitate lateral groundwater flow. It is likely that the aquifer provides shallow groundwater base-flow to the River Alver to the east of the site and also be in continuity with The Solent Estuary. Any contaminants present within shallow groundwater therefore have the potential to migrate to nearby surface waters.

**Hydrology**

3.4. The site hydrology is summarised in Table 3.3 and the associated references presented at the rear of the report.

**TABLE 3.3: SUMMARY OF HYDROLOGY**

| Type | Distance | Description | Reference |
|---|---|---|---|
| Surface Waters | 30m South west<br>484m East<br><c.10m North<br><c.10m North | The Solent<br>River Alver<br>Tributary / drainage ditch of the River Alver<br>Drainage ditch along B3344 at Peel Common | [2] [3] [4] |
| River Quality | 484m East | River Alver<br>Reach: Tide Gate – Newlands Farm (7.6m long)<br>GQA Grade: River Quality E (yr 2000)<br><br>(The nearest EA River Quality Record for 2009 is the River Meon approx 2km north west of the site) | [2] [4] |
| EA Floodplain status | On Site | The site in not situated within a flood risk area. | [2] [4] |

3.5. The nearest significant watercourses to the site are The Solent and the River Alver. The Solent is located approximately 30m to the south west of the Waterfront zone, although this area has a slipway that provides access directly into The Solent. The River Alver flows in a southerly direction to the east of Lee-on-the-Solent.

3.6. Additionally, there are numerous drainage ditches, ponds and small tributaries of the River Alver present within the locale. One of these drainage ditches or tributaries is indicated adjacent to Hangars East and passes beneath Broom Way joining with the River Alver at Shoot Farm. The River Alver then passes through the 'The Wild Grounds' Nature Reserve, to the west of Rowner, and discharges into The Solent approximately 3km downstream at Stokes Bay.

3.7. Another drainage ditch runs along the B3344 Gosport Road, which borders the northern boundary of the site and appears to emanate from the Peel Common sewage works.

3.8. The site is located within Environment Agency Flood Zone 1. This comprises land assessed as having a less than 1 in 1000 annual probability of river and coastal flooding in any year (<0.1%). In accordance with PPS25 all uses of land are considered appropriate in this zone.

3.9. The risk of fluvial and coastal flooding at the site is considered to be low.

3.10. The site is considered to have a **Medium** sensitivity with respect to hydrology and associated ecological designations (discussed in Section 3.16).

**Radon**

3.11. The available information indicates the site is in an area where there is a risk of <1% of homes exceeding the radon action level.

3.12. [6] Building Research Establishment Report BR 211 "Radon: Guidance on Protective Measures for New Dwellings" was consulted with respect to determining the risk to the study area posed by radon gas.

3.13. BRE211 indicates that the study area does not fall within an area where basic or full protection measures are required by default and also confirms that a site specific geological risk assessment is not required for the site.

3.14. The Radon Atlas of England and Wales [5] indicates the study area is in an area where <1% of homes exceed the Radon Action Level of 200 Bq/$m^3$ for residential properties and 400 Bq/$m^3$ for commercial properties.

3.15. Taking into account information provided above, the risk posed by radon is considered to be **Low**.

**Sensitive Land-Uses**

***Ecology and Conservation***

3.16. Daedalus lies within two kilometres of a number of sites designated at international, national and local level on the basis of their ecological value. These are listed in Table 3.4.

**TABLE 3.4: ECOLOGICAL DESIGNATIONS**

| Site Name | Designation(s) | Distance from site | Ref |
|---|---|---|---|
| Solent and Southampton Water | SPA and Ramsar | 65m | [3] [10 -13] |
| Lee-on-the-Solent to Itchen Estuary | SSSI | 65m | |
| The Wild Grounds | SSSI and LNR | 1540m | |
| Titchfield Haven | NNR / LNR | 1980m | |

3.17. Special Protection Areas (SPAs) are areas which have been identified as being of international importance for the breeding, feeding, wintering or migration of rare and vulnerable species of birds found within European Union countries. They are classified under the Birds Directive (EC Directive on the conservation of wild birds (79/409/EEC)).

3.18. Ramsar sites are wetlands of international importance, designated under the Ramsar Convention 1971.

3.19. Sites of Special Scientific Interest (SSSIs) are nationally protected sites designated by Natural England in accordance with the Wildlife and Countryside Act 1981 (as amended) and the Countryside and Rights of Way Act 2000 for their special floral, faunal, geomorphological or physiological aspects.

***Japanese Knotweed***

3.20. One stand of Japanese Knotweed (Fallopia japonica) has been recorded within the site boundary (15m x 4m x 1.2m tall). This was identified adjacent to Building 166. Many of the stems were old with only two or three saplings noted during the 2009 survey. Additionally, a second small stand of Japanese Knotweed (0.4m x 0.2m x 1.2m tall) has been noted just outside of the site boundary to the south of Building 142.

3.21. Japanese Knotweed has also been identified adjacent to building 301 in Hangars East albeit outside the site boundary.

3.22. Japanese Knotweed is listed under Schedule 9 Part II Section 14 of the Wildlife and Countryside Act 1981 (as amended). Under Section 14, if any person plants or otherwise causes to grow any plant listed in Schedule 9, they shall be guilty of an offence.

3.23. The site is considered to have a **High** sensitivity with respect to the ecological setting.

***Built Heritage***

3.24. There are three Listed Buildings that lie within 'Waterfront – Conservation'. These are listed in Table 3.5.

**TABLE 3.5: LISTED BUILDINGS WITHIN 'WATERFRONT – CONSERVATION'**

| Building No. | Building Name | Grade | Brief Description | Ref |
|---|---|---|---|---|
| 91 | Dining Room and Cook House | II | Dining room and cook house for ratings. Dated 1931 and 1939, with minor addition post-1941. | [10 – 13] |
| 118 | The Wardroom and Officers' Mess | II | Dated 1935, the building formed part of the original 1930s expansion of the base. It was soon evident that the original Officers' Mess, in Westcliffe House, would be inadequate for the station. Officers' Mess for 100 and quarters for 54 single officers (ceased use 1995). | |
| 119 | Westcliffe House | II | Large detached villa formerly pupils' quarters, mess and class rooms and then the Officers' Mess and WRNS Officers' accommodation. Built 1904. | |

3.25. None of the buildings within Waterfront – Commercial are Listed, however CampbellReith's Site Appraisal Reports refer to a document (HGP Report, dated March 2010), which states that two other buildings are being considered for Listing (Buildings 31 and 33).

3.26. None of the buildings within Hangars West and Hangars East are Listed and none lie within a Conservation Area.

## 4.0 SITE HISTORY AND INDUSTRIAL SETTING

### Site History

4.1. Information relating to the site history has been obtained by reference to the previous studies undertaken for the site and ordnance survey mapping presented in the [4] Landmark Envirocheck Report and is summarised for the site and surrounds in Table 4.1 – 4.2.

**TABLE 4.1: SITE HISTORY**

| Date | Development | Reference |
|---|---|---|
| Pre 1900s | The site was open farmland until the 1880s when there was an attempt to develop a seaside health resort at Lee-on-the-Solent. | [10-13] |
| 1910 - 1911 | The site is generally shown to be undeveloped with the exception of Westcliffe House in the Waterfront zone and what is indicated to be several new development plots and an associated road layout. The wider parts of the site generally consisted of agricultural field boundaries, hamlets, farms and copses. A school, kiln and brick works were located within the northern parts of the current airfield, which was dissected by Millfield Lane. | [4] [16] |
| 1932 - 1942 | Historical maps dated 1938 and 1942 show few changes from the previous plan of 1911, however the removal of important features such as airfields and bases from maps was routine practice during times of war. Allotments and playing fields are shown within the site boundary in the west of the site.<br><br>The site was first established as a seaplane base (RNAS Lee-on-Solent) in 1917 during the First World War and later became the main seaplane training establishment and administrative centre. In the initial development stages of the site as a base in 1917, accommodation was largely provided by bell tents and temporary Bessonneau 'canvas' hangars for seaplane aircraft. An aerial photograph dated circa. 1917- 1918 is presented as Figure 8<br><br>In 1918, the RNAS combined with the Royal Flying Corps (RFC) to form the Royal Air Force (RAF) and the Lee-on-Solent Naval Seaplane Training School became an RAF station and then part of the Fleet Air Arm when it was formed in 1924.<br><br>Previous desk study information and historical reviews indicate the site to have undergone a major expansion by 1932, when the Headquarters of Coastal Area moved from Central London to Lee-on-the-Solent. The site expanded with the acquisition of additional land, and aerodrome construction began with new barrack blocks, administration and technical buildings. The number of aircraft stationed at the site increased, with both land and seaplane training taking place on the base and significant site development continued into the mid 1930's.<br><br>The base was transferred to the Admiralty during this period, and commissioned as HMS Daedalus, used extensively for both training and squadron flying. | [4] [16]<br><br>[16] |
| 1944 - 1945 | During early 1944, as part of the build up to Operation Overlord, the number of aircraft stationed at HMS Daedalus rose considerably to over 100 Spitfires and Seafires plus at least three more squadrons. | [16] |
| 1945 - 1959 | Following the war, repairs and improvements were made to the base. | [16] |

| | | |
|---|---|---|
| | Operations did not significantly reduce, although in 1946 marine operations ceased and the slipway was abandoned. Various squadrons used the base through the remainder of the 1940's and into the 1950's, including for helicopter pilot training. | |
| 1959 - 1962 | In 1959, HMS Daedalus was developed as the Fleet Air Arm's major technical training establishment. The air electrical school long established on-site was re-named HMS Ariel, and this became the name of the base. | [16] |
| 1962 - 1968 | The Ordnance Survey map shows the plan of the airfield, large aircraft hangars adjacent to the airfield and the barracks area including Westcliffe House. The airfield exhibited three runways in a triangular arrangement with numerous small hangars and taxi ways in the eastern and north western parts. Historical reviews note that in 1962, the Joint Service Hovercraft Unit was established on the site, for the purposes of testing hovercraft for military use, particularly in mine countermeasures. The site continued to be used by squadrons as a helicopter base. In about 1965 there were approximately ten aircraft based on site at this time. | [4] [16] |
| 1970 - 1988 | During 1970, the Naval Air Command Headquarters and Air Engineering School vacated the site, and closure of the site was under consideration. However, the site reverted to its original role of training. In addition, an RAF search and rescue unit operated from the base between 1973 and 1988. The communications element of 781 squadron closed in 1981 and search and rescue moved away in 1988. At around this time, the local Coast Guard began operating helicopters from the base.<br><br>Additionally, the site housed guided missile research within building 302.<br><br>Also, Southampton University Air Squadron and the police used the base around this time. The site was also used for refuelling aircraft operating from ships in the English Channel. A new accommodation block was opened in 1980 followed by upgrading of pre-war RAF accommodation.<br><br>Ordnance survey maps of 1975 and 1983 show no changes to the site itself. | [16]<br><br>[4] |
| 1991 | The Ordnance Survey map dated 1991 shows some reduction in the number of buildings at the far north of the base and access tracks in the west of the site. In addition the area of heath close to the centre of the airfield is no longer shown. | [4] |
| 1999 | The aerial photographs for 1999 show the site layout similar to the present-day layout. An area of disturbed ground in the far southwest corner of the site is shown on oblique aerial photos taken in October 1999 (NMR 18534/19). A further area of possible disturbed ground is shown on photo NMR 18534/04 in the south-east corner of the site. | [4] [16] |
| 2000 | An ordnance survey plan for the year 2000 shows no significant changes from previous maps, on site. | [4] |

**TABLE 4.2: ADJACENT LAND HISTORY**

| Date | Development | |
|---|---|---|
| 1910 - 1911 | The surrounding area was principally agricultural with small hamlets and copses present. A sparse settlement is shown adjacent to the south east of the site populated by relatively few properties, a nursery and St Faith's Church. It was served by a main road named West Cliffe Park (now called Marine Way) that ran along the seafront. Stubbington Lane traversed northwards to Stubbington to the northwest of the site from a | [4] [16] |

| | | |
|---|---|---|
| | junction between Sea Lane and West Cliffe Park to the west of the Waterfront zone. To the east, the general area was wooded or heathland and a smithy was located to the south of Shoot Farm. A gravel pit was also present between Cherque and Shoot Farms to the south east of the site (east of the Waterfront zone). Another was present to the west of the site in the vicinity of Stubbington Lane. To the north and just within the site boundary there was also a small brick works and kiln present with a much larger brick works at Peel to the north east. A school is shown adjacent to the northern site boundary and to the south of Hollyers Copse. | |
| 1938 - 1942 | The settlement to the south east of the site appears on the historical mapping to have become more fully developed by this time and a slipway to The Solent is shown with the juncture of West Cliff Park. An extensive area of disturbed ground / heathland characterised the area of the gravel pit in the vicinity of Cherque and Shoot Farms to the south east of the site, although a second gravel pit had been formed to the south of Shoot Farm over the location of the smithy. To the north of the site, extensive sewage filter beds were present at the end of the lane that dissects the site (airfield). A new settlement called 'Peel Common' with terraced workers houses had been formed to the south of Peel. To the west, a large nursery had been constructed midway along Stubbington Lane. | [4] [16] |
| 1962 - 1963 | By 1963, the centre of the site had become an airfield. The settlement to the south east of the Waterfront zone had become more densely populated and a new barracks complex had been constructed to the east of the Waterfront zone comprising numerous small accommodation blocks. To the west, Stubbington Lane appears to have become populated along it full length between The Solent and Stubbington. A school is still shown adjacent to the northern site boundary and to the north west, the beginnings of a new residential estate was shown. | [4] [16] |
| 1968 - 1975 | The 1968 map shows significant residential development on land surrounding the site, mainly to the north west and south east of site. A substantial increase in residential property had occurred particularly in the Stubbington area. In addition, there had been a substantial redevelopment of the barracks complex to the east of the Waterfront zone, which now exhibited several very large buildings. To the east, a new Golf Course is shown with a distinct absence of woodland that previously characterised this area. The disturbed area of land in the centre of the airfield is shown on the map as 'heath' at this time. | [4] [16] |
| 1983 - 1991 | There had been no significant change in the development of the surrounding area with the exception of the new Peel Common Sewage Works to the north of the site, which exhibited extensive earthworks and bunds around its boundary. | [4] [16] |
| 2000 | No significant change. | [4] [16] |

**Summary of Previous Studies and Site Investigations**

4.2. The following core reports have been produced in relation to contamination issues at the site:

[14] WSP Phase One (Desk Study), May 1995;

[15] Entec LQA Review Draft Technical Note, 5 January 2001;

[16] Entec Phase One Desk Study, May 2005; and,

[17] Entec Phase Two: Shallow Groundwater Investigation for Defence Estates, 8 May 2003.

***[14] WSP Phase One (Desk Study), May 1995***

4.3. This report provided a detailed informative of potential areas of contamination observed during a comprehensive site reconnaissance exercise. Particular attention was made to areas of:

- hydrocarbon storage;
- drums, bottles and cylinders;
- demolition rubble and building material areas;
- engineering and maintenance areas;
- pesticides and herbicides;
- unexploded ordnance and munitions;
- miscellaneous potentially contaminative users; and,
- sewage and drainage.

4.4. A detailed walkover survey was undertaken by G&E Consultants on behalf of WSP in 1994 and is detailed within this report. Notable areas of potential contamination have been included within the Preliminary Conceptual Site Model in Chapter 5.0.

***[15] Entec LQA Review Draft Technical Note, 5 January 2001***

4.5. It is understood that WSP undertook an intrusive site investigation following the production of the Desk study. Unfortunately, the WSP Site Investigation report is not available for review by CampbellReith, although Entec were able to summarise its contents. They reported that WSP's intrusive investigation was undertaken in 1995 and proposed drilling 116 No. shallow probe-holes targeted at the hangar areas where the desk study had identified a high likelihood of contamination to be present.

4.6. Areas of contamination identified by the WSP work was summarised by Entec, although the location of where contamination was encountered was not reported.

*[16] Entec Phase One Desk Study, May 2005*

4.7. A detailed review of commercial activities at Daedalus was undertaken by Entec in November 2004, and provided a detailed account of all tenanted activity and areas of potential contamination. These potential sources have been included within Table 5.1 of Chapter 5.0 Preliminary Conceptual Site Model.

4.8. In addition, a large number of historic potentially contaminative operations and processes were identified to have occurred at the site and these relate to the:

- Bulk Fuel Installation (BFI);
- hangars, workshops for aircraft maintenance and repair;
- Motor Transport (MT Section) and petrol dispensing station had underground fuel tanks;
- former Central Boiler House and associated storage tanks;
- numerous fuel storage tanks at workshops and hangar locations;
- Petrol Tanker Shed (Crash Tender Bay) near BFI;
- historic Workshops - blacksmiths, joiners, polishers, shipwrights and engineering works;
- burning grounds and fire training areas in Hangars East and West;
- firing ranges;
- scrap Metal Compound and coal yard; and,
- asbestos associated with fabric of buildings and also in soils (notably demolished buildings.

***Bulk Fuel Installation (BFI)***

4.9. The Bulk Fuel Installation (BFI) comprised an arrangement of 6 No. cylindrical underground aviation fuel tanks, a motor room, pump room and pipe infrastructure and vent pipes encased within a circular earth mound in the west of the Waterfront zone and designated as building 10 on the plans.

4.10. Figure 9 shows the arrangement of the underground fuel storage tanks at the former BFI prior to its decommissioning.

***Former Central Boiler House***

4.11. Entec reported that the former boiler house (building 81) and above ground fuel storage tanks (buildings 82 and 83) were located to the south of the Dunning Hangar (building 73). The boiler

house served the southern parts of the former commercial areas of the Waterfront zone and was replaced in the 1990s by the nearby facility adjacent to the south of Dunning Hangar.

***Motor Transport Section***

4.12. The Motor Transport Section consisted of the following structures:

- MT Section oil store, pump house and underground petrol storage tanks (building 99);
- MT Shed (building 100); and,
- MT Hangars and oil stores on slipway (buildings 35-39).

4.13. In the initial development stages of HMS Daedalus, accommodation was largely provided by 'Bell' tents and temporary 'Bessonneau (canvas) hangars for aircraft. One of these was initially used for the MT garage until a permanent structure was built on the same site. As such, fuel storage areas were initially located upon bare ground.

***Fuel Storage Tanks***

4.14. The Entec Phase One desk study provides a list of fuel storage tanks present at the site at the time of their walkover survey and this is reproduced in Table 4.3.

**TABLE 4.3: SUMMARY OF FUEL AND HYDROCARBON STORAGE TANKS**

| Location | Contents | Current or Former | AST/UST | Comments | Entec 2003 SI | Area |
|---|---|---|---|---|---|---|
| Buildings 82 & 83 | Fuel Oil | Former | AST | Fuel for Old Boiler House | BH202 | 2 |
| Central Boiler House | Fuel Oil | Current (disused) | AST | No evidence of spillage | | 2 |
| Bulk Fuel Installation | Aviation Fuel | Current (disused) tanks removed | UST | TCE and fuel contamination | BH218, 219, 220 | 1 |
| Building 99 (MT Fuel Store) | Petroleum | Former | UST | Petroleum Contamination | BH201 | 5a |
| Building 274 (Ground Maintenance Section) | Fuel Oil | Former | UST | Diesel Contamination | BH203 | Offsite |
| Building 295 | Fuel Oil | Current (disused) | AST | Historical surface staining observed | BH204, 205, 206 | Hangars East |
| Building 301 | Fuel Oil | Current (disused) | AST | Historical surface staining observed | BH207, 208, 209 | |

| Location | Contents | Current or Former | AST/UST | Comments | Entec 2003 SI | Area |
|---|---|---|---|---|---|---|
| Building 303 | Fuel Oil | Current (disused) | AST | Historical surface staining observed | | |
| Building 343 | Fuel Oil | Current | UST | | BH210, 211, 212 | Hangars West |
| Building 344 | Fuel Oil | Current | AST | | | |
| Building 353 | Fuel Oil | Former | AST | | BH213 | |
| Building 351 | Diesel | Current | AST | Surface staining | BH214 | |
| Building 51 & 55 | Diesel | Current | AST | | - | 7a |
| Building 16 (Air Traffic Control) | Fuel Oil & Aviation Fuel | Current | AST | | - | Offsite near 1 |
| Site S | Waste Oil | Current | AST | | - | Unknown |
| Site J2 Building 159 | Diesel | Current | AST | Surface staining evident | - | Unknown |

4.15. Figure 10 shows the arrangement of numerous fuel storage tanks predominantly located in Hangars East and the Waterfront zone.

***Electrical Substations and Transformers (Polychlorinated Biphenyls (PCBs))***

4.16. The WSP and Entec Phase One Desk Studies included a review of onsite electricity substations / transformers. This is because of the potential for polychlorinated biphenyls (PCBs), which are a class of organic compound widely used for many applications (especially as dielectric fluids in transformers, capacitors, and coolants) to be present in the ground. Due to PCB's toxicity and classification as a persistent organic pollutant, they have been banned but may still leave a legacy of contamination in areas where they were used.

4.17. WSP reported that the main transformers and switchgear were contained within Building 141. However, transformer oils used on the site are reported to be PCB free, but there is a high possibility that they contained PCBs in the past.

4.18. The transformer station (building 298) was built between 1985 and 1988 and is unlikely to have used oils containing PCBs. However, tests carried out on transformer oils from transformers 1, 2, 4, 6, 7 and 8 all showed the presence of Type 1260 PCBs up to concentrations of 4ppm, although the locations of these structures is currently unknown.

4.19. Entec also reported that a number of electrical transformers were present on the site and these locations included buildings 27, 141, 269, 298, 340 and 361.

***Radioactive Materials***

4.20. Previous studies for the Daedalus site reported that historical site operations included the potential to cause radioactive contamination and these activities included the following:

- Aircraft Hangars, Workshops and Maintenance facilities – Possible that radium luminised instruments were maintained and stored within the hangars. Radium luminised instrumentation would have repaired along with the storage of radium luminising paints and this may have led to the ad-hoc disposal of such materials locally to the ground around these facilities.

- Fire Training Area – Entec reported that obsolete and damaged aircraft were burnt for fire training purposes. Furthermore, it is noted that the Defence Radiological Protection Services (DRPS) had undertaken a radiological survey of an area within Hangars East and subsequent remedial works to remove the radiological sources identified.

- Burning Grounds / Waste Disposal Areas – Three potential waste burial and burning ground were identified on the south eastern areas of the airfield. Such areas may contain radium contaminated residues.

- Anecdotal Evidence – Entec reported that a crash investigation team were based within buildings 343 and 344 in Hangars West and radioactively contaminated aircraft debris may have been released to the ground.

4.21. Further information regarding the potential for radioactive contamination is summarised within Chapter 9.0.

***[17] Entec Phase Two: Shallow Groundwater Investigation for Defence Estates, 8 May 2003***

4.22. Entec undertook an intrusive shallow groundwater investigation on behalf of their client (Defence Estates) in May 2003. The Entec study identified that the previous site investigations had been insufficient to understand the full extent of groundwater impaction and radiological contamination of the soil and so recommended that additional intrusive investigations be undertaken in order to clarify the potential risks posed by groundwater and radiological contamination.

4.23. The works comprised the drilling of 20 No. boreholes (referred to as BH201-BH220 and an additional shallow well at BH201 referred to as BH201B) and the installation of monitoring

standpipes. These were generally targeted at areas of historic land uses and sources of potential contamination as detailed in Table 4.4.

**TABLE 4.4: SCHEDULE OF EXPLORATORY HOLE LOCATIONS**

| Exploratory Hole Location | Building No | Former Use | Likely Contamination | Development Area |
|---|---|---|---|---|
| BH201 | Building 39 | MT Section | Hydrocarbons | 5a |
| BH202 | Building 81 | Central Boiler House | | 2 |
| BH203 | Building 273 | Ground Staff & Maintenance | | Offsite but adjacent to 3 |
| BH204 | Building 293 | Workshop | | Hangars East |
| BH205 | Building 293 | Workshop | | |
| BH206 | Building 293 | Workshop | | |
| BH207 | Building 301 | N Hangar | | |
| BH208 | Building 301 | N Hangar | | |
| BH209 | Building 301 | N Hangar | | |
| BH210 | Building 343 | R Hangar | | Hangars West |
| BH211 | Building 343 | R Hangar | | |
| BH212 | Building 343 | R Hangar | | |
| BH213 | Building 353 | Northwest Boiler House | | |
| BH214 | Building 353 | Northwest Boiler House | | |
| BH215 | Building 356 | No 4 Bellman Hangar | Mercury, boron, ethylbenzene in groundwater | |
| BH216 | Building 390 | Fire Burning Area | Copper and zinc in soil and hydrocarbons in groundwater | Hangars East |
| BH217 | Building 390 | Fire Burning Area | | |
| BH218 | Building | BFI | Hydrocarbons | 1 |
| BH219 | Building | BFI | | |
| BH220 | Building | BFI | | |

4.24. Borehole monitoring standpipes were monitored on four occasions to investigate the tidal influence upon groundwater levels. Table 4.5 shows the data for both morning and afternoon readings undertaken on two consecutive days (6th and 7th March 2003) shortly after high and low tides. Entec's findings showed that BH217, BH218 and BH219 displayed a daily variation of 0.02m indicating only a minor tidal influence, although being located within 50m of The Solent.

**TABLE 4.5: EXCERPT FROM ENTEC REPORT (2003) TABLE 5.3 RESULTS OF GROUNDWATER LEVEL MONITORING**

| Borehole No. | 06/03/2003 | | | | 07/03/2003 | | | |
|---|---|---|---|---|---|---|---|---|
| | GW Level (m AOD) | Time | GW Level (m AOD) | Time | GW Level (m AOD) | Time | GW Level (m AOD) | Time |
| BH201B (shallow) | 6.39 | 8.18 | 6.59 | 16.29 | 6.41 | 09.35 | 6.38 | 14.20 |
| BH201 (deep) | 4.48 | 8.19 | 4.51 | 16.31 | 4.50 | 09.31 | 4.54 | 14.21 |
| BH202 | 5.43 | 8.33 | 5.43 | 16.11 | 5.44 | 09.17 | 5.45 | 14.06 |
| BH203 | 5.96 | 8.38 | 5.96 | 16.15 | 5.98 | 09.22 | 6.00 | 14.02 |
| BH204 | 5.50 | 8.43 | 5.50 | 16.05 | 5.53 | 09.10 | 5.55 | 13.17 |
| BH205 | 5.48 | 8.46 | 5.41 | 16.04 | 5.41 | 09.08 | 5.42 | 13.21 |
| BH206 | 5.41 | 8.45 | 5.40 | 16.02 | 5.41 | 09.05 | 5.41 | 13.20 |
| BH207 | 6.20 | 8.53 | 6.19 | 15.56 | 6.19 | 08.56 | 6.19 | 13.24 |
| BH208 | 6.64 | 8.59 | 5.13 | 15.59 | 6.55 | 08.53 | 6.58 | 13.29 |
| BH209 | 5.87 | 8.56 | 5.86 | 15.57 | 5.85 | 08.58 | 5.86 | 13.26 |
| BH210 | 8.07 | 9.12 | 8.07 | 15.15 | 8.06 | 08.41 | 8.09 | 13.40 |
| BH211 | 7.85 | 9.10 | 7.84 | 15.36 | 7.85 | 08.45 | 7.86 | 13.36 |
| BH212 | 7.88 | 9.11 | 7.87 | 16.37 | 7.89 | 08.44 | 7.91 | 13.39 |
| BH213 | 7.38 | 9.16 | 7.37 | 15.42 | 5.41 | 08.36 | 7.45 | 13.45 |
| BH214 | 7.42 | 9.20 | 7.42 | 15.44 | 7.46 | 08.39 | 7.51 | 13.47 |
| BH215 | 7.76 | 9.30 | 7.77 | 15.46 | 7.70 | 08.34 | 7.65 | 13.52 |
| BH216 | 7.68 | 9.03 | 7.07 | 15.52 | 7.68 | 08.50 | 7.73 | 14.29 |
| BH217 | 8.08 | 9.37 | 7.92 | 15.50 | 7.99 | 08.48 | 8.03 | 14.31 |
| BH218 | 4.23 | 8.27 | 4.21 | 16.26 | 4.20 | 09.29 | 4.21 | 14.17 |
| BH219 | 4.18 | 8.25 | 4.20 | 16.23 | 4.19 | 09.27 | 4.30 | 14.15 |
| BH220 | 4.19 | 8.23 | 4.17 | 16.21 | 4.17 | 09.25 | 4.28 | 14.13 |

4.25. Plotted groundwater contours as shown in Figure 11 infers that groundwater flow is generally towards the south west in the direction of The Solent.

4.26. Well head chemistry observed during the groundwater monitoring is shown in Table 4.6. Visual and olfactory evidence of contamination was observed in the form of strong petrol odours at BH201 (former MT section), BH203 (former grounds maintenance area) and headspace analysis using a Photoionization Detector (PID) meter recorded elevated VOCs at 600ppm in BH201B at approximately 2.0m bgl with an oily sheen observed on the interface probe sensor in BH211.

**TABLE 4.6: EXCERPT FROM ENTEC 2003 WELL HEAD CHEMISTRY DURING GROUNDWATER SAMPLING**

| Borehole | pH | | | EC (uS/cm) | | | DO% | | | Temperature (˚c) | | | Groundwater Level (m bgl) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vol 1 | Vol 2 | Vol 3 | Vol 1 | Vol 2 | Vol 3 | Vol 1 | Vol 2 | Vol 3 | Vol 1 | Vol 2 | Vol 3 | Vol 0 | Vol 1 | Vol 2 | Vol 3 |
| 201 | 7.1 | 7.0 | 6.9 | 1010 | 816 | 714 | 3.2 | 13.5 | 19.8 | 12.4 | 12.6 | 12.4 | 3.73 | - | - | - |
| 201B | 7.4 | - | - | 640 | - | - | 51.6 | - | - | 10.1 | - | - | 1.79 | Dry | - | - |
| 202 | 6.5 | 6.5 | 6.7 | 493 | 500 | 506 | 50 | 49.8 | 54.5 | 11.5 | 11.4 | 11.6 | 3.43 | - | - | - |
| 203 | 6.3 | 6.3 | 6.4 | 963 | 1000 | 980 | - | - | - | 10.4 | 10.8 | 10.8 | 1.93 | 1.97 | 1.98 | 1.94 |
| 204 | 7.2 | 7.3 | 7.4 | 2131 | 1609 | 1314 | 62.0 | 47.6 | 50.1 | 11.5 | 11.8 | 11.8 | 2.95 | - | - | - |
| 205 | 7.0 | 6.9 | - | 483 | 482 | - | 20.1 | 21.1 | - | 12.0 | 11.9 | | 2.60 | - | Dry | - |
| 206 | 6.8 | 7.0 | 7.0 | 399 | 395 | 394 | 38.8 | 40.0 | 42.3 | 10.5 | 10.7 | 10.7 | 2.80 | - | - | - |
| 207 | 7.2 | 7.3 | - | 626 | 623 | - | 30.8 | 35.4 | - | 10.0 | 10.1 | - | 0.9 | - | Dry | - |
| 208 | 7.1 | 6.8 | - | 506 | 490 | - | 48.3 | 61.9 | - | 11.1 | 11.9 | | - | - | Dry | - |
| 209 | 7.1 | 7.1 | 7.1 | 610 | 620 | 622 | 31.0 | 44.3 | 30.9 | 9.7 | 9.8 | 10.1 | | - | | |
| 210 | 7.5 | 7.6 | - | 1170 | 541 | - | 4.94 | 8.36 | - | 9.9 | 9.7 | - | 1.98 | - | Dry | |
| 211 | 7.4 | 7.4 | 7.4 | 1085 | 1001 | 976 | 11.0 | 18.0 | 13.7 | 11.5 | 11.3 | 11.4 | 2.37 | - | - | - |
| 212 | 10.6 | 8.2 | 7.6 | 679 | 646 | 640 | 26.1 | 25.5 | 16.9 | 8.2 | 10.0 | 10.6 | - | - | - | - |
| 213 | 6.3 | 6.6 | 6.5 | 719 | 525 | 488 | 33.1 | 35.2 | 37.6 | 10.5 | 10.5 | 10.7 | 3.88 | - | - | - |
| 214 | 6.5 | 6.6 | 6.7 | 670 | 566 | 548 | 24.1 | 28.5 | 27.8 | 10.8 | 10.5 | 10.4 | 2.11 | - | - | - |
| 215 | 6.1 | 6.3 | - | 924 | 603 | - | 43.0 | 49.8 | - | 10.1 | 10.0 | - | 1.58 | - | - | - |
| 216 | 7.3 | 7.3 | - | 1338 | 1294 | - | 3.43 mg/l | 5.5 mg/l | - | 11.0 | 11.8 | - | 0.80 | - | Dry | - |
| 217 | 7.9 | 8.0 | - | 890 | 930 | - | 29.6 | 27.4 | - | 10.2 | 10.7 | - | - | - | Dry | - |
| 218 | 6.3 | 6.5 | 6.6 | 568 | 475 | 468 | | - | - | 11.8 | 11.9 | 11.9 | 3.74 | 3.74 | 3.74 | 3.74 |
| 219 | 6.2 | 6.3 | 6.4 | 402 | 394 | 395 | | - | - | 11.3 | 11.3 | 11.0 | 3.83 | 3.84 | 3.84 | 3.84 |
| 220 | 5.7 | 5.9 | 6.0 | 372 | 532 | 460 | 33.1 | 40.2 | - | 11.2 | 11.3 | 11.1 | 4.07 | 4.03 | 4.04 | 4.05 |

4.27. Entec reported that the results of the investigation indicate that the majority of the groundwater underlying the site is likely to be free from significant contamination. However, there are localised areas where contamination is present.

4.28. The principal contaminant of concern encountered was reported to be the chlorinated solvents in the groundwater within the south west of the site around the former BFI. The extent of the solvent contamination in the groundwater was not accurately defined but Entec concluded that the plume was likely to extend some distance up-gradient of the BFI with the likely origin at the aircraft hangars and workshops.

4.29. In addition, localised occurrences of hydrocarbon contamination (DRO and PRO) were also identified in shallow perched groundwater at the former MT Section refuelling area and DRO contamination was also encountered at the location of a former grounds maintenance depot (offsite to the east of the waterfront). The extent of hydrocarbon contamination in the groundwater was considered to be limited at these locations.

4.30. Whilst the risk to groundwater with respect to chlorinated solvents, petroleum hydrocarbons and diesel range organics was assessed as high, as these contaminants have been identified to be present within the groundwater, the risk to coastal waters was assessed as low. Impacted groundwaters were considered to be in hydraulic continuity with The Solent, but it was considered unlikely to have a significant impact due to dilution effects. The risk to surface waters (River Alver) was assessed as low, although there was no mention of the tributary located onsite in Hangars East.

4.31. Entec recommended that the site was suitable for redevelopment to a residential or commercial end use subject to measures being taken to address risk identified from organic contamination in groundwater. The most effective risk reduction measures would be to undertake a more detailed groundwater investigation.

**Summary of Previous Remediation Works**

4.32. The Bulk Fuel Installation (BFI) comprised 6 No 54,000 litre (30' x 9') horizontal cylindrical tanks buried beneath a hardened bunker. Records show that the facility was decommissioned and the underground storage tanks removed in 2005 as detailed in [18] Adler + Allan.

***[18] Adler + Allan Health, Safety & Environmental Technical Return (Tender Document), dated December 2004***

4.33. The works comprised the decommissioning and physical removal of the tanks, which were filled with water at the time of their removal but were recorded as last containing AVTUR (Aviation Turbine Fuel) and AVGAS (a high-octane aviation fuel).

4.34. During the works, strong odours were associated with the soils surrounding one of the tanks and arrangements for soil sampling were made. OHES Environmental (consultants) were then instructed to review the analytical data on the behalf of Adler and Allan. Observations of the works in February 2005 showed that potentially contaminated soils were stockpiled and that excavations extended to approximately 3m bgl. Upon review of the analytical data, the hydrocarbon content was shown to be low with a maximum concentration of 350mg/kg. As such, soils were aerated to remove volatile organic compounds associated with the aviation fuel contamination prior to be placed back in the excavations.

**Current Industrial Setting**

4.35. HMS Daedalus closed in 1996 when the Ministry of Defence (MoD) declared it surplus to requirements. It was subsequently purchased by SEEDA and the Maritime and Coastguard Agency (MCA) in 2006 and the airfield has been retained by the MCA as an active private airfield. SEEDA have retained a variety of commercial and industrial operations across the remaining parts of the site around the airfield.

4.36. Table 4.7 summarises identified industrial features which may present a potential source of contamination to the site based upon a review of previous reports and [4] Landmark Envirocheck Report.

**TABLE 4.7: INDUSTRIAL SETTING**

| Type | Distance | Description | Reference |
|---|---|---|---|
| Contemporary Trade Entries | On Site | Area D1 (located in north east corner of the commercial area) - BP haulage - oil filters and unbunded 200 litre drums resting on grassed area. | [4] [16] |
| | On Site | M & J Transport (located to the north of the E & T Block and BFI) - oily drums, batteries and metal oil tank. | |
| | On Site | Area J (located adjacent east of the Overlord Hangar) - Buckland & Langley Demolition - oily residue on yard surface. | |

| Type | Distance | Description | Reference |
|---|---|---|---|
| | On Site | 2 No Contemporary Trade Directory Entries: Hampshire Pallets – inactive and active. | |
| | 0 – 500m | 24 No Contemporary Trade Directory Entries comprising engineering, garage services, maintenance contractors, glass engravers, plastics suppliers, cleaners, haulage, car dealers, printers and aggregate supplies. | |
| Petrol Stations | <10m South east | 'Total' petrol filling station on Broom Way. | [4] [16] |
| | 409m NW | 'Shell' petrol station at Stubbington. | |
| Registered Landfill Sites | 0m South east | Chark Farm licensed to BM Recycling Limited in 1978 and recorded to have accepted household and commercial waste. Status: either lapsed, cancelled, revoked or surrendered. | [4] [16] |
| | 0m South east | Chark Farm licensed to Hampshire County Council in 1986 for commercial, household and industrial waste including sand, chalk, gravel and earth spoil. Status: either lapsed, cancelled, revoked or surrendered. | [4] [16] |
| | 10m East | F Dykes Pit, Sandhills Lane licensed to Hall Aggregates Ltd in 1977 for concrete and concrete drum washings. Status: either lapsed, cancelled, revoked or surrendered. | [4] [16] |
| | 170m East | Shoot Farm, Shoot Lane, licensed to K & R Demolition in 1985 for construction and Demolition waste, biodegradable, contaminated rubble, special waste, paper and cardboard, poison, noxious and polluting wastes. Non-operational. Status: either lapsed, cancelled, revoked or surrendered. | [4] [16] |
| | 300m South east | Cherque Farm licensed to Hall Aggregates in 1982 for construction and demolition waste, biodegradable, contaminated rubble, special waste, paper and cardboard, poison, noxious and polluting wastes. Status: either lapsed, cancelled, revoked or surrendered. | [4] [16] |
| | 180m South east | Land at Cherque Farm – Historic landfill first received waste in 1981 comprising inert commercial and house waste. | [2] |
| | 300m South East | F Dykes Pit and Shoot Farm Historic Landfills located around Sandhills Lane received a mixture of industrial, commercial and household waste from the 1970s and 1980s. | [2] |
| | 180m South east | Cherque Farm Authorised Landfill operated by RMC Logistics (south east) Ltd for construction, demolition and dredgings waste) | [2] |

| Type | Distance | Description | Reference |
|---|---|---|---|
| | | License 19951<br>Landfill Class: Pending<br>Status: Closure | |
| Victorian Landfills | On Site | Anecdotal information suggests that a Victorian Tip is present within the northern boundary of the airfield and adjacent hangar areas although there is no evidence shown on historical mapping. | [16] |
| Licensed Waste Management Facilities | 200 South east | Cheque Farm, Lee-on-Solent licensed to RMC Aggregates Southern) Ltd (licence 19951) from 1992 for construction, demolition and dredgings equal to or greater then 75,000 tonnes per year.<br>Status: Active | [4] [16] |
| Pollution Incidents | 0m at airfield Control Tower<br><br>51m South east<br><br>463m North west | In addition, loss of 9000 litres of aviation fuel (JET-A1/AVTVR) from an above ground tank near the Control Tower occurred in March 2005.<br><br>Category 3 Minor Incident involving oil on pond and fish killed.<br><br>Category 3 Minor Incident involving discharge of chemicals (paints and dyes) to storm water drain at domestic/residential property. | [7] [16]<br><br>[4] [16]<br><br>[4] [16] |
| Discharge Consents | Off Site<br>0 - 500m | 10 No discharge consents although none of the discharge consent records relate to discharges from the site. | [4] [16] |
| Radioactive Substances | On Site | 3 No records of Registered Radioactive Substances authorised under the Radioactive Substances Act. All three records are for radioactive materials held at the site:<br><br>Interserve (Defence) Ltd Authorisation under 5 13 of RSA for disposal of Radioactive Waste;<br><br>Ministry of Defence Authorisation under 57 of RSA for keeping and use of radioactive material;<br><br>Ministry of Defence Authorisation under 57 of R5A for keeping and use of radioactive materials -1 or more closed sources (<4 terabecquerels). | [4] [16] |

4.37. Research did not establish the presence of any of the following at or within 500m of the subject site:

- **Agency and Hydrological:** Contaminated Land Register Entries and Notices; Discharge Consents; Enforcement and Prohibition Notices; Integrated Pollution Controls; Integrated Pollution Prevention and Control; Local Authority Integrated Pollution Prevention and Control; Local Authority Pollution Prevention and Controls; Local Authority Pollution Prevention and Control Enforcements; Prosecutions Relating to Authorised Processes; Prosecutions Relating to Controlled Waters; Substantiated Pollution Incident Registers; and, Water Industry Act Referrals.

- **Waste:** BGS Recorded Landfill Sites; Integrated Pollution Control Registered Waste Sites; Licensed Waste Management Facilities (Locations); Local Authority Recorded Landfill Sites; Registered Waste Transfer Sites; and, Registered Waste Treatment or Disposal Sites.

- **Hazardous Substances:** Control of Major Accident Hazards Sites (COMAH); Explosive Sites; Notification of Installations Handling Hazardous Substances (NIHHS); Planning Hazardous Substance Consents; and, Planning Hazardous Substance Enforcements.

**Liaison With Regulatory Authorities**

4.38. Recent Consultation with the Environment Agency on 18th June 2010 [7] was undertaken in order to update the regulator in regard to the proposed development and to understand the regulatory position in relation to Controlled Waters at the site and in the surrounding area.

4.39. The consultation included a discussion on the relative sensitivity of the River Alver to the east of the site in terms of river quality etc and it was indicated that this area may be subject to more stringent environmental controls in future.

**Current Tenant Activity**

4.40. Table 4.8 presents details of current tenant activity at the Daedalus site, which are referenced on the existing site layout for the site (Figures 2-4). Activities where potential contamination is considered to be a risk are included within Table 5.1 - 5.4 of the Preliminary Conceptual Site Model in Chapter 5.0, although currently tenanted activity does not infer a significant risk.

**TABLE 4.8: CURRENT TENANTED USE (JANUARY 2011)**

| Building / Site | Occupied By | Comments |
|---|---|---|
| Building 14 | SEEDA | |
| Hardstand (North of Bldg 14) | Eclips Corporation | Lorry parking. |
| Bldg 15 | Powerboat P1 Management Ltd | Marine use, boat and lorry parking. |
| Site A (Helipad) | SEEDA | Very occasional use by helicopters i.e. Open days. |
| Site Adj. to Bldg 27 | Darren Strand t/a Owton Freight Limited | Lorry parking. |
| Bldgs 31 & 40 + Ext Store Area | The Hovercroft Museum Trust | |
| Site adj to Bldgs 31 & 40 | Professor Wensley Hayden-Ballie | |
| Building 35A | AFI Uplift Ltd | Storage and maintenance of highlift platforms/cherry pickers |
| Building 35B | Ross-Smith Marine | Small marine craft restoration and maintenance |
| Part Building 37A | SEEDA | |
| Building 39(A) | Gosport Borough Council | Storage of wheelie bins |
| Building 39(B) | The Provincial Society | Storage of vintage buses |
| Building 39(C) | Southampton City Council | Storage of buses |
| Building 39 (D) | SEEDA | |
| Bldg 51, Pt Bldg 37B & Pt Site P | Hampshire Pallets Ltd | Manufacture and storage of new timber pallets |
| Site adj. Bldg 51 | Cougar Marine Sales Ltd | Boat mould storage |
| Building 55 | Nightingale Contractors Ltd | |
| Building 56 | SEB Furnishings | Furniture manufacture |
| Building 61 | SEEDA | |
| Part Building 67 | Shearwood Steel Fabrications | Large structural steel fabrication |
| Part Building 67 | Tracey O'Grady | Blacksmith and arc welding |
| Part only of Building 67 | Beauty Glass by WEN X1A Ltd | Importing & exporting small goods |
| Nrth Wkshop Prt Buiding 67 | Tony O'Grady | Steelworking fabrication |
| Building 67 (Part) | Colin Mcaskill | Storage and refurbishment of vehicles |
| Workshop adj to Building 67 | Kevin Duffy | General storage and workshop |
| Building 68 (Swann Building) | SMR Automotive Mirrors UK Ltd | Warehousing for motor trade |
| Hardstanding adj. Bldg 68 | Whiteley Skips | Storage of empty skips |
| Building 71 (A) | Airport Precision Engineering | Machining workshop |
| Building 71(B) | Skirts & Shirts Ltd | |
| Building 71 (C) | SEEDA | |
| Part Building 73 (Dunning Hangar) | Marine Concepts Ltd | Moulding and fabrication of medium/large marine craft |
| Part Building 73 | BN Group Ltd | Manufacture of aircraft parts |
| Building 96 (A) | Dave & Nicole Caswell t/a Blast Off UK Ltd | Spray painting |
| Building 96B & Adj. Hardstanding | Cougar Marine Sales Ltd | Small marine equipment storage and vehicles. |
| Pt Bldg 100 & Forecourt | J & H Repairs | Car repairs |

| Building / Site | Occupied By | Comments |
|---|---|---|
| U.A & Forecourt Adj Bldg 100 | SEEDA | |
| Pt Bldg 100 (3 bays) & H'stand | KTL Landscaping & Son | |
| Unit C-storage adj. Bldg 100 | SEEDA | |
| Pt Bldg 100 & Forecourt | Arrow Tools (UK) Ltd | |
| Building 153 (Part) | Alison & Thomas Stocker | |
| Building 153 (Part) | The Flower Co. | Storage of wedding accessories |
| Building 153 (Part) | SEEDA | |
| Site Adj. to Building 153 | SEEDA | |
| Hardstand to Rear Bldg 154 | Paul Ingrey t/a 'Kwikfr8' | Lorry storage |
| Part Building 154 | Bees Marquees Ltd | Marquee storage and maintenance |
| Building 159 & Site | Premier Pallets Supplies Ltd | Repair and storage of timber pallets |
| Building 286 (Hangar A) | Clarks Caravan & Boat Haulage Ltd | Storage of boats and vehicles |
| Building 287 (Hangar C) | Solent Ribs Ltd | |
| Land Adj.Bldg 287 | SEEDA | |
| Building 289 (Hangar D) | Vision Travel Minibuses Ltd | Storage of buses and coaches |
| Hardst.Adj.Bldg 289 (Hangar D) | Vision Travel Minibuses Ltd | Storage of buses and driver training |
| Building 290 (Hangar E) | Vision Travel International Ltd | Storage of buses and coaches |
| Building 291 (Hangar F) | Ian Blamire | Aviation hangar |
| Building 292 (Hangar B) | Lee Flying Association Ltd | Aviation hangar used by Flying Club |
| Site Adj.to Hangar B | SEEDA | |
| Building 296 (Hangar G) | Ashwin G Hill Esq | |
| Buildings 297 & 298 | SEEDA | |
| Buildings 300 & 301 (Hangar N) | Kevin Butcher | General storage and use of microlight plus small workshop |
| Building 303 (Hangar M) | Solent Microlight Group | Storage and maintenance of microlight aircraft |
| Building 304 (Hanger L) | Atlas Helicopters Ltd | Commercial helicopter operation |
| Building 305 (Hangar K) | B-N Group Ltd | |
| Eastern Dispersal - North H'stand Area | SEEDA | |
| Building 306 (Hangar J) | The Portsmouth Naval Gliding Club | |
| Building 307 (Hangar H) | Brian Nutley t/a Nason Energy | Storage of a portable hangar building |
| Land adj Bldg 307 (Fuel Tank Bund) | SEEDA | |
| Land adj Bldg 307 | Russell Luke | |
| Eastern dispersal Area - South Hardst | Flying at Lee on Solent | |
| B'man 4 & Adj H'stand, Hang O & Q & Bldgs 351/352 | The Portsmouth Naval Gliding Club | |
| Hangar Bellman 1 | BN Defence Ltd | |
| Part Building 389 | - | Vehicle and ancillary storage |
| Pt Building 389 | 1st Choice Recovery | Vehicle storage and ancillary use |

| Building / Site | Occupied By | Comments |
|---|---|---|
| Site PPI adjac. Building 389 | Premier Pallets Supplies Ltd | Vehicle parking |
| Hangars P & R | Paul: Malcolm | Two aviation hangars |
| Westcliffe House | SEEDA | |
| Whytecroft House | First Secretary of State | |
| Site D1 | Boarhunt Group Ltd | Lorry storage |
| Part Site J | Portsmouth Demolition & Salvage Ltd | Demolition contractors compound |
| Site J3 - Eastern Section | Commercial Exports Ltd | Open storage |
| Site J2 | Commercial Exports Ltd | Open storage |
| Site M | Eden (GM Ltd) | New car storage |
| Part Site P2 | O'Neil Construction (Fareham) Ltd | Vehicle storage and ancillary |
| Sites Q1, Q2 & Q3 & H to R Bldg 96 | DK Transport | Lorry storage |
| Site S | M & J Transport (Southampton) Ltd | Lorry storage |
| Hangar T (Building 339) | Hampshire Police Authority | |
| Telecoms Mast | Hutchison 3G UK Ltd | |
| Telecoms Mast | Telefónica O2 UK Ltd | |
| Telecoms Mast | Vodafone Ltd | |
| Manor Way | Jade Cronin | |
| Plot 1 Stubbington Lane | Wilson:Marilyn Anne | |
| North-east Field | Dunley Estates | |
| Slipway | SEEDA | |
| Land North of Hanger J | TUV Product Service Ltd | |
| Tower (ELECTRICITY) | Hampshire Police Air Support Unit | |
| Hanger U Daedalus Broom Way | Hampshire Police Air Support Unit | |
| Garage 9 | Mathison Engineering | |

## 5.0 PRELIMINARY CONCEPTUAL SITE MODEL

5.1. Current practice for land contamination evaluation involves appraisal of contaminant source-pathway-receptor pollutant linkages. These are summarised below, based upon information presented in the previous sections.

**Potential Sources of Contamination**

5.2. Tables 5.1–5.5 summarise the potential contamination sources that have been identified on or near the site. This utilises information contained within both the [14] WSP and [16] Entec Phase One Desk Study Reports. In addition, assessment of potentially contaminating activities by tenanted use was made by both WSP in 1995 and Entec in 2005. Those activities or areas that were considered to require further investigation have been included within the following summary of potential sources and shown on Figures 12-14. Radioactive contamination and Unexploded Ordnance issues are summarised in Chapters 9.0 and 10.0 respectively.

5.3. The potential contaminant types associated with these is then given based upon a review of CLR11, industry profiles and anecdotal information.

5.4. The potential sources of contamination are considered on the basis of the existing zones:

- Waterfront – Commercial;
- Waterfront – Conservation;
- Hangars West; and,
- Hangars East.

5.5. Furthermore, the proposed development areas are also indicated as this reflects proposed end users of differing sensitivities.

**TABLE 5.1: SOURCES OF CONTAMINATION IN WATERFRONT - COMMERCIAL ZONE**

| Feature on or near site | Potential Contaminant | Development Area |
|---|---|---|
| **Areas of Potential Contamination** | | |
| Bulk Fuel Installation (BFI) (building 10) | H | 1 |
| E & T Block | | |
| Historic Central Boiler House (building 81), fuel tanks (buildings 82-83), and oil stores (buildings 84-85) | H | 2 |
| Two large circular oil tanks of the more recent Central Boiler House (building 74) now used for Emergency Water Storage (building 79) | H | 2 |
| Hangars for aircraft maintenance and repair. The use of a solvent called 'BASOL' was used to clean the floors of hangars and workshops | H, VOCs | 2 |
| Naval Stores (building 71) | M, H, ACM | |
| Dunning Hangar (building 73) WSP reported that this location contained a small drum store of synthetic lubricating oil for aircraft engines with hardstanding in poor condition and drum corroded and holed. Some drums held contaminated oil for disposal | H | 2 |
| Building 84 (oil store) has a blacktop apron displaying spillage. Area contained hydraulic and lubricating oils, white spirit, petrol, diesel, brush cleaner and jointing compound. | H | 2 |
| Building 40 (HTU Hangar) located on the west side of the slipway exhibited a bunded fuel oil tank with moderate spillage evident | H | 8b |
| Crash Tender Bay used as a petrol tanker shed (building 15) | H | 1 |
| Old Workshops - Blacksmiths, joiners, polishers, shipwrights and engineering works adjacent to Scrap Metal Compound and Naval Stores Buildings (buildings 41-51) | H, M, ACM | 7a |
| Bund for 2 nr 60,000l and 20,000l double tank arrangement near building 60 | H | 7b |
| Slipway - a winch and pulley system was utilised to take the seaplanes to the sea at the end of Richmond Road | H | 8b |
| Former pistol firing range located near to building 161 | M | 3 |
| Scrap Metal Compound (near to building 64) | M, H | 7a |
| An area of potential or identified asbestos was highlighted in the north eastern parts of the commercial zone (near to Area D1) | ACM | 3 |
| Kingston Villa (building 14) exhibited an auto-start generator with 4,660 litre diesel tank and spillage was evident. In addition, there were 14 No 40 gallon drums containing ethylene glycol for de-icing and diesel. Two of the drums were leaking onto the gravel surface | H | 1 |
| Electricity substation (building 27) in vicinity of the slipway | PCB | 8b |
| New Central Boiler House (building 74) - chemical storage containing 'caustic' and hydrochloric acid' | M, H | 2 |

| Feature on or near site | Potential Contaminant | Development Area |
|---|---|---|
| Paint Store (building 62) – WSP noted that the gully cover appeared to have paint residue on the surface and inside, spillages of polyurethane varnish, toluene and xylene was evident | H | 7b |
| Building 6 was reported by WSP to contain eight fuel tanks for outboard motors although no spillage was apparent. | - | 1 |
| **Areas Potentially Contaminative Uses by Previous Tenants** | | |
| Area D1 (located in north east corner of the commercial area) BP Haulage – discarded oil filters / fuel drums | H | 3 |
| M & J Transport (located to the north of the E & T Block and BFI) | H | 1 |
| Area J (located adjacent east of the Overlord Hangar) Buckland & Langley Demolition – oily yard area | H | 3 |
| **Areas of Identified Contamination** | | |
| WSP Investigation:<br>Building 41 Paint Stores<br>Building 60 (location to be confirmed) Timber Stores<br>Building 81 Historic Central Boiler House | <br>Zinc in soil<br>Oil in soil<br>Oil in soil | <br>8b<br>7b<br>2 |
| Entec 2003 Investigation:<br>BH202 at 2.0m bgl<br>Widespread elevated metals, notably zinc in BH218, BH219 and BH220 (in the vicinity of BFI) | <br>VOCs (337$\mu$g/kg)<br>Trichloroethene (6$\mu$g/kg) | <br>2 |
| **Notes:** **M** – Metals. **H** – Hydrocarbons. **VOC** – Volatile Organic Compounds. **PRO** - Petrol Range Organics. **DRO** - Diesel Range Organics. **ACM** – Asbestos Contaminant Materials. **PCB** – Polychlorinated Biphenyl, **R** – Radioactivity. | | |

**TABLE 5.2: SOURCES OF CONTAMINATION IN WATERFRONT - CONSERVATION ZONE**

| Feature on or near site | Potential Contaminant | Proposed Development Area |
|---|---|---|
| **Areas of Potential Contamination** | | |
| Motor Transport (MT Section) oil store and petrol dispensing station during early stages comprised underground fuel tanks at building 99 | H | 7b |
| Former building 59 near to the double tank arrangement and air raid shelter at building 60 exhibited general spillage in cracked concrete forecourt | H | 7b |
| Hangars and workshops at slipway | M, H, ACM | 8b |
| Shipwrights shop (building 103) | M, H, ACM | 6 |
| Former Coal Storage Compound (north of main officers wardroom at building 118 ) | H | 5a |

| Feature on or near site | Potential Contaminant | Proposed Development Area |
|---|---|---|
| Guardhouse boiler house (building 131) | H, ACM | 5a |
| Triumph Galley and boiler house (building 91) | H, ACM | 5a |
| Former laundry (building 141) exhibits a new bunded tank (capacity 14,100 litres) is currently used for drum and bottle storage and exhibits hydrocarbon spillage and staining inside | H | 5a |
| Fire Booster Pump - house boiler house had an underground fuel tank (building 133) | H, ACM | 5a |
| Printing shop (building 164) | H | 4 |
| Eagle Block (building 116) – WSP report that this building was cleared of blue (crocilodite) asbestos in 1978 | ACM | 5a |
| Asbestos associated with fabric of buildings and also in soils (notably demolished buildings) | ACM | - |
| Electricity substation at building 132 in vicinity of fire pump house and fire /police station | PCB | 5a |
| Electricity substation at the main transformer (building 141) | PCB | 5a |
| **Areas of Identified Contamination** | | |
| Entec 2003 Investigation:<br>BH201B (MT Section) at 2.0m bgl<br>BH201B at 2.0m bgl<br>BH201 adjacent to the former Military Transport Compound and BH201B (installed in the perched groundwater) | PRO (206mg/kg)<br>VOC (59,231µg/kg)<br>H – BTEX, VOC (naphthalene)<br>PRO (15,053µg/l comprising Benzene at 837µg/l and toluene at 3,306µg/l)<br>DRO (279µg/l)<br>VOC analysis comprised Benzene (1,159 µg/l), Toluene 5,053 µg/l) Ethylbenzene 1,118 (µg/l) Xylene (2,497 µg/l) Naphthalene (86 µg/l)<br>Perched groundwater comprised 9,827µg/l of BTEX and a VOC concentration of 10,200µg/l | 5a |

**Notes:** **M** – Metals. **H** – Hydrocarbons. **VOC** – Volatile Organic Compounds. **PRO** - Petrol Range Organics. **DRO** - Diesel Range Organics. **ACM** – Asbestos Contaminant Materials. **PCB** – Polychlorinated Biphenyl, **R** – Radioactivity.

**TABLE 5.3: SOURCES OF CONTAMINATION IN HANGARS WEST**

| Feature on or near site | Potential Contaminant | Proposed Development Area |
|---|---|---|
| **Areas of Potential Contamination** | | |
| Hangars for aircraft maintenance and repair. The use of BASOL solvent was used to clean the floors of hangars and workshops | H, VOCs | HANGARS WEST |
| WSP referred to a gas bottle store in building 386, although not located on any map | H | |
| Hangar P (building 344) displayed an oil tank in moderately good condition with little spillage at the filling point | H | |
| No1 and 4 Bellman Hangar (Building 356 and 358) occupied by HM Coast Guard (MCA). Oily contamination around fuel bowsers. Building 358 displayed two 40 gallon cans and drums of super diesel , aviation lubricant and spillage was evident on the tarmac surface | H | |
| Cylindrical SW tank near to building 361 | H | |
| Areas of potential burning from aerial photography of the Bellman Hangar No 4 (building No 356) | M, H, ACM, R | |
| Asbestos associated with fabric of buildings and also in soils (notably demolished buildings) | ACM | |
| Former 0.303 rifle firing range near to building 361 | M | |
| Hangar R (building 343) displayed possible broken asbestos ACM in demolition rubble | ACM | |
| WSP referred to building 350 (Nissen hut at the Fleetlands Store) had asbestos cement exterior in poor condition, broken and delaminating | ACM | |
| WSP referred to building 381 and 389 displayed broken ACM sheeting on the ground | ACM | |
| Electricity substation at building 340 | PCB | |
| A pistol range was indicated at building 349 | M | |
| Electricity substation at building 361 | PCB | |
| **Areas of Identified Contamination** | | |
| WSP Investigation:<br>Building 343 R Hangar<br>Building 353 Northwest Boiler House (disused) evidence of spillage around intake cover and pipes and staining evident<br>Building 356 No 4 Bellman Hangar<br>Building 390 Fire ground and scrap aircraft area | Oil in soils. Oil, ethylbenzene and aromatics in groundwaters<br>Oils in groundwater<br>Mercury, boron, ethylbenzene in groundwater Copper and zinc in soil and oil in groundwater | HANGARS WEST |
| Entec 2003 Investigation:<br>BH212 near building 343 (Hangar R) | DRO (1,252mg/kg) | |

| Feature on or near site | Potential Contaminant | Proposed Development Area |
|---|---|---|
| BH211 near building 343 (Hangar R)<br>BH211 | DRO (789 mg/kg), VOCs, Zinc (165-348 µg/l) in soils and DRO (370µg/l) in groundwater | |
| Notes: **M** – Metals. **H** – Hydrocarbons. **VOC** – Volatile Organic Compounds. **PRO** - Petrol Range Organics. **DRO** - Diesel Range Organics. **ACM** – Asbestos Contaminant Materials. **PCB** – Polychlorinated Biphenyl, **R** – Radioactivity. | | |

**TABLE 5.4: SOURCES OF CONTAMINATION IN HANGARS EAST**

| Feature on or near site | Potential Contaminant | Proposed Development Area |
|---|---|---|
| **Areas of Potential Contamination** | | |
| Fuel and oil storage tanks associated with boiler houses etc (fuel tanks at individual hangars. Approximately 6 No 10,000l tanks at Hangar B, N, M, L, K and J and possible new tanks at hangars B, C, D, E, F and G | H | HANGARS EAST |
| Hangar B (building 292) displayed possible contamination and the presence of several oil cans in addition to a 40 gallon drum with hand dispensing attachment | H | |
| Building 293 - MARSTU Workshop | M,H, ACM | |
| Hangar N (building 301) was reported by WSP to have showed a significant amount of spillage on the soft landscaping areas and leakage was visible from a pipe along the front of the building | H | |
| Two burning areas located near building 286 (Hangar A) and 322 in Hangars East (identified as the Aircraft Dumping Ground) and fire training area). WSP reported a very strong odour of aviation fuel downwind of the fire training area. Some bituminous materials were also dumped in this location, which exhibited recent disposal of drum and cyclinders following recent works at the time of WSP's walkover survey | M, H, VOC, R | |
| Adjacent to building 295 exhibited a above ground storage fuel storage tank for the boiler house and showed extensive staining of the blacktop apron and significant dissolution of the bitumen binder adjacent to the bund wall | H | |
| Building 298 contained an electricity substation | PCB | |
| Building 310 contained paints, thinners, oils, greases and solvents | H | |
| Building 311 exhibited a brick compound containing drums showing spillage of oily material | H | |
| **Areas Potentially Contaminative Uses by Previous Tenants** | | |
| Hangar F (building 291) currently occupied by Blamire & Barton. Some fibrous lagging on ground outside - possible asbestos | ACM | HANGARS EAST |

| Feature on or near site | Potential Contaminant | Proposed Development Area |
|---|---|---|
| Hangar H (building 307) - currently occupied by Atlas Helicopters. Anecdotal evidence of oily contamination in runoff from adjacent grass | H | |
| Hangar J (building 306) currently occupied by AM Ware. Possibly fibrous lagging visible on grass outside hangar indicative of potential asbestos | ACM | |
| Hangar K (building 305) - currently occupied by Marine Concepts – discarded empty resin drums | H, M | |
| **Areas of Identified Contamination** | | |
| WSP Investigation:<br>Building 293 MARSTU Workshop nr Hangar B<br>Building 301 Hangar N | H - Ethylbenzene and hydrocarbons in groundwater<br>H - Oil in soil and groundwater | HANGARS EAST |
| Entec 2003 Investigation:<br>BH205 (3.5m bgl) (Hangar B)<br>BH216 (Fire Training Area)<br>BH216 (Fire Training Area)<br>BH209 DRO<br>BH216<br>BH216<br>BH216 | M - (arsenic 22.6 mg/kg)<br>M – (cadmium copper and zinc)<br>DRO (911mg/kg)<br>VOCs<br>PAH (107mg/kg)<br>M - zinc (168-333 $\mu$g/l) in groundwater<br>M - chromium and copper in groundwater | |

**Notes:** **M** – Metals. **H** – Hydrocarbons. **VOC** – Volatile Organic Compounds. **PRO** - Petrol Range Organics. **DRO** - Diesel Range Organics. **ACM** – Asbestos Contaminant Materials. **PCB** – Polychlorinated Biphenyl, **R** – Radioactivity.

**TABLE 5.5: SOURCES OF CONTAMINATION OFF SITE**

| Feature on or near site | Potential Contaminant | Proposed Development Area |
|---|---|---|
| Air Traffic Control Tower (building 16) occupied by Hampshire Police. Central Heating Oil tank and Aircraft Fuel Tank facilities. Records show a 10,000l and 7,000l tank arrangement located in the grounds of the Control Tower. Consultation with the Environment Agency indicated a localised fuel spillage in the past at this location. | H, ACM | N/A |
| Building 273 - grounds maintenance area<br>WSP Investigation: Building 273 (offsite) Grounds Maintenance Stores<br>Entec 2003 Investigation BH203 at 2.9-3.1m bgl (former grounds maintenance area and building 273) | M, H, ACM<br>Oil in soils and groundwater | |
| Building 227 - former incinerator | M, H, ACM | |
| Building 269 – electricity substation | | |
| Boiler house and fuel storage tanks located in the centre of the airfield | H, ACM | |
| Victorian Landfill area (located adjacent to the northern parts of Hangars East) | M, H | |
| Three landfills are recorded as being within 500m of the site to the east between the site and the River Alver to the east | M, H | |
| Large sewage works to the north at Peel Common | M, H | |
| Two petrol filling stations to the east | H, M, VOC, PRO, DRO, ACM | |

Notes: **M** – Metals. **H** – Hydrocarbons. **VOC** – Volatile Organic Compounds. **PRO** - Petrol Range Organics. **DRO** - Diesel Range Organics. **ACM** – Asbestos Contaminant Materials. **PCB** – Polychlorinated Biphenyl, **R** – Radioactivity.

**Pathways**

5.6. In the context of the proposed site uses, the potential pathways presented in Table 5.6 for residential, mixed and proposed commercial use are considered applicable.

**TABLE 5.6: EXPOSURE PATHWAYS**

| Pathway | | Phase |
|---|---|---|
| **Proposed Commercial Areas** | | |
| Ingestion of soil / dust | Outdoor | C, O |
| | Indoor | C, O |
| Inhalation of soil / dust | Outdoor | C, O |
| | Indoor | C, O |
| Inhalation of vapour from soil / dust / water | Outdoor | C, O |
| | Indoor | C, O |
| Dermal contact with soil / dust / water | Outdoor | C, O |
| | Indoor | C, O |
| Migration of soil gasses to confined spaces / structures | Indoor | C, O |
| Uptake by flora / fauna | Outdoor | O |
| **Additional Pathways for Proposed Residential Areas** | | |
| Consumption of vegetables / plants | Outdoor | O |
| **Additional Pathways for Proposed Mixed-Use Areas** | | |
| Uptake by flora / fauna | Outdoor | O |
| **Pathways Relevant to Controlled Waters** | | |
| Leaching of contamination from Made Ground | On-site | C, O |
| | Off-site | C, O, E |
| Migration of water borne contaminants | On-site | C, O |
| | Off-site | C, O, E |
| **Pathways Relevant to Buildings and Infrastructure** | | |
| Leaching of contamination from Made Ground | On-site | C, O |
| | Off-site | C, O, E |
| Movement of contaminants to engineered structures (e.g. water pipes) | On-site | C, O |
| **Notes**: **C** Construction. **O** Occupation. **E** Environmental Affect (e.g. Groundwater Quality). **NA** Non Applicable. | | |

**Receptors**

5.7. In the context of the above the following potential receptors have been identified:

**TABLE 5.7: POTENTIAL RECEPTORS**

| Receptor | Description | Sensitivity | Area(s) |
|---|---|---|---|
| End Users (Residential) | Residential end users including private gardens proposed at Drake Gardens (including part of Seaplane Square) and a second zone at Wykeham Hall (including part of Barracks Square) sub-areas | High | 1, 4, 5b, 8a |
| End Users (Mixed Use) | End users within mixed use areas including residential flats, areas of public open space, sheltered accommodation, communal soft landscaping and leisure facilities proposed in parts of Barracks Square, Unicorn Triangle and leisure facilities at Westcliffe Seafront | Medium | 5a, 6, 7b |
| End Users (Commercial) | Commercial end users with limited soft landscaping proposed | Low | 2, 3, 7a, 8b |
| Groundworks Workers | Construction workers associated with the development are likely to be exposed in the short term only, however, longer and intermittent visits are likely to be made by maintenance workers | Medium | All |
| Controlled Waters (Hydrogeological) | Secondary 'A' Aquifer associated with the underlying superficial and solid geology | Medium | N/A |
| Controlled Waters (Hydrological) | The Solent and associated ecological designations | Medium | N/A |
| Ecological Conservation Areas | Offsite internationally and nationally designated ecological features such as The Solent assessed in terms of Controlled Waters (hydrological) sensitivity | High | N/A |
| Adjacent end-users | Residential areas to the south west along Marine Way, north west and south east and schools to the north are situated in the surrounding area | Medium | N/A |
| Buildings & Infrastructure | Buried concrete and other materials, such as water supply pipework, to be installed as part of the development | Medium | All |

## 6.0 SITE INVESTIGATION

**Summary of Investigation**

***Entec and Halcrow Investigations, 2005***

6.1. The Entec / Halcrow site investigations were undertaken concurrently in November and December 2005 by the same ground investigation contractor (Subsurface Ltd) and laboratory testing by TES Bretby albeit for two differing scopes of works. It is understood Entec were acting on the behalf of Defence Estates, who were the owners of the site at the time, and Halcrow, on behalf of SEEDA as part of the due diligence acquisition of the site.

6.2. The exploratory locations from this combined site investigation are shown on Figures 15-17.

***[19] Halcrow Ground Investigation Interpretative Report, 31 March 2006***

6.3. The scheduled site work comprised:

- 21 No boreholes (HBH402-403, HBH405-410, HBH412-413, HBH416-426);
- 9 No window samples (HWS401, HWS404 - HWS416);
- 12 No trial pits (HTP401 - HTP416); and,
- 3 No trial trenches (HTT401-HTT403).

6.4. Sampling and chemical testing was undertaken to assess ground and groundwater conditions.

6.5. A number of installations targeted particular strata: HBH416 and HBH418 to determine the nature of near surface groundwater within the airfield; HBH413 to assess the nature of sand lenses within the Bracklesham Beds; HBH423 to assess the near surface groundwater regime within sand lenses where the Plateau Gravels were absent; and HBH402 to determine near surface groundwater quality where visual diesel contamination was evident.

6.6. Groundwater monitoring comprised a single round of monitoring undertaken in December 2005.

6.7. A trial trenching exercise was targeted at the former Bulk Fuel Installation, which had previously contained 6 No. underground storage tanks. Whilst these works removed the fuel storage tanks and associated infrastructure it has been recorded that impacted soils were replaced at this location after it was found they were unacceptable for disposal to landfill. Evidence of

contamination was made by visual observations and PID readings with maximum PID readings of VOCs recorded at 1640ppm (HTT1). No contamination testing data for this area has been provided.

***[20] Entec Phase Two Site Investigation (DE Project No 05002), 3 May 2007***

6.8. The scheduled site work comprised:

- 10 No boreholes (EBH301-EBH310);
- 12 no window samples (EWS301 - EWS312); and,
- 26 no trial pits (ETP301 - ETP326).

6.9. Visual and olfactory evidence of contamination was observed during these works and comprised staining and hydrocarbon odours in EBH302 (southwest corner of the Swann Hangar), EBH306 (to the north of Dunning Hangar), EBH307, EBH309 (MT Section and slipway down gradient), EWS310 (in the vicinity of the former grounds maintenance yard) and strong odours in ETP307 (within the former aircraft breaking area of Hangars East) and EWS312 (near circular oil tank adjacent to the former firing range in Hangars West).

6.10. Entec monitored ground gas in well standpipes and utilised a PID for VOC monitoring. Volatile Organic Compounds (VOCs) were detected at maximum concentrations of 640ppm in EBH307 and 415ppm in EBH309 being indicative of hydrocarbon contamination at the former MT Section and the slipway to the south west.

6.11. Whilst no discernible thickness of free product (NAPL or DNAPL) was detected during groundwater monitoring, Entec did note that an oily sheen was observed on the interface probe when recording groundwater levels from BH211 in the vicinity of Hangar R.

***Sampling and Analysis***

6.12. A combined total (Entec / Halcrow) of 33 samples of Made Ground and 48 samples of natural soils were analysed at the laboratory to assess ground conditions.

6.13. A total of 92 soil samples were analysed to identify elevated contaminants in soils for the human heath risk assessment. This data was combined with 46 soils samples from the Entec 2003 data to increase the coverage of the development sites and utilised within the assessments presented in Chapter 7.0.

6.14. Chemical testing data is available for HBH426 but with no exploratory hole location apparent on report figures.

6.15. Furthermore, sample data refers to borehole HBH10, which has been incorrectly referenced and does not exist on the plans. It is assumed that it relates to HBH410.

6.16. A total of 26 sample leachates were prepared and analysed to assess the potential mobility of identified contaminants.

6.17. A total of 30 groundwater samples from both the Entec and Halcrow 2005 investigations were also undertaken. These were combined with 23 water samples from the Entec 2003 investigation for the respective assessments for Controlled Waters presented in Chapter 7.0.

6.18. Chemical testing data is absent for the following exploratory hole locations:

- EBH307 - EBH310;
- EWS306-307;
- Trial trenches from BFI (HTT401-403);
- HBH402;
- HTP428; and,
- HWS405.

6.19. In addition, it is noted that some of the Entec / Halcrow exploratory hole locations are positioned outside of the proposed development areas and therefore not included within the assessments made herein.

***Investigation Coverage and Uncertainty***

6.20. Upon review of the distribution of all previous exploratory hole locations it is noted that exploratory hole locations are widely positioned and are currently considered to correspond with a 'preliminary' level of investigation given the size of the site and will require further investigatory work in due course as development planning proceeds. Several areas of potential contamination have not been adequately targeted by the Entec / Halcrow site investigation and this is particularly relevant to areas occupied by the former Boiler House, scrap metal compound, various fuel tank locations, MT Oil Store on the slipway and the location of former workshops. Furthermore, the central areas of the Waterfront zone between the large hangars was also inadequately investigated in terms of characterising the tetrachloroethene plume in groundwater that was previously identified by the Entec 2003 investigation.

6.21. It is also noted that the positions of some exploratory holes do not correspond with those presented on the drawings from Entec / Halcrow and their joint subcontractor and furthermore, typographical errors appear to have resulted in the duplication of some positions. In some cases there are significant disparities in distance between referenced positions (as great as 75-100m) possibly attributable to the inaccuracy of the drawings or survey coordinate errors recorded on the logs. A particular case in point relates to HBH408, which indicates the position of the maximum tetrachloroethene solvent contamination in the underlying groundwater in the vicinity of both the Central Boiler House and the Triumph Galley in the Waterfront zone approximately 75m to the south. As such, there is a high degree of uncertainty associated with the location of the tetrachloroethene contamination encountered and thus doubt over other assertions of the Entec / Halcrow reports.

6.22. Additionally, two locations for HTP405 have been identified on the Halcrow plan and so there is uncertainty as to its true location of the point and the data gathered from it.

6.23. The site investigation disparities and areas of uncertainty in the 2005 site investigations for Entec / Halcrow are shown in Figures 15-17.

***Ground Gas Monitoring***

6.24. Monitoring standpipes were monitored for soil gas and VOCs using a PID and infra-red gas analyser on one occasion.

***Visual and Olfactory Evidence of Contamination***

6.25. Visual and olfactory evidence of contamination was generally observed across three distinct areas of the site. These are summarised in Table 6.1.

**TABLE 6.1 EXCERPT FROM ENTEC (2003) TABLE 4.2 SUMMARY OF VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION**

| Exploratory | Depth (m bgl) | Description Hole | Areas |
|---|---|---|---|
| EBH302 | 6.0-6.2 | Slight hydrocarbon odour | 1 |
| EBH305 | 0.4-0.45 | Possible fragments of cement bonded asbestos containing materials | 2 |
| EBH306 | 1.5-3.5 | Possible slight hydrocarbon odour | 2 |
| EBH307 | 3.5-5.5 | Slight staining and slight hydrocarbon odour | 5a |
| EBH309 | 2.8-3.0 | Medium to strong hydrocarbon odour | 8b |

| Exploratory | Depth (m bgl) | Description Hole | Areas |
|---|---|---|---|
| EBH309 | 3.1-4.5 | Hydrocarbon odour, possibly diesel, diminishing with depth | 8b |
| EBH310 | 0.2 | Possible fragments of cement bonded asbestos containing materials | 3 |
| EWS310 | 1.5-1.8 | Slight hydrocarbon odour | Hangars East |
| EWS312 | 2.3-2.5 | Slight hydrocarbon odour | Hangars East |
| EWS312 | 2.5-2.6 | Strong hydrocarbon odour | Hangars East |
| ETP307 | 1.40-3.00 | Strong hydrocarbon odour | Hangars West |
| ETP307 | 3.00-3.80 | Hydrocarbon odour | Hangars West |
| ETP323 | 1.30 | Rotten egg odour, decomposing organic matter | Hangars West |

***Summary of Overall Ground Conditions***

6.26. The following is a combined summary from the WSP, Entec and Halcrow investigations across the entire Daedalus site:

- **Made Ground** - comprising sandy silt clay fill and reworked natural ground with brick and concrete at depths between 0.10m - 2.70mbgl. Maximum depths of MG were encountered by Entec at the MT Section (in BH201, 3201A and 201B).
- **Brickearth** - Soft to firm mottled yellow to brown sandy clay with flint gravel ('Brickearth') between 0.30m and 2.60m bgl (BH214 in Hangars West).
- **Plateau and Terrace Gravels** - Medium dense and dense sandy fine to coarse flint gravel with sand horizons between 2.50m and 7.00m bgl.
- **Bracklesham Group** - Medium dense yellowish grey mottled silty fine sands alternating with firm to stiff bluish grey laminated clay up to 10.5m bgl although Entec encountered this stratum at depths between 3.70m to 6.50m bgl.

**Waterfront - *Commercial Zone***

6.27. The Made Ground was generally be encountered at varying thickness across this zone between 0.35 - 1.50m bgl with an average 0.75m bgl. A notably thicker area of Made Ground of 2.70m bgl was recorded in BH202 near the Central Boiler House. In the area of the slipway, the Made Ground was generally recorded to be between 0.30 - 0.50m in thickness, whilst to the north around the hangars and former BFI, the Made Ground was observed to be thicker, between 0.50 - 0.80m and 0.40 - 1.50m respectively.

6.28. Brickearth deposits generally comprised of a sandy, silty clay with gravel and ranged between 1.00m and 1.70m in thickness across the site with the greatest thicknesses occurring in the

vicinity of the hangars and areas adjacent to the airfield in EWS305 and HTP405. Average thicknesses of Brickearth were 1.10m in this zone.

6.29. The Plateau and Terrace Gravel ranged between 2.40m and 7.00m (HBH408) in thickness overlying the Bracklesham Beds. The thickness was greatest in the north of this zone (7.00m in EBH304 to the north of Swann Hangar, 6.1m in EBH305 near the Dunning Hangar, 6.10m in HBH426 near the former BFI). On average, the gravels were around 4.70m in thickness with the thinnest deposits in an area to the east of the former BFI and the area to the north of the Dunning and Overlord Hangars.

6.30. The Bracklesham Beds were encountered below the gravels. Bracklesham Beds were encountered at 3.5m bgl in EBH306 (Dunning Hangar).

***Waterfront - Conservation Zone***

6.31. Made Ground was recorded between 0.30 - 2.50m bgl. In the south of this zone, it was approximately 0.60m thick on average, whilst in central and eastern parts of this zone it has a marginally thicker average of 0.70m. BH201 (located in the MT Section) recorded Made Ground to a depth of 2.50m bgl.

6.32. Brickearth deposits were generally comprised of a sandy silty clay with gravel and ranged between 0.70m - 2.00m thick with the maximum thickness occurring in HBH410 in the vicinity of the Triumph Galley.

6.33. The Plateau and Terrace Gravel ranged between 1.20m – c.5.00m in thickness overlying the Bracklesham Beds.

***Hangars West***

6.34. Made Ground was recorded between 0.10 - 1.30m bgl and are generally shallow in comparison with the Waterfront zones respectively with average thicknesses around 0.35m.

6.35. Brickearth deposits were generally comprised of a sandy silty clay with gravel and ranged between 0.50m - 2.60m thick with the maximum thickness occurring in BH214, BH215 in the vicinity of No 4 Bellman hangar (building 356) and HTP415 near Hangar P.

6.36. The Plateau and Terrace Gravels were encountered at shallow depth, although their depth was not proven. The logs show them to be very thin and interspersed with sands and clays of the Bracklesham Beds in the north of the site.

***Hangars East***

6.37. For this specific development zone, the majority of exploratory hole locations encountered a topsoil in the top 0.20m typically comprising brown loamy and clayey topsoil. The ground conditions beneath generally comprise several alternating bands of an orange-brown clayey sand and a sandy clay stratum overlying olive green/grey laminated silty sand and clay deposits at around 4-5m bgl.

6.38. In the south of this zone, the ground conditions show around 0.90 - 1.0m of clay (Brickearth) overlying a band of gravel (around 1.30m in thickness) and then a sandy clay, which becomes increasingly granular with depth. In some places, the clay is more granular and therefore classified as sandy strata.

**Groundwater Observations**

6.39. Groundwater monitoring was undertaken by Entec and Halcrow and their observations are presented in Table 6.2.

**TABLE 6.2: EXCERPT OF HALCROW TABLE 2.2 GROUNDWATER LEVEL DATA**

| Location | Elevation (m AOD) | Depth to Water (m bgl) | Groundwater Level (m AOD) |
|---|---|---|---|
| **Halcrow** | | | |
| HBH402 | 4.23 | 1.00 | 3.23 |
| HBH403 | 8.54 | 4.65 | 3.89 |
| HBH 405 | 8.51 | 4.70 | 3.81 |
| HBH406 | 8.42 | 4.40 | 4.02 |
| HBH407 | 8.61 | 3.85 | 4.76 |
| HBH408 | 8.18 | 3.00 | 5.18 |
| HBH409 | 8.55 | 2.48 | 6.07 |
| HBH410 | 8.27 | 2.82 | 5.45 |
| HBH412 | 8.19 | 2.90 | 5.29 |
| HBH413 | 8.01 | 2.58 | 5.43 |
| HBH416 | 7.12 | 1.05 | 6.07 |
| HBH417 | 7.36 | 1.88 | 5.48 |
| HBH418 | 6.61 | 1.20 | 5.41 |
| HBH419 | 8.47 | 3.85 | 4.62 |
| HBH420 | 7.98 | 1.26 | 6.72 |
| HBH421 | 8.38 | 1.17 | 7.21 |
| HBH422 | 8.42 | 1.29 | 7.13 |

| Location | Elevation (m AOD) | Depth to Water (m bgl) | Groundwater Level (m AOD) |
|---|---|---|---|
| HBH423 | 9.54 | 0.91 | 8.63 |
| HBH424 | 8.79 | 1.97 | 6.82 |
| HBH425 | 9.05 | 1.00 | 8.05 |
| HBH426 | 8.06 | 3.06 | 5.00 |
| **Entec** | | | |
| EBH301 | 8.23 | 5.05 | 3.18 |
| EBH302 | 8.14 | 4.64 | 3.50 |
| EBH303 | 8.52 | 4.76 | 3.76 |
| EBH304 | 8.18 | 4.63 | 3.55 |
| EBH305 | 8.21 | 3.41 | 4.80 |
| EBH306 | 7.97 | 2.98 | 4.99 |
| EBH307 | 8.37 | 2.59 | 5.78 |
| EBH308 | 8.72 | 4.54 | 4.18 |
| EBH309 | 8.23 | 2.48 | 5.75 |
| EBH310 | 8.86 | 3.24 | 5.62 |

6.40. The following summary of groundwater levels across the site includes groundwater level observations from the Entec 2003 site investigation as well as the recent studies by Entec and Halcrow in 2005.

***Waterfront - Commercial Zone***

6.41. Based upon previous ground investigations, groundwater depths within the Plateau and Terrace Gravels have been reported at an average level of 4.6m AOD.

***Waterfront - Conservation Zone***

6.42. Based upon previous ground investigations, groundwater depths within the Plateau and Terrace Gravels have been reported at an average level of 4.8m AOD.

***Hangars West***

6.43. Based upon previous ground investigations, groundwater depths within the Plateau and Terrace Gravels have been reported at an average level of 7.7m AOD.

***Hangars East***

6.44. Based upon previous ground investigations, groundwater depths within the Plateau and Terrace Gravels have been reported at an average level of 6.3m AOD.

## 7.0 TIER 2 ENVIRONMENTAL RISK ASSESSMENT

**Assessment Framework**

7.1. Subsequent to the identification and quantification of contaminant species in soils, waters and gases, it is necessary to select a method for assessing their significance in view of the current and proposed future use of the land. The initial assessment comprises a comparison of identified contaminant levels to generic screening values that have been prepared to assess the risk to the receptors identified. The guidance used to provide this initial screening is listed in Table 7.1 in order of application. The assessment is primarily orientated toward identifying land affected by contamination under PPS23.

**TABLE 7.1: TIER 2 (GENERIC) SCREENING VALUES**

| | Key Guidance |
|---|---|
| **SOIL** | Environment Agency, Soil Guideline Values based upon Contaminated Land Exposure Assessment Model (CLEA) and the CLEA 1.06 software. SGV Reports SC050021/SGV. |
| | Generic Assessment Criteria based upon Environment Agency CLEA Version 1.06 software. Environment Agency Science Reports SC050021 SR2/SR3, Toxicological Reports SC050021/Tox. EA Toxicological Reports 1-25. |
| | Generic Assessment Criteria published by CL:AIRE. The Soil Generic Assessment Criteria for Human Health Risk Assessment. December 2009. |
| | Generic Assessment Criteria based upon Environment Agency CLEA UK Beta Version 1.0. Environment Agency Toxicological Reports: 1-25. |
| **WATER** | Environmental Quality Standards for the protection of aquatic life. |
| | Surface Water Standards. |
| | EC and UK Drinking Water Standards. |
| | Background Water Quality. |
| **GAS** | CIRIA Report C665, 'Assessing Risks Posed by Hazardous Ground Gases to Buildings' |
| | British Standard BS:8485, 2007, 'Code of practice for the characterization and remediation from ground gas in affected developments'. |
| | CIRIA Report 150 'Methane Investigation Strategies'. |
| | BRE 414 'Protective Measures for Housing on Gas Contaminated Land', 2001. |
| | The Building Regulations 2000, Approved Document C, Section 2. Updated 2004. |
| | BR211, 'Radon: Guidance on Protective Measures for New Buildings', 2007. |
| | Health Protection Agency Publication HPA RPD-033, 2007,' Indicative Atlas of Radon in England and Wales. |

7.2. With respect to human health risk assessment, the selection of screening values considers the proposed land use sensitivity based upon the Masterplan and Design Access Statement. These areas are listed in Table 2.5 in Section 2.0 and are summarised below to:

**Residential With Plant Uptake**

- Proposed residential areas in the west of the Waterfront – [Area 1 - Drake Gardens] and [Area 8a - Seaplane Square] have been assessed against a '**Residential With Plant Uptake'** scenario use to reflect the activities associated with private gardens. It is recognised that this assessment is conservative as some of the properties within the Drake Gardens will consist of residential buildings that are greater than two storeys in height with no private gardens;

- Proposed residential areas in the east of the Waterfront – [Area 4 - Wykeham Hall] and [Area 5b - part of Barracks Square] have been assessed against a **'Residential With Plant Uptake'** scenario use to reflect the activities associated with private gardens;

**Residential Without Plant Uptake**

- Areas of Mixed-Use – [Area 5a - Barracks Square] comprising sheltered accommodation, community use and leisure [Area 6 - Westcliffe Seafront] and Residential blocks of flats at [Area 7b - Unicorn Triangle] have been conservatively appraised against **'Residential Without Plant Uptake'** assuming a less intensive communal land use of this zone. It is recognised that some private gardens may be feature of this zone (sheltered accommodation areas) but for simplicity and based upon the site coverage, the assessment scenario is considered to be appropriate; and,

**Commercial**

- Proposed commercial areas within the entire Waterfront development zone have been assessed as a single development area and include [Area 2 - Airport Park], [Area 3 - Marine Business Park], [Area 7a - Unicorn Triangle], and [Area 8b - Seaplane Square].

7.3. These assessment areas for human health risk to proposed end users are shown in Figure 7.

7.4. In view of the limited site investigation coverage afforded by the combined Entec and Halcrow site investigation and in consideration of the need to appraise the various land use proposals indicated within the Masterplan, chemical testing data provided within the Entec Phase Two, Shallow Groundwater Investigation (dated 8th May 2003) has been incorporated and utilised within this assessment and provides data at key locations within all the proposed development zones.

7.5. The assessment for human health risk from soils conservatively assumes a 1% Soil Organic Matter (SOM) content.

7.6. This report also considers potential risks to Controlled Waters (groundwaters and surface waters) in relation to risks from any historical contamination. The most stringent test is that defined for Contaminated Land under Part 2A of the Environmental Protection Act, 1990. However, it should be recognised that a wider evaluation of risk is considered within the planning regime described in PPS23 and CLR 11.

7.7. Furthermore, the Environment Agency has a wider policy agenda for the protection of Controlled Waters that will impinge upon judgements in relation to land contamination issues. This includes those for the Water Framework Directive and Groundwater Directive and wider legislation for both groundwater, surface water and associated elements (such as fisheries)[5].

7.8. The results of water analysis for the Waterfront, Hangars West and Hangars East development zones have been compared to screening values selected to assess the potential risk to the identified Controlled Waters receptors in the Conceptual Site Model. The specific standards utilised for this purpose are considered in the assessment table footnotes and typically comprise: Environmental Quality Standards for the protection of aquatic life; Surface Water Standards; EC and UK Drinking Water Standards; or Background water quality (where no applicable standard exists).

[5] Refer to Environment Agency Publications for Groundwater Protection Policy and Practice. http://publications.environment-agency.gov.uk/pdf/GEHO0708BOGU-e-e.pdf?lang=_e

**Generic Quantitative Soil Risk Assessment**

**Drake Gardens and Seaplane Square Residential [Areas 1 and 8a]**

***Soil Analyses***

7.9. The statistics associated with soil analysis are summarised in Table 7.3. The Mean Value (95%ile) and Maximum Value Tests were undertaken on the sample population for those parameters exceeding the Tier 2 screening levels. If required the Maximum Value Test was undertaken to identify any potential localised areas of increased risk or 'hotspots'. Where the 95%ile exceeds the Tier 2 screen, these results are highlighted and discussed. The remainder are not considered indicative of significant contamination for the proposed end use.

**TABLE 7.2: SUMMARY OF SOIL SAMPLES ANALYSED**

| Exploratory Holes | Sample (m bgl) |
|---|---|
| EBH301 | 1.2, 7.8 |
| BH218 | 0.5, 4.0 |
| HBH428 | - |
| HTP416 | 0.6, 2.2 |
| BH220 | 3.0 |
| BH219 | 0.3, 5.8, 5.8 duplicate |

7.17. Elevated contaminant concentrations in relation to the proposed end use are shown on Figure 18.

**TABLE 7.3: SUMMARY OF SOIL ANALYSIS RESIDENTIAL WITH PLANT UPTAKE (1.0% SOM)**

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Metals** | | | | | |
| Arsenic | mg/kg | 0/ 10 | 13.2 | NC | 32[F] |
| Cadmium | mg/kg | 0/ 10 | 0.5 | NC | 10[F] |
| Chromium | mg/kg | 0/ 10 | 43 | NC | 627[E] |
| Copper | mg/kg | 0/ 10 | 20 | NC | 2310[E] |
| Inorganic Mercury | mg/kg | 0/ 10 | 0.5 | NC | 170[F] |
| Nickel | mg/kg | 0/ 10 | 14.2 | NC | 127[F] |
| Lead | mg/kg | 0/ 10 | 76 | NC | 450[C] |
| Selenium | mg/kg | 0/ 10 | 0.5 | NC | 350[F] |
| Zinc | mg/kg | 0/ 10 | 610 | NC | 1634[E] |
| **Organics** | | | | | |
| Benzene | mg/kg | 0/ 10 | 0.01 | NC | 0.08[E] |
| Toluene | mg/kg | 0/ 10 | 0.281 | NC | 119[E] |
| Ethylbenzene | mg/kg | 0/ 10 | 0.01 | NC | 65[E] |

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| o - Xylene | mg/kg | 0/ 3 | 0.01 | NC | 45[E] |
| **Speciated Total Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | mg/kg | 0/ 2 | 0.84 | NC | 11[E] |
| Aromatics >EC8-EC10 | mg/kg | 0/ 2 | 0.84 | NC | 16[E] |
| Aliphatics >EC10-EC12 | mg/kg | 0/ 2 | 0.84 | NC | 53[E] |
| Aromatics >EC10-EC12 | mg/kg | 0/ 2 | 0.84 | NC | 66[E] |
| Aromatics >EC12-EC16 | mg/kg | 0/ 2 | 1.68 | NC | 156[E] |
| Aliphatics >EC12-EC16 | mg/kg | 0/ 2 | 1.68 | NC | 237[E] |
| Aliphatics >EC16-EC21 | mg/kg | 0/ 2 | 2.1 | NC | 17670[E] |
| Aromatics >EC16-EC21 | mg/kg | 0/ 2 | 2.1 | NC | 272[E] |
| Aromatics >EC21-EC35 | mg/kg | 0/ 2 | 5.89 | NC | 887[E] |
| Aliphatics >EC21-EC35 | mg/kg | 0/ 2 | 5.89 | NC | 17670[E] |
| **Speciated Polyaromatic Hydrocarbons** | | | | | |
| Polynuclear aromatic hydrocarbons (Total) | mg/kg | 4/ 4 | **4.0** | **4.0** | 0.76[E] |
| Naphthalene | mg/kg | 0/ 4 | 0.2 | NC | 1.54[E] |
| Acenaphthylene | mg/kg | 0/ 4 | 0.2 | NC | 145[E] |
| Acenaphthene | mg/kg | 0/ 4 | 0.2 | NC | 150[E] |
| Fluorene | mg/kg | 0/ 4 | 0.2 | NC | 155[EX] |
| Phenanthrene | mg/kg | 0/ 4 | 0.2 | NC | 206[ES] |
| Anthracene | mg/kg | 0/ 4 | 0.2 | NC | 38[E] |
| Fluoranthene | mg/kg | 0/ 4 | 0.2 | NC | 130[E] |
| Pyrene | mg/kg | 0/ 4 | 0.2 | NC | 284[E] |
| Chrysene | mg/kg | 0/ 4 | 0.2 | NC | 6[E] |
| Benzo (a) anthracene | mg/kg | 0/ 4 | 0.2 | NC | 3.1[E] |
| Benzo (b) fluoranthene | mg/kg | 0/ 4 | 0.2 | NC | 7.8[E] |
| Benzo (k) fluoranthene | mg/kg | 0/ 4 | 0.2 | NC | 8.5[E] |
| Benzo (a) pyrene | mg/kg | 0/ 4 | 0.2 | NC | 0.83[E] |
| Indeno (1,2,3 - cd) pyrene | mg/kg | 0/ 4 | 0.2 | NC | 4.9[E] |
| Benzo (ghi) perylene | mg/kg | 0/ 4 | 0.2 | NC | 9.7[E] |
| Dibenzo (ah) anthracene | mg/kg | 0/ 4 | 0.2 | NC | 0.76[E] |
| **Other** | | | | | |
| 1,1,2 - Trichloroethane | mg/kg | 0/ 3 | 0.006 | NC | 0.6[D] |
| 1,1 Dichloroethane | mg/kg | 0/ 2 | 0.006 | NC | 2.4[D] |
| 1,1 - Dichloroethene | mg/kg | 0/ 2 | 0.006 | NC | 0.23[D] |
| cis 1,2 - Dichloroethene | mg/kg | 0/ 2 | 0.006 | NC | 0.11[D] |
| 1,2 - Dichloropropane | mg/kg | 0/ 3 | 0.006 | NC | 0.024[D] |
| Bromobenzene | mg/kg | 0/ 3 | 0.006 | NC | 0.87[D] |
| Bromoform | mg/kg | 0/ 3 | 0.006 | NC | 2.8[D] |
| Bromodichloromethane | mg/kg | 0/ 3 | 0.006 | NC | 0.016[D] |
| Chloromethane | mg/kg | 0/ 2 | 0.006 | NC | 0.0083[D] |
| iso - Propylbenzene | mg/kg | 0/ 3 | 0.006 | NC | 11[D] |
| Styrene | mg/kg | 0/ 3 | 0.006 | NC | 8.1[D] |
| Trans - 1,2 - Dichloroethene | mg/kg | 0/ 2 | 0.006 | NC | 0.19[D] |
| Tetrachloroethene | mg/kg | 0/ 3 | 0.031 | NC | 0.997[C] |
| Trichloroethene | mg/kg | 0/ 3 | 0.006 | NC | 0.133[C] |
| Vinyl chloride | mg/kg | 2/ 2 | **0.006** | LoD>T | 0.00118[C] |
| **No Tier 2 Screen** | | | | | |
| C5 - C6 | mg/kg | - | 0.2 | NC | NT |
| C7 - C8 | mg/kg | - | 0.2 | NC | NT |

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| C8 - C10 | mg/kg | - | 0.2 | NC | NT |
| 1,1,1,2 - Tetrachloroethane | mg/kg | - | 0.01 | NC | NT |
| 1,2 - Dichloroethane | mg/kg | - | 0.006 | NC | NT |
| cis 1,3 - Dichloropropene | mg/kg | - | 0.006 | NC | NT |
| Sulphide | mg/kg | - | 5 | NC | NT |

Residential with Plant Uptake, Assumming 1.0 % SOM, **A** SGV from CLEA V1.04 at 6% SOM only, **B** GAC from CLEA v1.04, **C** SGV/GAC based on CLEA UK Beta Version at 1%, 2.5% and 5%, **D** GAC from CL:AIRE V1.06 : 1%, 2.5% and 6% SOM (note: 2.5% SOM rather than 3%), **E** GAC from CLEA V1.06 at 1%, 3% and 6% SOM, **F** SGV from CLEA V1.06 at 1%,3% and 6% SOM, CLEA GACs assume that no free product is present, **X** Oral GAC used, no inhalation GAC derived (inhalation data not available) **Z** Soil Saturation limit used as a cap to GAC due to high value of oral GAC and absence of inhalation GAC (No data available), **NC** Not Calculated.

**TABLE 7.4: EXPLORATORY HOLES EXCEEDING TIER 2 SCREEN VALUES**

| Contaminant | Hole ID | Concentration (mg/kg) | Tier 2 ScreenValue | Depth |
|---|---|---|---|---|
| Polynuclear aromatic hydrocarbons (Total) | HTP416 | 3.5 | 0.76 | 2.2 |
| | HTP416 | 3.9 | 0.76 | 0.6 |
| Vinyl chloride | HTP416 | 0.005 | 0.00118 | 2.2 |
| | HTP416 | 0.006 | 0.00118 | 0.6 |

7.18. No outliers were identified in any of the samples.

7.19. Vinyl chloride (a VOC) was recorded at the Level of Detection (LoD), which varied between 5-7 mg/kg but nonetheless was above the Tier 2 screen.

7.20. Contaminant concentrations were not identified in excess of the screening values with the exception of total polyaromatic hydrocarbons identified in the two samples tested in this zone. Further statistical analysis (mean value or maximum value tests) were therefore not applied to the remaining dataset. Total PAH concentrations are considered below.

Polyaromatic Hydrocarbons

7.21. Total PAHs were detected in two exploratory hole locations to be above the screen for human health in this development area corresponding with the location of Kingston Villa. Speciated assessment of PAHs was undertaken and the results compared to the GACs for each PAH species. No individual PAH concentrations were identified in excess of the screening level and as such no further assessment of PAH concentrations is required herein in terms of human health risk assessment.

7.22. It is noted that benzo(a)pyrene was detected by the Entec investigation at 2.6mg/kg in EWS302 and therefore above the screen in the vicinity of the Control Tower, although it is noted that this location is outside of the current red line boundary of the development.

Lead

7.23. It is noted that some data from the Entec / Halcrow investigation has not been provided. Where statistical assessment of the available data did not highlight any exceedences of the screen, it was reported by Entec, that lead was present at 1570mg/kg in EBH301 at 0.3m bgl located in the vicinity of the former BFI.

**Wykeham Hall and Barracks Square Residential [Areas 4 and 5b]**

**Soil Analyses**

7.24. The statistics associated with soil analysis are summarised in Table 7.6. The Mean Value (95%ile) and Maximum Value Tests were undertaken on the sample population for those parameters exceeding the Tier 2 screening levels. If required the Maximum Value Test was undertaken to identify any potential localised areas of increased risk or 'hotspots'. Where the 95%ile exceeds the Tier 2 screen, these results are highlighted and discussed. The remainder are not considered indicative of significant contamination for the proposed end use.

**TABLE 7.5: SUMMARY OF SOIL SAMPLES ANALYSED**

| Exploratory Holes | Sample (m bgl) |
|---|---|
| EWS304 | 0.3, 0.8 |
| HTP411 | 0.5, 2.0 |
| HBH409 | - |

7.29. Elevated contaminant concentrations are shown on Figure 18.

**TABLE 7.6: SUMMARY OF SOIL ANALYSIS RESIDENTIAL WITH PLANT UPTAKE (1.0% SOM)**

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Metals** | | | | | |
| Arsenic | mg/kg | 0/ 4 | 10.3 | NC | 32[F] |
| Cadmium | mg/kg | 0/ 4 | 0.15 | NC | 10[F] |
| Chromium | mg/kg | 0/ 4 | 27.4 | NC | 627[E] |
| Copper | mg/kg | 0/ 4 | 21.6 | NC | 2310[E] |
| Inorganic Mercury | mg/kg | 0/ 4 | 0.1 | NC | 170[F] |
| Nickel | mg/kg | 0/ 4 | 18.4 | NC | 127[F] |
| Lead | mg/kg | 0/ 4 | 158.2 | NC | 450[C] |
| Selenium | mg/kg | 0/ 4 | 0.6 | NC | 350[F] |
| Zinc | mg/kg | 0/ 4 | 78.9 | NC | 1634[E] |
| **Organics** | | | | | |
| Benzene | mg/kg | 0/ 4 | 0.031 | NC | 0.08[E] |
| Toluene | mg/kg | 0/ 4 | 0.031 | NC | 119[E] |

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Ethylbenzene | mg/kg | 0/ 4 | 0.031 | NC | 65[E] |
| o - Xylene | mg/kg | 0/ 4 | 0.01 | NC | 45[E] |
| **Speciated Total Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | mg/kg | 0/ 2 | 0.83 | NC | 11[E] |
| Aromatics >EC8-EC10 | mg/kg | 0/ 2 | 0.83 | NC | 16[E] |
| Aliphatics >EC10-EC12 | mg/kg | 0/ 2 | 0.83 | NC | 53[E] |
| Aromatics >EC10-EC12 | mg/kg | 0/ 2 | 0.83 | NC | 66[E] |
| Aromatics >EC12-EC16 | mg/kg | 0/ 2 | 1.67 | NC | 156[E] |
| Aliphatics >EC12-EC16 | mg/kg | 0/ 2 | 1.67 | NC | 237[E] |
| Aliphatics >EC16-EC21 | mg/kg | 0/ 2 | 2.08 | NC | 17670[E] |
| Aromatics >EC16-EC21 | mg/kg | 0/ 2 | 2.08 | NC | 272[E] |
| Aromatics >EC21-EC35 | mg/kg | 0/ 2 | 5.82 | NC | 887[E] |
| Aliphatics >EC21-EC35 | mg/kg | 0/ 2 | 5.82 | NC | 17670[E] |
| **Speciated Polyaromatic Hydrocarbons** | | | | | |
| Naphthalene | mg/kg | 0/ 2 | 0.2 | NC | 1.54[E] |
| Acenaphthylene | mg/kg | 0/ 2 | 0.2 | NC | 145[E] |
| Acenaphthene | mg/kg | 0/ 2 | 0.2 | NC | 150[E] |
| Fluorene | mg/kg | 0/ 2 | 0.2 | NC | 155[EX] |
| Phenanthrene | mg/kg | 0/ 2 | 0.2 | NC | 206[ES] |
| Anthracene | mg/kg | 0/ 2 | 0.2 | NC | 38[E] |
| Fluoranthene | mg/kg | 0/ 2 | 0.6 | NC | 130[E] |
| Pyrene | mg/kg | 0/ 2 | 0.6 | NC | 284[E] |
| Chrysene | mg/kg | 0/ 2 | 0.4 | NC | 6[E] |
| Benzo (a) anthracene | mg/kg | 0/ 2 | 0.4 | NC | 3.1[E] |
| Benzo (b) fluoranthene | mg/kg | 0/ 2 | 0.4 | NC | 7.8[E] |
| Benzo (k) fluoranthene | mg/kg | 0/ 2 | 0.2 | NC | 8.5[E] |
| Benzo (a) pyrene | mg/kg | 0/ 2 | 0.2 | NC | 0.83[E] |
| Indeno (1,2,3 - cd) pyrene | mg/kg | 0/ 2 | 0.2 | NC | 4.9[E] |
| Benzo (ghi) perylene | mg/kg | 0/ 2 | 0.2 | NC | 9.7[E] |
| Dibenzo (ah) anthracene | mg/kg | 0/ 2 | 0.2 | NC | 0.76[E] |
| **Other** | | | | | |
| 1,1,2 - Trichloroethane | mg/kg | 0/ 2 | 0.006 | NC | 0.6[D] |
| 1,1 Dichloroethane | mg/kg | 0/ 2 | 0.006 | NC | 2.4[D] |
| 1,1 - Dichloroethene | mg/kg | 0/ 2 | 0.006 | NC | 0.23[D] |
| cis 1,2 - Dichloroethene | mg/kg | 0/ 2 | 0.006 | NC | 0.11[D] |
| 1,2 - Dichloropropane | mg/kg | 0/ 2 | 0.006 | NC | 0.024[D] |
| Bromobenzene | mg/kg | 0/ 2 | 0.006 | NC | 0.87[D] |
| Bromoform | mg/kg | 0/ 2 | 0.006 | NC | 2.8[D] |
| Bromodichloromethane | mg/kg | 0/ 2 | 0.006 | NC | 0.016[D] |
| Chloromethane | mg/kg | 0/ 2 | 0.006 | NC | 0.0083[D] |
| iso - Propylbenzene | mg/kg | 0/ 2 | 0.006 | NC | 11[D] |
| Styrene | mg/kg | 0/ 2 | 0.006 | NC | 8.1[D] |
| Trans - 1,2 - Dichloroethene | mg/kg | 0/ 2 | 0.006 | NC | 0.19[D] |
| Tetrachloroethene | mg/kg | 0/ 2 | 0.03 | NC | 0.997[C] |
| Trichloroethene | mg/kg | 0/ 2 | 0.006 | NC | 0.133[C] |
| Vinyl chloride | mg/kg | 2/ 2 | **0.006** | LoD>T | 0.00118[C] |
| **No Tier 2 Screen** | | | | | |
| C5 - C6 | mg/kg | - | 0.2 | NC | NT |
| C7 - C8 | mg/kg | - | 0.2 | NC | NT |
| C8 - C10 | mg/kg | - | 0.2 | NC | NT |

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| 1,1,1,2 - Tetrachloroethane | mg/kg | - | 0.01 | NC | NT |
| 1,2 - Dichloroethane | mg/kg | - | 0.006 | NC | NT |
| cis 1,3 - Dichloropropene | mg/kg | - | 0.006 | NC | NT |
| Sulphide | mg/kg | - | 6 | NC | NT |

Residential with Plant Uptake, Assumming 1.0 % SOM, **A** SGV from CLEA V1.04 at 6% SOM only, **B** GAC from CLEA v1.04, **C** SGV/GAC based on CLEA UK Beta Version at 1%, 2.5% and 5%, **D** GAC from CL:AIRE V1.06 : 1%, 2.5% and 6% SOM (note: 2.5% SOM rather than 3%), **E** GAC from CLEA V1.06 at 1%, 3% and 6% SOM, **F** SGV from CLEA V1.06 at 1%,3% and 6% SOM, CLEA GACs assume that no free product is present, **X** Oral GAC used, no inhalation GAC derived (inhalation data not available) **Z** Soil Saturation limit used as a cap to GAC due to high value of oral GAC and absence of inhalation GAC (No data available), **NC** Not Calculated.

**TABLE 7.7: EXPLORATORY HOLES EXCEEDING TIER 2 SCREEN VALUES**

| Contaminant | Hole ID | Concentration (mg/kg) | Tier 2 ScreenValue | Depth |
|---|---|---|---|---|
| Vinyl chloride | HTP411 | 0.005 (LOD) | 0.00118 | 0.5 |
| Vinyl chloride | HTP411 | 0.006 (LOD) | 0.00118 | 2 |

7.30. No outliers were identified in any of the samples.

7.31. No exceedences of the screen were identified for this development area with the exception of vinyl chloride (a VOC), which was recorded at the LoD and therefore above the Tier 2 screen by default.

**Barracks Square, Westcliffe Seafront and Unicorn Triangle Mixed-Use [Areas 5a, 6 and 7b]**

***Soil Analyses***

7.32. The statistics associated with soil analysis are summarised in Table 7.9. The Mean Value (95%ile) and Maximum Value Tests were undertaken on the sample population for those parameters exceeding the Tier 2 screening levels. If required the Maximum Value Test was undertaken to identify any potential localised areas of increased risk or 'hotspots'. Where the 95%ile exceeds the Tier 2 screen, these results are highlighted and discussed. The remainder are not considered indicative of significant contamination for the proposed end use.

**TABLE 7.8: SUMMARY OF SOIL SAMPLES ANALYSED**

| Exploratory Holes | Sample (m bgl) |
|---|---|
| HBH410 | - |
| HBH408 | - |
| HTP407 | 2.0 |
| HTP404 | - |
| HTP405 | 0.3, 0.9, 2.5 |
| HBH407 | - |

| Exploratory Holes | Sample (m bgl) |
|---|---|
| HTP406 | 0.5, 2.0 |
| HBH405 | 0.3, 1.3 |
| HBH403 | 0.35, 1.0 |
| HWS409 | - |
| HWS408 | - |
| HWS407 | - |
| EBH307 | - |
| BH201 | 2.0 |
| EBH308 | - |

7.34. Elevated contaminant concentrations are shown on Figure 18.

**TABLE 7.9: SUMMARY OF SOIL ANALYSIS RESIDENTIAL WITHOUT PLANT UPTAKE (1.0% SOM)**

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Metals** | | | | | |
| Arsenic | mg/kg | 1/ 11 | **55.8** | 10.59* | 35[E] |
| Cadmium | mg/kg | 0/ 11 | 0.94 | NC | 85[E] |
| Chromium | mg/kg | 0/ 11 | 25.5 | NC | 627[E] |
| Copper | mg/kg | 0/ 11 | 54 | NC | 3802[E] |
| Inorganic Mercury | mg/kg | 0/ 11 | 0.6 | NC | 238[E] |
| Nickel | mg/kg | 0/ 11 | 28.4 | NC | 127[E] |
| Lead | mg/kg | 1/ 11 | **572.9** | 36.53* | 450[B] |
| Selenium | mg/kg | 0/ 11 | 0.82 | NC | 595[E] |
| Zinc | mg/kg | 0/ 11 | 619 | NC | 20216[E] |
| **Organics** | | | | | |
| Benzene | mg/kg | 2/ 11 | **0.29** | 0.12 | 0.26[E] |
| Toluene | mg/kg | 0/ 11 | 0.326 | NC | 607[E] |
| Ethylbenzene | mg/kg | 0/ 11 | 0.42 | NC | 162[E] |
| o - Xylene | mg/kg | 0/ 5 | 0.01 | NC | 60[E] |
| **Speciated Total Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | mg/kg | 0/ 3 | 0.84 | NC | 11[E] |
| Aromatics >EC8-EC10 | mg/kg | 0/ 3 | 0.84 | NC | 18[E] |
| Aliphatics >EC10-EC12 | mg/kg | 0/ 3 | 0.84 | NC | 53[E] |
| Aromatics >EC10-EC12 | mg/kg | 0/ 3 | 0.84 | NC | 93[E] |
| Aromatics >EC12-EC16 | mg/kg | 0/ 3 | 1.67 | NC | 450[E] |
| Aliphatics >EC12-EC16 | mg/kg | 0/ 3 | 1.67 | NC | 237[E] |
| Aliphatics >EC16-EC21 | mg/kg | 0/ 3 | 2.08 | NC | 17697[E] |
| Aromatics >EC16-EC21 | mg/kg | 0/ 3 | 2.08 | NC | 928[E] |
| Aromatics >EC21-EC35 | mg/kg | 0/ 3 | 5.84 | NC | 1328[E] |
| Aliphatics >EC21-EC35 | mg/kg | 0/ 3 | 5.84 | NC | 17697[E] |
| **Speciated Polyaromatic Hydrocarbons** | | | | | |
| Polynuclear aromatic hydrocarbons (Total) | mg/kg | 3/ 3 | **3.9** | **4.09** | 0.865[E] |
| Naphthalene | mg/kg | 0/ 10 | 0.2 | NC | 1.637[E] |
| Acenaphthylene | mg/kg | 0/ 9 | 0.2 | NC | 463.5[E] |
| Acenaphthene | mg/kg | 0/ 9 | 0.2 | NC | 338.8[E] |

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Fluorene | mg/kg | 0/ 9 | 0.2 | NC | 855.7[EX] |
| Phenanthrene | mg/kg | 0/ 9 | 0.2 | NC | 494.6[ES] |
| Anthracene | mg/kg | 0/ 9 | 0.2 | NC | 396[E] |
| Fluoranthene | mg/kg | 0/ 9 | 0.6 | NC | 504.2[E] |
| Pyrene | mg/kg | 0/ 9 | 0.7 | NC | 1201[E] |
| Chrysene | mg/kg | 0/ 9 | 0.5 | NC | 8.839[E] |
| Benzo (a) anthracene | mg/kg | 0/ 9 | 0.5 | NC | 3.72[E] |
| Benzo (b) fluoranthene | mg/kg | 0/ 9 | 0.5 | NC | 9.822[E] |
| Benzo (k) fluoranthene | mg/kg | 0/ 9 | 0.2 | NC | 10.06[E] |
| Benzo (a) pyrene | mg/kg | 0/ 9 | 0.4 | NC | 1[E] |
| Indeno (1,2,3 - cd) pyrene | mg/kg | 0/ 9 | 0.2 | NC | 6.9[E] |
| Benzo (ghi) perylene | mg/kg | 0/ 9 | 0.4 | NC | 10.27[E] |
| Dibenzo (ah) anthracene | mg/kg | 0/ 9 | 0.2 | NC | 0.865[E] |
| **Other** | | | | | |
| 1,1,2 - Trichloroethane | mg/kg | 0/ 4 | 0.006 | NC | 0.88[D] |
| 1,1 Dichloroethane | mg/kg | 0/ 2 | 0.006 | NC | 2.5[D] |
| 1,1 - Dichloroethene | mg/kg | 0/ 2 | 0.006 | NC | 0.23[D] |
| cis 1,2 - Dichloroethene | mg/kg | 0/ 2 | 0.006 | NC | 0.12[D] |
| 1,2 - Dichloropropane | mg/kg | 0/ 4 | 0.006 | NC | 0.024[D] |
| Bromobenzene | mg/kg | 0/ 7 | 0.006 | NC | 0.91[D] |
| Bromoform | mg/kg | 0/ 7 | 0.006 | NC | 5.2[D] |
| Bromodichloromethane | mg/kg | 0/ 7 | 0.006 | NC | 0.019[D] |
| Trichloroethene | mg/kg | 0/ 7 | 0.006 | NC | 0.15[C] |
| Vinyl chloride | mg/kg | 2/ 2 | **0.006** | LoD>T | 0.00155[C] |
| Chloromethane | mg/kg | 0/ 2 | 0.006 | NC | 0.0085[D] |
| iso - Propylbenzene | mg/kg | 0/ 7 | 0.006 | NC | 12[D] |
| Styrene | mg/kg | 0/ 7 | 0.006 | NC | 35[D] |
| Trans - 1,2 - Dichloroethene | mg/kg | 0/ 5 | 0.006 | NC | 0.19[D] |
| Tetrachloroethene | mg/kg | 0/ 7 | 0.031 | NC | 1.46[C] |
| **No Tier 2 Screen** | | | | | |
| C5 - C6 | mg/kg | - | 0.2 | NC | NT |
| C7 - C8 | mg/kg | - | 0.2 | NC | NT |
| C8 - C10 | mg/kg | - | 0.2 | NC | NT |
| 1,1,1,2 - Tetrachloroethane | mg/kg | - | 0.01 | NC | NT |
| 1,2 - Dichloroethane | mg/kg | - | 0.006 | NC | NT |
| cis 1,3 - Dichloropropene | mg/kg | - | 0.006 | NC | NT |
| Sulphide | mg/kg | - | 5 | NC | NT |

Residential without Plant Uptake, Assumming 1.0 % SOM, **A** SGV from CLEA V1.04 at 6% SOM only, **B** GAC from CLEA v1.04 **C** SGV/GAC based on CLEA UK Beta Version at 1%, 2.5% and 5%, **D** GAC from CL:AIRE V1.06 : 1%, 2.5% and 6% SOM (note: 2.5% SOM rather than 3%), **E** GAC from CLEA V1.06 at 1%, 3% and 6% SOM, **F** SGV from CLEA V1.06 at 1%,3% and 6% SOM, CLEA GACs assume that no free product is present, **X** Oral GAC used, no inhalation GAC derived (inhalation data not available), **Z** Soil Saturation limit used as a cap to GAC due to high value of oral GAC and absence of inhalation GAC (No data available), **NC** Not Calculated.

**TABLE 7.10: EXPLORATORY HOLES EXCEEDING TIER 2 SCREEN VALUES**

| Contaminant | Hole ID | Depth | Concentration (mg/kg) | Tier 2 Screen Value |
|---|---|---|---|---|
| Arsenic | HBH403 | 0.35 | 55.8 | 35 |
| Benzene | HTP405 | 2.5 | 0.29 | 0.26 |
| Benzene | HBH405 | 1.3 | 0.29 | 0.26 |

| Contaminant | Hole ID | Depth | Concentration (mg/kg) | Tier 2 Screen Value |
|---|---|---|---|---|
| Lead | HTP405 | 0.3 | 572.9 | 450 |
| Polynuclear aromatic hydrocarbons (Total) | HTP407 | 2 | 3.4 | 0.865 |
| Polynuclear aromatic hydrocarbons (Total) | HTP406 | 2 | 3.7 | 0.865 |
| Polynuclear aromatic hydrocarbons (Total) | HTP406 | 0.5 | 3.9 | 0.865 |
| Vinyl chloride | HTP407 | 2 | 0.005 (LOD) | 0.00155 |
| Vinyl chloride | HTP406 | 0.5 | 0.006 (LOD) | 0.00155 |
| Vinyl chloride | HTP405 | 0.3 | 0.006 (LOD) | 0.00155 |
| Vinyl chloride | HTP405 | 0.9 | 0.006 (LOD) | 0.00155 |
| Vinyl chloride | HTP405 | 2.5 | 0.006 (LOD) | 0.00155 |

**TABLE 7.11: LIST OF OUTLIERS**

| Contaminant | Hole Ref | Depth | Concentration (mg/kg) |
|---|---|---|---|
| Arsenic | HBH403 | 0.35 | 55.8 |
| Lead | HTP405 | 0.3 | 572.9 |

7.35. Contaminants were generally not observed to be in excess of the screening values with the exception of arsenic, lead, benzene, total polyaromatic hydrocarbons and vinyl chloride, which are discussed in turn below.

Arsenic

7.36. Elevated arsenic was identified on a single occasion HBH403 at 55.8mg/kg, which is marginally above the screen for this development area. This exploratory hole corresponds with proposed residential block of flats and communal landscaping in the vicinity of the slipway in Area 6. This data value was also identified as an outlier, which is potentially indicative of a separate localised area of arsenic contamination.

Lead

7.37. Elevated lead was also identified on a single occasion in HTP405 at 572.9mg/kg, which is marginally above the screen for this development area and corresponds with public open space in the vicinity of the sheltered accommodation. This data value was also identified as an outlier which is potentially indicative of a separate localised area of lead contamination.

Benzene

7.38. Elevated benzene was found on two occasions in exceedence of the screen in HTP405 and HBH405, which correspond with the public open space of the proposed sheltered accommodation blocks and area to the south of Westcliffe House.

Total Polyaromatic Hydrocarbons

7.39. Total polyaromatic hydrocarbons were detected in two of the three exploratory hole locations to be above the screen for human health in this development area in the vicinity if Westcliffe House and the Triumph Galley. Speciated assessment of PAHs was undertaken and the results compared to the GACs for each PAH species. No individual PAH concentrations were identified in excess of the screening level and as such no further assessment of PAH concentrations is required herein in terms of human health risk assessment.

Vinyl chloride

7.40. Vinyl chloride (a VOC) was recorded at the LoD and therefore above the Tier 2 screen by default.

**Airport Park, Marine Business Park, Unicorn Triangle and Seaplane Square Commercial Areas [Areas 2, 3, 7a and 8b]**

***Soil Analyses***

7.41. The statistics associated with soil analysis are summarised in Table 7.13. The Mean Value (95%ile) and Maximum Value Tests were undertaken on the sample population for those parameters exceeding the Tier 2 screening levels. If required the Maximum Value Test was undertaken to identify any potential localised areas of increased risk or 'hotspots'. Where the 95%ile exceeds the Tier 2 screen, these results are highlighted and discussed. The remainder are not considered indicative of significant contamination for the proposed end use.

**TABLE 7.12: SUMMARY OF SOIL SAMPLES ANALYSED**

| Exploratory Holes | Sample (m bgl) |
|---|---|
| EBH302 | 6.0, 7.0 |
| EBH303 | 0.3, 1.5, 6.0 |
| EBH304 | 0.1, 6.5 |
| EBH305 | 0.2, 5.5 |
| EBH306 | 1.6, 4.0 |

| Exploratory Holes | Sample (m bgl) |
|---|---|
| EBH309 | - |
| EBH310 | - |
| HWS401 | 0.4 |
| HWS404 | 0.4 |
| HWS405 | - |
| HWS406 | 0.2 |
| HWS415 | 0.2 |
| HTP409 | 2.3 |
| HTP405 | 0.3, 0.9, 2.5 |
| HTP410 | - |
| BH202 | 2.0, 7.9 |
| EWS305 | 2.5 |
| EWS303 | 1.9 |
| HBH413 | 0.4, 1.2, 4.4 |
| HBH412 | 0.3, 0.7, 5.0 |

7.43. Elevated contaminant concentrations are shown on Figure 18.

**TABLE 7.13: SUMMARY OF SOIL ANALYSIS COMMERCIAL (1.0% SOM)**

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Metals** | | | | | |
| Arsenic | mg/kg | 0/ 29 | 19.7 | NC | 640[F] |
| Cadmium | mg/kg | 0/ 29 | 6.29 | NC | 230[F] |
| Chromium | mg/kg | 0/ 29 | 34 | NC | 5,175[E] |
| Copper | mg/kg | 0/ 29 | 270.6 | NC | 49,146[E] |
| Inorganic Mercury | mg/kg | 0/ 29 | 0.76 | NC | 3,600[F] |
| Nickel | mg/kg | 0/ 29 | 35.8 | NC | 1,800[F] |
| Lead | mg/kg | 1/ 29 | **1033.5** | 37.11 | 750[C] |
| Selenium | mg/kg | 0/ 29 | 1.8 | NC | 13,000[F] |
| Zinc | mg/kg | 0/ 29 | 376.3 | NC | 332,700[E] |
| **Organics** | | | | | |
| Benzene | mg/kg | 0/ 32 | 0.31 | NC | 28[E] |
| Toluene | mg/kg | 0/ 32 | 0.326 | NC | 870[E] |
| Ethylbenzene | mg/kg | 0/ 32 | 0.31 | NC | 520[E] |
| o - Xylene | mg/kg | 0/ 32 | 0.29 | NC | 480[E] |
| Phenol (Total) | mg/kg | 0/ 32 | 12 | NC | 3,200[E] |
| **Speciated Total Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | mg/kg | 0/ 11 | 7.6 | NC | 1195[E] |
| Aromatics >EC8-EC10 | mg/kg | 0/ 11 | 7.6 | NC | 1969[E] |
| Aliphatics >EC10-EC12 | mg/kg | 0/ 11 | 7.6 | NC | 5885[E] |
| Aromatics >EC10-EC12 | mg/kg | 0/ 11 | 7.6 | NC | 9737[E] |
| Aromatics >EC12-EC16 | mg/kg | 0/ 11 | 37.1 | NC | 29375[E] |
| Aliphatics >EC12-EC16 | mg/kg | 0/ 11 | 15.3 | NC | 24929[E] |
| Aliphatics >EC16-EC21 | mg/kg | 0/ 11 | 19.1 | NC | 1067249[E] |

| | | | | | |
|---|---|---|---|---|---|
| Aromatics >EC16-EC21 | mg/kg | 0/ 11 | 241 | NC | 26151[E] |
| Aromatics >EC21-EC35 | mg/kg | 0/ 11 | 610 | NC | 28406[E] |
| Aliphatics >EC21-EC35 | mg/kg | 0/ 11 | 53.4 | NC | 1067249[E] |
| **Speciated Polyaromatic Hydrocarbons** | | | | | |
| Polynuclear aromatic hydrocarbons (Total) | mg/kg | 5/ 21 | **188.8** | 5.06* | 13[E] |
| Naphthalene | mg/kg | 0/ 22 | 3.2 | NC | 204[E] |
| Acenaphthylene | mg/kg | 0/ 22 | 1 | NC | 37,210[E] |
| Acenaphthene | mg/kg | 0/ 22 | 3.1 | NC | 31,242[E] |
| Fluorene | mg/kg | 0/ 22 | 3.1 | NC | 32,888[E] |
| Phenanthrene | mg/kg | 0/ 22 | 34.3 | NC | 11,750[E] |
| Anthracene | mg/kg | 0/ 22 | 8.1 | NC | 25,547[E] |
| Fluoranthene | mg/kg | 0/ 22 | 33 | NC | 11,412[E] |
| Pyrene | mg/kg | 0/ 22 | 34.3 | NC | 27,359[E] |
| Chrysene | mg/kg | 0/ 22 | 15 | NC | 137[E] |
| Benzo (a) anthracene | mg/kg | 0/ 22 | 14.3 | NC | 90[E] |
| Benzo (b) fluoranthene | mg/kg | 0/ 22 | 12.7 | NC | 140[E] |
| Benzo (k) fluoranthene | mg/kg | 0/ 22 | 5.1 | NC | 141[E] |
| Benzo (a) pyrene | mg/kg | 0/ 22 | 11.3 | NC | 14[E] |
| Indeno (1,2,3 - cd) pyrene | mg/kg | 0/ 22 | 4.7 | NC | 156E |
| Benzo (ghi) perylene | mg/kg | 0/ 22 | 4 | NC | 143[E] |
| Dibenzo (ah) anthracene | mg/kg | 0/ 22 | 1 | NC | 13[E] |
| **Other** | | | | | |
| 1,1,2 - Trichloroethane | mg/kg | 0/ 21 | 0.007 | NC | 94[D] |
| 1,1 Dichloroethane | mg/kg | 0/ 10 | 0.007 | NC | 280[D] |
| 1,1 - Dichloroethene | mg/kg | 0/ 10 | 0.007 | NC | 26[D] |
| cis 1,2 - Dichloroethene | mg/kg | 0/ 10 | 0.007 | NC | 14[D] |
| 1,2 - Dichloropropane | mg/kg | 0/ 21 | 0.007 | NC | 3.3[D] |
| 2,4 - Dimethylphenol | mg/kg | 0/ 1 | 12 | NC | 16000[D] |
| 24DNT | mg/kg | 0/ 1 | 3 | NC | 3700[D] |
| 2,6 - Dinitrotoluene | mg/kg | 0/ 1 | 3 | NC | 1900[D] |
| bis (2 - ethylhexyl) phthalate | mg/kg | 0/ 1 | 3 | NC | 85000[D] |
| Butyl benzyl phthalate | mg/kg | 0/ 1 | 3 | NC | 940000[D] |
| Biphenyl | mg/kg | 0/ 1 | 1 | NC | 18000[D] |
| Bromobenzene | mg/kg | 0/ 21 | 0.007 | NC | 97[D] |
| Bromoform | mg/kg | 0/ 21 | 0.007 | NC | 760[D] |
| Bromodichloromethane | mg/kg | 0/ 21 | 0.007 | NC | 2.1[D] |
| Chloromethane | mg/kg | 0/ 10 | 0.007 | NC | 1[D] |
| Di-n-butyl phthalate | mg/kg | 0/ 1 | 3 | NC | 15000[D] |
| Di - n - octyl phthalate | mg/kg | 0/ 1 | 1 | NC | 89000[D] |
| Hexachloroethane | mg/kg | 0/ 1 | 3 | NC | 22[D] |
| iso - Propylbenzene | mg/kg | 0/ 21 | 0.007 | NC | 1400[D] |
| Styrene | mg/kg | 0/ 21 | 0.007 | NC | 3300[D] |
| Trans - 1,2 - Dichloroethene | mg/kg | 0/ 10 | 0.007 | NC | 22[D] |
| Tetrachloroethene | mg/kg | 0/ 21 | 0.177 | NC | 63.1[C] |
| Trichloroethene | mg/kg | 0/ 21 | 0.007 | NC | 6.42[C] |
| Vinyl chloride | mg/kg | 0/ 10 | 0.007 | NC | 0.0709[C] |
| **No Tier 2 Screen** | | | | | |
| C5 - C6 | mg/kg | - | 6 | NC | NT |
| C7 - C8 | mg/kg | - | 6 | NC | NT |
| C8 - C10 | mg/kg | - | 6 | NC | NT |

| | | | | | |
|---|---|---|---|---|---|
| 1,1,1,2 - Tetrachloroethane | mg/kg | - | 0.29 | NC | NT |
| 1,2 - Dichloroethane | mg/kg | - | 0.007 | NC | NT |
| cis 1,3 - Dichloropropene | mg/kg | - | 0.007 | NC | NT |
| 2,4,6 - Trichlorophenol | mg/kg | - | 12 | NC | NT |
| Hexachlorobenzene | mg/kg | - | 3 | NC | NT |
| Hexachlorobutadiene | mg/kg | - | 3 | NC | NT |
| Pentachlorophenol | mg/kg | - | 30 | NC | NT |
| Sulphide | mg/kg | - | 28 | NC | NT |

All Tier 2 screening values are calculated for a 'Commercial / Industrial' land use at a Soil Organic Matter (SOM) of 1%.
**A** SGV from CLEA V1.04 at 6% SOM only, **B** GAC from CLEA V1.04, D GAC from CL:AIRE V1.06 : 1%, 2.5% and 6% SOM (note: 2.5% SOM rather than 3%), **E** GAC from CLEA V1.06 at 1%, 3% and 6% SOM,
**F** SGV from CLEA V1.06 at 1%,3% and 6% SOM, CLEA GACs assume that no free product is present,
**X** Oral GAC used, no inhalation GAC derived (inhalation data not available), **Z** Soil Saturation limit used as a cap to GAC due to high value of oral GAC and absence of inhalation GAC (No data available),
**NC** Not Calculated, * Outliers identified using the maximum value test (omitted from the 95th percentile calculation)

**TABLE 7.14: EXPLORATORY HOLES EXCEEDING TIER 2 SCREEN VALUES**

| Contaminant | Hole ID | Depth | Concentration (mg/kg) | Tier 2 Screen Value |
|---|---|---|---|---|
| Polynuclear aromatic hydrocarbons (Total) | HWS406 | 0.3 | 18 | 13 |
| Polynuclear aromatic hydrocarbons (Total) | HWS415 | 0.3 | 188.8 | 13 |
| Polynuclear aromatic hydrocarbons (Total) | HWS401 | 0.4 | 61.5 | 13 |
| Lead | HTP409 | 0.3 | 1033.5 | 750 |

**TABLE 7.15: LIST OF OUTLIERS**

| Contaminant | Hole Ref | Depth | Concentration (mg/kg) |
|---|---|---|---|
| Polynuclear aromatic hydrocarbons (Total) | HWS415 | 0.3 | 188.8 |
| Polynuclear aromatic hydrocarbons (Total) | HWS401 | 0.4 | 61.5 |
| Polynuclear aromatic hydrocarbons (Total) | HWS406 | 0.3 | 18 |

7.44. With the exception of Total PAHs and an isolated lead concentration, contaminant concentrations in excess of the screening values were not identified. As such no further statistical analysis (mean value or maximum value tests) were applied to the dataset. Lead and total PAH concentrations are considered further herein.

Lead

7.45. Elevated lead was detected above the screen at 1033.5mg/kg in HTP409 in the vicinity of the historical workshops (blacksmiths and joiners etc) in Area 2.

Polyaromatic Hydrocarbons

7.46. Elevated total polyaromatic hydrocarbons were detected above the screen and all were identified to be outliers indicative of localised hotspots of contamination at HWS401 (Swann Hangar). HWS406 (Slipway) and HWS415 (Dunning Hangar). Speciated assessment of these PAHs was undertaken and the results compared to the GACs for each PAH species. No individual PAH

concentrations were identified in excess of the screening level and as such no further assessment of PAH concentrations is required herein in terms of human health risk assessment.

Asbestos

7.47. Chrysotile (white) asbestos 2-15% was encountered by the Entec investigation at EBH310 between 0.2-0.4mbgl located in the vicinity of the proposed Marine Business Park.

**Hangars West Commercial Area**

***Soil Analyses***

7.48. The statistics associated with soil analysis are summarised in Table 7.17. The Mean Value (95%ile) and Maximum Value Tests were undertaken on the sample population for those parameters exceeding the Tier 2 screening levels. If required the Maximum Value Test was undertaken to identify any potential localised areas of increased risk or 'hotspots'. Where the 95%ile exceeds the Tier 2 screen, these results are highlighted and discussed. The remainder are not considered indicative of significant contamination for the proposed end use.

**TABLE 7.16: SUMMARY OF SOIL SAMPLES ANALYSED**

| Exploratory Holes | Sample (m bgl) |
|---|---|
| BH210 | 2.3, 2.3 duplicate, 4.0 |
| BH211 | 1.6, 5.0, 7.8 |
| BH212 | 1.3, 2.4 |
| BH213 | 5.3 |
| BH214 | 2.5, 2.5 duplicate, 5.6, 5.6 duplicate |
| BH215 | 0.1, 6.0 |
| HTP414 | 2.4, 3.5 |
| HTP415 | 0.4, 2.5 |
| HBH423 | 0.5, 1.4 |
| EWS312 | 2.7 |
| EWS310 | 1.1, 1.5 |
| EWS311 | 0.9, 1.4 |
| HBH425 | 0.0, 2.2 |
| HBH424 | 0.4, 1.9 |

7.50. Elevated contaminant concentrations are shown on Figure 19.

**TABLE 7.17: SUMMARY OF SOIL ANALYSIS COMMERCIAL (1.0% SOM)**

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Metals** | | | | | |
| Arsenic | mg/kg | 0/ 27 | 15.4 | NC | 640[F] |
| Cadmium | mg/kg | 0/ 27 | 1.68 | NC | 230[F] |
| Chromium | mg/kg | 0/ 27 | 38 | NC | 5,175[E] |
| Copper | mg/kg | 0/ 27 | 767.5 | NC | 49,146[E] |
| Inorganic Mercury | mg/kg | 0/ 27 | 0.6 | NC | 3,600[F] |
| Nickel | mg/kg | 0/ 27 | 49.6 | NC | 1,800[F] |
| Lead | mg/kg | 1/ 27 | **1100** | 14.04* | 750[C] |
| Selenium | mg/kg | 0/ 27 | 2.4 | NC | 13,000[F] |
| Zinc | mg/kg | 0/ 27 | 595.7 | NC | 332,700[E] |
| **Organics** | | | | | |
| Benzene | mg/kg | 0/ 25 | 0.34 | NC | 28[E] |
| Toluene | mg/kg | 0/ 25 | 0.446 | NC | 870[E] |
| Ethylbenzene | mg/kg | 0/ 25 | 0.34 | NC | 520[E] |
| o - Xylene | mg/kg | 0/ 12 | 0.34 | NC | 480[E] |
| **Speciated Total Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | mg/kg | 0/ 10 | 0.92 | NC | 1195[E] |
| Aromatics >EC8-EC10 | mg/kg | 0/ 10 | 0.92 | NC | 1969[E] |
| Aliphatics >EC10-EC12 | mg/kg | 0/ 10 | 0.92 | NC | 5885[E] |
| Aromatics >EC10-EC12 | mg/kg | 0/ 10 | 0.92 | NC | 9737[E] |
| Aromatics >EC12-EC16 | mg/kg | 0/ 10 | 1.85 | NC | 29375[E] |
| Aliphatics >EC12-EC16 | mg/kg | 0/ 10 | 1.85 | NC | 24929[E] |
| Aliphatics >EC16-EC21 | mg/kg | 0/ 10 | 2.31 | NC | 1067249[E] |
| Aromatics >EC16-EC21 | mg/kg | 0/ 10 | 2.31 | NC | 26151[E] |
| Aromatics >EC21-EC35 | mg/kg | 0/ 10 | 6.46 | NC | 28406[E] |
| Aliphatics >EC21-EC35 | mg/kg | 0/ 10 | 6.46 | NC | 1067249[E] |
| **Speciated Polyaromatic Hydrocarbons** | | | | | |
| Polynuclear aromatic hydrocarbons (Total) | mg/kg | 2/ 12 | **64.2** | **28.48** | 13[E] |
| Naphthalene | mg/kg | 0/ 15 | 0.3 | NC | 204[E] |
| Acenaphthylene | mg/kg | 0/ 13 | 0.3 | NC | 37,210[E] |
| Acenaphthene | mg/kg | 0/ 13 | 0.5 | NC | 31,242[E] |
| Fluorene | mg/kg | 0/ 13 | 0.5 | NC | 32,888[E] |
| Phenanthrene | mg/kg | 0/ 13 | 9.4 | NC | 11,750[E] |
| Anthracene | mg/kg | 0/ 13 | 3 | NC | 25,547[E] |
| Fluoranthene | mg/kg | 0/ 13 | 11.9 | NC | 11,412[E] |
| Pyrene | mg/kg | 0/ 13 | 10.1 | NC | 27,359[E] |
| Chrysene | mg/kg | 0/ 13 | 6 | NC | 137[E] |
| Benzo (a) anthracene | mg/kg | 0/ 13 | 6.4 | NC | 90[E] |
| Benzo (b) fluoranthene | mg/kg | 0/ 13 | 8.1 | NC | 140[E] |
| Benzo (k) fluoranthene | mg/kg | 0/ 13 | 2.7 | NC | 141[E] |
| Benzo (a) pyrene | mg/kg | 0/ 13 | 5 | NC | 14[E] |
| Indeno (1,2,3 - cd) pyrene | mg/kg | 0/ 13 | 2.1 | NC | 156E |
| Benzo (ghi) perylene | mg/kg | 0/ 13 | 2.5 | NC | 143[E] |
| Dibenzo (ah) anthracene | mg/kg | 0/ 13 | 0.8 | NC | 13[E] |
| **Other** | | | | | |
| 1,1,2 - Trichloroethane | mg/kg | 0/ 8 | 0.007 | NC | 94[D] |
| 1,1 Dichloroethane | mg/kg | 0/ 6 | 0.007 | NC | 280[D] |
| 1,1 - Dichloroethene | mg/kg | 0/ 6 | 0.007 | NC | 26[D] |

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| cis 1,2 - Dichloroethene | mg/kg | 0/ 6 | 0.007 | NC | 14[D] |
| 1,2 - Dichloropropane | mg/kg | 0/ 8 | 0.007 | NC | 3.3[D] |
| Bromobenzene | mg/kg | 0/ 8 | 0.007 | NC | 97[D] |
| Bromoform | mg/kg | 0/ 8 | 0.007 | NC | 760[D] |
| Bromodichloromethane | mg/kg | 0/ 8 | 0.007 | NC | 2.1[D] |
| Chloromethane | mg/kg | 0/ 6 | 0.007 | NC | 1[D] |
| iso - Propylbenzene | mg/kg | 0/ 8 | 0.007 | NC | 1400[D] |
| Styrene | mg/kg | 0/ 8 | 0.007 | NC | 3300[D] |
| Trans - 1,2 - Dichloroethene | mg/kg | 0/ 6 | 0.007 | NC | 22[D] |
| Tetrachloroethene | mg/kg | 0/ 8 | 0.034 | NC | 63.1[C] |
| Trichloroethene | mg/kg | 0/ 8 | 0.007 | NC | 6.42[C] |
| Vinyl chloride | mg/kg | 0/ 6 | 0.007 | NC | 0.0709[C] |
| **No Tier 2 Screen** | | | | | |
| C5 - C6 | mg/kg | - | 7 | NC | NT |
| C7 - C8 | mg/kg | - | 7 | NC | NT |
| C8 - C10 | mg/kg | - | 7 | NC | NT |
| 1,1,1,2 - Tetrachloroethane | mg/kg | - | 0.34 | NC | NT |
| 1,2 - Dichloroethane | mg/kg | - | 0.007 | NC | NT |
| cis 1,3 - Dichloropropene | mg/kg | - | 0.007 | NC | NT |
| Sulphide | mg/kg | - | 5 | NC | NT |

All Tier 2 screening values are calculated for a 'Commercial / Industrial' land use at a Soil Organic Matter (SOM) of 1%.
**A** SGV from CLEA V1.04 at 6% SOM only, **B** GAC from CLEA V1.04, D GAC from CL:AIRE V1.06 : 1%, 2.5% and 6% SOM (note: 2.5% SOM rather than 3%), **E** GAC from CLEA V1.06 at 1%, 3% and 6% SOM,
**F** SGV from CLEA V1.06 at 1%,3% and 6% SOM, CLEA GACs assume that no free product is present,
**X** Oral GAC used, no inhalation GAC derived (inhalation data not available), **Z** Soil Saturation limit used as a cap to GAC due to high value of oral GAC and absence of inhalation GAC (No data available),
**NC** Not Calculated, * Outliers identified using the maximum value test (omitted from the 95th percentile calculation)

**TABL 7.18: LIST OF OUTLIERS**

| Contaminant | Hole Ref | Depth | Concentration (mg/kg) |
|---|---|---|---|
| Lead | EWS310 | 1.7 | 1100 |

**TABLE 7.19: EXPLORATORY HOLES EXCEEDING TIER 2 SCREEN VALUES**

| Contaminant | Hole ID | Depth | Concentration (mg/kg) | Tier 2 ScreenValue |
|---|---|---|---|---|
| Polynuclear aromatic hydrocarbons (Total) | EWS310 | 1.4 | 62.7 | 13 |
| Polynuclear aromatic hydrocarbons (Total) | EWS311 | 1.2 | 64.2 | 13 |
| Lead | EWS310 | 1.7 | 1100 | 750 |

7.51. Contaminants were generally not observed to be in excess of the screening values with the exception of lead and polyaromatic hydrocarbons, which are discussed in turn below.

Lead

7.52. Elevated lead was identified on a single occasion in EWS310 at 1100mg/kg, which is above the screen (750mg/kg) for this development area and corresponds with a former oil storage tank near

to buildings 358 (Bellman Hangar) and building 361. This value was also identified as a statistical outlier being potentially indicative of a separate localised area of lead contamination.

Polyaromatic Hydrocarbons

7.53. Total polyaromatic hydrocarbons were detected in two of the eleven exploratory hole locations to be above the screen for human health in this development area. The data also showed that the average concentration was above the screen indicating a site wide issue with PAHs. However, limited speciated assessment of PAHs was undertaken and the results compared to the GACs for each PAH species. No individual PAH concentrations were identified in excess of the screening level and as such no further assessment of PAH concentrations is required herein in terms of human health risk assessment.

**Hangars West –Allotment Area**

***Soil Analyses***

7.54. There are only a few exploratory hole locations corresponding with the area proposed for allotments in Hangars West and unfortunately no soil data that can be used in the assessment. As such, this appraisal for human health in this area will be based upon a conservative qualitative appraisal of desk study information.

**Hangars East –Commercial Area**

***Soil Analyses***

7.55. The statistics associated with soil analysis are summarised in Table 7.21. The Mean Value (95%ile) and Maximum Value Tests were undertaken on the sample population for those parameters exceeding the Tier 2 screening levels. If required the Maximum Value Test was undertaken to identify any potential localised areas of increased risk or 'hotspots'. Where the 95%ile exceeds the Tier 2 screen, these results are highlighted and discussed. The remainder are not considered indicative of significant contamination for the proposed end use.

**TABLE 7.20: SUMMARY OF SOIL SAMPLES ANALYSED**

| Exploratory Holes | Sample (m bgl) |
|---|---|
| ETP323 | - |
| ETP324 | - |
| ETP310 | - |

| Exploratory Holes | Sample (m bgl) |
|---|---|
| ETP309 | - |
| ETP308 | - |
| ETP307 | - |
| ETP325 | - |
| ETP326 | - |
| BH217 | 2.2, 4.5 |
| BH216 | 0.0, 4.8 |
| BH208 | 2.0, 7.0 |
| BH207 | 1.5, 3.1 |
| BH209 | 2.0, 3.3 |
| BH204 | 0.9, 4.1 |
| BH205 | 2.0, 3.5, 6.0, 8.0 |
| BH206 | 0.6, 4.7 |
| HBH422 | 3.0 |
| EWS309 | 1.2, 2.6 |
| EWS308 | 0.2 |
| HBH421 | 0.4, 2.6 |
| HTP402 | - |
| HBH420 | 0.1, 2.6 |
| HBH419 | 0.6, 4.0 |
| HTP401 | 0.5, 1.7 |
| ETP306 | - |
| ETP305 | - |
| ETP305B | - |
| ETP304 | - |
| ETP303 | 0.3 |
| ETP301 | 0.3, 0.6 |
| ETP302 | 0.3 |
| HBH418 | - |
| HBH417 | - |
| HBH416 | - |

7.57. Elevated contaminant concentrations are shown on Figure 20.

**TABLE 7.21: SUMMARY OF SOIL ANALYSIS COMMERCIAL (1.0% SOM)**

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Metals** | | | | | |
| Arsenic | mg/kg | 0/ 34 | 22.6 | NC | 640[F] |
| Cadmium | mg/kg | 0/ 34 | 12.9 | NC | 230[F] |
| Chromium | mg/kg | 0/ 34 | 113 | NC | 5,175[E] |
| Copper | mg/kg | 0/ 34 | 570 | NC | 49,146[E] |
| Inorganic Mercury | mg/kg | 0/ 34 | 0.9 | NC | 3,600[F] |
| Nickel | mg/kg | 0/ 34 | 23 | NC | 1,800[F] |
| Lead | mg/kg | 1/ 34 | **1570** | 7.41* | 750[C] |

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Selenium | mg/kg | 0/ 34 | 1.46 | NC | 13,000[F] |
| Zinc | mg/kg | 0/ 34 | 506 | NC | 332,700[E] |
| **Organics** | | | | | |
| Benzene | mg/kg | 0/ 29 | 0.31 | NC | 28[E] |
| Toluene | mg/kg | 0/ 29 | 0.31 | NC | 870[E] |
| Ethylbenzene | mg/kg | 0/ 29 | 1.053 | NC | 520[E] |
| o - Xylene | mg/kg | 0/ 8 | 0.01 | NC | 480[E] |
| **Speciated Total Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | mg/kg | 0/ 6 | 0.93 | NC | 1195[E] |
| Aromatics >EC8-EC10 | mg/kg | 0/ 6 | 0.93 | NC | 1969[E] |
| Aliphatics >EC10-EC12 | mg/kg | 0/ 6 | 0.93 | NC | 5885[E] |
| Aromatics >EC10-EC12 | mg/kg | 0/ 6 | 0.93 | NC | 9737[E] |
| Aromatics >EC12-EC16 | mg/kg | 0/ 6 | 1.85 | NC | 29375[E] |
| Aliphatics >EC12-EC16 | mg/kg | 0/ 6 | 1.85 | NC | 24929[E] |
| Aliphatics >EC16-EC21 | mg/kg | 0/ 6 | 2.31 | NC | 1067249[E] |
| Aromatics >EC16-EC21 | mg/kg | 0/ 6 | 2.31 | NC | 26151[E] |
| Aromatics >EC21-EC35 | mg/kg | 0/ 6 | 6.47 | NC | 28406[E] |
| Aliphatics >EC21-EC35 | mg/kg | 0/ 6 | 6.47 | NC | 1067249[E] |
| **Speciated Polyaromatic Hydrocarbons** | | | | | |
| Polynuclear aromatic hydrocarbons (Total) | mg/kg | 1/ 16 | **117** | 4.19* | 13[E] |
| Naphthalene | mg/kg | 0/ 16 | 1 | NC | 204[E] |
| Acenaphthylene | mg/kg | 0/ 16 | 1 | NC | 37,210[E] |
| Acenaphthene | mg/kg | 0/ 16 | 1.6 | NC | 31,242[E] |
| Fluorene | mg/kg | 0/ 16 | 1 | NC | 32,888[E] |
| Phenanthrene | mg/kg | 0/ 16 | 15.4 | NC | 11,750[E] |
| Anthracene | mg/kg | 0/ 16 | 5.3 | NC | 25,547[E] |
| Fluoranthene | mg/kg | 0/ 16 | 22.8 | NC | 11,412[E] |
| Pyrene | mg/kg | 0/ 16 | 18.7 | NC | 27,359[E] |
| Chrysene | mg/kg | 0/ 16 | 8.5 | NC | 137[E] |
| Benzo (a) anthracene | mg/kg | 0/ 16 | 8.9 | NC | 90[E] |
| Benzo (b) fluoranthene | mg/kg | 0/ 16 | 8.7 | NC | 140[E] |
| Benzo (k) fluoranthene | mg/kg | 0/ 16 | 5 | NC | 141[E] |
| Benzo (a) pyrene | mg/kg | 0/ 16 | 8.4 | NC | 14[E] |
| Indeno (1,2,3 - cd) pyrene | mg/kg | 0/ 16 | 4.3 | NC | 156E |
| Benzo (ghi) perylene | mg/kg | 0/ 16 | 4.6 | NC | 143[E] |
| Dibenzo (ah) anthracene | mg/kg | 0/ 16 | 1 | NC | 13[E] |
| **Other** | | | | | |
| 1,1,2 - Trichloroethane | mg/kg | 0/ 4 | 0.007 | NC | 94[D] |
| 1,1 Dichloroethane | mg/kg | 0/ 2 | 0.007 | NC | 280[D] |
| 1,1 - Dichloroethene | mg/kg | 0/ 2 | 0.007 | NC | 26[D] |
| cis 1,2 - Dichloroethene | mg/kg | 0/ 2 | 0.007 | NC | 14[D] |
| 1,2 - Dichloropropane | mg/kg | 0/ 4 | 0.007 | NC | 3.3[D] |
| Bromobenzene | mg/kg | 0/ 4 | 0.007 | NC | 97[D] |
| Bromoform | mg/kg | 0/ 4 | 0.007 | NC | 760[D] |
| Bromodichloromethane | mg/kg | 0/ 4 | 0.007 | NC | 2.1[D] |
| Chloromethane | mg/kg | 0/ 2 | 0.007 | NC | 1[D] |
| iso - Propylbenzene | mg/kg | 0/ 4 | 0.008 | NC | 1400[D] |
| Styrene | mg/kg | 0/ 4 | 0.007 | NC | 3300[D] |
| Trans - 1,2 - Dichloroethene | mg/kg | 0/ 2 | 0.007 | NC | 22[D] |

| Contaminant | Units | Exceeding | Max | 95th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Tetrachloroethene | mg/kg | 0/ 4 | 0.034 | NC | 63.1[C] |
| Trichloroethene | mg/kg | 0/ 4 | 0.007 | NC | 6.42[C] |
| Vinyl chloride | mg/kg | 0/ 2 | 0.007 | NC | 0.0709[C] |
| **No Tier 2 Screen** | | | | | |
| C5 - C6 | mg/kg | - | 0.3 | NC | NT |
| C7 - C8 | mg/kg | - | 0.3 | NC | NT |
| C8 - C10 | mg/kg | - | 0.3 | NC | NT |
| 1,1,1,2 - Tetrachloroethane | mg/kg | - | 0.01 | NC | NT |
| 1,2 - Dichloroethane | mg/kg | - | 0.007 | NC | NT |
| cis 1,3 - Dichloropropene | mg/kg | - | 0.007 | NC | NT |
| Sulphide | mg/kg | - | 5 | NC | NT |

All Tier 2 screening values are calculated for a 'Commercial / Industrial' land use at a Soil Organic Matter (SOM) of 1%. **A** SGV from CLEA V1.04 at 6% SOM only, **B** GAC from CLEA V1.04, D GAC from CL:AIRE V1.06 : 1%, 2.5% and 6% SOM (note: 2.5% SOM rather than 3%), **E** GAC from CLEA V1.06 at 1%, 3% and 6% SOM, **F** SGV from CLEA V1.06 at 1%,3% and 6% SOM, CLEA GACs assume that no free product is present, **X** Oral GAC used, no inhalation GAC derived (inhalation data not available), **Z** Soil Saturation limit used as a cap to GAC due to high value of oral GAC and absence of inhalation GAC (No data available), **NC** Not Calculated, * Outliers identified using the maximum value test (omitted from the 95th percentile calculation)

**TABLE 7.22: EXPLORATORY HOLES EXCEEDING TIER 2 SCREEN VALUES**

| Contaminant | Hole ID | Depth | Concentration (mg/kg) | Tier 2 Screen Value |
|---|---|---|---|---|
| Polynuclear aromatic hydrocarbons (Total) | HBH420 | 0.2 | 117 | 13 |
| Lead | ETP301 | 0.3 | 1570 | 750 |

**TABLE 7.23: LIST OF OUTLIERS**

| Contaminant | Hole Ref | Depth | Concentration (mg/kg) |
|---|---|---|---|
| Polynuclear aromatic hydrocarbons (Total) | HBH420 | 0.2 | 117 |
| Lead | ETP301 | 0.3 | 1570 |

7.58. Contaminants were generally not observed to be in excess of the screening values with the exception of lead and polyaromatic hydrocarbons, which are discussed in turn below.

Lead

7.59. Elevated lead was identified on a single occasion in ETP301 at 1570mg/kg, which is above the screen (750mg/kg) for this development area and corresponds with the southern parts of Hangars East. This data value was also identified as an outlier, which is potentially indicative of a separate localised area of lead contamination, although no indication of its origin is currently apparent.

Polyaromatic Hydrocarbons

7.60. Total polyaromatic hydrocarbons were detected on a single occasion at HBH420 at 117mg/kg. This data value was also identified as an outlier, which is potentially indicative of a separate localised area of PAH contamination. Speciated assessment of PAHs was undertaken and the results compared to the GACs for each PAH species. No individual PAH concentrations were identified in excess of the screening level and as such no further assessment of PAH concentrations is required herein in terms of human health risk assessment.

**Leachate Analysis**

7.61. Soil samples were scheduled and subsequently analysed in the laboratory for leaching analysis depending, in part, on visual and olfactory observations made by Entec / Halcrow. A total of 26 sample leachates were prepared and analysed to assess the potential mobility of identified contaminants. This included two soil samples which contained ash and displayed elevated metal concentrations were scheduled for leaching test analysis.

7.62. The assessment of leachate data has been undertaken in view of potential risks to Controlled Waters and is not considered to be development specific. As such, the appraisal of leachate and groundwater impaction has been based upon the broad zoning of the site (Waterfront, Hangars West and Hangars East).

7.63. The results of the leachate analyses have been compared to the values contained within the references detailed in Table 7.1 for water quality. The selection of Environmental Quality Standards (EQS) for saltwater (where available) has been assumed in light of the site's location upon a Secondary A Aquifer and vicinity to The Solent.

***Waterfront Zone***

7.64. The concentrations of those contaminants encountered in excess of Tier 2 screening levels are summarised in Table 7.24. Results below the limits of detection are excluded. The locations of potentially leachable contaminants are shown in Figure 21.

**TABLE 7.24: LEACHATE CONCENTRATIONS EXCEEDING TIER 2 SCREEN**

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Inorganics** | | | | | |
| Arsenic | µg/ l | 1/ 18 | **31** | 4.05 | 25[1] |
| Cadmium | µg/ l | 0/ 18 | 0.4 | NC | 2.5[1] |
| Cyanide | µg/ l | 18/ 18 | **50** | LoD>T | 1[1] |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Chromium | µg/ l | 2/ 18 | **76** | 10.7 | 15[1] |
| Copper | µg/ l | 6/ 18 | **14** | 5.22 | 5[1] |
| Inorganic Mercury | µg/ l | 0/ 18 | 0.2 | NC | 0.3[1] |
| Nickel | µg/ l | 1/ 18 | **121** | 9 | 15[1] |
| Lead | µg/ l | 0/ 18 | 14 | NC | 25[1] |
| Selenium | µg/ l | 0/ 18 | 8 | NC | 10[k] |
| Zinc | µg/ l | 8/ 18 | **578** | **69.8** | 40[1] |
| **Organics** | | | | | |
| Benzene | µg/ l | 1/ 3 | **24000** | **8003** | 30[J] |
| Toluene | µg/ l | 1/ 3 | **90** | 33.3 | 40[1] |
| Ethylbenzene | µg/ l | 0/ 3 | 10 | NC | 20[1] |
| o - Xylene | µg/ l | - | 10 | NC | NT |
| Phenol (Total) | µg/ l | 0/ 3 | 5.96 | NC | 30[1] |
| **Speciated Petroleum Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | µg/ l | - | 2 | NC | NT |
| Aromatics >EC8-EC10 | µg/ l | - | 2.2 | NC | NT |
| Aliphatics >EC10-EC12 | µg/ l | - | 2.9 | NC | NT |
| Aromatics >EC10-EC12 | µg/ l | - | 2.9 | NC | NT |
| Aromatics >EC12-EC16 | µg/ l | - | 1.7 | NC | NT |
| Aliphatics >EC12-EC16 | µg/ l | - | 1.7 | NC | NT |
| Aliphatics >EC16-EC21 | µg/ l | - | 2.1 | NC | NT |
| Aromatics >EC16-EC21 | µg/ l | - | 2.2 | NC | NT |
| Aliphatics >EC21-EC35 | µg/ l | - | 5.9 | NC | NT |
| Aromatics >EC21-EC35 | µg/ l | - | 15.8 | NC | NT |
| C5 - C6 | µg/ l | - | 10 | NC | NT |
| C6 - C7 | µg/ l | - | 10 | NC | NT |
| C7 - C8 | µg/ l | - | 310 | NC | NT |
| C8 - C10 | µg/ l | - | 10 | NC | NT |
| **Poly Aromatic Hydrocarbons** | | | | | |
| Acenaphthylene | µg/ l | - | 0.312 | NC | NT |
| Acenaphthene | µg/ l | - | 4.217 | NC | NT |
| Anthracene | µg/ l | 0/ 18 | 0.04 | NC | 0.1[11] |
| Benzo (a) anthracene | µg/ l | - | 0.139 | NC | NT |
| Benzo (a) pyrene | µg/ l | 0/ 18 | 0.04 | NC | 0.05[11] |
| Benzo (b) fluoranthene | µg/ l | 3/ 18 | **8** | **1.34** | 0.03[11] |
| Benzo (ghi) perylene | µg/ l | 18/ 18 | **0.04** | LoD>T | 0.002[11] |
| Benzo (k) fluoranthene | µg/ l | 3/ 18 | **0.04** | 0.016 | 0.03[11] |
| Chrysene | µg/ l | - | 0.139 | NC | NT |
| Fluorene | µg/ l | - | 1.11 | NC | NT |
| Fluoranthene | µg/ l | 0/ 18 | 0.04 | NC | 0.002[1] |
| Dibenzo (ah) anthracene | µg/ l | - | 0.04 | NC | NT |
| Indeno (1,2,3 - cd) pyrene | µg/ l | 18/ 18 | **0.04** | LoD>T | 0.002[11] |
| Naphthalene | µg/ l | 0/ 18 | 0.073 | NC | 10[J] |
| Phenanthrene | µg/ l | - | 0.222 | NC | NT |
| Pyrene | µg/ l | - | 0.04 | NC | NT |
| **Volatile Organic Hydrocarbons** | | | | | |
| 1,1,1,2 - Tetrachloroethane | µg/ l | - | 5 | NC | NT |
| 1,1,1 - Trichloroethane | µg/ l | 0/ 3 | 10 | NC | 100[1] |
| 1,1,2 - Trichloroethane | µg/ l | 0/ 3 | 10 | NC | 300[1] |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| 1,1 - Dichloroethane | µg/ l | - | 10 | NC | NT |
| 1,1 - Dichloroethene | µg/ l | - | 10 | NC | NT |
| 1,2,4 - Trimethylbenzene | µg/ l | - | 10 | NC | NT |
| 1,2 - Dibromo - 3 - Chloropropane | µg/ l | - | 10 | NC | NT |
| 1,2 - Dichloroethane | µg/ l | 0/ 3 | 10 | 2.80 | 10[G] |
| cis 1,2 - Dichloroethene | µg/ l | - | 10 | NC | NT |
| 1,2 - Dichloropropane | µg/ l | - | 10 | NC | NT |
| cis 1,3 - Dichloropropene | µg/ l | - | 10 | NC | NT |
| 2,4,6 - Trichlorophenol | µg/ l | - | 0.4 | NC | NT |
| 2,4 - Dimethylphenol | µg/ l | - | 0.4 | NC | NT |
| 2,4 - Dinitrotoluene | µg/ l | - | 0.1 | NC | NT |
| 2,6 - Dinitrotoluene | µg/ l | - | 20 | NC | NT |
| Bromobenzene | µg/ l | - | 10 | NC | NT |
| Bromoform | µg/ l | - | 10 | NC | NT |
| Bromodichloromethane | µg/ l | - | 10 | NC | NT |
| Chloroform | µg/ l | 1/ 3 | **32** | 8.80 | 12[F] |
| Chloromethane | µg/ l | - | 10 | NC | NT |
| Di - n - octyl phthalate | µg/ l | - | 40 | NC | NT |
| Hexachloroethane | µg/ l | - | 0.1 | NC | NT |
| Hexachlorobenzene | µg/ l | 3/ 3 | **0.1** | LoD>T | 0.03[F] |
| Hexachlorobutadiene | µg/ l | 0/ 3 | 0.1 | NC | 0.1[F] |
| iso - Propylbenzene | µg/ l | - | 10 | NC | NT |
| Pentachlorophenol | µg/ l | 3/ 3 | **1** | LoD>T | 0.4[11] |
| Styrene | µg/ l | 0/ 3 | 10 | NC | 50[1] |
| Trans - 1,2 - Dichloroethene | µg/ l | - | 10 | NC | NT |
| Tetrachloroethene | µg/ l | 1/ 3 | **1405** | 469 | 10[G] |
| Trichloroethene | µg/ l | 1/ 3 | **23** | 8.33 | 10[G] |
| Vinyl chloride | µg/ l | - | 10 | NC | NT |

**Source: Environmental Agency Chemical Standards for Water:**

[1] Environmental Quality Standard Average (Maximum Allowable) Concentrations - Saltwater Range. [Values derived from EA Publication 'Technical Advice to 3rd Parties on Pollution of Controlled Waters for Part IIa].

**Driver**
Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances: Council Directive 76/464/EEC Substances) (Classification) Regulations 1998: S.I. 1998/389

[11] Directive establishing a framework for Community action in the field of water policy (Water Framework Directive):Directive 2000/60/EC

[F] Surface Waters (Dangerous Substances) (Classification) Regulations 1989: S.I. 1989/2286

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[G] Surface Waters (Dangerous Substances) (Classification) Regulations 1992: S.I. 1992/337

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[J] UK Standard for protection of aquatic life in surface waters - Surface Waters (Dangerous Substances) (Classification) Regulations 1998: S.I. 1998/389

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community - List II substances

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| [K] UK Drinking Water Standards or World Health Organisation Guidelines for Drinking Water 1984. | | | | | |

Heavy Metals

7.65. Elevated heavy metals such as arsenic, chromium, copper, nickel and zinc are indicated to be leachable from soil samples collected from this development zone and at concentrations that are above the screen. Additionally, average concentrations of zinc also exceeded the screen protective of Controlled Waters and therefore infers that shallow groundwater may be of poor quality as a result, although it is unlikely to represent a significant risk to Controlled Waters receptors.

Cyanide

7.66. Cyanide was detected at 50ug/l in a leachate sample from soils taken from HWS401 (in the vicinity of Swann Hangar) and infers a potential leachate concentration that would significantly exceed the screen protective of Controlled Waters.

Benzene

7.67. Elevated benzene and associated BTEX compound toluene were identified to be highly leachable from a soil sample originating from exploratory hole position HBH410 indicating that contaminants are readily transmittable from the soil to the aqueous media. This infers that the underlying groundwater may be impacted by BTEX compounds at this location.

7.68. In addition to benzene, elevated Gasoline Range Organics between C7 –C8 were also detected up to 310$\mu$g/l in HBH410.

Benzo (b) fluoranthene

7.69. Benzo(b)fluoranthene and to a lesser extent benzo(k)fluoranthene were also identified within leachate three samples to be above the screen.

Tetrachloroethene

7.70. Tetrachloroethene, and to a lesser extent, trichloroethene and chloroform, were identified to be highly leachable from the same soil sample referenced HBH410. Similarly to BTEX, this result infers that the underlying groundwater may be impacted by chlorinated solvents at this location.

***Hangars West***

7.71. In comparison to the standards selected, several elevated concentrations were noted. The concentrations of those contaminants encountered in excess of Tier 2 screening levels are summarised in Table 7.25. Results below the limits of detection are excluded. The locations of potentially leachable contaminants are shown in Figure 22.

**TABLE 7.25: LEACHATE CONCENTRATIONS EXCEEDING TIER 2 SCREEN**

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Inorganics** | | | | | |
| Arsenic | µg/ l | 0/ 2 | 1 | NC | 25[1] |
| Cadmium | µg/ l | 0/ 2 | 0.1 | NC | 2.5[1] |
| Cyanide | µg/ l | 2/ 2 | **10** | LoD>T | 1[1] |
| Chromium | µg/ l | 0/ 2 | 6 | NC | 15[1] |
| Copper | µg/ l | 0/ 2 | 3 | NC | 5[1] |
| Inorganic Mercury | µg/ l | 0/ 2 | 0.1 | NC | 0.3[1] |
| Nickel | µg/ l | 0/ 2 | 3 | NC | 15[1] |
| Lead | µg/ l | 0/ 2 | 4 | NC | 25[1] |
| Selenium | µg/ l | 0/ 2 | 1 | NC | 10[K] |
| Zinc | µg/ l | 1/ 2 | **45** | 28.5 | 40[1] |
| **Poly Aromatic Hydrocarbons** | | | | | |
| Acenaphthylene | µg/ l | - | 0.053 | NC | NT |
| Acenaphthene | µg/ l | - | 0.134 | NC | NT |
| Ammoniacal nitrogen | µg/ l | - | 10 | NC | NT |
| Anthracene | µg/ l | 0/ 2 | 0.012 | NC | 0.1[11] |
| Benzo (a) anthracene | µg/ l | - | 0.13 | NC | NT |
| Benzo (a) pyrene | µg/ l | 0/ 2 | 0.012 | NC | 0.05[11] |
| Benzo (b) fluoranthene | µg/ l | 0/ 2 | 0.012 | NC | 0.03[11] |
| Benzo (ghi) perylene | µg/ l | 2/ 2 | **0.012** | LoD>T | 0.002[11] |
| Benzo (k) fluoranthene | µg/ l | 0/ 2 | 0.012 | NC | 0.03[11] |
| Chrysene | µg/ l | - | 0.13 | NC | NT |
| Dibenzo (ah) anthracene | µg/ l | - | 0.012 | NC | NT |
| Fluorene | µg/ l | - | 0.012 | NC | NT |
| Fluoranthene | µg/ l | 2/ 2 | **0.012** | LoD>T | 0.002[1] |
| Indeno (1,2,3 - cd) pyrene | µg/ l | 2/ 2 | **0.012** | LoD>T | 0.002[11] |
| Naphthalene | µg/ l | 0/ 2 | 0.094 | NC | 10[J] |
| Phenanthrene | µg/ l | - | 0.012 | NC | NT |
| Pyrene | µg/ l | - | 0.012 | NC | NT |

**Source: Environmental Agency Chemical Standards for Water:**

[1] Environmental Quality Standard Average (Maximum Allowable) Concentrations - Saltwater Range. [Values derived from EA Publication 'Technical Advice to 3rd Parties on Pollution of Controlled Waters for Part IIa].

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Driver**<br>Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances: Council Directive 76/464/EEC Substances) (Classification) Regulations 1998: S.I. 1998/389<br><br>[11] Directive establishing a framework for Community action in the field of water policy (Water Framework Directive):Directive 2000/60/EC<br><br>[F] Surface Waters (Dangerous Substances) (Classification) Regulations 1989: S.I. 1989/2286<br><br>**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances<br><br>[G] Surface Waters (Dangerous Substances) (Classification) Regulations 1992: S.I. 1992/337<br><br>**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances<br><br>[J] UK Standard for protection of aquatic life in surface waters - Surface Waters (Dangerous Substances) (Classification) Regulations 1998: S.I. 1998/389<br><br>**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community - List II substances<br><br>[K] UK Drinking Water Standards or World Health Organisation Guidelines for Drinking Water 1984. | | | | | |

7.72. There are no exceedences of the screen with the exception of marginally elevated zinc above the screen and those results for contaminants with LoDs above the Tier 2 screen.

***Hangars East***

7.73. In comparison to the standards selected, several elevated concentrations were noted. The concentrations of those contaminants encountered in excess of Tier 2 screening levels are summarised in Table 7.26. Results below the limits of detection are excluded. The locations of potentially leachable contaminants are shown in Figure 23.

**TABLE 7.26: LEACHATE CONCENTRATIONS EXCEEDING TIER 2 SCREEN**

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Inorganics** | | | | | |
| Arsenic | µg/ l | 0/ 2 | 3 | NC | 25[1] |
| Cadmium | µg/ l | 0/ 2 | 0.1 | NC | 2.5[1] |
| Cyanide | µg/ l | 1/ 1 | **10** | LoD>T | 1[1] |
| Chromium | µg/ l | 0/ 2 | 3 | NC | 15[1] |
| Copper | µg/ l | 0/ 2 | 4 | NC | 5[1] |
| Inorganic Mercury | µg/ l | 0/ 2 | 0.1 | NC | 0.3[1] |
| Lead | µg/ l | 0/ 2 | 1 | NC | 15[1] |
| Nickel | µg/ l | 0/ 2 | 2 | NC | 25[1] |
| Selenium | µg/ l | 0/ 2 | 1 | NC | 10[K] |
| Zinc | µg/ l | 0/ 2 | 32 | NC | 40[1] |
| **Organics** | | | | | |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Benzene | µg/ l | 0/ 1 | 5 | NC | 30[J] |
| Toluene | µg/ l | 0/ 1 | 5 | NC | 40[1] |
| Ethylbenzene | µg/ l | 0/ 1 | 5 | NC | 20[1] |
| o - Xylene | µg/ l | - | 5 | NC | NT |
| Phenol (Total) | µg/ l | 0/ 1 | 0.4 | NC | 30[1] |
| **Speciated Total Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | µg/ l | - | 1.1 | NC | NT |
| Aromatics >EC8-EC10 | µg/ l | - | 1.2 | NC | NT |
| Aliphatics >EC10-EC12 | µg/ l | - | 2 | NC | NT |
| Aromatics >EC10-EC12 | µg/ l | - | 2.5 | NC | NT |
| Aromatics >EC12-EC16 | µg/ l | - | 1.4 | NC | NT |
| Aliphatics >EC12-EC16 | µg/ l | - | 1.4 | NC | NT |
| Aliphatics >EC16-EC21 | µg/ l | - | 1.7 | NC | NT |
| Aromatics >EC16-EC21 | µg/ l | - | 1.9 | NC | NT |
| Aliphatics >EC21-EC35 | µg/ l | - | 4.8 | NC | NT |
| Aromatics >EC21-EC35 | µg/ l | - | 6.2 | NC | NT |
| C5 - C6 | µg/ l | - | 10 | NC | NT |
| C6 - C7 | µg/ l | - | 10 | NC | NT |
| C7 - C8 | µg/ l | - | 10 | NC | NT |
| C8 - C10 | µg/ l | - | 10 | NC | NT |
| **Poly Aromatic Hydrocarbons** | | | | | |
| Naphthalene | µg/ l | 0/ 2 | 0.04 | NC | 10[J] |
| Acenaphthylene | µg/ l | - | 0.04 | NC | NT |
| Acenaphthene | µg/ l | - | 0.04 | NC | NT |
| Anthracene | µg/ l | 0/ 2 | 0.04 | NC | 0.1[11] |
| Benzo (a) anthracene | µg/ l | - | 0.04 | NC | NT |
| Benzo (a) pyrene | µg/ l | 0/ 2 | 0.04 | NC | 0.05[11] |
| Benzo (b) fluoranthene | µg/ l | 1/ 2 | **8** | **4.01** | 0.03[11] |
| Benzo (ghi) perylene | µg/ l | 2/ 2 | **0.04** | LoD>T | 0.002[11] |
| Benzo (k) fluoranthene | µg/ l | 1/ 2 | **0.04** | LoD>T | 0.03[11] |
| Chrysene | µg/ l | - | 0.04 | NC | NT |
| Dibenzo (ah) anthracene | µg/ l | - | 0.04 | NC | NT |
| Fluorene | µg/ l | - | 0.04 | NC | NT |
| Fluoranthene | µg/ l | 1/ 2 | **0.04** | LoD>T | 0.002[1] |
| Phenanthrene | µg/ l | - | **0.04** | LoD>T | NT |
| Pyrene | µg/ l | - | **0.04** | LoD>T | NT |
| Indeno (1,2,3 - cd) pyrene | µg/ l | 2/ 2 | **0.04** | LoD>T | 0.002[11] |
| **Volatile Organic Compounds** | | | | | |
| 1,1,1,2 - Tetrachloroethane | µg/ l | - | 5 | NC | NT |
| 1,1,1 - Trichloroethane | µg/ l | 0/ 1 | 1 | NC | 100[1] |
| 1,1,2 - Trichloroethane | µg/ l | 0/ 1 | 1 | NC | 300[1] |
| 1,1 - Dichloroethane | µg/ l | - | 1 | NC | NT |
| 1,1 - Dichloroethene | µg/ l | - | 1 | NC | NT |
| 1,2,4 - Trimethylbenzene | µg/ l | - | 1 | NC | NT |
| 1,2 - Dibromo - 3 - Chloropropane | µg/ l | - | 1 | NC | NT |
| 1,2 - Dichloroethane | µg/ l | 0/ 1 | 1 | NC | 10[G] |
| cis 1,2 - Dichloroethene | µg/ l | - | 1 | NC | NT |
| 1,2 - Dichloropropane | µg/ l | - | 1 | NC | NT |
| cis 1,3 - Dichloropropene | µg/ l | - | 1 | NC | NT |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| 2,4,6 - Trichlorophenol | µg/ l | - | 0.4 | NC | NT |
| 2,4 - Dimethylphenol | µg/ l | - | 0.4 | NC | NT |
| 2,4 - Dinitrotoluene | µg/ l | - | 0.1 | NC | NT |
| 2,6 - Dinitrotoluene | µg/ l | - | 20 | NC | NT |
| Bromobenzene | µg/ l | - | 1 | NC | NT |
| Bromoform | µg/ l | - | 1 | NC | NT |
| Bromodichloromethane | µg/ l | - | 1 | NC | NT |
| Chloroform | µg/ l | 0/ 1 | 1 | NC | 12[F] |
| Chloromethane | µg/ l | - | 1 | NC | NT |
| Di - n - octyl phthalate | µg/ l | - | 40 | NC | NT |
| Hexachloroethane | µg/ l | - | 0.1 | NC | NT |
| Hexachlorobenzene | µg/ l | 1/ 1 | **0.1** | LoD>T | 0.03[F] |
| Hexachlorobutadiene | µg/ l | 0/ 1 | 0.1 | NC | 0.1[F] |
| iso - Propylbenzene | µg/ l | - | 1 | NC | NT |
| Pentachlorophenol | µg/ l | 1/ 1 | **1** | LoD>T | 0.4[11] |
| Styrene | µg/ l | 0/ 1 | 1 | NC | 50[1] |
| Trans - 1,2 - Dichloroethene | µg/ l | - | 1 | NC | NT |
| Tetrachloroethene | µg/ l | 0/ 1 | 1 | NC | 10[G] |
| Trichloroethene | µg/ l | 0/ 1 | 1 | NC | 10[G] |
| Vinyl chloride | µg/ l | - | 1 | NC | NT |

**Source: Environmental Agency Chemical Standards for Water:**

[1] Environmental Quality Standard Average (Maximum Allowable) Concentrations - Saltwater Range. [Values derived from EA Publication 'Technical Advice to 3rd Parties on Pollution of Controlled Waters for Part IIa].

**Driver**
Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances: Council Directive 76/464/EEC Substances) (Classification) Regulations 1998: S.I. 1998/389

[11] Directive establishing a framework for Community action in the field of water policy (Water Framework Directive):Directive 2000/60/EC

[F] Surface Waters (Dangerous Substances) (Classification) Regulations 1989: S.I. 1989/2286

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[G] Surface Waters (Dangerous Substances) (Classification) Regulations 1992: S.I. 1992/337

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[J] UK Standard for protection of aquatic life in surface waters - Surface Waters (Dangerous Substances) (Classification) Regulations 1998: S.I. 1998/389

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community - List II substances

[K] UK Drinking Water Standards or World Health Organisation Guidelines for Drinking Water 1984.

7.74. There are no exceedences of the screen with the exception of marginally elevated benzo(b)fluoranthene above the screen and those results for contaminants with LoDs above the Tier 2 screen.

**Groundwater Analyses**

7.75. The results of the groundwater analyses have been compared to the values contained within the references detailed in Table 7.1 for water quality.

7.76. The assessment of groundwater data has been undertaken in view of potential risks to Controlled Waters and is not considered to be development specific. As such, the appraisal of leachate and groundwater impaction has been based upon the traditional zoning of the site (Waterfront, Hangars West and Hangars East).

7.77. The selection of Environmental Quality Standards (EQS) for saltwater (where available) has been assumed in light of the site's location upon a Secondary A Aquifer, nearby abstractions and vicinity to The Solent.

***Waterfront Zone***

7.78. The statistics associated with groundwater analysis are summarised in Table 7.27 and elevated metal contamination in groundwaters is shown on Figure 21 and VOCs in Figure 24.

**TABLE 7.27: SUMMARY OF GROUNDWATER ANALYSIS IN WATERFRONT ZONE**

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Inorganics** | | | | | |
| Arsenic | µg/ l | 1/ 21 | **28** | 4.19 | 25[1] |
| Cadmium | µg/ l | 0/ 21 | 1.6 | NC | 2.5[1] |
| Chromium | µg/ l | 1/ 21 | **19** | 4.71 | 15[1] |
| Copper | µg/ l | 5/ 21 | **43** | 4.81 | 5[1] |
| Inorganic Mercury | µg/ l | 4/ 21 | **0.5** | LoD>T | 0.3[1] |
| Nickel | µg/ l | 5/ 21 | **33** | 8.14 | 15[1] |
| Lead | µg/ l | 0/ 21 | 18 | NC | 25[1] |
| Selenium | µg/ l | 2/ 18 | **45** | 7.28 | 10[K] |
| Zinc | µg/ l | 7/ 21 | **307** | **55.8** | 40[1] |
| **Organics** | | | | | |
| Benzene | µg/ l | 0/ 22 | 10 | NC | 30[J] |
| Toluene | µg/ l | 0/ 22 | 18 | NC | 40[1] |
| Ethylbenzene | µg/ l | 0/ 22 | 10 | NC | 20[1] |
| o - Xylene | µg/ l | - | 12 | NC | NT |
| Xylene (Total) | µg/ l | - | 10 | NC | NT |
| Phenol (Total) | µg/ l | 0/ 17 | 5.96 | NC | 30[1] |
| **Speciated Petroleum Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | µg/ l | - | 50.2 | NC | NT |
| Aromatics >EC8-EC10 | µg/ l | - | 55.6 | NC | NT |
| Aliphatics >EC10-EC12 | µg/ l | - | 41.2 | NC | NT |
| Aromatics >EC10-EC12 | µg/ l | - | 52.2 | NC | NT |
| Aromatics >EC12-EC16 | µg/ l | - | 69.1 | NC | NT |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Aliphatics >EC12-EC16 | µg/ l | - | 84.9 | NC | NT |
| Aliphatics >EC16-EC21 | µg/ l | - | 187 | NC | NT |
| Aromatics >EC16-EC21 | µg/ l | - | 152 | NC | NT |
| Aliphatics >EC21-EC35 | µg/ l | - | 198 | NC | NT |
| Aromatics >EC21-EC35 | µg/ l | - | 202 | NC | NT |
| C5 - C6 | µg/ l | - | 400 | NC | NT |
| C7 - C8 | µg/ l | - | 1790 | NC | NT |
| C8 - C10 | µg/ l | - | 290 | NC | NT |
| Total GRO | µg/ l | - | 3210 | NC | NT |
| **Poly Aromatic Hydrocarbons** | | | | | |
| Acenaphthylene | µg/ l | - | 0.076 | NC | NT |
| Acenaphthene | µg/ l | - | 0.943 | NC | NT |
| Anthracene | µg/ l | 3/ 17 | **0.574** | 0.10 | 0.1[11] |
| Benzo (a) anthracene | µg/ l | - | 1.136 | NC | NT |
| Benzo (a) pyrene | µg/ l | 2/ 17 | **1.515** | **0.13** | 0.05[11] |
| Benzo (b) fluoranthene | µg/ l | 17/ 17 | **8** | LoD>T | 0.03[11] |
| Benzo (ghi) perylene | µg/ l | 2/ 17 | **1.849** | LoD>T | 0.002[11] |
| Benzo (k) fluoranthene | µg/ l | 2/ 17 | **1.148** | LoD>T | 0.03[11] |
| Chrysene | µg/ l | - | 1.098 | NC | NT |
| Fluorene | µg/ l | - | 1.311 | NC | NT |
| Fluoranthene | µg/ l | 4/ 17 | **2.728** | LoD>T | 0.002[1] |
| Naphthalene | µg/ l | 0/ 18 | 1 | NC | 10[J] |
| Dibenzo (ah) anthracene | µg/ l | - | 0.26 | NC | NT |
| Phenanthrene | µg/ l | - | 1.955 | NC | NT |
| Pyrene | µg/ l | - | 3.026 | NC | NT |
| Indeno (1,2,3 - cd) pyrene | µg/ l | 1/ 17 | **1.648** | **0.13** | 0.002[11] |
| **Volatile Organic Hydrocarbons** | | | | | |
| 1,1,1,2 - Tetrachloroethane | µg/ l | - | 5 | NC | NT |
| 1,1,1 - Trichloroethane | µg/ l | 0/ 18 | 10 | NC | 100[1] |
| 1,1,2 - Trichloroethane | µg/ l | 0/ 18 | 10 | NC | 300[1] |
| 1,1 - Dichloroethane | µg/ l | - | 10 | NC | NT |
| 1,1 - Dichloroethene | µg/ l | - | 10 | NC | NT |
| 1,2,4 - Trimethylbenzene | µg/ l | - | 34 | NC | NT |
| 1,2 - Dibromo - 3 - Chloropropane | µg/ l | - | 10 | NC | NT |
| 1,2 - Dichloroethane | µg/ l | 0/ 18 | 10 | NC | 10[G] |
| cis 1,2 - Dichloroethene | µg/ l | - | 10 | NC | NT |
| 1,2 - Dichloropropane | µg/ l | - | 10 | NC | NT |
| cis 1,3 - Dichloropropene | µg/ l | - | 10 | NC | NT |
| 2,4,6 - Trichlorophenol | µg/ l | - | 0.4 | NC | NT |
| 2,4 - Dimethylphenol | µg/ l | - | 0.4 | NC | NT |
| 2,4 - Dinitrotoluene | µg/ l | - | 0.1 | NC | NT |
| 2,6 - Dinitrotoluene | µg/ l | - | 20 | NC | NT |
| bis (2 - ethylhexyl) phthalate | µg/ l | - | 20 | NC | NT |
| Butyl benzyl phthalate | µg/ l | - | 20 | NC | NT |
| Biphenyl | µg/ l | 0/ 17 | 0.04 | NC | 25[J] |
| Bromobenzene | µg/ l | - | 10 | NC | NT |
| Bromoform | µg/ l | - | 10 | NC | NT |
| Bromodichloromethane | µg/ l | - | 10 | NC | NT |
| Chloroform | µg/ l | 1/ 18 | **32** | 4.06 | 12[F] |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Chloromethane | µg/ l | - | 10 | NC | NT |
| Carbon tetrachloride | µg/ l | - | 10 | NC | NT |
| Di-n-butyl phthalate | µg/ l | - | 2.412 | NC | NT |
| Di - n - octyl phthalate | µg/ l | - | 40 | NC | NT |
| Hexachloroethane | µg/ l | - | 0.1 | NC | NT |
| Hexachlorobenzene | µg/ l | 0/ 17 | 0.01 | NC | 0.03[F] |
| Hexachlorobutadiene | µg/ l | 1/ 18 | **1** | **0.15** | 0.1[F] |
| iso - Propylbenzene | µg/ l | - | 10 | NC | NT |
| Pentachlorophenol | µg/ l | 17/ 17 | **1** | LoD>T | 0.4[11] |
| Styrene | µg/ l | 0/ 18 | 10 | NC | 50[1] |
| Trans - 1,2 - Dichloroethene | µg/ l | - | 10 | NC | NT |
| Tetrachloroethene | µg/ l | 5/ 18 | **2069** | **206.5** | 10[G] |
| Trichloroethene | µg/ l | 2/ 18 | **62** | 5.89 | 10[G] |
| Vinyl chloride | µg/ l | - | 10 | NC | NT |
| XYLTOT | µg/ l | - | 17 | NC | NT |

**Source: Environmental Agency Chemical Standards for Water:**

[1] Environmental Quality Standard Average (Maximum Allowable) Concentrations - Saltwater Range. [Values derived from EA Publication 'Technical Advice to 3rd Parties on Pollution of Controlled Waters for Part IIa].

**Driver**
Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances: Council Directive 76/464/EEC Substances) (Classification) Regulations 1998: S.I. 1998/389

[11] Directive establishing a framework for Community action in the field of water policy (Water Framework Directive):Directive 2000/60/EC

[F] Surface Waters (Dangerous Substances) (Classification) Regulations 1989: S.I. 1989/2286

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[G] Surface Waters (Dangerous Substances) (Classification) Regulations 1992: S.I. 1992/337

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[J] UK Standard for protection of aquatic life in surface waters - Surface Waters (Dangerous Substances) (Classification) Regulations 1998: S.I. 1998/389

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community - List II substances

[K] UK Drinking Water Standards or World Health Organisation Guidelines for Drinking Water 1984.

7.79. Contaminants in the groundwater were generally observed to comprise elevated metals, PAHs (Benzo(a)pyrene and Indeno(1,2,3 - cd)pyrene) and several VOCs.

Heavy Metals

7.80. Elevated heavy metals such as arsenic, chromium, copper, nickel, selenium and zinc have been identified to be present within the groundwaters underlying this development zone and with the average concentration of zinc indicated as a potential site wide issue. However, in the majority

of cases, the concentrations of these metals are only marginally above the screen used in the assessment and so unlikely to represent a significant risk to Controlled Waters.

Polyaromatic Hydrocarbons

7.81. Speciated PAHs have been identified in the analysis to be above the respective screen for Controlled Waters on a frequent basis. This is related to the very low Tier 2 screening thresholds associated with these compounds.

7.82. Benzo(a)pyrene was detected on two occasion above the LOD in EBH307 and EBH309.

7.83. Indeno (1,2,3 - cd)pyrene was recorded once above the LOD in EBH309.

Volatile Organic Compounds

7.84. Elevated VOCs, notably tetrachloroethene and trichloroethene (the former up to 2,069ug/l in HBH408 and 1,405ug/l in HBH410) have been detected within the underlying groundwaters of this development zone at levels that exceed the respective screen.

7.85. In addition, the previous Entec investigation recorded the following in BH201 and BH203 located in the central area of the Waterfront zone and are shown on Figure 24.

**TABLE 7.28: ELEVATED HYDROCARBONS AND VOC CONTRATIONS FROM ENTEC 2003 INVESTIGATION**

| Contaminant | Units | Concentration | | Tier 2 Screen |
|---|---|---|---|---|
| | | BH201 | BH203 | |
| Total Volatile C4 - C13 | µg/l | 15053 | 156 | NT |
| MTBE | µg/l | 538 | < 10 | NT |
| Benzene | µg/l | 837 | < 10 | 30[J] |
| Toluene | µg/l | 3306 | < 10 | 40[1] |
| Ethylbenzene | µg/l | 563 | < 10 | 20[1] |
| Total Xylene | µg/l | 1570 | < 10 | NT |
| DRO | µg/l | 279 | 2074 | NT |

**Source: Environmental Agency Chemical Standards for Water:**

[1] Environmental Quality Standard Average (Maximum Allowable) Concentrations - Saltwater Range. [Values derived from EA Publication 'Technical Advice to 3rd Parties on Pollution of Controlled Waters for Part IIa].

**Driver**
Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances: Council Directive 76/464/EEC Substances) (Classification) Regulations 1998: S.I. 1998/389

[J] UK Standard for protection of aquatic life in surface waters - Surface Waters (Dangerous Substances) (Classification) Regulations 1998: S.I. 1998/389

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community - List II substances

7.86. In addition, total Gasoline Range organics were detected in borehole EBH309 up to 3210µg/ l and this location corresponds with the four hangars on the slipway in the vicinity of The Solent.

7.87. based upon the above, a potential risk to offsite Controlled Waters receptors may be present as the data shows concentrations to progressively weaken with distance towards the west around the former BFI.

***Hangars West***

7.88. The statistics associated with groundwater analysis are summarised in Table 7.29 and elevated contamination in groundwaters is shown on Figure 22.

**TABLE 7.29: SUMMARY OF GROUNDWATER ANALYSIS IN HANGARS WEST**

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Inorganics** | | | | | |
| Arsenic | µg/ l | 0/ 9 | 5 | NC | 25[1] |
| Cadmium | µg/ l | 0/ 9 | 1.5 | NC | 2.5[1] |
| Chromium | µg/ l | 0/ 9 | 13 | NC | 15[1] |
| Copper | µg/ l | 6/ 9 | **12** | **7.33** | 5[1] |
| Nickel | µg/ l | 2/ 9 | **17** | 12.11 | 15[1] |
| Inorganic Mercury | µg/ l | 6/ 9 | **0.5** | LoD>T | 0.3[1] |
| Lead | µg/ l | 0/ 9 | 2 | NC | 25[1] |
| Selenium | µg/ l | 0/ 3 | 3 | NC | 10[K] |
| Zinc | µg/ l | 6/ 9 | **215** | **125** | 40[1] |
| **Organics** | | | | | |
| Benzene | µg/ l | 0/ 9 | 10 | NC | 30[J] |
| Toluene | µg/ l | 0/ 9 | 10 | NC | 40[1] |
| Ethylbenzene | µg/ l | 0/ 9 | 10 | NC | 20[1] |
| o - Xylene | µg/ l | - | 5 | NC | NT |
| Xylene (Total) | µg/ l | - | 10 | NC | NT |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Phenol (Total) | µg/ l | 0/ 3 | 0.4 | NC | 30[1] |
| **Speciated Petroleum Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | µg/ l | - | 1.5 | NC | NT |
| Aromatics >EC8-EC10 | µg/ l | - | 4.8 | NC | NT |
| Aliphatics >EC10-EC12 | µg/ l | - | 1.7 | NC | NT |
| Aromatics >EC10-EC12 | µg/ l | - | 4.8 | NC | NT |
| Aromatics >EC12-EC16 | µg/ l | - | 4.1 | NC | NT |
| Aliphatics >EC12-EC16 | µg/ l | - | 1.7 | NC | NT |
| Aliphatics >EC16-EC21 | µg/ l | - | 2.5 | NC | NT |
| Aliphatics >EC21-EC35 | µg/ l | - | 35.7 | NC | NT |
| Aromatics >EC16-EC21 | µg/ l | - | 4.9 | NC | NT |
| Aromatics >EC21-EC35 | µg/ l | - | 9.1 | NC | NT |
| C5 - C6 | µg/ l | - | 10 | NC | NT |
| C7 - C8 | µg/ l | - | 10 | NC | NT |
| C8 - C10 | µg/ l | - | 10 | NC | NT |
| Total GRO | µg/ l | - | 10 | NC | NT |
| Diesel Range Organics | µg/ l | - | 370 | NC | NT |
| MTBE | µg/ l | - | 10 | NC | NT |
| **Poly Aromatic Hydrocarbons** | | | | | |
| Acenaphthylene | µg/ l | - | 0.04 | NC | NT |
| Acenaphthene | µg/ l | - | 0.048 | NC | NT |
| Anthracene | µg/ l | 0/ 3 | 0.04 | NC | 0.1[11] |
| Benzo (a) anthracene | µg/ l | - | 0.04 | NC | NT |
| Benzo (a) pyrene | µg/ l | 0/ 3 | 0.04 | NC | 0.05[11] |
| Benzo (b) fluoranthene | µg/ l | 3/ 3 | **8** | LoD>T | 0.03[11] |
| Benzo (ghi) perylene | µg/ l | 3/ 3 | **0.04** | LoD>T | 0.002[11] |
| Benzo (k) fluoranthene | µg/ l | 3/ 3 | **0.04** | LoD>T | 0.03[11] |
| Chrysene | µg/ l | - | 0.04 | NC | NT |
| Fluorene | µg/ l | - | 0.06 | NC | NT |
| Fluoranthene | µg/ l | 3/ 3 | **0.04** | LoD>T | 0.002[1] |
| Naphthalene | µg/ l | 0/ 3 | 0.148 | NC | 10[J] |
| Dibenzo (ah) anthracene | µg/ l | - | 0.04 | NC | NT |
| Indeno (1,2,3 - cd) pyrene | µg/ l | 3/ 3 | **0.04** | LoD>T | 0.002[11] |
| Phenanthrene | µg/ l | - | 0.124 | NC | NT |
| Pyrene | µg/ l | - | 0.04 | NC | NT |
| **Volatile Organic Hydrocarbons** | | | | | |
| 1,1,1,2 - Tetrachloroethane | µg/ l | - | 5 | NC | NT |
| 1,1,1 - Trichloroethane | µg/ l | 0/ 2 | 1 | NC | 100[1] |
| 1,1,2 - Trichloroethane | µg/ l | 0/ 2 | 1 | NC | 300[1] |
| 1,1 - Dichloroethane | µg/ l | - | 1 | NC | NT |
| 1,1 - Dichloroethene | µg/ l | - | 1 | NC | NT |
| 1,2,4 - Trimethylbenzene | µg/ l | - | 1 | NC | NT |
| 1,2 - Dibromo - 3 - Chloropropane | µg/ l | - | 1 | NC | NT |
| 1,2 - Dichloroethane | µg/ l | 0/ 2 | 1 | NC | 10[G] |
| cis 1,2 - Dichloroethene | µg/ l | - | 1 | NC | NT |
| 1,2 - Dichloropropane | µg/ l | - | 1 | NC | NT |
| cis 1,3 - Dichloropropene | µg/ l | - | 1 | NC | NT |
| 2,4,6 - Trichlorophenol | µg/ l | - | 0.4 | NC | NT |
| 2,4 - Dimethylphenol | µg/ l | - | 0.4 | NC | NT |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| 2,4 - Dinitrotoluene | µg/ l | - | 0.1 | NC | NT |
| 2,6 - Dinitrotoluene | µg/ l | - | 20 | NC | NT |
| bis (2 - ethylhexyl) phthalate | µg/ l | - | 20 | NC | NT |
| Butyl benzyl phthalate | µg/ l | - | 20 | NC | NT |
| Biphenyl | µg/ l | 0/ 3 | 0.04 | NC | 25[J] |
| Bromobenzene | µg/ l | - | 1 | NC | NT |
| Bromoform | µg/ l | - | 1 | NC | NT |
| Bromodichloromethane | µg/ l | - | 2 | NC | NT |
| Chloroform | µg/ l | 0/ 2 | 3 | NC | 12[F] |
| Chloromethane | µg/ l | - | 5 | NC | NT |
| Carbon tetrachloride | µg/ l | - | 1 | NC | NT |
| Di-n-butyl phthalate | µg/ l | - | 0.528 | NC | NT |
| Di - n - octyl phthalate | µg/ l | - | 40 | NC | NT |
| Hexachloroethane | µg/ l | - | 0.1 | NC | NT |
| Hexachlorobenzene | µg/ l | 0/ 3 | 0.01 | NC | 0.03[F] |
| Hexachlorobutadiene | µg/ l | 0/ 3 | 0.1 | NC | 0.1[F] |
| iso - Propylbenzene | µg/ l | - | 1 | NC | NT |
| Pentachlorophenol | µg/ l | 3/ 3 | **1** | LoD>T | 0.4[11] |
| Styrene | µg/ l | 0/ 2 | 1 | NC | 50[1] |
| Trans - 1,2 - Dichloroethene | µg/ l | - | 1 | NC | NT |
| Tetrachloroethene | µg/ l | 0/ 3 | 1 | NC | 10[G] |
| Trichloroethene | µg/ l | 0/ 2 | 1 | NC | 10[G] |
| Vinyl chloride | µg/ l | - | 1 | NC | NT |
| XYLTOT | µg/ l | - | 10 | NC | NT |

**Source: Environmental Agency Chemical Standards for Water:**

[1] Environmental Quality Standard Average (Maximum Allowable) Concentrations - Saltwater Range. [Values derived from EA Publication 'Technical Advice to 3rd Parties on Pollution of Controlled Waters for Part IIa].

**Driver**
Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances: Council Directive 76/464/EEC Substances) (Classification) Regulations 1998: S.I. 1998/389

[11] Directive establishing a framework for Community action in the field of water policy (Water Framework Directive):Directive 2000/60/EC

[F] Surface Waters (Dangerous Substances) (Classification) Regulations 1989: S.I. 1989/2286

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[G] Surface Waters (Dangerous Substances) (Classification) Regulations 1992: S.I. 1992/337

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[J] UK Standard for protection of aquatic life in surface waters - Surface Waters (Dangerous Substances) (Classification) Regulations 1998: S.I. 1998/389

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community - List II substances

[K] UK Drinking Water Standards or World Health Organisation Guidelines for Drinking Water 1984.

7.89. Contaminants in the groundwater were generally observed to be heavy metals and PAHs.

Heavy Metals

7.90. Elevated heavy metals such as copper, nickel and zinc have been identified to be present within the groundwaters underlying this development zone with the average concentration of copper and zinc also exceeding the screen indicating a more site wide issue. However, in the majority of cases, the concentrations of these metals are only marginally above the screen used in the assessment and so are considered unlikely to represent a significant risk to Controlled Waters.

7.91. In addition to elevated diesel range organics were also detected at 370ug/l within BH211 in the vicinity of Hangar R (building 343) indicating some localised impaction.

Polyaromatic Hydrocarbons

7.92. Speciated polyaromatic hydrocarbons were detected in a limited number of groundwaters tests with limits of detection above the level of the screen.

***Hangars East***

7.93. The statistics associated with groundwater analysis are summarised in Table 7.30 and elevated contamination in groundwaters is shown on Figure 23.

**TABLE 7.30: SUMMARY OF GROUNDWATER ANALYSIS IN HANGARS EAST**

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| **Inorganics** | | | | | |
| Arsenic | µg/ l | 0/ 15 | 3 | NC | 25[1] |
| Cadmium | µg/ l | 0/ 15 | 1.6 | NC | 2.5[1] |
| Chromium | µg/ l | 1/ 15 | **16** | 7.33 | 15[1] |
| Copper | µg/ l | 9/ 15 | **12** | **6.66** | 5[1] |
| Inorganic Mercury | µg/ l | 9/ 15 | **0.5** | LoD>T | 0.3[1] |
| Nickel | µg/ l | 3/ 15 | **19** | 9.6 | 15[1] |
| Lead | µg/ l | 0/ 15 | 2 | NC | 25[1] |
| Selenium | µg/ l | 0/ 7 | 4 | NC | 10[K] |
| Zinc | µg/ l | 8/ 15 | **333** | **131.6** | 40[1] |
| **Organics** | | | | | |
| Benzene | µg/ l | 0/ 15 | 10 | NC | 30[J] |
| Toluene | µg/ l | 0/ 15 | 10 | NC | 40[1] |
| Ethylbenzene | µg/ l | 0/ 15 | 10 | NC | 20[1] |
| o - Xylene | µg/ l | - | 5 | NC | NT |
| Phenol (Total) | µg/ l | 0/ 6 | 0.4 | NC | 30[1] |
| **Speciated Petroleum Hydrocarbons** | | | | | |
| Aliphatics >EC8-EC10 | µg/ l | - | 1.9 | NC | NT |
| Aromatics >EC8-EC10 | µg/ l | - | 4.3 | NC | NT |
| Aliphatics >EC10-EC12 | µg/ l | - | 2.4 | NC | NT |
| Aromatics >EC10-EC12 | µg/ l | - | 4.3 | NC | NT |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Aromatics >EC12-EC16 | µg/ l | - | 3.7 | NC | NT |
| Aliphatics >EC12-EC16 | µg/ l | - | 1.8 | NC | NT |
| Aliphatics >EC16-EC21 | µg/ l | - | 3.6 | NC | NT |
| Aromatics >EC16-EC21 | µg/ l | - | 4.7 | NC | NT |
| Aliphatics >EC21-EC35 | µg/ l | - | 14.9 | NC | NT |
| Aromatics >EC21-EC35 | µg/ l | - | 20.3 | NC | NT |
| C5 - C6 | µg/ l | - | 10 | NC | NT |
| C7 - C8 | µg/ l | - | 10 | NC | NT |
| C8 - C10 | µg/ l | - | 10 | NC | NT |
| Diesel Range Organics | µg/ l | - | 10 | NC | NT |
| MTBE | µg/ l | - | 10 | NC | NT |
| **Poly Aromatic Hydrocarbons** | | | | | |
| Acenaphthylene | µg/ l | - | 0.04 | NC | NT |
| Acenaphthene | µg/ l | - | 0.054 | NC | NT |
| Anthracene | µg/ l | 0/ 7 | 0.04 | NC | 0.1[11] |
| Benzo (a) anthracene | µg/ l | - | 0.04 | NC | NT |
| Benzo (a) pyrene | µg/ l | 0/ 7 | 0.04 | NC | 0.05[11] |
| Benzo (b) fluoranthene | µg/ l | 7/ 7 | **8** | LoD>T | 0.03[11] |
| Benzo (ghi) perylene | µg/ l | 7/ 7 | **0.04** | LoD>T | 0.002[11] |
| Benzo (k) fluoranthene | µg/ l | 7/ 7 | **0.04** | LoD>T | 0.03[11] |
| Chrysene | µg/ l | - | 0.04 | NC | NT |
| Chrysene | µg/ l | - | 0.04 | NC | NT |
| Dibenzo (ah) anthracene | µg/ l | - | 0.04 | NC | NT |
| Fluorene | µg/ l | - | 0.05 | NC | NT |
| Fluoranthene | µg/ l | 7/ 7 | **0.04** | LoD>T | 0.002[1] |
| Indeno (1,2,3 - cd) pyrene | µg/ l | 7/ 7 | **0.04** | LoD>T | 0.002[11] |
| Naphthalene | µg/ l | 0/ 7 | 0.138 | NC | 10[J] |
| Phenanthrene | µg/ l | - | 0.084 | NC | NT |
| Pyrene | µg/ l | - | 0.04 | NC | NT |
| **Volatile Organic Hydrocarbons** | | | | | |
| 1,1,1,2 - Tetrachloroethane | µg/ l | - | 5 | NC | NT |
| 1,1,1 - Trichloroethane | µg/ l | 0/ 7 | 22 | NC | 100[1] |
| 1,1,2 - Trichloroethane | µg/ l | 0/ 7 | 1 | NC | 300[1] |
| 1,1 - Dichloroethane | µg/ l | - | 1 | NC | NT |
| 1,1 - Dichloroethene | µg/ l | - | 1 | NC | NT |
| 1,2,4 - Trimethylbenzene | µg/ l | - | 1 | NC | NT |
| 1,2 - Dibromo - 3 - Chloropropane | µg/ l | - | 1 | NC | NT |
| 1,2 - Dichloroethane | µg/ l | 0/ 7 | 1 | NC | 10[G] |
| cis 1,2 - Dichloroethene | µg/ l | - | 1 | NC | NT |
| 1,2 - Dichloropropane | µg/ l | - | 1 | NC | NT |
| cis 1,3 - Dichloropropene | µg/ l | - | 1 | NC | NT |
| 2,4,6 - Trichlorophenol | µg/ l | - | 0.4 | NC | NT |
| 2,4 - Dimethylphenol | µg/ l | - | 0.4 | NC | NT |
| 2,4 - Dinitrotoluene | µg/ l | - | 0.1 | NC | NT |
| 2,6 - Dinitrotoluene | µg/ l | - | 20 | NC | NT |
| bis (2 - ethylhexyl) phthalate | µg/ l | - | 20 | NC | NT |
| Butyl benzyl phthalate | µg/ l | - | 20 | NC | NT |
| Biphenyl | µg/ l | 0/ 7 | 0.04 | NC | 25[J] |
| Bromobenzene | µg/ l | - | 1 | NC | NT |

| Contaminant | Units | Exceeding | Max | 50th% | Tier 2 Screen |
|---|---|---|---|---|---|
| Bromoform | µg/ l | - | 1 | NC | NT |
| Bromodichloromethane | µg/ l | - | 1 | NC | NT |
| Chloroform | µg/ l | 0/ 7 | 1 | NC | 12[F] |
| Chloromethane | µg/ l | - | 11 | NC | NT |
| Carbon tetrachloride | µg/ l | - | 1 | NC | NT |
| Di-n-butyl phthalate | µg/ l | - | 0.525 | NC | NT |
| Di - n - octyl phthalate | µg/ l | - | 40 | NC | NT |
| Hexachloroethane | µg/ l | - | 0.1 | NC | NT |
| Hexachlorobenzene | µg/ l | 0/ 7 | 0.01 | NC | 0.03[F] |
| Hexachlorobutadiene | µg/ l | 0/ 7 | 0.1 | NC | 0.1[F] |
| iso - Propylbenzene | µg/ l | - | 1 | NC | NT |
| Pentachlorophenol | µg/ l | 6/ 7 | 1 | LoD>T | 0.4[11] |
| Styrene | µg/ l | 0/ 7 | 1 | NC | 50[1] |
| Xylene (Total) | µg/ l | - | 10 | NC | NT |
| Trans - 1,2 - Dichloroethene | µg/ l | - | 1 | NC | NT |
| Tetrachloroethene | µg/ l | 0/ 7 | 1 | NC | 10[G] |
| Trichloroethene | µg/ l | 0/ 7 | 1 | NC | 10[G] |
| Vinyl chloride | µg/ l | - | 1 | NC | NT |
| XYLTOT | µg/ l | - | 10 | NC | NT |

**Source: Environmental Agency Chemical Standards for Water:**

[1] Environmental Quality Standard Average (Maximum Allowable) Concentrations - Saltwater Range. [Values derived from EA Publication 'Technical Advice to 3rd Parties on Pollution of Controlled Waters for Part IIa].

**Driver**
Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances: Council Directive 76/464/EEC Substances) (Classification) Regulations 1998: S.I. 1998/389

[11] Directive establishing a framework for Community action in the field of water policy (Water Framework Directive):Directive 2000/60/EC

[F] Surface Waters (Dangerous Substances) (Classification) Regulations 1989: S.I. 1989/2286

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[G] Surface Waters (Dangerous Substances) (Classification) Regulations 1992: S.I. 1992/337

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances

[J] UK Standard for protection of aquatic life in surface waters - Surface Waters (Dangerous Substances) (Classification) Regulations 1998: S.I. 1998/389

**Driver:** Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community - List II substances

[K] UK Drinking Water Standards or World Health Organisation Guidelines for Drinking Water 1984.

7.94. Contaminants in the groundwater were generally observed to be heavy metals and PAHs and are discussed below.

Heavy Metals

7.95. Elevated heavy metals such as chromium, copper, nickel and zinc have been identified to be present within the groundwaters underlying this development zone with the average concentrations of copper and zinc also exceeding the screen indicating a more site wide issue for these contaminants. However, in the majority of cases, the concentrations of these metals are only marginally above the screen used in the assessment and so unlikely to represent a significant risk to Controlled Waters.

Polyaromatic Hydrocarbons

7.96. Speciated polyaromatic hydrocarbons were detected in a limited number of groundwaters tests with limits of detection above the level of the screen.

**Ground Gas Assessment**

7.97. Ground gas monitoring was undertaken on a single visit by the Entec site investigation for a limited number of borehole installations corresponding with the proposed development zones listed in Table 7.31.

**TABLE 7.31: GAS MONITORING WITHIN PROPOSED DEVEOPMENT ZONES**

| Proposed Development Zone | Borehole |
|---|---|
| Drake Gardens and Seaplane Square Residential [Areas 1 and 8a] | EBH301 |
| | EBH302 |
| Wykeham Hall and Barracks Square Residential [Areas 4 and 5b] | - |
| Barracks Square, Unicorn Triangle and Westcliffe Seafront Mixed-use [Area 5a, 6 and 7b] | EBH307 |
| | EBH308 |
| Airport Park, Marine Business Park, Unicorn Triangle and Seaplane Square Commercial [Areas 2, 3, 7a, 8b] | EBH303 |
| | EBH304 |
| | EBH305 |
| | EBH306 |
| | EBH309 |
| | EBH310 |
| | EWS305 |
| Hangars West | - |
| Hangars East | ETP301 |

7.98. Based upon the above, a preliminary appraisal of ground gas issues can be made at this time for those proposed development areas where gas monitoring was completed. It is noted however, that additional gas monitoring is required throughout the site.

***Drake Gardens and Seaplane Square Residential [Areas 1 and 8a]***

7.99. The notable pre-purge results, where carbon dioxide exceeded 1.5%, methane 1% and/or oxygen fell below 18%, and elevated PID readings are summarised in Table 7.32.

**TABLE 7.32: SUMMARY GAS CONCENTRATIONS**

| Borehole | Date | Oxygen (%v/v) | Carbon Dioxide (%v/v) | Methane (%v/v) | Carbon Monoxide (ppm) | $H_2S$ (ppm) | PID (ppm) | Atmospheric Pressure (mb) |
|---|---|---|---|---|---|---|---|---|
| EBH301 | 06/12/05 | 20.8 | 0.0 | 0.0 | 5 | 0 | 0.3 | 1005 |
| EBH302 | 06/12/05 | 20.5 | 0.0 | 0.0 | 2 | 0 | 0.2 | 1007 |

7.100. During the course of this monitoring, no detectable concentrations of carbon dioxide ($CO_2$) or methane ($CH_2$) were detected. With regards to oxygen, concentrations ranged between typically average concentrations of 20.5-20.8%.

7.101. PID readings (Volatile Organic Compounds (VOCs)), carbon monoxide (CO) and hydrogen sulphide ($H_2S$) were generally low or below detectable limits.

7.102. Based upon the guidance presented in Table 7.1, an initial assessment has been made of the requirements for gas protection that consider sources of gas generation, gas flows and concentrations and potential exposure routes. This is summarised below:

- Potential on-site source of generation. Identified sources of ground gas and VOCs comprise the former BFI and identified VOC impaction of groundwater.
- Potential off-site source of generation. Identified sources of gas generation offsite have been recorded as historic pollution incident at the Control Tower.
- Gas Flows – None recorded.
- A Gas Screening Value has not been calculated.
- Exposure Routes. Gas at the site primarily presents a concern following ingress into confined spaces both during and after construction.

7.103. Initial gas monitoring data infers a CIRIA Characteristic Situation 1, although it is noted that elevated VOCs are present within underlying groundwaters, which will require additional consideration.

7.104. For this development area, CIRIA 665 recommends a total of 12 monitoring visits over a period of 6 months. This monitoring frequency is considered suitable for high sensitivity (residential with gardens) end use and sites with a moderate-high potential for ground gas generation. Such a

frequency is considered appropriate for this site and may require approval with the local authority.

***Wykeham Hall and Barracks Square Residential [Areas 4 and 5b]***

7.105. No gas monitoring has been undertaken within this proposed development area. In accordance with CIRIA 665, it is recommended that a total of 9 monitoring visits over a period of six months. This monitoring frequency is considered suitable for high sensitivity (residential with gardens) end use and sites with a low potential for ground gas generation. Such a frequency is considered appropriate for this site and may require approval with the local authority.

***Barracks Square, Unicorn Triangle and Westcliffe Seafront Mixed-Use [Areas 5a, 6 and 7b]***

7.106. The notable pre-purge results, where carbon dioxide exceeded 1.5%, methane 1% and/or oxygen fell below 18%, are summarised in Table 7.33.

**TABLE 7.33: SUMMARY GAS CONCENTRATIONS**

| Borehole | Date | Oxygen (%v/v) | Carbon Dioxide (%v/v) | Methane (%v/v) | Carbon Monoxide (ppm) | $H_2S$ (ppm) | PID (ppm) | Atmospheric Pressure (mb) |
|---|---|---|---|---|---|---|---|---|
| EBH307 | 06/12/05 | 19.9 | 0.0 | 0.0 | 5 | 0 | 610 | 1007 |
| EBH308 | 06/12/05 | 20.0 | 0.0 | 0.0 | 4 | 0 | 21.7 | 1007 |

7.107. During the course of this monitoring, no detectable concentrations of carbon dioxide ($CO_2$) or methane ($CH_2$) were detected. With regards to oxygen, concentrations were typically 20%.

7.108. PID readings (Volatile Organic Compounds (VOCs) were notably elevated at this location with a maximum reading of 610ppm in EBH307. It is noted that this borehole location corresponds with identified groundwater impaction at the former MT Section fuel store.

7.109. Based upon the guidance presented in Table 7.1, an initial assessment has been made of the requirements for gas protection that consider sources of gas generation, gas flows and concentrations and potential exposure routes. This is summarised below:

- Potential on-site source of generation. Identified sources of ground gas and VOCs comprise the former MT Section, fuel storage areas and VOC impacted groundwater.
- Potential off-site source of generation. Former commercial areas to the north of this zone.
- Gas Flows. None recorded.

- A Gas Screening Value has not been calculated.
- Exposure Routes. Gas at the site primarily presents a concern following ingress into confined spaces both during and after construction.

7.110. Initial gas monitoring data infers a CIRIA Characteristic Situation 1, although it is noted that elevated VOCs are present within underlying groundwaters, which will require additional consideration.

7.111. For this development area, CIRIA 665 recommends a total of 6 monitoring visits over a period of 3 months. This monitoring frequency is considered suitable for moderate sensitivity (mixed-use and residential flats) end use and sites with a low potential for ground gas generation, although VOCs have been detected in groundwater. Such a frequency is considered appropriate for this site and may require approval with the local authority.

***Airport Park, Marine Business Park, unicorn Triangle and Seaplane Square Commercial [Areas 2, 3, 7a and 8b]***

7.112. The notable pre-purge results, where carbon dioxide exceeded 1.5%, methane 1% and/or oxygen fell below 18%, are summarised in Table 7.34.

**TABLE 7.34: SUMMARY GAS CONCENTRATIONS**

| Borehole | Date | Oxygen (%v/v) | Carbon Dioxide (%v/v) | Methane (%v/v) | Carbon Monoxide (ppm) | $H_2S$ (ppm) | PID (ppm) | Atmospheric Pressure (mb) |
|---|---|---|---|---|---|---|---|---|
| EBH303 | 06/12/05 | 20.0 | 0.0 | 0.0 | 2 | 0 | 1.0 | 1011 |
| EBH304 | 06/12/05 | 20.9 | 0.0 | 0.0 | 6 | 0 | 0.2 | 1005 |
| EBH305 | 06/12/05 | 20.2 | 0.0 | 0.0 | 0 | 0 | 1.0 | 1016 |
| EBH306 | 06/12/05 | 20.6 | 0.0 | 0.0 | 6 | 0 | 0.2 | 1004 |
| EBH309 | 06/12/05 | 19.9 | 0.0 | 0.0 | 3 | 0 | 415 | 1008 |
| EBH310 | 06/12/05 | 20.0 | 0.0 | 0.1 | 5 | 0 | 17 | 1017 |
| EWS305 | 06/12/05 | 20.0 | 0.0 | 0.0 | 2 | 0 | 0.3 | 1016 |

7.113. During the course of this monitoring, no detectable concentrations of carbon dioxide ($CO_2$) or methane ($CH_2$) were detected. With regards to oxygen, concentrations ranged between typically average concentrations of 19.9 – 20.9%.

7.114. PID readings (Volatile Organic Compounds (VOCs) were notably elevated with a maximum reading of 415ppm in EBH309 at the slipway in Seaplane Square, which is down-gradient of previous occurrences of VOCs at the former MT Section fuel store.

7.115. Based upon the guidance presented in Table 7.1, an initial assessment has been made of the requirements for gas protection that consider sources of gas generation, gas flows and concentrations and potential exposure routes. This is summarised below:

- Potential on-site source of generation. Identified sources of ground gas and VOCs comprise the hangar areas and identified VOC impaction of groundwater.
- Potential off-site source of generation. Identified sources of ground gas generation offsite have been recorded as areas around the former BFI to the west and MT Section to the south of this zone and historic pollution incident at the Control Tower.
- Gas Flows. None recorded.
- A Gas Screening Value has not been calculated.
- Exposure Routes. Gas at the site primarily presents a concern following ingress into confined spaces both during and after construction.

7.116. Initial gas monitoring data infers a CIRIA Characteristic Situation 1, although it is noted that elevated VOCs are present within underlying groundwaters, which will require additional consideration.

7.117. For this development area, CIRIA 665 recommends a total of 6 monitoring visits over a period of 3 months. This monitoring frequency is considered suitable for low sensitivity (commercial) end use and sites with a moderate potential for ground gas generation corresponding with the historical use of this area. Such a frequency is considered appropriate for this site and may require approval with the local authority.

***Hangars West Commercial***

7.118. No gas monitoring has been undertaken within this proposed development area. In accordance with CIRIA 665, it is recommended that a total of 6 monitoring visits over a period of 2 months. This monitoring frequency is considered suitable for low sensitivity (commercial) end use and sites with a low potential for ground gas generation. Such a frequency is considered appropriate for this site and may require approval with the local authority.

***Hangars East Commercial***

7.119. The notable pre-purge results, where carbon dioxide exceeded 1.5%, methane 1% and/or oxygen fell below 18%, are summarised in Table 7.35.

**TABLE 7.35: SUMMARY GAS CONCENTRATIONS**

| Borehole | Date | Oxygen (%v/v) | Carbon Dioxide (%v/v) | Methane (%v/v) | Carbon Monoxide (ppm) | $H_2S$ (ppm) | PID (ppm) | Atmospheric Pressure (mb) |
|---|---|---|---|---|---|---|---|---|
| ETP301 | 06/12/05 | 19.9 | 0.0 | 0.0 | 6 | 0 | 0.1 | 1016 |

7.120. During the course of this monitoring, no detectable concentrations of carbon dioxide ($CO_2$) or methane ($CH_2$) were detected. With regards to oxygen, concentrations recorded 19.9%.

7.121. PID readings (Volatile Organic Compounds (VOCs)), carbon monoxide (CO) and hydrogen sulphide ($H_2S$) were generally below detectable limits

7.122. Based upon the guidance presented in Table 7.1, an assessment has been made of the requirements for gas protection that consider sources of gas generation, gas flows and concentrations and potential exposure routes. This is summarised below:

- Potential on-site source of generation. Areas of Made Ground and potential fuel spillage from storage tanks around aircraft hangars.
- Potential off-site source of generation. Identified sources of gas generation offsite have been recorded as nearby landfills to the east and Victoria landfill to the north, organic rich deposits associated with the tributary of the River Alver and areas of Made Ground.
- Gas Flows. None recorded.
- A Gas Screening Value has not been calculated.
- Exposure Routes. Gas at the site primarily presents a concern following ingress into confined spaces both during and after construction.

7.123. Initial gas monitoring data infers a CIRIA Characteristic Situation 1.

7.124. For this development area, CIRIA 665 recommends a total of 6 monitoring visits over a period of 2 months. This monitoring frequency is considered suitable for low sensitivity (commercial) end use and sites with a low potential for ground gas generation. Such a frequency is considered appropriate for this site and may require approval with the local authority.

## 8.0 REVISED CONCEPTUAL MODEL AND RISK ASSESSMENT

8.1. Current guidance for contaminated land advocates the assessment of risk by determining the presence of pollutant linkages and weighting the likelihood of harm occurring with the potential severity of that harm. The framework is set out in various publications by the DETR, Environment Agency, Institute for Environment and Health and CIRIA.

8.2. Tables 5.1 - 5.7 indicate the potential contaminants, pollutant linkages and receptors that have been considered at the site. Following the investigation of these by Entec / Halcrow, a revised Conceptual Site Model is presented below in Tables 8.1 - 8.7 for each of the viable pollutant linkages and particular receptors and illustrated in Figures 25-27. For the purpose of this assessment, the following descriptions of risk have been utilised, which take into account the magnitude of the source contamination identified, likelihood of exposure via a pathway and significance of harm likely to result on the given receptor[6]:

- **High Risk.** Pollutant linkage is likely to exist and be causing significant harm.
- **Medium Risk.** Pollutant linkage is likely to exist but significant harm is unlikely.
- **Low Risk**. Pollutant linkage may exist but any harm is likely to be mild.

[6] IEH 'Guidelines for Environmental Risk Assessment and Management' and CIRIA 552 'Contaminated Land Risk Assessment, Guide to Good Practice'. Section 6 of CIRIA 552 presents matrices for risk assessment. These have been simplified herein.

**TABLE 8.1: END USERS DURING OCCUPATION IN RESIDENTIAL AREAS**

| PATHWAY | RISK | COMMENT |
|---|---|---|
| **Drake Gardens and Seaplane Square Residential [Areas 1 and 8a]** | | |
| Inhalation of vapour from soil / dust / water | High• | This assessment is based upon the findings of:<br><br>• Potential sources of contamination (Table 5.1)<br>• Soil results screened against thresholds (Table 7.3)<br>• Leachate results (Table 7.24)<br>• Groundwater results (Table 7.27)<br>• Gas Results (Table 7.32)<br><br>The investigation has not identified contamination by metal and hydrocarbons to soils with the exception of lead at EBH301.<br><br>Elevated VOCs comprising BTEX and Tetrachloroethene (HBH410) in groundwater have been identified that could present a risk to human health.<br><br>A **MEDIUM / HIGH** risk is considered to exist associated with VOCs and the potential for fuel based hydrocarbons / unforeseen contamination to be present locally due to the potential sources of contamination at the bulk fuel installation listed in Table 5.1.<br><br>Further gas monitoring is required. |
| Inhalation of soil / dust | Medium• | |
| Ingestion of soil / dust | Medium• | |
| Dermal contact with soil / dust / water | Medium• | |
| Migration of soil gases to confined spaces/structure | High | |
| Consumption of home-grown vegetables | High• | |
| Uptake by flora / fauna | Medium | |
| **Wykeham Hall and Barracks Square Residential [Areas 4 and 5b]** | | |
| Inhalation of vapour from soil / dust / water | Low | This assessment is based upon the findings of:<br><br>• Potential sources of contamination (Table 5.1)<br>• Soil results screened against thresholds (Table 7.6)<br>• Leachate results (Table 7.24)<br>• Groundwater results (Table 7.27)<br><br>The investigation has not identified contamination by |
| Inhalation of soil / dust | Medium | |
| Ingestion of soil / dust | Medium | |
| Dermal contact with soil / dust / water | Medium | |
| Migration of soil gases to confined spaces/structure | Low | |

| PATHWAY | RISK | COMMENT |
|---|---|---|
| Consumption of home-grown vegetables | Low/Medium | metal and hydrocarbons to soils or groundwaters, although sampling in this area was limited.<br><br>On the basis that offsite contamination was previously identified at the former grounds maintenance area (building 273) and asbestos inferred within demolition arisings, a **LOW / MEDIUM** risk is considered.<br><br>Further gas monitoring is required. |
| Uptake by flora / fauna | Medium | |
| **Hangars West Allotments** | | |
| Inhalation of vapour from soil / dust / water | Low• | Insufficient information from the site investigation exists, however, desk study information infers localised contamination around an area of burning, boiler house, oil store and rifle range.<br><br>A **MEDIUM / HIGH** risk is considered to exist associated with the potential for metals, hydrocarbons and asbestos or unforeseen contamination to be present locally at the site although the proposed usage suggests limited exposure.<br><br>Further gas monitoring is not required in this area due to proposed outdoor usage. |
| Inhalation of soil / dust | High• | |
| Dermal contact with soil / dust / water | High• | |
| Ingestion of soil / dust | High• | |
| Consumption of home-grown vegetables | High• | |
| Uptake by flora / fauna | Medium | |

• Associated with areas of allotment growing areas corresponding with identified contamination.

**TABLE 8.2: END USERS DURING OCCUPATION IN MIXED-USE AREAS**

| PATHWAY | RISK | COMMENT |
|---|---|---|
| **Barracks Square, Unicorn Triangle and Westcliffe Seafront Mixed-use [Areas 5a, 6 and 7b]** | | |
| Inhalation of vapour from soil / dust / water | High• | This assessment is based upon the findings of:<br><br>• Potential sources of contamination (Table 5.1)<br>• Soil results screened against thresholds (Table 7.9)<br>• Leachate results (Table 7.24)<br>• Groundwater results (Table 7.27)<br>• Gas Results (Table 7.33)<br><br>The investigation identified localised contamination by arsenic (HBH403), lead (HTP405) and benzene (HTP405 and HBH405) in soils and elevated BTEX and VOCs (tetrachloroethene) in the groundwater in the area of the former MT Section (proposed residential part of Unicorn Triangle and sheltered accommodation in Barracks Square).<br><br>A **MEDIUM / HIGH** risk is considered to exist associated with VOCs and the potential for fuel based hydrocarbons / unforeseen contamination to be present locally.<br><br>Further gas monitoring is required. |
| Inhalation of soil / dust | Medium• | |
| Ingestion of soil / dust | Medium• | |
| Dermal contact with soil / dust / water | Medium• | |
| Migration of soil gases to confined spaces/structure | Medium/High• | |
| Uptake by flora / fauna | . Medium• | |

• Associated with areas of private gardens / soft landscaping corresponding with identified contamination.

**TABLE 8.3: END USERS DURING OCCUPATION IN COMMERCIAL AREAS**

| PATHWAY | RISK | COMMENT |
|---|---|---|
| **Airport Park, Marine Business Park, Unicorn Triangle and Seaplane Square Commercial [Areas 2, 3, 7a and 8b]** | | |
| Inhalation of vapour from soil / dust / water | Low/Medium | This assessment is based upon the findings of: |

| PATHWAY | RISK | COMMENT |
|---|---|---|
| Inhalation of soil / dust | Low | • Potential sources of contamination (Table 5.1)<br>• Soil results screened against thresholds (Table 7.13)<br>• Leachate results (Table 7.24)<br>• Groundwater results (Table 7.27-28)<br>• Gas Results (Table 7.34)<br><br>The investigation has identified localised lead (1033.5mg/kg at HTP409) and PAH contamination in soils at the vicinity of the historical workshops (south of Esmonde Hangar) and elevated levels of VOCs in groundwater.<br><br>In addition, localised asbestos has previously been detected within Area 3 – Marine Business Park, which may present a risk if used within landscaping areas.<br><br>A **LOW / MEDIUM** risk is considered to exist associated with VOCs and the potential for fuel based hydrocarbons / unforeseen contamination to be present locally.<br><br>Further gas monitoring is required. |
| Ingestion of soil / dust | Low | |
| Dermal contact with soil / dust / water | Low | |
| Uptake by flora / fauna | Low | |
| Migration of soil gases to confined spaces/structure | Medium• | |
| **Hangars West Commercial** | | |
| Inhalation of vapour from soil / dust / water | Low | This assessment is based upon the findings of:<br><br>• Potential sources of contamination (Table 5.1)<br>• Soil results screened against thresholds (Table 7.17)<br>• Leachate results (Table 7.25)<br>• Groundwater results (Table 7.29) |
| Inhalation of soil / dust | Low/Medium | |
| Ingestion of soil / dust | Low/Medium | |
| Dermal contact with soil / dust / water | Low/Medium | |
| Uptake by flora / fauna | Low | |

| PATHWAY | RISK | COMMENT |
|---|---|---|
| Migration of soil gases to confined spaces/structure | Low | The investigation has identified localised lead (1100mg/kg at EWS310) and PAH contamination in soils in the vicinity of the former circular above ground oil tank although PAHs are not considered to represent a risk to human health.<br><br>A **LOW** risk is considered to exist associated with the potential for metals and hydrocarbons or previously unforeseen contamiantion to be present locally at the site.<br><br>Further gas monitoring is required. |
| **Hangars East Commercial** | | |
| Inhalation of vapour from soil / dust / water | Low | This assessment is based upon the findings of:<br><br>• Potential sources of contamination (Table 5.1)<br>• Soil results screened against thresholds (Table 7.21)<br>• Leachate results (Table 7.26)<br>• Groundwater results (Table 7.30)<br>• Gas Results (Table 7.35)<br><br>The investigation has identified localised lead (ETP301) and PAH contamination in soils in the south of this development zone not corresponding with the footprint of the commercial development.<br><br>A **LOW** risk is considered to exist associated with the potential for metals and hydrocarbons or previously unforeseen contamiantion to be present locally at the site.<br><br>Further gas monitoring is required. |
| Inhalation of soil / dust | Low/Medium | |
| Ingestion of soil / dust | Low/Medium | |
| Dermal contact with soil / dust / water | Low/Medium | |
| Uptake by flora / fauna | Low | |
| Migration of soil gases to confined spaces/structure | Low | |

• Associated with areas of soft landscaping corresponding with identified contamination.

**TABLE 8.4: RISK ASSESSMENT: BUILDINGS & INFRASTRUCTURE**

| PATHWAY | RISK | COMMENT |
|---|---|---|
| **Drake Gardens and Seaplane Square Residential [Areas 1 and 8a]** | | |
| Leaching of contamination from Made Ground | High | The investigation has identified metal and hydrocarbon impacted soils and groundwater and metals, cyanide (west of Swann Hangar), benzene and VOCs were found to be readily leachable from soils in the Waterfront zone. |
| Movement of contaminants to engineered structures (e.g. water pipes) | High | |
| **Wykeham Hall and Barracks Square Residential [Areas 4 and 5b]** | | |
| Leaching of contamination from Made Ground | Low/Medium | The investigation has identified metal and hydrocarbons in leachates and groundwater samples, although there is limited data from this development area. |
| Movement of contaminants to engineered structures (e.g. water pipes) | Low/Medium | |
| **Barracks Square, Unicorn Triangle and Westcliffe Seafront Mixed-use [Areas 5a, 6 and 7b]** | | |
| Leaching of contamination from Made Ground | High | The investigation identified significantly elevated BTEX leachate from impacted soils and presence in groundwater in the vicinity of the former MT Section. VOC contamination was identified in the northern parts of this development zone [Area 5a]. |
| Movement of contaminants to engineered structures (e.g. water pipes) | High | |
| **Airport Park, Marine Business Park, Unicorn Triangle and Seaplane Square Commercial [Areas 2, 3, 7a and 8b]** | | |
| Leaching of contamination from Made Ground | High | The investigation has identified VOC hydrocarbon impacted groundwater in the vicinity of the former BFI and Boiler House / Triumph Galley. |
| Movement of contaminants to engineered structures (e.g. water pipes) | High | |
| **Hangars West Commercial** | | |
| Leaching of contamination from Made Ground | Low | The investigation has not identified widespread |

| PATHWAY | RISK | COMMENT |
|---|---|---|
| Movement of contaminants to engineered structures (e.g. water pipes) | Low | contamination in the soils and no elevated leachate. |
| **Hangars East Commercial** | | |
| Leaching of contamination from Made Ground | Low | The investigation has not identified widespread contamination in the soils and no elevated leachate. |
| Movement of contaminants to engineered structures (e.g. water pipes) | Low | |

**TABLE 8.5: RISK ASSESSMENT: CONTROLLED WATERS**

| PATHWAY | RISK | COMMENT |
|---|---|---|
| **Waterfront zone** | | |
| Leaching of contamination from Made Ground | Medium/High• | The investigation has identified hydrocarbon impacted soils, metals and hysdrocarbons readily leachable from soils and impacted groundwater comprising dissolved phase VOCs in the vicinity of the hangars and former BFI.<br><br>Elevated heavy metals such as arsenic, chromium, copper, nickel, selenium and zinc are indicated to be leachable from soil samples but unlikely to represent a significant risk to Controlled Waters receptors.<br><br>Cyanide was identified to be highly leachable from HWS401 (in the vicinity of Swann Hangar) and infers a potential leachate concentration that would significantly exceed the screen protective of Controlled Waters.<br><br>Tetrachloroethene, and to a lesser extent, trichloroethene and BTEX were identified to be highly leachable at HBH10 (possibly near building 141).<br><br>Identified contamination exists and a **MEDIUM / HIGH** risk is considered to exist which requires further assessment and/or remediation. |
| Migration of water borne contaminants | Medium/High• | |
| **Hangars West Commercial** | | |
| Leaching of contamination from Made Ground | Low | The investigation has identified a single lead hotspot at EWS310 in soils. However, several elevated metals were present in groundwaters above the screen but there were no |

| PATHWAY | RISK | COMMENT |
|---|---|---|
| | | exceedences of the screen from leachates. |
| Migration of water borne contaminants | Medium• | Identified localised contamination exists which may require further assessment although currently considered unlikely to present a significant risk to Controlled Waters and a **LOW / MEDIUM** risk is currently considered to exist. |
| **Hangars East Commercial** | | |
| Leaching of contamination from Made Ground | Low | The investigation has identified a single lead hotspot at ETP301 in soils and several elevated metals present in groundwater above the screen but there were no exceedences of the screen from leachates with the exception of zinc. |
| Migration of water borne contaminants | Medium• | Identified localised contamination exists which may require further assessment although currently considered unlikely to present a significant risk to Controlled Waters and a **LOW / MEDIUM** risk is currently considered to exist. |

• Associated with area in vicinity identified contamination.

**TABLE 8.6: GROUNDWORKS (ASSUMING BASIC PPE)***

| PATHWAY | RISK | COMMENT |
|---|---|---|
| Ingestion of soil/dust | Medium• | Redevelopment or maintainance of the site may involve ground workers coming into contact with the underlying soils and water.<br><br>Hydrocarbon impacted soils and groundwater have been identfied locally associated with the former use of the site resulting in a **MEDIUM** risk across the site.<br><br>Normal Health and Safety precautions associated with a site where potential contamination may exist (of the levels identified), will mitigate the general risk to **LOW**. |
| Inhalation of soil/dust | Medium• | |
| Inhalation of vapour from soil / dust / water | Medium• | |
| Dermal contact with soil / dust / water | High• | |
| Migration of soil gases to confined spaces | High | |
| Migration of water borne contaminants | Medium• | |
| Leaching of contamination from Made ground | Low• | |

* Separate assessments are required in relation to asbestos risk. • Associated with area in vicinity of identified contamination.

**TABLE 8.7: RISK ASSESSMENT: OFFSITE RECEPTORS**

| PATHWAY | RISK | COMMENT |
|---|---|---|
| **Adjacent Residential Areas** | | |
| Dermal contact with soil / dust / water | Low | Hydrocarbon VOC impacted groundwater has been identified in the Waterfront zone.<br><br>Residential properties bound the site along Marine Way.<br><br>There is a **MEDIUM** risk is considered in relation to the risk of contaminants migrating beneath adjacent offsite properties. |
| Inhalation of vapour from soil / dust / water | High• | |
| Migration of soil gases to confined spaces/structure | Medium/High• | |
| Movement of contaminants to engineered structures (e.g. water pipes) | Medium• | |
| **Controlled Waters** | | |
| Migration of water borne contaminants | Medium/High | As Table 8.5 above. |

• Associated with area in vicinity identified contamination.

## 9.0 RADIOACTIVE CONTAMINATION

9.1. Under Part IIA of the Environmental Protection Act 1990, (amended by regulation 4(a) of the Modification Regulations), land is determined as contaminated by virtue of radioactivity if 'harm' is being caused or if there is a significant possibility of 'harm' being caused.

9.2. Furthermore, Paragraph A41 of the Statutory Guidance states that a local authority should regard 'harm' as being caused where lasting exposure gives rise to doses that exceed one or more of the following criteria:

- An effective dose of 3 millisieverts per annum (3.0 $mSv.y^{-1}$);
- An equivalent does of the lens of the eye of 15 millisieverts per annum (15 $mSv.y^{-1}$); or
- An equivalent dose to the skin of 50 millisieverts per annum (50 $mSv.y^{-1}$).

9.3. As such, these criteria are referred to as the 'A41' criteria' and are central to undertaking risk assessments into radioactive contamination.

9.4. However, whilst the above definition of radioactive contamination is provided by Part IIA, it is Planning Policy Statement 23 (PPS23) that will be the controlling framework to address radiation contamination risk via the planning process.

9.5. The following text provides a review of the various investigations into radioactive contamination at the Daedalus site, which are referenced [21 – 25] and illustrated in Figures 28-30.

***[21] Defence Radiological Protection Service (DRPS), 24 April 1996***

9.6. A review of available information suggested that in previous years, aircraft were burned on the fire ground site in Hangars East for fire fighting and training purposes. As such, it is likely that old aircraft fitted with radioactively luminised dials (such as Radium $226^{Ra}$) would have been released to the ground. Similar burning areas may have existed in the north of Hangars West. In addition, Thorium-232 was also considered to be a potential contaminant as it may be found within aircraft engines, where it was present as an alloy of magnesium.

9.7. The DRPS undertook a radiological survey in 1996 of the fire-fighting training ground in Hangars East and their survey comprised monitoring by hand-held instrumentation (Mini-Monitor 900 and a portable dose meter) in addition to the collection of three samples for both qualitative and quantitative assessment of the radioactivity.

9.8. The analysis, by gamma spectroscopy, identified radioactive contaminants radium-226 and thorium-232 to be present within the ground that would be of regulatory concern with levels up to 21.0Bq.g$^{-1}$ and exceeding the threshold set at the time (Schedule 3 of the Radioactive Substances Act 1993 - 0.37Bq.g$^{-1}$), therefore requiring remedial action. It was recommended that the radioactively contaminated material covering an area of approximately 65m$^2$ be removed from the site.

9.9. Whilst no verification report for this remediation has been made available, reference to a letter report by DRPS (dated 9 March 1998), was made by Entec in their Phase One Desk Study and this provides confirmation that radiological material had been cleared from the Fire Training Ground by Westechem.

***[22] Entec Phase Two Radiological Survey Draft Report, 8 April 2003***

9.10. Entec undertook a walkover survey of the wider area in 2003, which comprised a review of former building land use, a radiological walkover survey and qualitative assessment. They described several historical operations identified as potential sources of radioactive contamination comprising:

- Aircraft hangars, workshops and maintenance facilities - possible maintenance and storage of radium luminised instruments and paints.
- Fire training area - potential burning of obsolete and damaged aircraft for fire training purposes. It is also noted that DRPS undertook a radiological survey of the fire training ground between January and February 1996 and subsequent remedial works to remove radiological sources identified within this area.
- Burning grounds / waste disposal areas - Three potential burning and waste burial grounds were identified on the south eastern area of the airfield. Entec noted that such areas may contain radium contaminated residues depending upon the nature of material buried. CampbellReith have also identified an area of burning from aerial photograph located in the Hangars West area adjacent to the Bellman Hangar No 4 (building No 356).
- Anecdotal information - evidence that a crash investigation team were based in Hangars R and P (buildings 343 and 344) and that aircraft wrecks were reassembled in these locations inferring that aircraft debris may have temporarily been stored outside of these buildings and radium released to the ground.

9.11. The works were considered by Entec to have covered 100% of all high risk areas such as the surrounds of hangars and workshops; 50 percent coverage of a 20m buffer surrounding these areas. Where small point sources were discovered, the 100% coverage was extended by 5m.

9.12. A guideline screening level of 0.34 $Bq.g^{-1}$ corresponding with 0.3 $mSv.y^{-1}$ (National Radiological Protection Board, NRPB, now part of the Health Protection Agency) as uniform surface contamination as opposed to surface patches was derived for the risk assessment. It is based upon:

- a dose constraint of 0.3 $mSv.yr^{-1}$ for exposure to a 'new' source corresponding to an annual risk of 10-5 of fatal cancer;
- dose limits for members of the public of 1.0$mSv.yr^{-1}$ (dose constraint for the public under the Ionising Radiation Regulations); and,
- a 10 $mSv.yr^{-1}$ dose (risk 5 x 10-4/yr) above which intervention is always justified on risk grounds.

9.13. The dose criteria for 10 mSv.yr-1 and 0.3 mSv.yr-1 screening levels in terms of activity concentrations have been proposed for two situations:

i) Uniform surface contamination i.e. radionuclides widely and fairly uniformly distributed in the top 15cm of soil; and,
ii) Surface patches and buried contamination where radionuclides are distributed in the top 15cm of soil over an area of less than about 20% of the site or radionuclides are at greater depth than 15cm.

**TABLE 9.1: EXCERPT FROM ENTEC PHASE 2 RADIOLOGICAL SURVEY REPORT, 2003, TABLE 5.1: SCREENING LEVELS FOR RADIUM ($Bq.g^{-1}$)**

| Situation | 10mS/yr | 0.3mS/yr |
|---|---|---|
| Uniform Surface Contamination | 11.47 | **0.34** |
| Surface Patches and Buried Contamination | 57.35 | 1.72 |

9.14. Overall, the walkover survey found the majority of the potentially high risk areas to be free from radiological contamination. However, 28 locations surrounding former workshops, hangars and burning grounds exhibited point sources of elevated radioactivity, although their locations have not been provided. They included localised areas where surface soils containing radium-226 were in excess of the Radioactive Substances Act threshold level of 0.37 Bq.g-1 and also exceeded the guideline screening level of 0.34 Bq.g-1.

9.15. The key findings of this study were:

- majority of locations were free from radioactive contamination;
- radioactive contamination was encountered at 28 locations as point sources;
- surface soils were also locally contaminated in excess of Radioactive Substances Act thresholds and guideline screening values recommended by NRPB;
- exposure to radioactive contamination from ingestion of soil and dust represents a potential hazard, although the likelihood is low and the risk to human health is considered by Entec to be moderate; and,
- Entec recommended intervention (i.e. removal of radioactive material to mitigate potential risks to human health).

***[23] Entec Radiological Survey Interim Report, 14 July 2005***

9.16. Another radiological walkover survey was undertaken by Entec in 2005 covering all soft landscaping areas with the exception of a field in the north east of the Hangars East that was ploughed at the time. Areas covered with hard surfacing (concrete, tarmac or by building footprint) were also not surveyed.

9.17. The study showed that the greater part of the site was unaffected by radioactive contamination, although several clusters and isolated hotspots were identified by surface probe measurements. Sources greater than 0.34 $Bq.g^{-1}$ were identified in 14 locations. Points 1 – 6 were located in the vicinity of the former hangars and workshops of the Waterfront zone. Most of these were already known from the previous 2003 survey. Points 7 - 11 were new finds not previously identified and were located adjacent to buildings in Hangars East. These occurrences were considered likely to require some form of remedial action in the context of site redevelopment. Points 12 – 14 were previously identified in Hangars East, with Points 13 and 14 within a burning area in the south.

9.18. Principal anomalies of concern are presented in Table 9.2.

**TABLE 9.2: EXCERPT FROM ENTEC RADIOLOGICAL SURVEY REPORT 2005 TABLE 4.1 RADIOACTIVE ANOMALIES**

| Point No | Location | Maximum Concentration above background (Bq/g) | Equivalent Maximum Dose Rate at Ground Level (μSv/hr) | Areas |
|---|---|---|---|---|
| 1 [a] | North of technical area | 0.37 | 0.2 | Offsite (near 3) |
| 2* | Grassed area near building 134 | 1.81 | 0.7 | 3 |
| 3 | East of Overlord Hangar | 3.98 | 1.3 | 3 |
| 4* | East of Overlord Hangar | 1.07 | 0.5 | 3 |
| 5* | Small oval area south west of building 73 (Dunning Hangar) | 1.09 | 0.5 | 2 |
| 6 | Grassed area near fuel bunker / Crash Tender Bay | 0.39 | 0.2 | 1 |
| 7 | Grassed area south of hangars in west of site | 0.86 | 0.4 | Hangars West |
| 8 | | 0.41 | 0.2 | |
| 9 | | 1.51 | 0.6 | |
| 10 | | 1.02 | 0.4 | |
| 11 | North of hangars in west of site | 0.66 | 0.3 | |
| 12* | Nr Hangar G (building 296) | 0.56 | 0.3 | Hangars East |
| 13* | Former burning area | 0.63 | 0.3 | |
| 14* | Former burning area | 2.37 | 0.9 | |

Note: [a] Denotes Hotspot 1 was not re-locatable. * Denotes identified by the 2003 Entec survey

9.19. Based upon both the 2003 and 2005 surveys, the general extent of radioactive contamination in the Waterfront zone comprised approximately 19 locations within southern parts near to the Aircraft Control Tower (building 16), the E & T Block (building 3), Crash Tender Bay (building 15), to the south west of Esmonde Hangar in the vicinity of Overlord Hangar, adjacent to the Wardroom Annex (building 107) in the vicinity of Westcliffe House, to the west and north of the Triumph Galley.

9.20. In Hangars West, the general extent of radioactive contamination comprised approximately 11 locations, 5 areas to the south of the 303 firing range; 3 locations positioned around Bellman Hangar No 4; and 3 locations to the north east in the vicinity of Hangars T and U.

9.21. The general extent of radioactive contamination in Hangars East comprised approximately 6 locations within southern parts near to Hangars A, B, E, F, G and J in the north near to the fire training burning ground.

***[24] Halcrow Appendices to Review of Data Room Information, September 2005***

9.22. A review by Halcrow of the Entec radiological surveys undertaken up to 2005 identified the following limitations:

- two areas were excluded from the surveys comprising a ploughed field to the north east and an area of undergrowth to the north. Whilst the ploughed field had not been used by the MOD and can be excluded, the area of undergrowth is relatively large and several identified sources of radioactivity have been reported in adjacent areas;
- the survey did not include areas beneath building footprints and concrete hardstanding. As such, it would be appropriate to determine when structures were built in order to assess any potential for radioactive material to be present beneath more recent installations; and,
- the majority of the site was surveyed utilising a wheeled system. Its ability to detect small sources 1m radially from the detector and below the surface of the ground is considered by Halcrow to have been limited. Whilst this is a criticism of the methodology employed, the system is of standard use for ground surveys and still likely to detect large sources and large areas of diffuse radiological contamination.

9.23. The subsequent recommendations were made by Halcrow:

- intrusive investigation to characterise the nature and volumes of radioactive material that is present on site. Halcrow also considered this to be a necessary further step in the investigation of the Daedalus site;
- areas not previously investigated e.g. large area of undergrowth should be cleared and surveyed (if within SEEDA's ownership);
- the potential for recent hardstanding and buildings constructed upon impacted ground should be re-considered;
- a remediation scheme should be developed for the site, which takes account of its currently proposed usage and future risks to occupants. The risk based strategy should be made cognisant of current guidance and government policy and consultation with the Environment Agency also undertaken in this regard.

***[25] Entec Radiological Survey Report, 31 May 2007***

9.24. Following the previous walkover surveys, Entec also undertook an intrusive investigation in September 2005 and this is reported in their 2007 report. The intrusive survey was undertaken in order to:

- investigate whether radioactive materials of higher activity were present in areas where surface probe readings were below 'exempt waste' levels but greater than 1.5 times the background readings;
- investigate the spatial extent of areas where probe readings were higher than the 'exempt waste threshold and whether it fell into the Low Level Waste (LLW) classification;
- collect soil sampling to fingerprint the radioactive contamination; and,
- quantify volumes in accordance with 'exempt waste' or low Level Waste (LLW) for the purposes of designing and costing a remediation strategy.

9.25. The scope of works comprised a total of 69 trial pits, which were excavated to a maximum depth of 1.60m bgl: 29 trial pits were excavated to investigate the 14 numbered hotspots identified during the 2003 and 2005 walkover survey. No above ground radioactivity was detectable in hotspots 1 and 13 so trial pits were subsequently not excavated in these areas. Furthermore, radioactive contamination was not found to extend into the natural ground.

9.26. A further 40 excavations were undertaken to investigate the 24 alphabetically denoted zones of 'elevated radiological activity' together with 15 additional 'minor anomalies'.

9.27. The extent of radioactivity following the intrusive site investigation confirmed 14 localised areas, which qualified for either 'radiological exempt waste' or 'low level waste' in accordance with RSA 1993. These locations are shown on Figures 28 – 30. Estimated volumes of 0.21$m^3$ of LLW and 7.3$m^3$ of radiological exempt waste were identified.

9.28. In addition to the intrusive works, Entec undertook an environmental risk assessment for the site, although confirmation or a reassessment by CampbellReith is outside the scope of this report.

9.29. Entec reported that the threshold criterion for formal determination under 'Part IIA' in cases of harm from radioactivity relating to lasting exposure is set at 3 $mSv.yr^{-1}$ above local background. On this basis and using the Environment Agency's Radioactively Contaminated Land Exposure Assessment (RCLEA) DEFRA methodology, a range of threshold concentrations can be derived for various land-use scenarios. For radium-226, assuming the most conservative end-use scenario (i.e. residential), it was calculated to be 1.1 Bq/g, although this threshold assumes a homogenous source averaged across the site. Notwithstanding this, Entec had previously derived a conservative level protective of risk to site users to be 0.34 Bq/g based upon dose criteria from the NRPB (1990) and continued to utilise this value as the clean-up threshold despite being significantly lower than the lowest RCLEA threshold.

9.30. The risk assessment was undertaken for the current use of the site and for a variety of potential future site users such as for a residential development, where areas indicated to contain radioactive material could potentially be incorporated into a domestic garden resulting in a scenario of greatest concern.

9.31. For existing site users, Entec concluded a **low** risk. Whilst the worst case scenario did illustrate the possibility of an individual receiving a dose in exceedence of the guideline thresholds, it was considered unlikely to occur in practice.

9.32. The risks to future site users were assessed as being **moderate** and on a risk basis, remediation was recommended to reduce potential dose less than 0.3mSv/yr. This could be achieved by removing all material having an activity concentration greater than 0.34 Bq/g above background levels.

***[26] Entec Phase Land Quality Assessment, Radiological Survey Report, Final Technical Note – Remediation Proposal 31 May 2007***

9.33. This report detailed of Entec's proposed remediation strategy, which considers the most appropriate remedial strategy for radioactively contaminated soils is to remove them from site for disposal at a suitably licensed repository.

9.34. This can be undertaken in accordance with the various categories of radium contaminated waste soils as defined by the Radioactive Substances Act 1993, the regulatory regime that governs the accumulation and disposal of radioactive waste. The activity concentrations of relevant categories of radium-contaminated material are given in Table 9.3.

**TABLE 9.3: EXCERPT FROM ENTEC RADIOLOGICAL SURVEY REPORT 2007 TABLE 5.1 RADIUM-CONTAMINATED WASTE CATEGORIES AS DEFINED BY RADIOACTIVE SUBSTANCES ACT 1993**

| Activity Concentration | Description | Classification |
|---|---|---|
| <0.37 Bq/g | Such material is not regarded as radioactive for the purposes of statutory control. | Free Release |
| >0.37 <4.9 Bq/g | Contaminated soil in this range is exempt from the controls in RSA93 by virtue of 'The Radioactive Substances (Phosphatic Substances, Rare Earths etc) Exemption Order 1962', Such material is generally disposed of to landfill under normal duty of care arrangements.<br>(Note: whilst some volume averaging may be acceptable in this category disposal of discrete sources would generally have 10be isolated and removed). | Exempt Waste |
| >4.9 Bq/g | Material above this concentration is regarded as low level Radioactive Waste (LLW). Such material is normally dispatched to BNFL Drigg in Cumbria for disposal under an authorisation issued by the Environment Agency. The upper activity | Low Level waste (LLW) |

| Activity Concentration | Description | Classification |
|---|---|---|
| | concentrations for such disposals is 4000 Bq/g for alpha activity and 12000 Bq/g for beta/gamma activity. For radium and daughters in equilibrium this would equate to a radium-226 concentration of 2000 Bq/g. | |

9.35. All wastes are disposed of according to their activity concentration. 'Free release' material is not classed as radioactive and therefore does not need to be removed from site. Exempt wastes may be sent to any suitably licensed landfill, subject to the agreement of the site operator. In the case of Low Level Waste (LLW), the only such site available is at Drigg, Cumbria, operated by the British Nuclear Group (formerly BNFL). There is currently no permanent disposal facility in the UK for material exceeding the upper limit of activity concentration for LLW, above which the material would be classed as intermediate level waste (ILW). However, no such material is expected to be found at this site.

## 10.0 MUNITIONS AND UNEXOPLODED ORDNANCE

10.1. The investigation into munitions and explosive ordnance at the site has been undertaken by a review of the studies referenced [27 – 31].

***[27] WSP Phase One (Desk Study), May 1995***

10.2. The WSP report generally describes the findings of the walkover survey and discussions with onsite personnel. Anecdotal evidence that the old NACTEC building / E & T Block (building No 3) housed the torpedo unit during the war. WSP also reported that four old inert 'depth charges' were stored on the ground in front of the concrete wall at the fire ground.

10.3. In Hangars West, WSP made reference to a rifle range to the west of the airfield near to building 356, which comprised a layer of sand where spent bullets and casing were removed, although the final material may have been rolled into the ground and buried.

10.4. In Hangars East, WSP made reference to the existence of an old bomb dump that was located to the east and north of the fire ground and surmised that 'Amatol' and 'Minol' (both explosive mixtures made from TNT and ammonium nitrate during World War Two) may have leaked into the ground as this did occur occasionally.

10.5. A pipemine was discovered between Swann and Dunning Hangars in the Waterfront zone.

***[28] Entec Phase One Desk Study, May 2005***

10.6. Entec reported that there was a large number of buildings where there was a potential for ordnance issues. Historical plans of the site indicate areas where explosives were stored and these locations are listed in Table 10.1 reproduced from the Entec Phase One Desk Study.

**TABLE 10.1: EXCERPT OF TABLE 3.3 BUILDINGS WITH POTENTIAL ORDNANCE ISSUES**

| Building No | Use |
|---|---|
| 3 | Held pyrotechnics for life rafts |
| 6 & 7 | Explosive Store |
| 8 | Explosive Store |
| 14 | Driving Store-Held Thunderflashes |
| 15 | Fire station ready use locker – held gas generators |
| 16 | Police tower – Held Pyrotechnics |
| 18, 20 & 21 | Explosive Store |
| 73 – Dunning Hangar | Bombed in WW2 |
| 87 | Armoury Store-Held pyrotechnics |
| 132 | Held small arms ammunition |

| Building No | Use |
|---|---|
| 153, 154 & 155 | Special Squadrons-held explosives |
| 161 | Small Arms Range |
| 165 | Naval Air Station classrooms – held pyrotechnics |
| 313-319 | Explosive Store |
| 349 | Pistol Range |
| 363 | 303 Range |
| 364 | Firing Point for 303 Range |

Notes: The use or storage of explosive ordnance at a location does not necessarily mean that these materials remain at the location or have been lost or disposed to ground.

10.7. The above locations are shown on Figure 31 - 33.

***[29] Environmental Science Group (ESG) Phase One Assessment for Defence logistics Organisation (DLO) report No ESG/05/041/F dated December 2005***

10.8. The ESG desk study report (December 2005) comprised discussions with former site personnel, research of documentation and site visits. The report noted the following areas of potential concern in this development zone as:

- Armoury - building now disused and cleared September 1997;
- Danger buildings - buildings with low explosive content required for pyrotechnics and ammunition;
- Torpedo workshop - explosives normally removed for servicing but reported not to be stored on site;
- Small arms range and stop butts - 25 yard firing range (offsite);
- Ground defence structures - concrete bunkers, emplacements, weapons pits or guard towers;
- Area 6, School of Aviation (located offsite residential area near main entrance) - inert munitions kept for training;
- Guard room - local defence weapons stored;
- approximately eight explosives stores were identified within the former aircraft breaking area and fire training area;
- Guided weapons workshop - servicing bays for test and maintenance. Building was later used a gliding club; and,
- Pipemines - laid in 1942-43 and subject to some clearance. A pipemine has been found near to the Dunning Hangar.

10.9. In addition, the following records are contained within the ESG report:

- Annex C of the ESG 2005 report described a 'bomb dump' in the vicinity of the aircraft breaking area and fire training ground;
- Annex D Site map 1973 - 'alleged lend/lease burial site' within central parts of Hangars East development zone;
- Annex E and F - WW2 bomb plots; and,
- Annex G, H and I - documentation of pipemines whereabouts and removal works.

10.10. The desk study highlighted a period of WW2 in which the airfield experienced the significant upheaval and rapid change whereby the site was bombed by the enemy and the airfield was laid with a matrix of airfield denial mines in accordance with the War Office in case of invasion.

10.11. The bombing raids are understood to have occurred on three occasions during WW2 (16th August 1940, 8th October 1940 and 23rd May 1944) targeting the main areas of the Waterfront zone as well as areas at the end of the runway and centrals parts of Hangars West. Records also show that the Dunning Hangar was hit by the bombing.

10.12. In relation to the pipemines, these were placed on a grid pattern across the exposed parts of the airfield and so are generally unlikely to be found within the development areas of the Waterfront, although a single pipemine has been removed from the vicinity of the Dunning Hangar. The locations of pipemines and surveyed areas can be seen on Figures 31-33.

10.13. ESG undertook an instrumental survey of the area within the perimeter track and recommended an intrusive (Phase Two) investigation. The airfield was deemed to present a medium risk until the completion of an intrusive investigation, although the surrounding areas occupied by buildings etc represented a low risk.

***[30] Environmental Science Group (ESG) Phase Two & Three Assessment for Defence Logistics Organisation (DLO) report dated January 2007***

10.14. ESG subsequently undertook a Phase Two and Three investigation in January 2007 and discovered the presence of one confirmed live pipemine and nineteen further suspected mines of undetermined explosive content. ESG in co-operation with 33 Engineer Regiment then coordinated the removal of these mines. The subsequent risk rating following these works was then considered to be very low, with an area of slight concern beneath an area of concrete hardstanding located in the south adjacent to building 389, where scanning could not differentiate between concrete reinforcing and a potentially explosive structure.

10.15. From the magnetrometry scans, ESG located and removed 8 expended air dropped British practice bombs located in a small cluster along the airfield near to the Air Traffic Control Tower in the Waterfront zone. No other bombs were identified onsite.

10.16. It is noted that the area subjected to Phase II and III clearance primarily covered the airfield with the northern parts of the Waterfront zone and central parts of Hangars West.

***[31] Entec Phase Two Site Investigation (DE Project No 05002), 3 May 2007***

10.17. Reference to Table 2.4 (Entec 2007) summarised the ordnance clearance and related activities:

- clearance of incomplete array of pipemines installed across the airfield 1939-1947; and,
- south of Swann Hangar - pipemine recovered in 1984.

10.18. Entec reported that there is no evidence of abandoned bombs at the site (referring to 33 Engineer Regiment correspondence, 8 October 2004). Furthermore, it was reported that pipemine plans for the site from 1943 were incomplete in two respects. Firstly, pipemines have been located in areas not marked as mined; and secondly, there are no mines marked on the northern part of the airfield and infers that the mining programme may have been cancelled mid way through once the threat of wartime invasion had receded.

10.19. Entec also reported that explosive ordnance clearance certification for this site had been withdrawn from the site as Defence Logistics Organisation Ordnance Group had concerns over their completeness, accuracy and whether they were applicable for site disposal purposes. A new clearance review was reportedly underway (commenced May 2005) but information as to this outcome has not been provided.

## 11.0 ENVIRONMENTAL CONCLUSIONS AND RECOMMENDATIONS

**Summary**

11.1. The site has historically been used as an operational Royal Navy air station, barracks and training establishment from 1917 until it was vacated by the MoD in 1996. Since its acquisition, the site has since been divided into a number of tenancies and is currently used for a variety of commercial / industrial uses with the airfield remaining in use and run by the MCA as a private aerodrome. In terms of the potential for pollution, the Waterfront zone in the south of the site has experienced the most industrial development with numerous potentially contaminating activities including the former bulk fuel installation (BFI), Central Boiler House, large maintenance hangars and old workshops.

11.2. The site is considered to lie in an area of **Medium** environmental sensitivity with respect to groundwaters due to the site's location over a Secondary A Aquifer and nearby private abstractions, and **Medium** sensitivity with respect to The Solent in terms of its ecological designations despite the size of the feature and relative dilution factor. The proposed residential end use is considered to be of **High** sensitivity, mixed-use as **Medium** sensitivity and commercial use as **Low** sensitivity. Tier 2 assessments for human health risk have been implemented based upon CLEA guidance.

**Contamination**

11.3. The site has been subject three historic site investigations by WSP, Entec (2003) and Entec / Halcrow (2005). Whilst in isolation the Entec / Halcrow 2005 site investigation appears to be limited, in conjunction with the previous shallow groundwater investigation by Entec in 2003, it is noted that the coverage is improved. The information from the 1996 WSP investigation has not been made available although principal areas of contamination were reported.

11.4. The site investigation commissioned jointly by Entec / Halcrow incorporated contamination testing of soils, leachates and groundwaters and limited monitoring of ground gas across the site.

11.5. In general, the site investigations have not identified a site wide concern with regard to soil contamination when assessed against generic UK screening thresholds. Identified contamination in the soil and groundwater generally comprises localised occurrences of elevated heavy metals and polyaromatic hydrocarbons in the soils associated with specific features such as the BFI.

11.6. Metals and Volatile Organic Compounds (VOCs, such as BTEX and tetrachloroethene) have been identified in groundwaters of the Waterfront zone. In terms of the VOCs, two groundwater plumes consisting of tetrachloroethene and, to a lesser extent, BTEX have been identified beneath the following development zones:

- Drake Gardens [Area 1] - tetrachloroethene
- Airport Park [Area 2] - tetrachloroethene
- Unicorn Triangle [Area 8] - tetrachloroethene
- Barracks Square [Area 5] - tetrachloroethene
- Barracks Square [Area 5] - BTEX

***Radioactivity***

11.7. In terms of radioactive contamination, several areas of elevated levels of radioactive contamination have been identified suggesting a low risk to current end users of the site and a moderate risk to potential future site users such as for a residential development.

***Unexploded Ordnance* / *Munitions***

11.8. In terms of unexploded ordnance and munitions, several survey studies have been conducted by specialists resulting in the removal of numerous pipemines over the years. However, it has been noted that ESG's Phase I report highlighted the risk from airfield pipemines and that the works described in their Phase II and III report were undertaken to address these risks only. A residual risk remains for the occurrence of unexploded ordnance or discovery of unrecorded wartime burial of munitions.

**Environmental Risk Assessment**

11.9. The site investigations to date have identified areas of localised soil impaction or 'hotspots' and potentially significant groundwater contamination within the Waterfront zone. Furthermore, currently unidentified sources of contamination may exist onsite given the numerous historical uses that have taken place at the site and in view of the current coverage afforded by the investigation.

***End Users***

11.3. The risks identified within the Revised Conceptual Site Model are summarised below based upon the proposed end use sensitivities:

***Drake Gardens and Seaplane Square Residential [Areas 1 and 8a]***

11.4. In summary, soil results were not generally observed to be in excess of the human health screening values with respect the proposed residential land use, although this assessment is based upon a limited number of samples. Elevated total Poly Aromatic Hydrocarbons (PAHs) have been detected above the screening levels in soils in the vicinity of Kingston Villa to the east of the former BFI, which may correspond with proposed gardens but speciated testing does not infer a significant risk to human health.

11.5. The presence of a large chlorinated solvent plume within Waterfront zone identified by the site investigations infers a potential risk to human health of end use occupiers within this development area.

11.6. The current assessment is based upon limited data and potential sources of contamination have been assumed. It is therefore recommended that further investigations are undertaken to fully characterise the various potential contamination sources (e.g. the BFI) and groundwater plume. The data from future investigations of the VOC plume should be appraised in accordance with CIRIA Publication C682 (2009) The VOCs handbook – Investigating, Assessing and managing Risks from Inhalation of VOCs at land affected by Contamination.

11.7. On the basis of the above, a **MEDIUM / HIGH** risk is considered.

***Wykeham Hall and Barracks Square Residential [Areas 4 and 5b]***

11.8. In summary, soil results were not generally observed to be in excess of the human health screening values with respect the proposed residential land use, although this assessment is based upon a limited number of samples.

11.9. On the basis that offsite contamination was previously identified at the former grounds maintenance area (building 273) and asbestos inferred within demolition arisings, currently unidentified contamination may be present as a result and further investigation is required. Consequently, a **LOW / MEDIUM** risk is considered.

***Barracks Square, Unicorn Triangle and Westcliffe Seafront Mixed-use [Areas 5a, 6 and 7b]***

11.10. Contaminants were generally not observed to be in excess of the screening values with the exception of localised occurrences of arsenic, lead and benzene. The arsenic and lead have been indicated to be potential hotspots of contamination, which are marginally above the screen for this development area corresponding with proposed residential block of flats in Area 6 and lead in the vicinity of the sheltered accommodation of Area 5a.

11.11. However, it should be recognised that several potential sources of contamination have been identified (particularly in Area 7b) with very limited sampling undertaken.

11.12. A **MEDIUM / HIGH** risk is considered to exist associated with the potential for VOCs, hydrocarbons and previously unforeseen contamination to be present locally at the site.

***Airport Park, Marine Business Park, Unicorn Triangle and Seaplane Square Commercial [Areas 2, 3, 7a and 8b]***

11.13. In summary, soil results were not generally observed to be in excess of the human health screening values with respect the proposed commercial land use, although this assessment is based upon a limited number of samples. However, it should be recognised that several potential sources of contamination have been identified, including the boiler house / tanks / oil store in Area 2 and hangars and workshops in Area 7a and 8b.

11.14. Elevated lead has been identified as an outlier indicative of a potential hotspot of contamination at HTP409 in Area 7a. The elevated lead concentration corresponds with the location of historical workshops.

11.15. Elevated levels of VOCs (notably tetrachloroethene) were identified to be widespread within the underlying groundwaters.

11.16. Asbestos containing materials (ACMs) have also been previously reported within demolition arisings within Area 3.

11.17. Based upon the above, a **LOW / MEDIUM** risk is considered to exist associated with the potential for VOC based contaminants or previously unforeseen contamination to be present locally at the site.

***Hangars West Allotments***

11.18. This area was not assessed due to the lack of soils data from the site investigation. Based upon the previous uses in this locale, the area of the proposed allotments should be conservatively assessed as being of **MEDIUM / HIGH** risk until site investigations confirm otherwise.

***Hangars West Commercial***

11.19. In summary, soil results were not generally observed to be in excess of the human health screening values with respect to a commercial end use scenario with the exception of elevated lead identified as a hotspot corresponding to the location of a former fuel oil storage tank, although this assessment is based upon a limited number of samples. However, it should be recognised that several potential sources of contamination have been identified (particularly in relation to fuel tanks and the use of solvents in hangars) with very limited sampling undertaken.

11.20. A **LOW** risk is considered to exist associated with the potential for metals and hydrocarbons or previously unforeseen contamination to be present locally at the site.

***Hangars East Commercial***

11.21. In summary, soil results were not generally observed to be in excess of the human health screening values with respect the proposed commercial land use, although this assessment is based upon a limited number of samples. Isolated occurrences of elevated lead and PAHs were both identified as hotspots of localised contamination corresponding with the southern parts of Hangars East. However, it should be recognised that several potential sources of contamination have been identified (particularly in relation to fuel tanks and the use of solvents in hangars) as shown in Figure 14 which do not appear to have been targeted by the investigations.

11.22. A **LOW** risk is considered to exist associated with the potential for metals and hydrocarbons or previously unforeseen contamination to be present locally at the site.

***Controlled Waters***

11.23. In terms of groundwater contamination, it has been reported that there was a widespread distribution of solvents across the Waterfront zone covering several proposed development areas and likely to be in close proximity to the site boundary with The Solent and associated ecological designations. As such, the risk to the underlying groundwater (classified as a Secondary A

Aquifer) has been assessed as **MEDIUM- HIGH** (given that chlorinated solvent and hydrocarbon contamination have already been detected within this media).

11.24. Further monitoring and Detailed Quantitative Risk Assessment (DQRA) of contaminant levels identified within groundwater will be required in relation to potential impaction of The Solent, which exhibits particular ecological conservation designations (SSSI and RAMSAR etc).

11.25. In terms of risk to the River Alver and its tributaries, it is noted that there are three landfills (both active and historic) at Cherque Farm and Sandhill Lane and a nearby sewage works (Peel Common), which discharges into the River Alver. Furthermore, it has been reported by the Environment Agency that there is generally poor water quality in this area and as such, marginal groundwater contamination in Hangars East is unlikely to present a significant risk. A **LOW** risk to these surface waters is therefore considered.

***Construction Workers***

11.26. The qualitative assessment identified a **MEDIUM** risk to construction workers who may come into contact with contaminated soils. The Health and Safety Plan and Risk Assessments / Method Statements for works should consider worker protection from skin contact, ingestion and inhalation of contaminants. It is noted the localised area of soils and waters containing hydrocarbons, volatile compounds and ACMs may be encountered. Provided appropriate health and safety provisions are made, the risk can be considered **LOW**.

***Adjacent Residential Receptors***

11.27. The potential presence of a large chlorinated solvent plume within the Waterfront zone infers a potential risk to offsite residential receptors in properties along Marine Way if it is found to be migrating towards these receptors. As such, it is recommended that further site investigation is undertaken to ascertain whether or chlorinated solvents are present at the site boundary. Should groundwater contamination extend this far towards offsite residential uses, a Detailed Quantitative Risk Assessment (DQRA) may be required to appraise the potential risks to the human health of occupiers.

11.28. Based upon the above, a **MEDIUM** risk to offsite receptors is considered.

***Contaminated Land Liability***

11.29. The principal legislation governing the identification and remediation of contaminated land is Part IIA of the Environmental Protection Act (EPA 1990), implemented in April 2000. The legislation is supported by the Contaminated Land (England) Regulations (2000) and Statutory Guidance (DETR Circular 02/2000 superseded by DEFRA Circular 01/2006), which together provide the regulatory regime, and sets out the nature of liabilities that can be incurred by owners of contaminated land and groundwater. From September 2006, the regime was extended to include radioactivity in Circular 01/2006.

11.30. However, it is noted that in respect to the change in site usage and classification, land quality would be addressed through the planning regime as described in Planning Policy Statement (PPS23) where land contamination is stated as a material planning consideration. Where a change the use of land is proposed as part of a planning application, the Planning Authority would satisfy itself that potential contamination is properly assessed and the development incorporates the necessary remediation. Annex 2 of the Planning Policy Statement 23 'Development on land affected by contamination', requires risk from contamination to be assessed in accordance with Part IIA principles, and after carrying out development and commencement of its use, the land should be both 'suitable for use' and not be capable of being determined under Part IIA.

11.31. With regard to the identified groundwater contamination by chlorinated solvents, a significant pollutant linkage may exist in relation to the Secondary Aquifer and the possibility of offsite contamination of coastal waters (Controlled Waters) and any associated ecological receptors. As such, this could potentially establish the site as 'contaminated land' under the statutory definition of Part IIA of the Environmental Protection Act 1990 and therefore require management. Furthermore, there is also a potential liability associated with Section 161 of the Water Resources Act 1991 whereby the Environment Agency has the power to remedy the pollution of Controlled Waters to any person who has 'caused or knowingly permitted' pollution.

11.32. It is also noted that as the site was formerly used by the MOD, it is possible that the site considered as a 'Special Site' under the contaminated land regime. As such, the primary regulator is likely to be the Environment Agency.

***Ground Gas***

11.33. Limited gas monitoring has been undertaken at the site to date. Whilst elevated methane or carbon dioxide have not been identified within borehole installations in any of the development zones, elevated VOCs have been detected primarily associated with chlorinated solvents and BTEX within groundwater.

**Recommendations**

11.34. Based upon the information available it is likely that the site will be suitable for proposed residential, mixed-use and commercial development subject to further investigation, risk assessments and/or remediation / groundworks in accord with regulatory approvals.

11.35. In terms of proposed residential end use areas, localised occurrences of contamination are likely to require limited remediation where gardens and soft landscaping areas are proposed. Further site investigation will be required for residential development in order to confirm the absence of contamination risk.

11.36. Notable solvent and hydrocarbon contamination in the groundwater requires further quantitative risk assessment also as this presents an additional potential pollutant linkages relating to human health that require specific consideration.

11.37. Based upon this review of available information and the findings of the assessments made in this report the following recommendations are made:

- regulatory discussions and planning consultation;
- design and procurement of further 'phased' site investigation and groundwater monitoring essential for identification / remediation of non-development related contamination liabilities and costs;
- gas monitoring tailored to each development area;
- Detailed Quantitative Risk Assessment for Controlled Waters and Human Health; and,
- Remediation Options Appraisal and Remediation Strategy / Groundworks Specification.

***Further Site Investigations Works***

11.38. The site investigations undertaken by Entec / Halcrow are considered to comprise a preliminary phase of works as it does not provide sufficient coverage of the site to fully characterise areas where contamination sources are likely to be found and associated pollutant linkages / risks.

11.39. The principal concerns at this stage also relate to a degree of uncertainty that exists in the current data set, comprising errors in reporting borehole locations and areas of ambiguity in the results. It is therefore considered essential that this uncertainty is addressed through the commissioning of further site investigation of these areas.

***Design Philosophy***

11.40. As a number of contamination hazards and risks associated with the site's contamination status have been identified and it is recommended that future work must be undertaken to confirm the sources of contamination, the extent of the contamination and determine whether there is a risk to receptors.

11.41. The site investigation works should be designed to support the use of the previously available information and to accord with current technical guidelines stemming from CLR11 and the requirements of the Environment Agency and Local Authorities. A phased programme of site investigation works are therefore proposed at the site in order to enable to fully established the contaminative status of each separate development zone and to form the basis for any remediation that may be required to facilitate development. This phase of works should aim to focus in on suspected 'high priority' areas such as identified contamination that correspond with proposed residential gardens and areas where there has been no site investigation coverage to date.

11.42. The proposed works will need to comprise a series of borehole installations and trial pit investigations to enable soil, groundwater and ground gas sampling. The design of the investigation should address the following objectives:

- existing boreholes have either not been located or previously decommissioned / backfilled, it will be necessary to target the identified areas of previously identified contamination to verify results;
- characterise the extent and nature of contamination already observed and suspected 'hotspot' areas;

- soil characterisation testing to provide sufficient data to enable risk assessment modelling and remedial design;
- investigate beneath existing structures and buildings;
- fully characterise the extent of groundwater contamination (e.g. VOC plumes). This will also require an array of shallow monitoring wells within the central area of the site, which have not been previously investigated;
- it is recommended that areas of inferred groundwater impaction are delineated to a certain extent with several wells positions down-gradient to aid modelling;
- monitoring boundary wells are required in order indicate whether there is breakthrough of identified groundwater contamination;
- examine the leaching potential of contaminants from the soil;
- fully characterise the depth profile and nature of made ground soils and characterise any hydrogeology - hydrology interactions;
- basic waste testing and classification of samples may be required to undertake an assessment of waste and infer either 'hazardous' or 'non-hazardous' waste classifications; and,
- fully characterise the underlying hazardous gas regime to inform the appropriate gas protection measures for structures.

11.43. A potential scope of works for each development zone is detailed in Table 11.1.

**TABLE 11.1: POTENTIAL SCOPE OF FURTHER SITE INVESTIGATIONS FOR EACH PROPOSED DEVELOPMENT ZONE**

| Zone | Scope of Site Investigation |
|---|---|
| Drake Gardens and Seaplane Square Residential [Areas 1 and 8a] | Former Bulk Fuel Installation should be reinvestigated and comprehensive testing undertaken to confirm the absence of risk as it is believed that impacted soil was replaced at this location after it was found to be unacceptable for disposal to landfill. |
| Wykeham Hall and Barracks Square Residential [Areas 4 and 5b] | This area should be formally investigated to substantially increase the site coverage in areas of proposed residential gardens. |
| Barracks Square, Unicorn Triangle and Westcliffe Seafront Mixed-use [Areas 5a, 6 and 7b] | This area requires increased site investigation coverage, particularly in areas of proposed public open space, communal gardens / landscaping. Furthermore, this area should be subject to a a specific groundwater investigation in view of the BTEX plume in the south and tetrachloroethene plume present in the north of the development zone. |
| Airport Park, Marine Business Park, Unicorn Triangle and Seaplane Square Commercial [Areas 2, 3, 7a and 8b] | This area requires increased site investigation coverage and particular groundwater monitoring works to fully investigate the presence of a tetrachloroethene plume identified in the vicinity of the former BFI in the west and Central Boiler House / Triumph |

| Zone | Scope of Site Investigation |
|---|---|
| | Galley in the east. It is currently envisaged that additional boreholes will be required in between these features to determine connectivity and strength of the plume. |
| Hangars West Commercial | This site requires an increase in site investigation coverage and particularly within the proposed commercial development and areas of soft landscaping. A particular part of the site investigation should be to fully investigate the 1 Ha area of proposed allotments to determine the suitability for use and/or remediation. |
| Hangars East Commercial | This site requires an increase in site investigation coverage and particularly within the proposed commercial development and areas of soft landscaping. |

11.56. In addition to the recommended intrusive works, additional gas monitoring is considered necessary in order to meet likely requirements and sign off potential risks from ground gas.

**TABLE 11.2: POTENTIAL GAS INVESTIGATION REQUIREMENTS FOR EACH PROPOSED DEVELOPMENT ZONE**

| Zone | CIRIA 665 Gas Monitoring Recommendations |
|---|---|
| Drake Gardens and Seaplane Square Residential [Areas 1 and 8a] | 12 monitoring visits over a period of 6 months is considered suitable for high sensitivity (residential with gardens) end use and sites with a moderate-high potential for ground gas generation. VOCs have been identified within groundwater beneath this development zone, which require monitoring. |
| Wykeham Hall and Barracks Square Residential [Areas 4 and 5b] | 9 monitoring visits over a period of 6 months is considered suitable for high sensitivity (residential with gardens) end use and sites with a low potential for ground gas generation. |
| Barracks Square, Unicorn Triangle and Westcliffe Seafront Mixed-use [Areas 5a, 6 and 7b] | 6 monitoring visits over a period of 3 months considered suitable for moderate sensitivity (mixed-use and residential flats) end use and sites with a low potential for ground gas generation. VOCs have been identified within groundwater beneath this development zone, which require monitoring. |
| Airport Park, Marine Business Park, Unicorn Triangle and Seaplane Square Commercial [Areas 2, 3, 7a and 8b] | 6 monitoring visits over a period of 3 months is considered suitable for low sensitivity (commercial) end use and sites with a moderate-high potential for ground gas generation. VOCs have been identified within groundwater beneath this development zone, which require monitoring. |
| Hangars West Commercial | 6 monitoring visits over a period of 2 is considered suitable for low sensitivity (commercial) end use and sites with a low potential for ground gas generation. |
| Hangars East Commercial | 6 monitoring visits over a period of 2 months is considered suitable for low sensitivity (commercial) end use and sites with a low potential for ground gas generation. |

11.70. Please note that these monitoring proposals are generic and should be reviewed after each visit. Curtailed monitoring periods or use of continued monitoring techniques may be appropriate.

***Detailed Quantitative Risk Assessments***

11.71. In addition to further site investigation works, it likely that detailed quantitative risk assessments will be required to address risk from VOCs in the soil and groundwater. These assessments may be required for both human health in proposed residential and commercial areas as well as to appraise the risk to Controlled Waters.

***Remediation of Radioactive Contamination***

11.72. Remediation of localised point sources has been recommended to reduce risks to future site users by removing all material having an activity concentration greater than 0.34Bq/g above background.

11.73. A remediation strategy should be developed for the site, which takes account of future risks to occupants. The risk based strategy should be made cognisant of current guidance and government policy and consultation with the Environment Agency also undertaken in this regard. Furthermore, consultation with the regulators will be required in order to ascertain the acceptability of the strategy.

***Unexploded Ordnance / Munitions***

11.74. Consultation with the Defence Logistics Organisation Ordnance Group to ascertain the status of the explosive ordnance clearance certification that was withdrawn in 2005 is recommended.

11.75. Furthermore, the risks associated with UXO should be fully recognised within the Health & Safety risk assessments for below ground works, provision of a watching brief and contingency plans should be prepared.

***Japanese Knotweed***

11.76. Areas affected by Japanese Knotweed identified on the site should be cordoned off and access to these areas prohibited until the area can be treated by Japanese Knotweed Specialists.

**General**

***Regulatory Consultation***

11.77. The approval of contaminated land assessments is an iterative process. This document should be submitted to the regulators via the planning process in order to agree the findings of this report. The Regulator may require a Remediation Strategy, Works Specification and subsequent Verification Report to control and verify the completion of matters as detailed above.

11.78. It is anticipated that planning conditions will be applied to the site associated with land quality issues. Normally these require the agreement of the site characterisation reports prior to the commencement of site works and agreement of further stages comprising works controls / remediation and verification.

11.79. Depending on the specifics of the contamination related planning conditions, the records noted above may be required for inclusion within a site Verification Report. If so, then the scope of these records should be detailed in a Remediation Specification. This is a common requirement of planning and should be discussed with the Local Authority.

***Groundworks***

11.80. Residential gardens and communal landscaping areas are likely to require the importation of a 'validated' topsoil/subsoil in the absence of a suitable medium for the construction of these features. However, proposed commercial areas within the Waterfront zone are indicated to primarily comprise hardstanding and so remediation of shallow soils may not be required to ameliorate risk to human health with the exception of areas of soft landscaping.

11.81. It should be recognised that additional remediation may be required to address the risks from localised hotspots of contamination and volatile organic compounds once those have been properly assessed.

11.82. Records should be maintained that certify the source, chemical suitability and appropriate placement of any imported soils that may be required by the landscape architect.

***Underground Services***

11.83. Given the site history and the identified VOC hydrocarbon concentrations in groundwaters, consideration should be given to the selection of service pipework resistant to degradation by

organic contaminants. Consultation with the Statutory Service Provider is recommended in this regard. Additional advice on this topic is available from UKWIR (Guidance for the Selection of Water Supply Pipes to be used on Brownfield Sites).

***Piling Risk Assessment***

11.84. The site is located on a Secondary A Aquifer associated with the superficial and slid geology. As such, if the foundation design is to include a piled solution, the risk of creating a contaminant migration pathway to the underlying major aquifer should be assessed (i.e. Piling Risk Assessment). Reference should be made to Environment Agency Guidance Document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination', (2001).

***Unforeseen Contamination***

11.85. A watching brief for unforeseen contamination should be maintained during works. Should any additional fuel tanks, interceptors, stained, odorous or contaminated soils (odorous, black staining, significant quantities of ash, etc) be encountered, the advice of an Environmental Scientist should be sought to determine appropriate action. In general, these soils should be separated in order to avoid mixing of waste streams in accord with the prepared method statement.

11.86. Taking into account the age of the current buildings there is potential for ACM to be present within the building fabric. It is a requirement of the Control of Asbestos at Work Regulations (CAWR) 2006 to complete an Asbestos Survey in accord with HSG 264 prior to the demolition of buildings on site.

11.87. Asbestos has been noted to be present at the site, as such, a watching brief should be undertaken during construction and the advice of an asbestos specialist sought should any potential asbestos containing material be observed. It should be anticipated that some ACM will intermittently occur in soils and associated precautions considered in advance.

11.88. A risk exists to construction workers who may come into contact with potentially contaminated soils, soil vapours, groundwater, UXOs or ACMs. As such it is required that a documented risk assessment and Health and Safety Plan is implemented by the Contractor to address these potential issues. The Contractor must also control matters such as waste disposal, further inspections for contamination and environmental protection. The scheme will fall under notifiable CDM regulations and will require a Site Waste Management Plan. Further guidance on this topic is provided in CIRIA C692 *'Environmental good practice on site'*.

***Sustainability***

11.89. Considering the overall site areas and mixture of potential issues there is considerable potential to manage both contamination and waste issues in a collective and sustainable manner. This is also likely to reflect cost and scale efficiencies, rather than incremental treatments applied to individual development areas.

11.90. In conjunction with the development of an overarching remediation strategy for the site, consideration should be given at an early stage to the adoption of a collective remediation process and central treatment/hub area, able to address contamination issues from soils across the development area. In addition, there is considerable potential for materials recycling at the site which could be exploited via the adoption of a considered materials management plan and site waste management plan.

11.91. CampbellReith provide support associated with sustainability, materials management, waste classification in conjunction with our wider engineering services and these have been previously applied to SEEDA sites of this nature to achieve cost efficiencies, CEEQUAL rating and awards for sustainability.

***Waste***

11.92. There is the potential for metal and hydrocarbon impacted soils exists associated with the point sources identified in this report, which could potentially be classed as 'hazardous waste' and require either remediation for reuse or disposal. Any subsequent works should implement a Materials Management Plan (MMP) to control these issues. Further discussion (and potentially testing) is required with respect to a final waste classification and associated tax band applied to waste soils arising from the site and all works will require completion in accord with Waste Management Duty of Care guidance.

11.93. All waste related activities must be undertaken in accordance with the Waste Management and Landfill Regulations. Any proposed reuse of materials must be in accordance with the Environmental Permitting (England and Wales) Regulations 2010 (as amended). With respect to waste soils disposal, as a minimum, the following information should be collected and retained by the Contractor for subsequent validation:

- source and origin of the waste;
- information on the process producing the waste;

- European Waste Catalogue code and characteristics of material;
- for hazardous waste, definition of the relevant properties according to the Hazardous Waste Directive (Annex III 91/689/EC);
- confirmation that waste is not prohibited waste;
- appearance of the waste;
- landfill class; and,
- Duty of Care records including full and completed chain of custody documentation.

11.94. **Given that the correct classification of waste is likely to have a significant impact on the redevelopment budget, all contractor submissions should confirm that their development tenders, incorporating waste removal, consider the full requirements of the Landfill Directive and associated waste legislation. This is to ensure waste is correctly classified and costed at the inception of the project. It is recommended that the waste classification aspect of the tenders should be reviewed independently by a consultant at the tender assessment stage.**

11.95. The Landfill Directive states that all hazardous and non-hazardous waste requires treatment prior to landfill. Treatment must provide a 'three-point step'. All three criteria must be satisfied for all the waste to have been treated:

1. a physical, chemical or biological process including sorting;
2. it must change the characteristics of the waste;
3. it must do so in order to:

    - reduce its volume; or,
    - reduce its hazardous nature; or,
    - facilitate its handling; or,
    - enhance recovery.

11.96. As such, provision for treating (including physical separation) should be made for all arisings that are likely to be classified as hazardous or non-hazardous so that each of the above three requirements are met.

11.97. Responsibility for waste classification, disposal and Duty of Care responsibilities (including record collection) should be clearly assigned and waste costs ascertained in advance of site works. A Site Waste Management Plan is likely to be required for this project.

## TECHNICAL REFERENCES

| Ref | Reference Title | Type |
|---|---|---|
| [1] | British Geological Survey 1:50 000.<br>Sheet 331 (Portsmouth) | Geological Map |
| [2] | Environment Agency website<br>www.environment-agency.gov.uk | Environment Agency Website |
| [3] | Multi Agency Geographical Information for the Countryside website (www.magic.gov.uk) | Website |
| [4] | Landmark Envirocheck Report ( Ref: 7167001-1-2, dated 9 November 2004) | Database Report |
| [5] | HPA Indicative Atlas of Radon in England and Wales. HPA-RPD-033. HPA 2007. | Publication |
| [6] | Building Establishment Research (BRE) Document 211 "Radon: Guidance on Protective Measures for New Dwellings", 2007 Edition. | Publication |
| [7] | Consultation with the Environment Agency | Regulatory Letter |

## SITE INVESTIGATION REPORTS OF OTHERS

| Ref | Report Title | Author | Date | ICARUS Reference |
|---|---|---|---|---|
| [8] | LDA Design Masterplan, Dwg No. REV8 2780_078_Masterplan Whole Site_REV_FEB_2011 | LDA Design | 2011 | - |
| [9] | Design & Access Statement | LDA Design | 2011 | - |
| [10] | Site Appraisal Report – Waterfront Commercial | CampbellReith | 2010 | - |
| [11] | Site Appraisal Report – Waterfront Conservation | CampbellReith | 2010 | - |
| [12] | Site Appraisal Report – Hangars West | CampbellReith | 2010 | - |
| [13] | Site Appraisal Report – Hangars East | CampbellReith | 2010 | - |
| [14] | Phase One LQA (Desk Study) (by G&E Consultants) | WSP | May 1995; | SILQ0067F19950500 |
| [15] | Draft Technical Note (LQA Review of WSP Phase Two Investigation ) | Entec | January 2001 | SILQ0058F20010105 |
| [16] | Phase One Desk Study including Envirocheck dated 9 November 2004<br>Ref: 7167001-1-2 | Entec | May 2005 | SILQ0059F20050518 |
| [17] | Phase Two: Shallow Groundwater Report for Defence Estates | Entec | 8 May 2003 | SILQ0059F20030508 |
| [18] | Environmental Investigation Report | Adler & Allen Ltd | March 25 | - |
| [19] | Ground Investigation Interpretative Report | Halcrow | 31 March 2006 | SILQ0009F20060331 |
| [20] | Phase Two: Site Investigation (DE Project No 05002 | Entec | 3 May 2007 | SILQ0008F20040503 |

| Ref | Report Title | Author | Date | ICARUS Reference |
|---|---|---|---|---|
| **Radiological Assessments** | | | | |
| [21] | Radiological Survey of HMS Daedalus | Defence Radiological Protection Service (DRPS) | 24 April 1996 | SILQ0053F19960424 |
| [22] | Phase Two Radiological Investigation for Defence Estates | Entec | 8 April 2003 | SILQ0051F20030408 |
| [23] | Radiological Survey Interim Report for Defence Estates | Entec | 14 July 2005 | SILQ0052F20050714 |
| [24] | Appendices to Review of Data Room Information | Halcrow | September 2005 | MULT0083F20050922 |
| [25] | Radiological Survey Report | Entec | 31 May 2007 | SILQ0050F20070531 |
| [26] | Phase Two Radiological Survey Report, Final Technical Note – Remediation Proposal | Entec | 31 May 2007 | SILQ0084F20070531 |
| **Munitions and Ordnance Report** | | | | |
| [27] | Phase One LQA (Desk Study) (by G&E Consultants) | WSP | May 1995 | SILQ0067F19950500 |
| [28] | Phase One Desk Study including Envirocheck dated 9 November 2004<br>Ref: 7167001-1-2 | Entec | May 2005 | SILQ0059F20050518 |
| [29] | Phase One Assessment for Defence Logistics Organisation (DLO) report No ESG/05/041/F dated | Environmental Science Group (ESG) | December 2005 | UXO0003F20051200 |
| [30] | Phase Two & Three Reports for Defence Logistics Organisation (DLO) | Environmental Science Group (ESG) | January 2007 | UXO0004F20070100 |
| [31] | Phase Two: Site Investigation (DE Project No 05002 | Entec | 3 May 2007 | SILQ0008F20040503 |

## ENVIRONMENTAL RISK ASSESSMENT SUPPORTING INFORMATION

**Soil Screening Values: CLEA Values**

The Environment Agency has published non statutory technical guidance for Regulators and their advisors to assess the chronic risk posed to human health from land contamination, known as the Contaminated Land Exposure Assessment (CLEA) Framework.

The CLEA Framework documents and associated risk assessment model are subject to ongoing technical review. The most recent and significant revision was in July 2008, with the withdrawal of guidance documents CLR7 to 10, which previously underpinned the CLEA Framework. In January 2009 the Environment Agency published CLEA V1.04 risk assessment software and associated guidance documents[7] as a replacement to the previous CLEA UK Beta Version and documents CLR 7 to 10. More recent revisions have been made in September 2009 to CLEA V1.05 and October 2009 to CLEA 1.06 risk assessment software.

The Environment Agency has produced several Soil Guideline Values (SGVs) based upon the revised framework. At the time of writing SGVs exist for the following substances: Benzene; Toluene; Ethylbenzene; Xylenes; Dioxins and dioxin like polychlorinated biphenyls; Arsenic; Cadmium, Mercury; Nickel; Phenol and Selenium. SGV reports are currently being compiled by the Environment Agency for: Chromium; Cyanide; Lead and PAHS.

In the absence of a comprehensive list of SGVs, CampbellReith have generated Generic Assessment Criteria (GAC) utilising CLEA 1.06 and the associated software. This is a rolling review and will continue as further Environment Agency publications become available. Contaminant specific toxicological data for GACs has been obtained from Environment Agency and DEFRA toxicological reports where available, or secondary 'authoritative literature references (as detailed in Appendix A of SR2).

Where CLEA compliant SGVs or GAC are not available reference may also be made to GAC derived using the CLEA UK model (beta version) or other values. These are currently used for lead and cyanide. Where referred to, the non compliant standing of these values is considered.

The recently published GACs within CL:AIRE Publication 'The Soil Generic Assessment Criteria for Human Health Risk Assessment', December 2009 have been applied where CLEA compliant CampbellReith GACs are not available.

**Selection of Appropriate Tier 2 Soil Screening Values**

The CLEA model is based upon defined exposure scenarios and three generic land uses are defined within the model. These set out a discrete set of circumstances where exposure may occur, including a source, the pathways, and the exposed population.

The three generic land use scenarios used in the development of SGVs are:

- **commercial / Industrial;**
- **allotments; and,**
- **residential (with or without plant uptake).**

It is noted that the CLEA screening values are generic and not always applicable. Where the CLEA conceptual model is not appropriate it will be necessary to develop site specific Detailed Quantitative Risk Assessment screening values as a further stage of assessment.

It is noted that the CLEA model does not consider risks from contaminated waters beneath the site to human health and the model also assumes that no free product is present. Should such conditions exist at the subject site the requirement for application of an alternative risk assessment model should be assessed. Alternatively, construction workers are potentially exposed to acute risk and therefore require separate consideration.

**Statistical Analysis of Soil Analytical Results**

Statistical analysis of soil based analytical results has been undertaken as detailed in Appendix A of CLEA R&D Publication CLR7, 2002. Although CLR 7 has recently been withdrawn, the use of the Mean Value Test and Maximum Value Test is still

[7] Environment Agency Report Ref: SC050021/SR2 - *Human Health Toxicological Assessment of Contaminants in Soil.* January 2009. Environment Agency Report Ref: SC050021/SR3 – *Updated background to the CLEA model.* January 2009.

considered appropriate for site assessments given current guidance[8]. This guidance advocates use of the one - sample t test, which is a variation of the mean value test and establishes the confidence level at which the assessor can determine whether a particular screening level has / has not been succeeded. The mean value test used herein is set at the 95th percentile confidence limit in order to be risk conservative.

The Maximum Value Test is a statistical tool that is used to identify outlier values from a numerical distribution of results for a given determinant. These outlier values can be excluded and considered separately, and the remaining values are then used to calculate upper bound 95th percentile values ($95^{\%ile}$) (Mean Value Test) for comparison with the screening values.

Unless specifically stated within the report text the statistical assessment has treated the site as a single averaging area and screened in its entirety. Additional tables are presented where appropriate to reflect distinct ground characteristics relevant to the conceptual model.

**Water Screening Values**

This assessment considers potential risks to controlled waters (groundwater and surface waters) in relation to risks from any historical contamination. The most stringent test is that defined for Contaminated Land under Part 2A of the Environmental Protection Act, 1990. However, it should be recognised that a wider evaluation of risk is considered within the planning regime described in PPS23 and CLR 11.

The Environment Agency has a wider policy agenda for the protection of controlled waters that will impinge upon judgements in relation to land contamination issues. This includes those for the Water Framework Directive and Groundwater Directive and wider legislation for both groundwater, surface water and associated elements (such as fisheries)[9].

The results of water analysis have been compared to screening values selected to assess the potential risk to the identified controlled water receptors in the Conceptual Site Model. The specific standards utilised for this purpose are considered in the assessment table footnotes and typically comprise: Environmental Quality Standards for the protection of aquatic life; Surface Water Standards; EC and UK Drinking Water Standards; or Background water quality (where no applicable standard exists).

The initial assessment considers the sensitivity of the receptor in the selection of the screening value. Advice for this purpose has been obtained principally from Environment Agency Technical Advice to Third Parties on Pollution of Controlled Waters for Part 2A of the Environmental Protection Act 1990, No 07/02. EA, 2002. (INFO-RA2-3e).

Where a viable pollutant linkage is considered to be present and the screening criteria exceeded, a qualitative risk assessment is presented with associated recommendations. Depending on the specific objectives, policy and practice of the Environment Agency, discussion of water screening values may be subsequently required.

[8]Guidance on Comparing Soil Contamination Data with a Critical Concentration, CL:AIRE, May 2008.
[9] Refer to Environment Agency Publications for Groundwater Protection Policy and Practice. http://publications.environment-agency.gov.uk/pdf/GEHO0708BOGU-e-e.pdf?lang=_e

## LIMITATIONS

This report provides available factual data for the site obtained only from the sources described in the text and related to the site on the basis of the location information provided by the Client.

Where any data or information supplied by the Client or other external source, including that from previous desk studies or reports, has been used, it has been assumed that the information is correct. No responsibility can be accepted by CampbellReith for inaccuracies within this data or information. In relation to historic maps it should be recognised that the accuracy of maps cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.

This report is limited to those aspects of historical land use and enquiries related to environmental matters reported on and no liability is accepted for any other aspects. The opinions expressed cannot be absolute due to the limit of time and resources implicit within the agreed brief and the possibility of unrecorded previous uses of the site and adjacent land.

The material encountered and samples obtained during on-site investigations represent only a small proportion of the materials present on the site. There may be other conditions prevailing at the site which have not been revealed and which have therefore not been taken into account in this report. These risks can be minimised and reduced by additional investigations. If significant variations become evident, additional specialist advice should be sought to assess the implications of these few findings

The generalised soil conditions described in the text are intended to convey trends in subsurface conditions. The boundaries between strata are approximate and have been developed on interpretations of the exploration locations and samples collected.

Water level and soil gas readings have been taken at times and under conditions stated on the exploration logs. It must be noted that fluctuations in the level of groundwater or soil gas may occur due to a variety of factors which may differ from those prevailing at the time the measurements were taken.

The findings and opinions expressed are relevant to those dates of the reported enquiries and site work and should not be relied upon to represent conditions at substantially later dates.

Please note that CampbellReith cannot accept any liability for observations or opinions expressed regarding the absence or presence of asbestos or on any product or waste that may contain asbestos. We recommend that an asbestos specialist, with appropriate professional indemnity insurance, is employed directly by the client in every case where asbestos may be present on the site or within the buildings or installations. Any comments made in this report with respect to asbestos, or asbestos containing materials, are only included to assist the client with the initial appraisal of the project and should not be relied upon in any way.

This report is produced solely for the benefit of the Client and no liability is accepted for any reliance placed upon it by any other party unless specifically agreed in writing.

## APPENDIX A: FIGURES

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## APPENDIX B: PHOTOGRAPHS

## APPENDIX C: DESK STUDY INFORMATION (CD)

1 Landmark Envirocheck Report, reference: 7167001-1-2, dated 9 November 2004,
2 Environment Agency Consultation letter dated 17th June 2010

## APPENDIX D: SITE INVESTIGATION INFORMATION (CD)

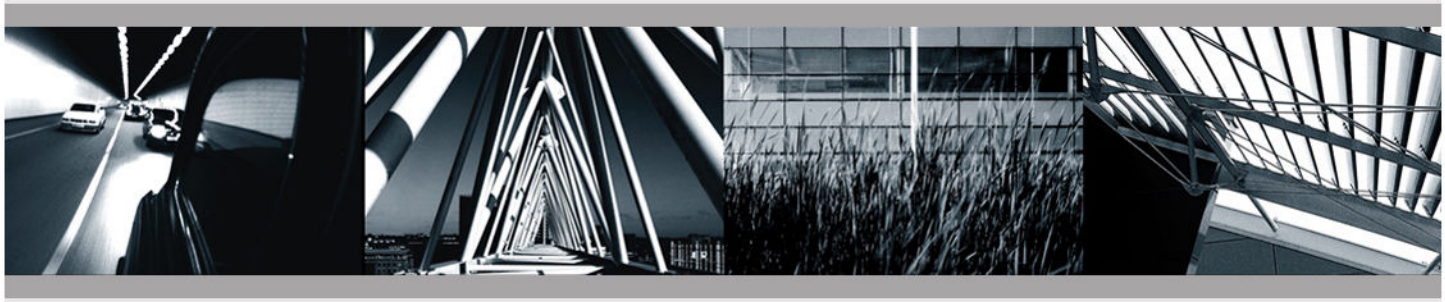
Halcrow, *Ground Investigation Interpretative Report,* dated 31 March 2006

Entec, *Phase Two: Site Investigation, Final Land Quality Assessment Report* (DE Project No 05002), dated 3 May 2007

# APPENDIX A: FIGURES

# APPENDIX B: PHOTOGRAPHS

# APPENDIX C – D (CD)

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