



Harts Farm Way Depot, Harts Farm Way, Havant

Phase 1 Desk Study and Phase 2 Site Investigation Report

Edgmond Holding Limited

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Contents

Contents	i
1 Introduction	1
1.1 Background	1
1.2 Objectives	1
1.3 Report Structure	2
2 Desk Study Methodology	4
2.1 Introduction	4
2.2 Information Sources	4
2.3 Ground Conditions	5
2.3.1 Geology	5
2.3.2 Geotechnical Issues	5
2.3.3 Mining Issues	6
2.4 Hydrogeology	6
2.4.1 Regional and Area Hydrogeology	6
2.4.2 Groundwater Abstractions	6
2.4.3 Groundwater Source Protection Zones	6
2.4.4 Groundwater Vulnerability	7
2.5 Hydrology	9
2.5.1 Surface Waters	9
2.5.2 Surface Water Quality	9
2.5.3 Flood Risk	11
2.6 Land Use	12
2.6.1 Historical Land-Use	12
2.6.2 Conservation Areas and Sensitive Land Use	12
3 Background Information	13

3.1	Site Location and Description	13
3.2	Land Use of Adjacent Areas	13
3.3	Historical Use of the Site and Surrounding Area.....	15
3.4	Geology.....	16
3.4.1	Regional Setting.....	16
3.4.2	Superficial Deposits	17
3.4.3	Solid Geology	17
3.4.4	Summary of Geology	17
3.4.5	Geotechnical Issues	17
3.4.6	Mining Issues	17
3.4.7	Radon.....	18
3.5	Regional Hydrogeology.....	18
3.5.1	Groundwater Vulnerability	18
3.5.2	Groundwater Source Protection Zones	19
3.5.3	Groundwater Abstractions.....	19
3.6	Local Hydrogeology	19
3.7	Previous Investigations.....	19
3.8	Hydrology	19
3.8.1	Surface Waters	19
3.8.2	Discharge Consents	20
3.9	Flood Risk.....	20
3.10	Conservation Areas and Sensitive Land Uses.....	20
3.11	Recorded Pollution Incidents and Prosecutions	21
3.12	Industrial Land Use / Registered Sites	21
3.12.1	IPC, IPPC and PPC Sites	21
3.12.2	Trade Directory Entries	21
3.12.3	Fuel Station Entries	21

3.13	Landfills and other Waste Facilities	22
4	Site Investigation Works	24
4.1	Intrusive Investigation Works Undertaken	24
4.1.1	Cable Percussion Borehole and Trial Pit Locations	24
4.1.2	Site Clearance	24
4.2	Cable Percussion	25
4.3	Trial Pitting	26
4.4	Testing, Sampling and Monitoring	26
4.4.1	Soil Sampling	26
4.4.2	PID Monitoring	26
4.4.3	Gas and Groundwater Sampling	27
4.4.4	Surface Water Sampling	27
4.4.5	Laboratory Analysis	27
5	Site Investigation Findings	29
5.1	Geology	29
5.1.1	Made Ground	29
5.1.2	Alluvium	29
5.1.3	Brickearth and Coombe Deposits	29
5.1.4	Upper Chalk	29
5.1.5	Geological Sequence Summary	30
5.2	Visual and Olfactory Evidence of Contamination	30
5.3	PID Readings	30
5.4	Gas Monitoring	31
5.5	Groundwater	32
6	Laboratory Analytical Results	34
6.1	Introduction	34
6.2	Groundwater Analytical Results	34

6.2.1	Groundwater Inorganic Parameters	35
6.2.2	Groundwater Organic Parameters.....	36
6.3	Soil Analytical Results	39
6.3.1	Soil Metal Parameters.....	39
6.3.2	Soil Inorganic Parameters.....	40
6.3.3	Soil Organic Parameters	41
6.4	Surface Water Analytical Results	44
6.4.1	Surface Water Inorganic Parameters	44
6.4.2	Surface Water Organic Parameters.....	45
7	Geotechnical Assessment.....	46
7.1	Introduction	46
7.2	Site Investigation and Ground Conditions	46
7.2.1	Introduction	46
7.3	Engineering Properties	47
7.3.1	Made Ground.....	47
7.3.2	Alluvium	48
7.3.3	Brickearth and Coombe	48
7.3.4	Upper Chalk.....	48
7.3.5	Ground Chemistry.....	49
7.4	Engineering Discussion	49
7.4.1	Foundations	49
7.4.2	Floor Slabs	50
7.4.3	Chemical Attack on Buried Concrete.....	50
7.4.4	Temporary Works.....	51
7.4.5	Car Parks and Pavements	51
7.4.6	Material Re-use and Slope Profiles	52
8	Conclusions	53

9	Recommendations	55
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Inventory of Tables

<i>Table 2.1. General Quality Assessment (GQA) Criteria – Chemistry</i>	<i>10</i>
<i>Table 2.2. General Quality Assessment (GQA) Criteria – Biology</i>	<i>11</i>
<i>Table 3.1. Historical Land Use of the Site and Adjacent Areas</i>	<i>15</i>
<i>Table 3.2. Summary of Site Geology.....</i>	<i>17</i>
<i>Table 3.3 Summary of Sensitive Land Uses.....</i>	<i>20</i>
<i>Table 3.4 Summary of Licensed Waste Management Facilities.....</i>	<i>22</i>
<i>Table 3.5 Summary of Registered Waste Transfer Sites</i>	<i>23</i>
<i>Table 4.1 Monitoring Well Installation Details.....</i>	<i>25</i>
<i>Table 5.1 Groundwater Level in Groundwater Monitoring Boreholes.</i>	<i>32</i>
<i>Table 6.1 Summary of Groundwater Chemical Analytical Results</i>	<i>36</i>

Drawings

JER3835 - 001 Intrusive Investigation Location Plan

4461- 001 Rev A Site Plan

2515 / PL / 018A Site Layout Plan

Appendices

Appendix A	Envirocheck Report
Appendix B	Plates
Appendix C	Exploratory Logs
Appendix D	Field Monitoring Results
Appendix E	Summary of Soil Chemical Results
Appendix F	Summary of Groundwater Chemical Results
Appendix G	Summary of Surface Water Chemical Results
Appendix H	Laboratory Analytical Certificates
Appendix I	Geotechnical Analytical Certificates
Appendix J	FES Intrusive Investigation Logs and Location Plan

1 Introduction

1.1 Background

RPS Planning and Development Chepstow were commissioned by Edgmond Holding Limited to complete a Phase 1 desk study and Phase 2 site investigation report of the former Havant District Council Depot on Harts Farm Way, Havant, Hampshire. The site is centred at National Grid Reference (NGR) 470700, 105910.

These works have been undertaken to establish the site history and presence of ground contamination associated with the historical activities on the site and to provide a comprehensive assessment of the geotechnical properties of the ground beneath the site. The information collected will be utilised in order to assess site environmental liabilities associated with the site and advise on the suitability to develop the premises for proposed commercial redevelopment. The scope of the intrusive site investigation works undertaken was provided by Gyoury Self Partnership on behalf on Space Property in a letter to RPS dated 21st of June 2007.

1.2 Objectives

The objectives of the report are to:

- Determine current and historical use of the site, and that of adjacent properties / areas.
- Determine current (baseline) environmental conditions at the site, including geology, hydrogeology, hydrology and potential land contamination.
- Identify the potential risks posed by the site to the environment and other sensitive receptors.
- Identify the potential risks posed to the site by adjacent land uses.
- Determine the sensitivity of the environment to any future change in land use at the site.

- Identify potential impacts on proposed / future redevelopment by current site conditions including a geotechnical assessment of the subsurface.

1.3 Report Structure

The remainder of the report is structured as follows:

Section 2; Desk Study Methodology: The methods of determining the environmental conditions and sensitivity of the site and neighbouring areas, from desk based sources, are detailed in this section.

Section 3; Background Information: This section assesses the environmental sensitivity of the site and the surrounding areas, and potential risks to sensitive receptors associated with the site by assessed using the maps, information databases and other literature resources available. In addition a qualitative assessment of potential risks is undertaken based on desk study information to determine site sensitivity and potential risks posed by the site, sensitive receptors, including controlled waters and site users.

Section 4; Site Investigation Works: This section provides a detailed summary of the intrusive investigation works undertaken as well as the follow up environmental monitoring.

Section 5; Site Investigation Findings: This section details the findings of the intrusive investigation in terms of ground conditions encountered and the presence of visual and olfactory evidence of contamination. The section also includes a description of the findings of the monitoring rounds.

Section 6; Laboratory Analytical Results: This section summaries the analysis of the soil, groundwater and surface water samples collected during the site investigation and monitoring rounds.

Section 7; Geotechnical Assessment: This section provides the geotechnical assessment follow the interpretation of in-situ and laboratory geotechnical tests.

Section 8; Conclusions. This section concludes the report discussing the overall assessment of the current contamination regime identified at the site.

Section 9; Recommendations: This section provides recommendations follow the interpretation of site conditions.

2 Desk Study Methodology

2.1 Introduction

The environmental sensitivity of the site and surrounding areas, and potential risks to sensitive receptors associated with the site have been assessed using the maps, information databases and other literature resources available.

The methods of determining the environmental conditions and sensitivity of the site and neighbouring areas, from desk-based sources, are detailed in the following sections with results of the findings presented in *Section 3* of this report.

In addition a qualitative assessment of potential risks has been undertaken based on desk study information to determine site sensitivity and potential risks posed by the site, sensitive receptors, including controlled waters, and site users.

2.2 Information Sources

The sources of information used to determine environmental conditions, site sensitivity and site use (current and historical) are detailed below. Sources of guidance followed are also referenced:

- Landmark Envirocheck Report. 23rd July 2007. Reference number: 22218039-1-1.
- British Geological Survey (BGS). England and Wales Sheet 316 - Fareham. Solid and Drift Geology. Scale 1:50,000 (1998).
- Environment Agency (EA). Groundwater Vulnerability Map Sheet 45 – West Sussex and Surrey. Scale 1:100,000.
- Institute of Geological Sciences. 1979. Hydrogeological map of the chalk and associated minor aquifers of Wessex. Scale 1:100,000.
- British Standards Institutions (BSI). 1999. BS5930: 1999 – Code of practice for site investigations.

- British Standards Institutions (BSI). 2001. BS10175:2001 – Investigation of potentially contaminated sites – Code of Practice.
- Environment Agency (EA) website for floodplains maps and Source Protection Zones (SPZs), General Quality Assessment (GQA) data for rivers etc – www.environment-agency.gov.uk/maps/
- Environment Agency PPS25, 'Development and Flood Risk'.
- Environment Agency Planning Policy Statement (PPS) 23 – Planning and Pollution Control. ODPM 2004.
- Department for Environment, Food and Rural Affairs (DEFRA). 2002. Potential Contaminants for the Assessment of Contaminated Land. R&D Publication CLR 8.

2.3 Ground Conditions

2.3.1 Geology

The ground conditions beneath the site may impact the development of the site. The superficial (drift) and solid geology beneath the site was determined from BGS Sheet 316 - Fareham.

2.3.2 Geotechnical Issues

Potential geotechnical issues, which may potentially impact current and future developments at the site, relating to stability (subsidence, landslips etc) are indicated in the Envirocheck Report (ref. no. 22218039_1_1), attached in *Appendix A*.

2.3.3 Mining Issues

Mining affected areas, which may potentially impact current and future developments at the site, are indicated in the Envirocheck Report (ref. no. 22218039_1_1).

2.4 Hydrogeology

2.4.1 Regional and Area Hydrogeology

The hydrogeology of the area is an important factor in determining the sensitivity of the site and surrounding areas. The hydrogeological map of the region was used to identify any local or regional groundwater features.

2.4.2 Groundwater Abstractions

Groundwater abstractions in the area of the site could represent potential receptors to processes impacting groundwater at the site, such as contaminant leaching from soils in to groundwater, and contamination already in groundwater beneath the site.

Licensed groundwater abstractions are detailed within the Envirocheck Report (ref. no. 22218039_1_1).

2.4.3 Groundwater Source Protection Zones

The proximity of an activity to a groundwater abstraction is one of the most important factors in assessing the risk to an existing groundwater resource. The orientation, shape and size of the zones are determined by the hydrogeological characteristics of the strata and the direction of groundwater flow. The zones identified by this classification are detailed below.

Zone I (Inner Source Protection Zone) – The area is defined by a 50-day travel time from any point below the water table to the source and as a minimum of 50 m radius from the source. The 50-day travel time is based on the time it takes for biological contaminants to decay.

Zone II (Outer Source Protection Zone) – This zone is larger than Zone I and is the area defined by a 400-day travel time from any point below the watertable to the source. The travel time is based upon that required to provide delay and attenuation of slowly degrading pollutants. In high storage aquifers the Zone II is the larger of

either the 400-day travel time or the recharge catchment area calculated using 25 percent of the long-term abstraction rate (the licensed rate) for the source.

Zone III (Total Catchment Zone) – This zone covers the complete catchment area of a groundwater source. All groundwater within it will eventually discharge to the source. It is defined as an area needed to support an abstraction from long-term annual groundwater recharge (effective rainfall). For wells and boreholes in the area it will be defined on the authorised abstraction rate whilst, for springs, it will be defined by the best known value of average annual total discharge.

The site location was checked against the Environment Agency (EA) Source Protection Zone (SPZ) maps (EA website) to see whether the site is within the Inner (I), Outer (II) or Total Catchment (III) Zones of any public water supplies.

2.4.4 Groundwater Vulnerability

Groundwater Vulnerability refers to potential impacts on groundwater from activities undertaken and contamination in soils etc. The Groundwater Vulnerability maps classify the geological units as Major, Minor and Non-Aquifers depending on their capacity for the storage of and ability to transmit groundwater. The classifications are described below.

Major Aquifer (highly permeable) – These are highly permeable formations usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes.

Minor Aquifer (variably permeable) – These can be fractured or potentially fractured rocks, which do not have a high primary permeability, or other formations of variable permeability including unconsolidated deposits. Although these aquifers will seldom produce large quantities of water for abstraction, they are important both for local supplies and in supplying base flow to rivers.

Non-Aquifer (negligibly permeable) – Formations that are generally regarded as containing insignificant quantities of groundwater form a third group. However, groundwater flow through such rocks, although imperceptible, does take place and needs to be considered in assessing the risks associated with persistent pollutants. Some non-aquifers can yield water in sufficient quantities for domestic use.

In addition to the aquifer classification, soil vulnerability groups divide soils into three soil vulnerability classes and six sub-classes. Each is based on soil physical and chemical properties that affect the downward passage of water and contaminants.

Soils of High Leaching Potential (H) 1, 2, 3, U – Soils with little ability to attenuate diffuse source pollutants and in which non-adsorbed diffuse source pollutants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater.

Soils with Intermediate Leaching Potential (I) 1, 2 – Soils that have a moderate ability to attenuate diffuse source pollutants or in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer.

Soils with Low Leaching Potential – Soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal or they have the ability to attenuate diffuse pollutants. Lateral flow from these soils may contribute to groundwater recharge elsewhere in the catchment. These generally have a high clay content.

The Groundwater Vulnerability map of the area (Sheet 45 – West Sussex and Surrey) was used to identify the sensitivity of the aquifer unit beneath the site and the soils leaching potential. An extract of the Groundwater Vulnerability Map of the area is included in the Envirocheck Report (ref. no. 22218039_1_1).

2.5 Hydrology

2.5.1 Surface Waters

The proximity of surface waters is important to determine potential flood risk issues and potential receptors for migration of contaminants in groundwater.

The presence of surface water features, including streams, rivers, ditches, and ponds and has been determined from Ordnance Survey maps from the Envirocheck Report (ref. no. 22218039_1_1).

2.5.2 Surface Water Quality

The water quality of any surface waters (rivers etc) near the site is a factor used in determining the sensitivity of the environment, and therefore relates to activities undertaken at the site or conditions on site. The Environment Agency publishes General Quality Assessment (GQA) information for surface waters, which is available from the EA website (www.environment-agency.org.uk/maps/).

The Environment Agency assesses the quality of rivers and canals by looking at nutrients, chemistry, and biology. About 7000 river and canal sites are tested 12 times a year to determine chemistry and nutrient concentrations so the EA can see whether there are any pollutants and whether we need to target areas for improvement.

The EA currently also have a three-year rolling sampling programme to test the biology of rivers. About 6000 sites are sampled twice during survey years to determine what species are living in the rivers.

For chemistry and biology the EA classify "A" as being very good down to "F" for bad. Nutrients are analysed for nitrate and orthophosphate, but are not classified as "good" or "bad". The EA just applies grades 1 (very low presence of nutrients) to 6 (very high presence of nutrients), as rivers across the country naturally have different levels of nutrients and is not necessarily bad for the environment.

The quality of estuarine waters is also classified by the Environment Agency, based on a different system.

Chemistry Classification Method

The EA test samples for ammonia, biochemical oxygen demand (BOD) and dissolved oxygen. The results for each site are averaged and percentiles are calculated. These are compared with limits set for each of the six grades detailed in the *Table 2.1*. The grade is assigned to the river according to the lowest grade achieved in any of the three tests.

Table 2.1. General Quality Assessment (GQA) Criteria – Chemistry

Classification	Description
A - very good	All abstractions Very good salmonid fisheries Cyprinid fisheries Natural ecosystems
B - good	All abstractions Very good salmonid fisheries Cyprinid fisheries Ecosystems at or close to natural
C - fairly good	Potable supply after advanced treatment Other abstractions Good cyprinid fisheries Natural ecosystems, or those corresponding to good cyprinid fisheries
D - fair	Potable supply after advanced treatment Other abstractions Fair cyprinid fisheries Impacted ecosystems
E - poor	Low grade abstraction for industry Fish absent or sporadically present, vulnerable to pollution ** Impoverished ecosystems **
F - bad	Very polluted rivers which may cause nuisance Severely restricted ecosystems

Notes: *providing other standards are met, **where the grade is caused by discharges of organic pollution

Biology

The EA compare the macro-invertebrates (small animals that can be seen with the naked eye) in the sample with the range of species expected if it was not polluted

and assign a grade. Natural changes such as geology and flow are taken into account.

Table 2.2. General Quality Assessment (GQA) Criteria – Biology

Classification	Description
A - very good	Biology similar to that expected for an unpolluted river
B - good	Biology is a little short of an unpolluted river
C - fairly good	Biology worse than expected for unpolluted river
D - fair	A range of pollution tolerant species present
E - poor	Biology restricted to pollution tolerant species
F - bad	Biology limited to a small number of species very tolerant of pollution

2.5.3 Flood Risk

Flood risk is an important consideration for any site development, and must be considered as part of the planning regime.

A floodplain is the natural 'overspill' area when a river rises above its banks or when high tides or stormy seas cause flooding of low-lying coastal areas. Floodplains may therefore be fluvial or coastal.

The floodplain maps show the extent of flooding for a 1:100 (1 %) chance of flooding each year.

Planning Policy Statement 25 (PPS25) sets out Government policy on development and flood risk. It's aims are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall.

This replaces Planning Policy Guidance Note 25: Development and Flood Risk (PPG25), published July 2001.

The Environment Agency floodplain data (www.environment-agency.org.uk/maps/) was used to assess whether the site was in the floodplain, or within 100 m of a

floodplain. An extract of the floodplain map of the area is included in the Envirocheck Report (ref. no. 22218039_1_1).

2.6 Land Use

The current and historical land use of the site and adjacent areas is important in determining potential impacts associated with activities undertaken at the site and environmental sensitivity.

2.6.1 Historical Land-Use

The Landmark Envirocheck Report (ref. no. 22218039_1_1) includes a series of historical Ordnance Survey Maps. These have been used to provide information about the history of the site and the surrounding area, and to determine the presence of any potentially contaminating activities.

2.6.2 Conservation Areas and Sensitive Land Use

The Landmark Envirocheck Report (ref. no. 22218039_1_1) was used to determine any areas of conservation within a 2 km radius of the site. These areas may limit activities undertaken within their boundaries, and reflects on the general sensitivity of an area.

3 Background Information

3.1 Site Location and Description

The site is located on former Havant District Council Depot at Harts Farm Way, Havant in Hampshire. The site is located at NGR 470700, 105900, and comprises a total site area of a little over four hectares and is currently unoccupied. The site was formerly in use as the council depot, including a car parking area, and contained four residential properties which have now been demolished.

The site is located at NGR 470700, 105900, and comprises a total site area of a little over four hectares and is currently unoccupied. The topography is reasonably flat, and comprises tarmac hardstanding and some made ground where buildings have been previously demolished. Natural ground was evident at the site boundaries and adjacent to a small stream running east to west across the site. The site also contains a pond, a watercourse and a number of mature and semi-mature trees including a valuable tree screen adjacent to the A27 trunk road to the north.

The site is bound to the north by the A27 and to the south by Harts Farm Way. The site is bound to the east by an unnamed road, which provides access to a number of commercial units to the east. The site is bound to the west by a waste transfer station. Almost the entire site is bound by a high security fence or wall.

3.2 Land Use of Adjacent Areas

The site is located within the Broadmarsh industrial area. To the west lies the HCC household waste and recycling area, the A27 lies to the north, Brockhampton Road with industrial units to the east, whilst Havant Business Centre, other industrial premises, a waste transfer station and an electricity sub-station are on the southern side of Harts Farm Way opposite the site.

Historical plans show surrounding land to be rough pasture with marsh and grassland since the first available map published in 1870. By 1972 some surrounding land becomes developed for industrial purposes with the A27 to the north, an electricity substation to the southwest, and a wastewater treatment plant over 300 metres to the south.

The site lies approximately 0.5 km north and northeast of the naturally formed Langstone Harbour.

3.3 Historical Use of the Site and Surrounding Area

The historical land use as indicated on the Ordnance Survey maps from 1867 to 2006, included within the Envirocheck Report (ref. 22218039-1-1), is summarised in *Table 3.1*.

Table 3.1. Historical Land Use of the Site and Adjacent Areas

Map / Date	Site History	Adjacent Areas
1867 - 1868, 1:2,500	Agricultural land, pasture and marsh land with Hart's Farm in the southeast corner of the current site area.	Brockhampton Mill to the south, Broad Water to the west. Open grassland in the surrounding local area.
1870, 1:10,560	No change	No change.
1897, 1:1,250	Watercress Beds now depicted on or immediately east of the current site	Watercress Beds now depicted on or immediately east of the current site
1898, 1:10,560	No change.	No change.
1909, 1:1,250 1909 – 1910, 1:10,560	No change.	Brockhampton Mill removed from map. Old Mill Pond and a weir are in its place.
1932, 1:2,500	No change.	No change.
1925, 1:10,560	No change.	No change.
1938 – 1946, 1:10,560	Watercress beds have expanded to cover the whole of the northeastern area of the current site.	No change.
1962 – 1963, 1:10,560	No change.	No change.
1966, 1:10,560	Watercress beds annotation has been removed.	Works and buildings are now depicted immediately to the east, with a large works building immediately east of Brockhampton Road. A27 constructed immediately north of the site.
1969, 1:2,500	Watercress Beds annotated in the far east of the site.	Two Brockhampton roads now exist. Old and new. Between the two roads which are east of the site, joinery works and engineering works have been constructed. Boat building works are present on the eastern side of new Brockhampton Road. A small electricity sub station is present immediately southeast of the site, adjacent to Hart's Farm. A larger electricity sub station is present immediately to the south of the southwestern area of the current site.
1961 – 1974, 1:2,500	Council Depot has been constructed on the site. Hart's Farm Cottages and Watercress Beds still present to	A road named Harts Farm Way has been constructed immediately to the south of the current site.

Map / Date	Site History	Adjacent Areas
	the east. North and northeastern areas off the site have been planted with trees.	
1972 – 1982, 1:10,000	No change.	No change.
1973, 1:2,500	No change.	No change.
1953 – 1987, 1:2,500	No change.	Commercial units are now present to the south of the site. An industrial site with a road is now present as is annotated with 'Incinerator' on the map.
1974 - 1982, 1:10,000	The pond has now been infilled. Around the southeastern part of the site there are slopes so the pits are possibly still present to some degree.	A new structure labelled the Works is present to the south of the site. Beyond the pits, which are part of the site is another structure although this is not identified. The land immediately to the north and west is heath with scattered coniferous trees and scrub. Manning's Heath to the southwest is enlarging. Many other builds to the south and southeast are identified as Works and depots. Beyond this area is a dense residential development.
1993, 1:2,500	The map indicates a series of high voltage cables now cross the site from the electricity sub station to the southwest to the north of the site.	Commercial units to the south are entitled Havant Business Centre.
2000, 1:10,000	No change.	No change.
2006, 1:10,000	No change.	No change.

3.4 Geology

The geology of the site has been determined from the BGS Geological Map, England and Wales Sheet 316 - Fareham. Solid and Drift Geology, 1:50,000.

3.4.1 Regional Setting

The site is situated in the Havant District, approximately 1 km north of the naturally formed Langstone Harbour. The geology of the surrounding area comprises of the London Clay overlying the Reading Beds that overlies the Upper Chalk Formation. The axial trace of a major anticline runs across the site trending east to west.

3.4.2 Superficial Deposits

The site is identified as being underlain by Alluvium, Head and River Terrace Deposits. The Envirocheck report indicates the superficial deposits are thin to none existent beneath the site.

3.4.3 Solid Geology

The solid geology underlying the site is depicted on the BGS 1:50,000 Series sheet 316, Fareham. The site is underlain by the Lewes Nodular Chalk Member of the Upper Chalk Group.

Lewes Nodular Chalk and other members of the chalk group in this area are a combination of white chalk with flint.

3.4.4 Summary of Geology

Table 3.2 summarises the general geological sequence anticipated at the site.

Table 3.2. Summary of Site Geology

Unit	Description	Anticipated Thickness (m)
Alluvium / Head / Brickearth and Coombe Deposits	Gravelly sandy clay/ Clayey Gravel / Sand and Gravel / Gravel (flint)	0 - 10
Upper Chalk	White Chalk with flint	35 - 75

3.4.5 Geotechnical Issues

The Landmark Envirocheck report indicates that the area is not at risk from ground dissolution, running sand, shrinking or swelling clay, collapsible and compressible ground stability hazards. The site is at very low risk of landslides.

3.4.6 Mining Issues

The Landmark Envirocheck report indicates that the site may not be located in an area affected by coal mining. There is no risk of shallow mining hazards.

3.4.7 Radon

The Health Protection Agency reports that less than 1% of homes are above the Action Level for radon. No radon protective measures are considered necessary.

3.5 Regional Hydrogeology

The site lies in the Havant District, with Brockhampton Stream approximately 100 m east to south east of the site. The Brockhampton Stream flows towards Langstone Harbour approximately 500 m to the southwest. Groundwater is presumed to flow towards to the southwest, in a similar direction to the stream. Due to the proximity of Langstone Harbour; tidal influence on groundwater levels and the local groundwater flow regime cannot be ruled out.

3.5.1 Groundwater Vulnerability

The Groundwater Vulnerability map of the area was used to identify the sensitivity of the aquifer unit beneath the site and the soils leaching potential.

The site is situated on a boundary between the major and minor aquifer classification. The southwestern half of the site is situated on a major aquifer, while the northeastern half is classed as being situated on a minor aquifer. The classification and more importantly the division is believed to be based on the fact that the site is situated on the axial trace of a major anticline.

Both sections of the site are located on soils classified as having a high leaching potential (U). Class U soils are defined as soil information for restored mineral workings and urban areas are based on fewer observations than elsewhere and therefore a worst-case vulnerability classification (H) is assumed until proved otherwise.

3.5.2 Groundwater Source Protection Zones

The site is not within a Groundwater Source Protection Zone. The site is located 135 m southwest of the closest SPZ (Zone 1 – Inner Protection Zone). A groundwater source protection zone borehole extracting groundwater from the Bedhampton and Havant Springs is situated 416 m northeast of the site.

3.5.3 Groundwater Abstractions

There are three licensed groundwater abstractions within 500 metres of the site. The nearest groundwater abstraction is approximately 289 m northwest of the site, which is used for abstraction of public water supply by Portsmouth Water Ltd.

3.6 Local Hydrogeology

The site is located on a minor aquifer due to the Bracklesham Group. There may be perched lenses of groundwater within the Made Ground. See *Section 3.5.1* for aquifer classification and classification of soils leaching potential. The tide may influence local groundwater levels and the local groundwater flow regime due to the proximity of Langstone Harbour.

3.7 Previous Investigations

A previous geo-environmental site investigation is known to have been undertaken at the site. Borehole and trial pit logs as well as a trial pit and borehole location plans from a previous geotechnical investigation have been received from the client. Foundation & Exploration Services (FES) undertook the intrusive investigation in early 2002. Intrusive investigation records suggest six cable percussion boreholes were advanced to a maximum depth of 13.2 m bgl with SPT test being undertaken at regular intervals. Eight trial pits were excavated to a maximum depth of 3.0 m bgl.

3.8 Hydrology

3.8.1 Surface Waters

The nearest surface water feature is a surface water stream flowing from east to west across the centre of the site. The stream rises at the Brockhampton and Havant

Springs 1.5 km to the northeast. The stream is culverted in the western area of the site and when it emerges off site it flows towards the Brockhampston Mill Lake and Langstone Harbour 500 m to the southwest of the site.

3.8.2 Discharge Consents

The Envirocheck report indicates that there are 22 active discharge consents within 500 m of the site, these are summarised in the Envirocheck Report (ref. no. 22218039_1_1).

3.9 Flood Risk

The Envirocheck report indicates that the site is in an area that is at risk of flooding. A flood risk map (*Appendix A*) supplied with the Envirocheck report shows the site is classified as being susceptible to flooding from rivers and sea without defences (Zone 3) along the surface water course and in the southwest corner of the site. The entire site is classified as being susceptible to extreme flooding from rivers and sea without defences (Zone 2). The area does not benefit from flood defences.

3.10 Conservation Areas and Sensitive Land Uses

Within the Envirocheck Report there are five sensitive land uses identified within a radius of 500 m of the site, these are summarised in *Table 3.3*.

Table 3.3 Summary of Sensitive Land Uses

Name	Distance and Direction from Site	Status
Not Supplied	0 m north east	Nitrate Vulnerable Zone
Chichester & Langstone Harbours	427 m southwest	Ramsar Site
Langstone Harbour	427 m southwest	Site of Special Scientific Interest (SSSI)
Solent Maritime	427 m southwest	Special Area of Conservation
Chichester & Langstone Harbours	427 m southwest	Special Protection Areas

3.11 Recorded Pollution Incidents and Prosecutions

The Envirocheck report records no pollution incidents associated with the site itself. However, there are records of 21 prosecutions relating to controlled waters.

At Brockhampton Road, approximately 122 m to the northeast of the site, a deliberate disposal to drain of miscellaneous- inert suspended solids resulted in Brockhampton Stream changing colour in August 1998. This category 3 – minor incident was preceded by another minor incident in November 1996. This incident is reported to have occurred on a road as a result of a road traffic accident, which resulted in the spillage of oil. The location of the incident is reported as Havant Borough Council, Harts Farm Way Depot. The third and final incident within a 250 m radius of the site is reported as being a category 2 – significant incident. The incident is reported as a spillage of oils which impacted a nearby stream and occurred 149 m west of the site on an industrial property in May 1994.

3.12 Industrial Land Use / Registered Sites

3.12.1 IPC, IPPC and PPC Sites

There are seventeen local authority and Environment Agency PPC, IPC or IPPC sites located within 1,000 m from the site. These have been identified in the Envirocheck report attached in *Appendix A*.

3.12.2 Trade Directory Entries

There are currently no trade directory entries registered on the site. There are a number of trade directory entries within 1,000 m of the site and these have been identified in the Envirocheck report, *Appendix A*.

3.12.3 Fuel Station Entries

There are five fuel stations in the vicinity of the site.

- Havant Lorry Park, approximately 130 m southwest, classified as non retail;
- Cambridge Garage, approximately 586 m north, classified as obsolete;
- Tesco Havant, approximately 636 m east, classified as open;

- Park Road South Service Station, approximately 760 m east, classified as closed;
- Hendy Lennox, approximately 815 m northeast, classified as obsolete.

3.13 Landfills and other Waste Facilities

The following presents a summary of the landfills and other waste management facilities within close proximity to the site. The Envirocheck report indicates that there are ten Licensed Waste Management Facilities within 1000 m of the site and these are summarised in Table 3.4.

Table 3.4 Summary of Licensed Waste Management Facilities

Operator Name	Distance and Direction from site	Site Category	License Status
Portsmouth Water Company Ltd.	259 m north	Landfills taking non-biodegradable wastes (not construction)	Active
Dudman Waste & Environmental Ltd.	9 m southwest	Household, commercial and industrial transfer stations.	Transferred
Associated Environmental Projects (Hampshire) Ltd.	11 m west	Household, commercial and industrial transfer stations.	Surrendered
Veolia E S Hampshie Ltd.	54 m west	Metal Recycling Sites (Mixed)	Issued
Hopkins Recycling Ltd.	56 m southwest	Household, commercial and industrial transfer stations	Modified
Hopkins Recycling Ltd.	76 m southwest	Household, commercial and industrial transfer stations	Issued
Sita Solent Ltd.	110 m south	Household, commercial and industrial transfer stations	Transferred
Southern Water Services Limited	332 m south	Treatment - Biological	Issued
Portsmouth Water Company Ltd.	592 m north	Landfills taking non-biodegradable wastes (not construction)	IPPC

There are four registered waste transfer sites within 1000 m of the site and these are summarised in *Table 3.5*.

Table 3.5 Summary of Registered Waste Transfer Sites

Licence Holder	Distance and Direction from site	Site Category	Maximum annual input
Assoc. Environmental Proj. (Hants) Ltd.	11 m west	Transfer	Small (= or > 10,000 and < 25,000 tonnes per yr.)
Hampshire Recycling Ltd.	56 m southwest	Civic Amenity	Small (= or > 10,000 and < 25,000 tonnes per yr.)
Skips R Us Ltd.	67 m south	Transfer	Medium (= or > 25,000 & < 75,000 tonnes per yr.)
A & J Bull (Solent) Ltd.	127 m southeast	Transfer	Medium (= or > 25,000 & < 75,000 tonnes per yr.)

The Envirocheck report indicates that there are is one BGS recorded landfill site within 1,000 m of the site, which is Storhouse Lake Tip approximately 515 m southwest of the site. Two historical landfill sites have been identified within 1,000 m of the site. These include 'Land South of Buds Farm Sewage Works', 217 m south and Harts Farm Way, 261 m southwest of the site. Two Local Authority recorded landfill sites have been identified within 1000 m of the site. These include Broadmarsh Site, 245 m southwest of the site and Southmoore Lane, 250 m south of the site.

4 Site Investigation Works

4.1 Intrusive Investigation Works Undertaken

The main objectives of the investigation were to provide a general assessment of the physical and chemical nature of the ground conditions beneath the site, to determine the presence or extent of any contamination in the soils and groundwater beneath the site and to provide an assessment of the geotechnical properties of the ground beneath the site. The initial scope of the intrusive site investigation works undertaken was provided by Gyoury Self Partnership on behalf on Space Property in a letter to RPS dated 21st of June 2007. The intrusive investigation scope included six boreholes to a minimum of 15 m and three trial pits or window sample positions to 3 m depth or refusal. Following the initial desk study and site walkover RPS increased the number of trial pits from three to 14 to provide a more defensible and representative assessment of the physical and chemical nature of the ground conditions as well as determining the presence or extent of any contamination in the soils underlying the site

All investigation works were undertaken in accordance with current guidance advocated by regulatory authorities, including BS10175:2001 *Code of Practice for Investigation of Potentially Contaminated Sites*.

4.1.1 Cable Percussion Borehole and Trial Pit Locations

Historical maps from a current Landmark Envirocheck report were used to identify areas of potential historical contamination and a preliminary site assessment was undertaken in order to assess historical potentially contaminative activities. Any areas where there was a potential for contamination were targeted for investigation. Sampling locations were distributed across the site to provide even coverage. All soil arisings were logged in accordance to BS5930: 1999 (*Code of Practice for Site Investigations*). The exploratory hole positions are depicted on *Drawing JER3835-001*.

4.1.2 Site Clearance

Prior to the advancement of the boreholes and trial pits a specialist contractor was commissioned to complete a service clearance survey at each of the intrusive investigation points in order to avoid disturbance to services across the site.

4.2 Cable Percussion

Between 26th July and 2nd August 2007 six exploratory boreholes were advanced by cable percussion drilling techniques to a maximum depth of 17.6 metres below ground level (m bgl). The borehole locations are depicted on *Drawing JER3835-001*.

The six boreholes were strategically positioned across the site to enable an assessment of geotechnical properties of the subsurface at priority locations. These boreholes were subsequently installed with permanent gas and groundwater monitoring standpipes. Boreholes were installed with dual installations of both shallow and deep standpipes to monitoring for the potential for separate shallow and deep groundwater aquifers. The shallow installations were also fitted with gas taps with the aim of providing a capacity to monitor ground gases in the made ground deposits. The monitoring well installation details are summarised in *Table 4.1*. Each installation was finished at ground level with a low permeability grout seal and a flush borehole cover. The borehole logs and installation details are provided in *Appendix C*.

Bulk soil samples were taken in the top five metres where changes in lithology were noted in order to provide baseline data for geotechnical purposes. In-situ undisturbed samples (U-100s) were taken in the chalk and alluvium strata. In-situ cone penetration tests (CPTs) were conducted every 1 m in the top 5 m, and then every 1.5 m to the final borehole depth in order to provide baseline data in terms of the geotechnical properties of the soils underlying the site. The results are presented on borehole logs attached in *Appendix C* to this report and are further discussed in *section 9* of this report.

Table 4.1 Monitoring Well Installation Details

Borehole Identity	Installation Details (m bgl)
BH1 D*	Plain: 0 – 8.6. Slotted: 8.6 – 17.6
BH1 S*	Plain: 0 – 1.0. Slotted: 1.0 – 3.0
BH2 D	Plain: 0 – 8.6. Slotted: 8.6 – 17.6
BH2 S	Plain: 0 – 0.6. Slotted: 0.6 – 3.0

BH3 D	Plain 0 – 5.4. Slotted: 5.4 – 14.4
BH3 S	Plain: 0 – 0.6. Slotted: 0.6 – 3.0
BH 4 D	Plain 0 – 6.0. Slotted: 6.0 – 15.0
BH4 S	Plain: 0 – 0.6. Slotted: 0.6 – 3.0
BH5 D	Plain 0 – 6.5. Slotted: 6.5 – 15.5
BH5 S	Plain: 0 – 0.6. Slotted: 0.6 – 3.0
BH6 D	Plain 0 – 6.0. Slotted: 6.0 – 15.0
BH6 S	Plain: 0 – 0.6. Slotted: 0.6 – 3.0

D – denotes deep groundwater installations

S – denotes shallow groundwater / gas monitoring installations

4.3 Trial Pitting

On the 31st July and 1st August 2007 fourteen trial pits were advanced with the use of a JCB 3CX to a maximum depth of 3 m bgl. The trial pit locations are depicted on *Drawing JER3835-001*.

The 11 trial pits were strategically positioned across the site to provide a defensible representative assessment of the physical and chemical nature of the ground conditions as well as determining the presence or extent of any contamination in the soils underlying the site. Three additional trial pits (TP12, 13 and 14) were excavated to enable further delineation of the hydrocarbon contamination encountered in TP1. All trial pits were subsequently backfilled with excavated arisings in an as dug order. The trial pit logs are provided in *Appendix C*.

4.4 Testing, Sampling and Monitoring

4.4.1 Soil Sampling

In order to provide sufficient samples for chemical analysis between two to three soil samples were collected from each borehole and trial pit location during advancement. One sample was obtained in the top metre and the others at a deeper interval. Any soils exhibiting visual or olfactory evidence of contamination were targeted for sampling and subsequent analysis.

Samples were placed into laboratory-supplied containers and dispatched for analysis to Alcontrol Geochem Analytical Services in Chester.

4.4.2 PID Monitoring

Screening of the soils for volatile organic compounds (VOCs) was undertaken with a Photo Ionisation Detector (PID), fitted with a 10.6ev lamp. Soil samples were screened where visual or olfactory evidence of contamination was apparent.

4.4.3 Gas and Groundwater Sampling

Gas and groundwater monitoring was undertaken on the 8th August 2007. A high-flow gas box was utilised to determine the concentration of the O₂, CO₂, N₂, CH₄, CO and H₂S gas within the monitoring wells as well as recording flow from the monitoring wells. A subsequent monitoring round was undertaken on the 15th of August to collect an additional set of gas data as well as collecting surface water samples from the surface water stream that flows across the site.

During the initial monitoring round, representative groundwater samples were collected where groundwater was encountered across the site. The water samples were placed into laboratory supplied containers and dispatched for analysis at Alcontrol Geochem in Chester on the day of sampling.

The recorded field data for the gas and groundwater monitoring is provided in *Appendix D*.

4.4.4 Surface Water Sampling

Surface water sampling was undertaken on the 15th August 2007. Two points along the surface water stream crossing the site were selected for surface water sampling locations. The surface water sampling locations are indicated on *Drawing JER3835-001*.

4.4.5 Laboratory Analysis

Laboratory analysis of soil and water was undertaken at a UKAS accredited laboratory, in accordance with MCERTS validation methodologies (in soils) where appropriate. The samples were analysed for the following contaminants of concern:

- Total Petroleum Hydrocarbons (TPH) – Initially a less specific level analysis with six broad carbon bands was undertaken to assess the total TPH concentration.

- Samples with an elevated TPH concentration were scheduled for speciated TPH analysis (aliphatic and aromatic split) with a breakdown of the proportions of C₆ – C₄₀.
- Polycyclic Aromatic Hydrocarbons (PAH).
- VOCs
- SVOCs
- Inorganic Compounds Including Total Sulphate, Boron, Arsenic Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc, Sulphide, Total Sulphur, Hexavalent Chromium, Phenols, Thiocyanate, Total Cyanide, Free Cyanide, and pH Value.

The summary of the soil chemical results and laboratory analysis data for the soil and groundwater samples is provided in *Appendix E* and *Appendix F*.

In addition to the chemical analysis bulk soil samples were taken in the top five metres of the boreholes in order to provide baseline data for geotechnical purposes. In-situ undisturbed samples (U-100s) were taken in the chalk and alluvium strata. The testing schedule and results of the analysis are discussed further in *section 9* of this report.

5 Site Investigation Findings

5.1 Geology

The main geological units identified during the intrusive site investigation are summarised in the following sections. Reference should also be made to the individual exploratory borehole and trial pit logs presented in *Appendix C*.

5.1.1 Made Ground

Made Ground was present over the majority of the site comprising tarmac, road base, granular fill material and occasional cohesive material at varying depths with much brick and rubble fragments in one area. The Made Ground was typically encountered down to depths of approximately 2 m. The Made Ground was changeable at depth and across the whole site, varying from tarmac, to fill material of gravelly clay to gravelly sandy clay with occasional brick and rubble fragments, and some horizons of competent chalk.

5.1.2 Alluvium

Alluvium was encountered at a number of borehole and trial pit locations, which comprised a soft to stiff, dark brown, slightly gravelly clay. The thickness of the alluvium varied from 0.7 m to 0.2 m with an average thickness, where encountered, of 0.5 m.

5.1.3 Brickearth and Coombe Deposits

The Brickearth and Coombe Deposits were encountered in all exploratory boreholes and trial pits. This recent deposit typically consisted of loose to medium dense, clayey gravel. Gravel is typically sub-rounded flint nodules to fine angular fragments of shattered flint in a soft chalk clay matrix. The thickness of these recent deposits range from 5.7 m at BH4 to 7.7 m at BH1, with an average thickness of 6.6 m.

5.1.4 Upper Chalk

The Upper Chalk is a mainly soft, white, fine-grained homogeneous limestone or clay with nodules of flint. All exploratory cable percussion boreholes terminate within this

stratum and, therefore, thickness of the chalk was not proven, as the maximum depth of boreholes was 17.6 m bgl.

5.1.5 Geological Sequence Summary

Table 6.1 summaries the geological sequence identified during the site investigation.

Table 6.1 Geological Sequence

Unit	Description	Depth to base of strata (and Thickness)
Made Ground	Comprising tarmac, road base, granular fill material and occasional cohesive material at varying depths with much brick and rubble fragments in one area	0.7 – 2.5 m bgl (max 2.5 m thick)
Alluvium	Comprised a soft to stiff, dark brown, slightly gravelly clay.	1.0 – 1.7 m bgl. (Varied from 0.7 m to 0.2 m).
Brickearth and Coombe Deposits (Recent Deposits)	Typically consisted of loose to medium dense, clayey gravel. Gravel is typically sub-rounded flint nodules to fine angular fragments of shattered flint in a soft chalk clay matrix	6.9 – 9.6 m bgl. (Range from 5.7 m at BH4 to 7.7 m at BH1)
Upper Chalk	Mainly soft, white, fine-grained homogeneous limestone or clay with nodules of flint.	Not proven. Encountered in all boreholes.

5.2 Visual and Olfactory Evidence of Contamination

Evidence of contamination was observed in TP1, TP12 and TP13 with a hydrocarbon odour with clearly visible staining in the surrounding Made Ground. The Made Ground was a fill material comprising gravelly clay to clayey sandy gravel. TP14 was noted to consist of entirely made ground material of brick, metal, rubble, plastic etc. Details are noted within the exploratory trial pit logs in *Appendix C*. Anecdotal evidence from conversations with members of staff from adjoining premises also confirmed the possible presence of an underground fuel storage tank in this area.

5.3 PID Readings

Monitoring of VOCs was undertaken on soils collected during the advancement of the above mentioned odorous trial pits using the PID. Average values ranged from 147 parts-per-million (ppm) in TP12 to 3.1 ppm in TP13. These reading suggest that VOCs are being released from TP12 at elevated concentrations.

5.4 Gas Monitoring

Gas monitoring round was undertaken at each of the six permanent shallow monitoring installations on the 8th and 15th August 2007. Full monitoring results are presented within *Appendix D*.

Current guidance on the assessment of soil gases is derived from a number of sources. Waste Management Paper 27 and Building Regulations (Department of Environment, 1992) require measures to be implemented to mitigate risks posed by potentially hazardous, explosive or asphyxiant gases at above guideline concentrations, that is:

- Methane exceeding 1% by volume;
- Carbon dioxide exceeding 5% by volume.

The guidance indicates that a gas assessment is required if methane concentrations within the ground are above 1 % or carbon dioxide concentrations are above 1.5 %.

Atmospheric pressure was recorded at each location at 1016 mb on the 8th of August decreasing to 996 mb on the 15th August. The concentration of methane was recorded below guidance concentration of 1% on both monitoring rounds. The gas valve attached to BH1 was not closed properly on the first visit and therefore the readings have not been included for accuracy purposes. BH6 exceeded the carbon dioxide concentration in the first gas monitoring round, however, from the second gas monitoring round, there is an exceedance of carbon dioxide above the recommended 1.5% level at locations BH1, BH3 and BH6. The exceedance at BH1 was considerably above the recommended level at 17%.

Flow rates are less than the detection limit litres per hour (l/h) in the 8th August monitoring round and range from less than the detection limit (BH1) to -2.1 l/h (BH4) in the 15th August monitoring round. Negative readings for flow are associated with the decrease in atmospheric pressure experienced during the two monitoring rounds. Groundwater levels and the level of contamination within the groundwater, as well as organic content of the made ground and alluvium can influence ground gas concentrations.

The site will require further monitoring in accordance with CIRIA C659 as part of any further investigation associated with site redevelopment. Flow rates are generally low or negative indicating that there is likely to be a very low flux of these gases. If further monitoring demonstrates that concentrations are prevalent then gas protection measures should be implemented within any future development.

5.5 Groundwater

Perched groundwater water strikes were observed during the advancement of all six boreholes. A groundwater sampling round was conducted on the 8th August 2007. Groundwater was encountered in all shallow and deep borehole installations. Groundwater was recovered from all deep borehole installations and five of the six shallow installations for subsequent laboratory analysis. A further round of groundwater level monitoring was undertaken on the 15th August. The groundwater monitoring data gave no clear indication of the groundwater flow direction. The groundwater levels are presented in *Table 5.1*.

Table 5.1 Groundwater Level in Groundwater Monitoring Boreholes.

Borehole location	Ground level (m AOD)	Groundwater Level (m b TOC) 8 th August 07	Groundwater level (m AOD)	Groundwater Level (m b TOC) 15 th August 07	Groundwater level (m AOD)
BH1 S	3.871	1.99	1.881	1.76	2.111
BH1 D	3.871	2.08	1.791	1.755	2.116
BH2 S	3.7	1.87	1.88	1.59	2.16
BH2 D	3.7	2.03	1.72	1.6	2.15
BH3 S	3.754	1.98	1.774	1.62	2.134
BH3 D	3.754	1.91	1.844	1.65	2.104
BH4 S	3.539	1.58	1.959	1.37	2.169
BH4 D	3.539	1.58	1.959	1.37	2.169
BH5 S	3.618	1.33	2.288	1.15	2.468
BH5 D	3.618	1.42	2.198	1.22	2.398
BH6 S	3.602	1.41	2.192	1.29	2.312
BH6 D	3.602	1.44	2.162	1.3	2.302

Consultation with the tide tables with the dates of groundwater monitoring reveal that the visit on the 8th of August corresponded with a low tide in the Solent, while the

groundwater level monitoring visit corresponds with a high tide at midday on the 15th of August. The differences in groundwater levels and comparison with tidal elevations in the Solent suggest that groundwater elevations are influenced by the tidal cycle due to the proximity of Langstone Harbour and the Solent.

6 Laboratory Analytical Results

6.1 Introduction

This section summarises the analysis of the soil, groundwater and surface water samples collected during the site investigation. The summary of soil chemical results, groundwater chemical results, surface water chemical results and laboratory certificates are included in *Appendix E*, *Appendix F*, *Appendix G* and *Appendix H* respectively.

The analytical results have also been compared to the relevant standards for soils and controlled waters considered to be protective of human health and the environment in order to give an initial assessment of the potential risks posed by the concentrations of contaminants on site.

6.2 Groundwater Analytical Results

The site investigation encountered groundwater in all six of the deeper cable percussive monitoring installations. Groundwater was encountered in six of the shallow borehole installations in addition to all trial pits excavated below 1.5 m bgl. Groundwater samples were collected from six deep, five shallow, and one trial pit location where visual and olfactory evidence of contamination was identified.

The laboratory analytical results have been subject to an initial screening exercise, comparing measured groundwater concentrations against the most appropriate water quality threshold to highlight the concentrations of contaminants that may constitute a risk to the surrounding environment.

Measured groundwater quality was compared to the following water standards where possible.

- The Environmental Quality Standards (EQS) for freshwater taken from the 'Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part IIA of the EPA 1990' (*The EQS were not adjusted for metals in relation to the hardness of the nearest surface waters, as no surface water sampling was undertaken*).

- The UK Drinking Water Standards (DWS) taken from the 'Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part IIA of the EPA 1990'.
- The World Health Organisation (WHO) Guidelines for Drinking Water Quality (1984) taken from the 'Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part IIA of the EPA 1990'.
- The US EPA Region 9 Preliminary Remediation Goals (PRG) where no other standard is available.

6.2.1 Groundwater Inorganic Parameters

The contaminants of concern screened within the water samples collected from site have been compared to the relevant water quality standards. A summary of the results of the groundwater laboratory analysis is presented in *Appendix F*. It should be noted that the EQS for chromium, copper, lead, nickel and zinc are given as a range, dependent upon the total hardness (CaCO_3) of the water. The groundwater chemical analytical results are summarised in *Table 6.1*.

Concentrations of all inorganic determinands fall below their respective water quality standards with the exception of copper. Dissolved copper exceeds the EQS value of 28 $\mu\text{g/l}$ in BH6-S, with a concentration of 54 $\mu\text{g/l}$.

The pH of the groundwater samples ranged from 7.62 in BH6-D, to 8.12 in BH2-D.

Cadmium, mercury, sulphide, free sulphur, hexavalent chromium, thiocyanate, total and free cyanide were all below the laboratory limit of detection. Arsenic concentrations range from below the laboratory limit of detection to 7 $\mu\text{g/L}$ (TP1). Dissolved boron concentrations range from below the laboratory limit of detection of <10 $\mu\text{g/L}$ (BH6-D) to 560 $\mu\text{g/L}$ (BH2-S). Chromium ranged from below the laboratory limit of detection of <1 $\mu\text{g/L}$ (various) to 39 $\mu\text{g/L}$ (BH3-S). Lead concentrations range from below the laboratory limit of detection of <1 $\mu\text{g/L}$ (various) to 2 $\mu\text{g/L}$ (BH4-D). Nickel concentrations ranged from 2 $\mu\text{g/L}$ (BH1-D, BH2-S) to 9 $\mu\text{g/L}$ (BH3-D). Selenium concentrations ranged from below the laboratory limit of detection of <1 $\mu\text{g/L}$ to 3 $\mu\text{g/L}$ (BH3-S, BH4-D). Zinc concentrations range from below the laboratory limit of detection of <3 $\mu\text{g/L}$ (various) to 47 $\mu\text{g/L}$ (BH3-S).

6.2.2 Groundwater Organic Parameters

Concentrations of MTBE and BTEX were reported at concentrations below the laboratory detection limit of 10 µg/L in all of the seven analysed samples. TPH concentrations were split into aliphatic and aromatic carbon bands for all samples from deep borehole installations and a trial pit (TP1). All samples were recorded below the laboratory limit of detection of 10 µg/L for aliphatic bands C5 – C8 and aromatic bands C6 – EC8. TP1 exceeded the EQS of 10 µg/L in aliphatic bands C8 - C35, and aromatic bands C8 – C35 with concentrations of 50,000µg/L and 30,000 µg/L respectively.

Analysis for Polycyclic Aromatic Hydrocarbons (PAHs) have reported concentrations ranging from below their respective laboratory detection limits to above the PRG standard for a number of each determinands. All samples have concentrations below the PRG standards for acenaphthene, fluorene, anthracene, flouranthene, pyrene, chrysene and benzo(k)fluroanthene. Napthalene concentrations range from below the laboratory limit of detection to 47 ug/l in TP1, which exceeds the PRG standard of 6.2 ug/l. Benzo(a)anthracene concentrations range from below the laboratory limit of detection, to 1.1 ug/L in TP1, which significantly exceeds the PRG standard of 0.092 ug/L. Benzo(b)fluoranthene concentrations range from below the laboratory limit of detection of 0.023 ug/L to 0.81 ug/L in TP1, which exceeds the EQS standard of 0.092 ug/L. Benzo(a)pyrene concentrations range from below the laboratory limit of detection of 0.0092 ug/L to 0.011 ug/L in BH2-S and to 0.42 ug/L in TP1, significantly exceeding the PRG of 0.0092 ug/L. Indeno(123cd)pyrene concentrations range from below the detection limit of 0.014 ug/L to 0.25 ug/L in BH1 that fails the PRG standard of 0.092 ug/L. Dibenzo(ah)anthracene concentrations range from below the laboratory limit of detection of 0.016 ug/L to 0.09 ug/L in TP1, which exceeds the PRG standard of 0.0092 ug/L.

SVOCs and VOCs were analysed for in two randomly selected samples to identify the presence of any organic solvents in the groundwater. Diethyl phthalate was the only SVOC or VOC detected above its laboratory limit of detection. Concentrations of 12 ug/l and 3 ug/l were detected in BH4-D and BH6-D respectively. Both concentrations are below the PRG standard of 29 ug/l for diethyl phthalate. Table 6.1 summarises the groundwater chemical analytical results.

Table 6.1 Summary of Groundwater Chemical Analytical Results

Determinand	Units	No. of Analyses	No. > LOD	Min	Max	WQS	Type	Pass / Fail
Arsenic Dissolved	ug/l	12	5	1	7	50	EQS	PASS
Boron Dissolved	ug/l	12	10	11	560	20000	EQS	PASS
Chromium Dissolved	ug/l	12	6	5	39	250	EQS	PASS
Copper Dissolved	ug/l	12	11	1	54	28	EQS	FAIL
Lead Dissolved	ug/l	12	3	1	2	250	EQS	PASS
Nickel Dissolved	ug/l	12	11	2	9	200	EQS	PASS
Selenium Dissolved	ug/l	12	6	1	3	10	DWS	PASS
Zinc Dissolved	ug/l	12	9	3	47	500	EQS	PASS
Sulphate (soluble)	mg/l	12	12	21	170	400	EQS	PASS
Phenols Monohydric	mg/l	12	1	0.01	0.01	0.03	EQS	PASS
pH Value	pH Units	12	12	7.62	8.12	9.5	EQS	PASS
EPH (DRO) (C10-C40) Aqueous	ug/l	4	1	400	400	10	DWS (1989)	FAIL
EPH C10-12 Aqueous	ug/l	4	1	73	73	10	DWS (1989)	FAIL
EPH >C12-16 Aqueous	ug/l	4	1	150	150	10	DWS (1989)	FAIL
EPH >C16-21 Aqueous	ug/l	4	1	89	89	10	DWS (1989)	FAIL
EPH >C21-40 Aqueous	ug/l	4	1	81	81	10	DWS (1989)	FAIL
GRO (C4-C12)	ug/l	7	1	360	360	10	DWS (1989)	FAIL
Aliphatics C5-C6	ug/l	7	0	0	0	10	DWS (1989)	PASS
Aliphatics >C6-C8	ug/l	7	0	0	0	10	DWS (1989)	PASS
Aliphatics >C8-C10	ug/l	7	1	41	41	10	DWS (1989)	FAIL
Aliphatics >C10-C12	ug/l	7	1	100	100	10	DWS (1989)	FAIL
Aliphatics >C12-C16 Aqueous	ug/l	7	1	15000	15000	10	DWS (1989)	FAIL
Aliphatics >C16-C21 Aqueous	ug/l	7	1	27000	27000	10	DWS (1989)	FAIL
Aliphatics >C21-C35 Aqueous	ug/l	7	1	8100	8100	10	DWS (1989)	FAIL
Total Aliphatics C5-C35 Aqueous	ug/l	7	1	50000	50000	10	DWS (1989)	FAIL
Aromatics C6-C7	ug/l	7	0	0	0	10	DWS (1989)	PASS
Aromatics >C7-C8	ug/l	7	0	0	0	10	DWS (1989)	PASS

Aromatics >EC8-EC10	ug/l	7	1	62	62	10	DWS (1989)	FAIL
Aromatics >EC10-EC12	ug/l	7	1	150	150	10	DWS (1989)	FAIL
Aromatics >EC12-EC16 Aqueous	ug/l	7	1	9400	9400	10	DWS (1989)	FAIL
Aromatics >EC16-EC21 Aqueous	ug/l	7	1	13000	13000	10	DWS (1989)	FAIL
Aromatics >EC21-EC35 Aqueous	ug/l	7	1	7400	7400	10	DWS (1989)	FAIL
Total Aromatics C6-C35 Aqueous	ug/l	7	1	30000	30000	10	DWS (1989)	FAIL
TPH (Aliphatics and Aromatics C5-C35) Aqueous	ug/l	7	1	80000	80000	10	DWS (1989)	FAIL
PAH by GCMS								
Naphthalene Aqueous	ug/l	11	2	0.063	47	6.2	PRG	FAIL
Acenaphthylene Aqueous	ug/l	11	3	0.051	3.1			
Acenaphthene Aqueous	ug/l	11	2	6.3	44	365	PRG	PASS
Fluorene Aqueous	ug/l	11	3	0.014	67	243.3	PRG	PASS
Phenanthrene Aqueous	ug/l	11	4	0.03	130			
Anthracene Aqueous	ug/l	11	2	1.8	20	1825	PRG	PASS
Fluoranthene Aqueous	ug/l	11	5	0.022	7.3	1500	PRG	PASS
Pyrene Aqueous	ug/l	11	7	0.034	17	182.5	PRG	PASS
Benz(a)anthracene Aqueous	ug/l	11	2	0.062	1.1	0.092	PRG	FAIL
Chrysene Aqueous	ug/l	11	3	0.03	2.8	9.2	PRG	PASS
Benzo(b)fluoranthene Aqueous	ug/l	11	1	0.081	0.081	0.092	PRG	FAIL
Benzo(k)fluoranthene Aqueous	ug/l	11	1	0.027	0.027	0.92	PRG	PASS
Benzo(a)pyrene Aqueous	ug/l	11	2	0.011	0.42	0.009	PRG	FAIL
Indeno(123cd)pyrene Aqueous	ug/l	11	1	0.25	0.25	0.092	PRG	FAIL
Dibenzo(ah)anthracene Aqueous	ug/l	11	1	0.09	0.09	0.009	PRG	FAIL
Benzo(ghi)perylene Aqueous	ug/l	11	1	0.37	0.37			
PAH 16 Total Aqueous	ug/l	11	8	0.033	350			
SVOC by GCMS								
Phthalates								
Diethyl phthalate	ug/l	2	2	3	12	29199	PRG	PASS

The EQS value is dependent on the hardness of the water and is reliant on whether the sample would pass or fail its EQS standard.

6.3 Soil Analytical Results

Two to three soil samples from each exploratory location were scheduled for chemical analysis; one of the samples was taken from the top metre. A summary of the results of the soil laboratory analysis is presented in *Appendix E*.

The analytical results have also been compared to the relevant standards for soils considered to be protective of human health and the environment in order to give an initial assessment of the potential risks posed by the concentrations of contaminants on site. The inorganic contaminants within the top 1 m of the soil have been screened against their respective CLEA SGV (Soil Guideline Values), of which if concentrations exceed this threshold, there is a potential risk to human health. RPS Group plc have derived a set of GAC values (Generic Assessment Criteria), for a number of different scenarios for organic contaminants of concern, which do not currently have CLEA guideline values. The screening level assessment provides an indication of whether any of the soil samples collected from across the site area present an unacceptable risk. Although the site is to be redeveloped for industrial/commercial use, the most sensitive remedial screening values developed for residential site use with plant uptake, have been utilised.

Where the screening level assessment indicates that concentrations of contaminants have the potential to pose an unacceptable risk to site end users a site-specific quantitative risk assessment may be required.

6.3.1 Soil Metal Parameters

A representative soil sample was collected from the top metre of each exploratory hole location and subsequently scheduled for the analysis of inorganic determinands.

In addition to this a further sample collected at depth was also analysed. In total 18 samples were analysed for inorganic parameters.

Laboratory values of pH ranged from 8.0 to 10.9 in these samples representing alkaline conditions.

Arsenic, cadmium, chromium, copper, lead, nickel and zinc were present at a number of locations across the site at low concentrations. All 18 samples were analysed for these inorganic determinands.

Arsenic was detected in 1 of the analysed samples with concentrations ranging from less than the laboratory detection limit of 3 mg/kg (various) to 12 mg/kg (TP4, 0.5 m bgl). No samples exceed the CLEA (Contaminated Land Exposure Assessment) SGV (Soil Guidance Value) for arsenic for residential use with plant uptake of 20 mg/kg.

Cadmium has been detected in 10 of the analysed samples with concentrations ranging from below a laboratory detection limit of 0.3 mg/kg (various) to 0.7 mg/kg (TP6, 0.7 m bgl). All of these values are below the CLEA SGV for cadmium for residential with plant uptake of 8 mg/kg for soil pH of 8.

Chromium has been detected in concentrations ranging from 8.2 mg/kg to 38 mg/kg (BH3, 1.0 m bgl), and was detected in all 16 of the sample locations. None of the samples exceed the CLEA SGV for chromium for residential use with plant uptake of 130 mg/kg.

Copper was detected in 10 of the samples analysed with concentrations ranging from 7 mg/kg (TP14, 0.5 m bgl) to 30 mg/kg (TP10, 0.8 m bgl).

Lead was detected in all of the samples analysed. The lowest lead concentration was recorded at 4 mg/kg (TP6, 0.7 m bgl); the highest concentration was recorded at 96 mg/kg (TP10, 0.8 m bgl). There are no exceedances above the CLEA SGV for lead for residential use with plant uptake of 450 mg/kg.

Nickel was detected in all but one of the samples analysed. The nickel concentrations ranged from 4 mg/kg (TP6, 1.0 m bgl) to 22 mg/kg (TP10, 0.8 m bgl). There were no exceedances above the CLEA SGV of 50 mg/kg for residential use with plant uptake.

Zinc was detected in all analysed samples, the lowest zinc concentration recorded was 16 mg/kg (BH4, 0.5 m bgl); the highest concentration recorded was 110 mg/kg (TP10, 0.8 m bgl).

6.3.2 Soil Inorganic Parameters

Total sulphate concentrations ranged from below the laboratory detection limit (TP2, 0.4 m bgl) to 20,000 mg/kg (TP14, 0.5 m bgl). Total sulphur concentrations ranged from 0.01% (BH3, 1.0 m bgl) to 0.87% (TP14, 0.5 m bgl).

Total cyanide was detected in one of the 18 samples at a concentration of 62 mg/kg in TP5 at 0.5 m bgl. Hexavalent chromium was only detected in TP14 at 0.5 m bgl (0.6 mg/kg).

Concentration of mercury, selenium, acid soluble sulphide, monohydric phenols, thiocyanate, and free cyanide were all below their respective limit of detection in each of the samples analysed.

6.3.3 Soil Organic Parameters

All collected samples were analysed for a range of organic determinands.

TPH was recorded above the laboratory detection limit of 0.01 mg/kg in 16 of the 37 samples initially screened. Initial screening indicated the majority of TPH detected is within the C21 – C40 ranges with the maximum concentration of 1400 mg/kg detected in TP1, 0.5 m bgl. No TPH was detected in carbon ranges C6 – C12.

Speciated hydrocarbon analysis was undertaken on two selected samples taken from trial pits in areas indicating visual and olfactory evidence of hydrocarbon contamination. The results indicate the majority of the contamination is within the aliphatic and aromatic bands C16 – C21 with the maximum concentration of 5,900 mg/kg at TP1, 0.5 m bgl.

A number of Polycyclic Aromatic Hydrocarbons (PAHs) was detected in the soil samples from across the site area. The highest PAH (16 Total) concentration was detected in a samples from TP4 (84 mg/kg, 0.5 m bgl; the lowest was detected in a sample from TP6 (0.094 mg/kg, 1.7 m bgl).

The concentration of naphthalene ranged from 0.012 mg/kg (TP9, 1.8 m bgl) to 1.8 mg/kg (TP4, 2.0 m bgl) while the concentration of benzo(a)pyrene ranged from below the laboratory detection limit of 0.012 mg/kg (TP4, 2.0 m bgl, TP6, 1.7 m bgl, and BH3, 1.0 m bgl) to 4.5 mg/kg (TP4, 0.5 m bgl).

SVOCs were analysed for in seven samples. Most determinands were recorded below the laboratory limit of detection with the exception of: bis(2-ethylhexyl) phthalate detected at 19 mg/kg in TP12 at 1.5 m bgl; 2-methylnaphthalene detected in three samples with a maximum concentration of 34 mg/kg recorded in TP1 at 1.2 m bgl; carbazole detected in two samples with a maximum concentration of 2.1

mg/kg detected in BH2 at 0.4 m bgl; and dibenzofuran detected in three samples with a maximum concentration of 1.2 mg/kg detected in BH2 at 0.4 m bgl.

VOCs were analysed for in seven samples. All determinands were recorded below their respective laboratory limit of detection with the exception of samples taken from TP1 (1.2 m bgl) and TP12 (1.5 m bgl) where VOCs containing benzene show elevated concentrations.

Table 6.2: Summary of Chemical Analytical Results for Soils

Determinand	Units	No. of Analyses	No. > LOD	Minimum	Maximum
Total Sulphate	mg/kg	18	17	150	20000
Boron Water Soluble	mg/kg	18	1	12	12
Arsenic	mg/kg	18	5	4	12
Cadmium	mg/kg	18	10	0.3	0.7
Chromium	mg/kg	18	16	8.2	38
Copper	mg/kg	18	10	7	30
Lead	mg/kg	18	18	4	96
Mercury	mg/kg	18	0	0	0
Nickel	mg/kg	18	17	1	22
Selenium	mg/kg	18	0	0	0
Zinc	mg/kg	18	18	16	110
Acid Soluble Sulphide	mg/kg	18	0	0	0
Hexavalent Chromium	mg/kg	18	1	0.6	0.6
Phenols Monohydric	mg/kg	18	0	0	0
Thiocyanate	mg/kg	18	0	0	0
Total Cyanide	mg/kg	18	1	62	62
Free Cyanide	mg/kg	18	0	0	0
pH Value	pH Units	18	18	8	10.9
Total Sulphur	%	18	18	0.01	0.87
GRO (C4-C12)	mg/kg	2	2	7.6	53
MTBE	mg/kg	2	0	0	0
Benzene	mg/kg	2	0	0	0
Toluene	mg/kg	2	0	0	0
Ethyl benzene	mg/kg	2	1	0.087	0.087
m & p Xylene	mg/kg	2	1	0.063	0.063
o Xylene	mg/kg	2	0	0	0
Aliphatics C5-C6	mg/kg	2	1	0.51	0.51
Aliphatics >C6-C8	mg/kg	2	2	0.38	9.3

Aliphatics >C8-C10	mg/kg	2	2	1.2	8.3
Aliphatics >C10-C12	mg/kg	2	2	1.6	9.1
Aliphatics >C12-C16	mg/kg	2	2	52	700
Aliphatics >C16-C21	mg/kg	2	2	370	2300
Aliphatics >C21-C35	mg/kg	2	2	170	890
Total Aliphatics C5-C35	mg/kg	2	2	590	3900
Aromatics C6-C7	mg/kg	2	0	0	0
Aromatics >C7-C8	mg/kg	2	0	0	0
Aromatics >EC8-EC10	mg/kg	2	2	1.9	12
Aromatics >EC10-EC12	mg/kg	2	2	2.4	14
Aromatics >EC12-EC16	mg/kg	2	2	61	400
Aromatics >EC16-EC21	mg/kg	2	2	320	930
Aromatics >EC21-EC35	mg/kg	2	2	260	640
Total Aromatics C6-C35	mg/kg	2	2	640	2000
TPH (Aliphatics and Aromatics C5-C35)	mg/kg	2	2	1200	5900
TPH C6-8	mg/kg	35	0	0	0
TPH >C8-10	mg/kg	35	0	0	0
TPH >C10-12	mg/kg	35	0	0	0
TPH >C12-16	mg/kg	35	3	19	120
TPH >C16-21	mg/kg	35	7	13	430
TPH >C21-40	mg/kg	35	16	13	850
TPH C6-40	mg/kg	35	16	13	1400
PAH by GCMS					
Naphthalene	mg/kg	37	35	0.012	1.8
Acenaphthylene	mg/kg	37	19	0.006	0.24
Acenaphthene	mg/kg	37	31	0.016	2.3
Fluorene	mg/kg	37	34	0.015	3.7
Phenanthrene	mg/kg	37	37	0.028	17
Anthracene	mg/kg	37	32	0.009	3.6
Fluoranthene	mg/kg	37	36	0.027	16
Pyrene	mg/kg	37	35	0.022	10
Benz(a)anthracene	mg/kg	37	37	0.019	5.3
Chrysene	mg/kg	37	36	0.010	6
Benzo(b)fluoranthene	mg/kg	37	35	0.017	7.1
Benzo(k)fluoranthene	mg/kg	37	27	0.028	3.3
Benzo(a)pyrene	mg/kg	37	34	0.013	4.5
Indeno(123cd)pyrene	mg/kg	37	30	0.015	2.7
Dibenzo(ah)anthracene	mg/kg	37	22	0.009	0.61

Benzo(ghi)perylene	mg/kg	37	35	0.010	2.9
PAH 16 Total	mg/kg	37	37	0.094	84
SVOC by GCMS					
PAHs					
2-Methylnaphthalene	mg/kg	7	3	0.4	34
Phthalates					
Bis(2-ethylhexyl) phthalate	mg/kg	7	1	19	19
Other Semi-volatiles	mg/kg				
Carbazole	mg/kg	7	2	0.2	2.1
Dibenzofuran	mg/kg	7	3	0.14	1.2
Volatile Organic Compounds					
Ethylbenzene	mg/kg	7	3	0.005	0.19
Isopropylbenzene	mg/kg	7	2	0.086	0.23
Propylbenzene	mg/kg	7	2	0.19	0.38
1.2.4-Trimethylbenzene	mg/kg	7	3	0.023	2.1
1.3.5-Trimethylbenzene	mg/kg	7	2	0.1	0.2
sec-Butylbenzene	mg/kg	7	2	0.12	0.2
Naphthalene	mg/kg	7	2	1.2	3

6.4 Surface Water Analytical Results

Two surface water samples were collected during the site visit on the 15th of August 2007. Sample locations were chosen to enable interpretation of the baseline and on-site surface water contaminant concentrations. A summary of the results of the surface water laboratory analysis is presented in *Appendix G*. The surface water sampling locations are indicated on *Drawing JER3835-001*.

The laboratory analytical results have been subject to an initial screening exercise, comparing measured surface water concentrations against the most appropriate water quality threshold to highlight the concentrations of contaminants that may constitute a risk to the surrounding environment.

6.4.1 Surface Water Inorganic Parameters

Concentrations of all inorganic determinands fall below their respective water quality standards. The pH of the groundwater samples range from 8.41 in SW1 to 8.21 in SW2.

6.4.2 Surface Water Organic Parameters

Concentrations of MBTE and BTEX were reported at concentrations below the laboratory detection limit of 10 ug/L in both samples.

Analysis of Polycyclic Aromatic Hydrocarbons (PAHs) have reported concentrations ranging from below their respective laboratory detection limits to above the PRG standard for a number of each determinands. Results from SW1 report all concentrations of PAHs are below their respective laboratory detection limits. Elevated concentrations from SW2 included; flouranthene (36 ng/l), pyrene (31 ng/l), chrysene (18 ng/l), benzo(b)flouranthene (110 ng/l), benzo(k)flouranthene (29 ng/l), benzo(a)pyrene (43 ng/l), indeno(123cd)pyrene (58 ng/l), benzo(ghi)perylene (74 ng/l) and PAH 16 Total (400 ng/l). Determinands which exceed their respective PRG standards in SW2 include benzo(b)flouranthene (110 ng/l) which has a PRG of 92 ng/l and benzo(a)pyrene (43 ng/l) which has a PRG of 9.2 ng/l.

7 Geotechnical Assessment

7.1 Introduction

Redevelopment of the site is proposed to incorporate 24 no. warehouse units incorporating maximum two storey office accommodation with associated access and parking.

It is understood that site levels are to remain predominantly as existing.

The information contained within this report is based upon the available information at the time of reporting.

There is presently no specific information available relating to structure type and loadings.

7.2 Site Investigation and Ground Conditions

7.2.1 Introduction

Details of the investigation works undertaken and the sequence of strata encountered are provided in *sections 4 and 5* of this report. The intrusive investigation location plan is provided in *Drawing JER3835-001*. The exploratory hole records are provided in *Appendix C*.

In addition to these works previous investigation was carried out by Foundation and Exploration Services in April 2002. The exploratory hole records and location plan are provide in *Appendix J*. No other data has been made available.

During the advancement of boreholes standard penetration testing was undertaken with sampling to enable subsequent laboratory testing. Results are shown on the relevant exploratory hole records. The testing undertaken is summarised in the following table with full results presented in *Appendix I*.

Table 8.1: Summary of Geotechnical Tests undertaken during the current Investigation.

Test Type	Made Ground	Alluvium	Brickearth and Coombe	Upper Chalk
Standard Penetration Test		4	35	34
Atterberg Limits		1		
Particle size Distribution			2	
Sulphate and pH		1	1	2
Bulk / Dry Density				6

Table 8.2: Summary of Geotechnical Tests undertaken during a Previous Investigation.

Test Type	Made Ground	Alluvium	Brickearth and Coombe	Upper Chalk
Standard Penetration Test	2	2	34	2

7.3 Engineering Properties

Descriptions and thicknesses of strata encountered are provided in *Section 5.1*. The following sections present the results of geotechnical testing undertaken both during site works (in situ) and subsequent laboratory analysis of samples recovered.

7.3.1 Made Ground

Made ground thickness is predominantly less than 1m. No testing of the made ground has been undertaken apart from 2 no. spt tests indicating a loose to medium relative density. This is consistent with the visual observations made.

7.3.2 Alluvium

The made ground is underlain intermittently by alluvial clay. The thickness is generally less than 1m.

A single atterberg limit test indicates a medium shrinkability clay with a plasticity index of 21 reported.

Results of 6 spt tests indicate the clay to be of variable consistency with spt ranging between 8 and 31.

7.3.3 Brickearth and Coombe

A granular deposit encountered across the whole site recorded in excess of 5.7m thickness.

Two particle size distribution tests confirm a sandy well graded gravel deposit. Less than 5% silt and clay is recorded.

Results of 69 spt tests indicate the deposit to be of variable consistency with spt ranging between 4 and 46. There is a general increasing trend with depth from approximately 10 at 2m depth to 15 at 8m depth.

7.3.4 Upper Chalk

Chalk was encountered at depths predominantly in excess of 8m depth.

36no. spt tests indicate variable relative density but an increasing trend with depth from approximately 10 at 8m depth to 20 at 16m depth. Two results below 16m indicate increased N value to in excess of 25. This is consistent with termination of boreholes on encountering competent chalk.

Results of 6 dry density tests on the chalk gave the following range of results

Dry density 1.49 to 1.69 Mg/m³

Bulk Density 1.93 to 2.06 Mg/m³

Moisture Content 22 to 30%

These results indicate a medium density chalk with one result falling in the low density class.

7.3.5 Ground Chemistry

Four samples from varying depths were tested for sulphates and pH. pH ranged between 7.2 and 7.4 with water-soluble sulphate ranging up to 880mg/l.

7.4 Engineering Discussion

7.4.1 Foundations

Made ground and intermittent soft alluvial clay is encountered to a depth of approximately 2m across the site, locally deeper (vicinity of TP1).

The underlying stratum is described as loose to medium dense gravels overlying upper Chalk from approximately 8m depth.

Groundwater has been encountered within the gravels. Groundwater strikes as shallow as 1 m below ground level have been recorded.

Poor excavation stability is recorded during trial pitting as a result of groundwater inflows.

Given the above we would consider that significant temporary works; dewatering would be required for the use of shallow foundations. Foundation excavation stability is likely to be poor with spalling to be expected. We would therefore consider that piling to depth would provide the least risk option for foundations of the buildings. This will minimise the need for deep excavation and associated groundwater control.

Pile selection would need to take account of loads to be carried, ground conditions (particularly the presence of made ground and the potential for development of negative skin friction), presence of overburden and ground water table and logistical constraints (e.g. presence of adjacent structures). In addition when piles are installed in a group then behaviour of the group needs to be considered as well as that for individual piles particularly with regard to settlement of the foundation as a whole.

Specialist contractor support will be required in developing a piled solution through to detailed design.

For preliminary design purposes utilising a pre cast driven pile of 450mm diameter to a depth of 15 m we would envisage an allowable pile working load of 450kN. Dependent upon actual required loads and pile grouping, shorter piles may be more appropriate. In areas of thick made ground development of additional negative skin friction will need to be considered and addressed.

Given our assessment of the contamination status at the site we would not envisage significant environmental issues with regard to the use of piles.

Further information on anticipated structures, layout and load distributions will be required in order to further define appropriate pile solutions layout and type.

7.4.2 Floor Slabs

Dependant on the floor tolerances required and loadings envisaged ground bearing floor slabs could be considered. Differential movement between the structure and floor could be managed through design. Where floor tolerances are greater a suspended floor slab should be utilised. We would not anticipate a need for a sub floor void.

Where a ground-bearing slab is considered the formation should be inspected proof rolled and any inconsistencies removed and replaced with suitably engineered fill.

7.4.3 Chemical Attack on Buried Concrete

Chemical results show levels of water-soluble sulphates up to 880mg/l, with a pH ranging between 7.2 and 7.4.

Based on the water-soluble sulphate results and pH the Design Sulphate Class, as defined by the BRE Special Digest 1 is DS-2 and the Aggressive Chemical Environment for Concrete (ACEC) site classification is AC-3z.

The recommendations of BRE Special Digest 1 should be followed for concrete foundations and sub structure concrete.

7.4.4 Temporary Works

It is considered that shoring of any shallow excavations will be required due to the granular nature of near surface materials. Precautions such as battering or trench support systems will be needed. This will be mandatory where access is required for construction personnel.

Shallow ground water was encountered and will need to be considered for all excavations at the site. Groundwater inflows are reported as rapid. Measures to isolate areas for dewatering should be considered to limit lateral impact of dewatering and the volumes of groundwater generated for disposal.

7.4.5 Car Parks and Pavements

Given the variable description of the made ground and the underlying intermittent alluvial deposits we would recommend design based on a CBR of 2% therefore requiring the use of additional capping material. CBR testing in advance of construction would enable refining of design. In any event the formation once exposed should be proof rolled and inspected with soft spots being removed and replaced with suitable compacted stone.

As good practice it is recommended that the construction of the pavements be carried out soon after preparation of the area so as to minimise excessive interaction with surface water, which may result in softening and sub grade degradation.

Given the nature of the likely sub grade it should be considered as frost susceptible.

In the event that a significant capping layer is required consideration could be given to the in situ treatment of the made ground thereby alleviating the need for its removal. In the event that this is considered input from a specialist contractor is required to develop relative costings for comparison.

In the event that levels are to be raised further consideration will be required in order to review potential settlements induced in the alluvial deposits beneath the made ground.

7.4.6 Material Re-use and Slope Profiles

Subject to chemical characteristics we would consider material excavated from shallow depth suitable for re use on the site as general fill. However further testing or trials would be needed prior to possible use as an engineered fill in order to demonstrate adequate performance when placed or to identify any significant variability in the fill.

8 Conclusions

RPS were instructed by Edgmond Holding Limited to undertake a Phase 1 desk study and Phase 2 site investigation of a development plot located on the former council depot, on Harts Farm Way in Havant, Hampshire.

The desk study indicated the site was previously open grassland and marshland until its development into a council depot in the 1960s. The site has been left derelict since the council vacated the land. All buildings and infrastructure have been removed. The council depot had a mechanics workshop and other automotive facilities such as fuel storage tanks, which are considered to be potential sources of contamination. The site is currently awaiting development for commercial use in accordance with surrounding properties.

The initial scope of the intrusive site investigation works undertaken was provided by Gyoury Self Partnership on behalf on Space Property in a letter to RPS dated 21st of June 2007. The intrusive site investigation was undertaken between the 26th of July and the 2nd of August 2007 and comprised the advancement of six exploratory boreholes to a maximum depth of 17.6 m bgl, and 14 trial pits to a maximum depth of 3 mbgl. All boreholes were installed as gas and groundwater monitoring points. Gas and groundwater monitoring was undertaken on 8th August 2007 and 15th August 2007.

Soils collected during the intrusive investigation were screened for a range of determinands based on the historical use of the site. The risks posed by potential contaminants on site were quantitatively screened against generic values based on the proposal to redevelop the site for commercial/industrial use. The assessment provided a first pass appraisal of whether a further more detailed site-specific quantitative assessment would be required in redeveloping the site. Future site users and redevelopment construction workers are considered the most sensitive receptors to any contaminants identified in soils on site.

The site investigation analytical data and screening exercise confirms that there are slightly elevated concentrations of inorganic determinands across the site. The exceedances are marginal and where compared to a screening scenario of residential use without plant uptake the concentrations would not be considered to be

present at concentrations that would present a risk to future site users. Screening of analytical results indicates elevated concentrations of organic determinants detected in soils at one location on the site (associated with TP1 and TP12). The concentrations are significant when compared to a screening scenario of residential use without plant uptake but concentrations fall marginally below when compared to a screening scenario of commercial/industrial use. The elevated concentrations are generally considered to be associated with a former underground fuel storage tank.

Elevated concentrations of organic determinands above water quality standards were measured in groundwater (BH2-S and TP1). The concentrations are present at concentrations that may pose a low risk to controlled waters however the contamination appears to be localised within groundwater around the area of hydrocarbon contamination discussed above. Concentrations of inorganic determinands above water quality standards were only measured for copper at BH6-S. Given that the localised nature of contamination and given the fact that the development will cap the site reducing infiltration the risks posed to controlled waters are considered to be moderate to low.

A preliminary geotechnical assessment relating to the potential development of the site for industrial / commercial use was undertaken using information from the site investigation. It is considered given the variability of made ground across the site areas that piling provides the least risk option for foundations of the proposed development. A specialist contractor should be utilised in developing a piled solution through to detailed design.

9 Recommendations

The site investigation confirms that there are localised areas of elevated levels of organic determinands in soils and groundwater.

Where redevelopment of the subject site is progressed it is considered that the Local Planning Authority will require a Quantitative Controlled Waters and Human Health Risk Assessment in accordance with PPS 23. The assessment will demonstrate whether the concentrations of contaminants of concern present in soils and groundwater pose a risk to controlled waters or human health. Where an unacceptable risk is demonstrated design mitigation measures or remedial works would need to be implemented. Based on the identified contaminants of concern in soils and groundwater it is considered that development should be feasible with minimal requirement for remedial works. We would recommend prior to finalising on a development agreement that liaisons with the regulatory authorities are undertaken in order to corroborate the opinion.

Soil contamination associated with hydrocarbon contamination in and around TP1, TP12, and TP14 is present at elevated concentrations. Appropriate remedial action following derivation of a site-specific remedial target is preliminarily anticipated to involve the excavation and disposal of the contaminated soils. Conservative estimates on the volume of material to be excavated range from 110 to 125 m³. A worst-case scenario is estimated to involve the excavation and disposal to hazardous landfill of approximately 250 m³. Current rates for the disposal of non-hazardous and hazardous material are approximately £70 and £200 per m³ respectively inclusive of landfill tax.

The contaminants of concern identified in the remaining area of the site whilst elevated would not restrict the redevelopment of the premises for retail / commercial end use once localised remedial works have been undertaken.

We consider that gas protection measures will be required within the proposed development in order to mitigate risks posed by gas and residual volatile organic compounds (VOCs) identified within the made ground and alluvium deposits. The vapours have the potential to migrate along pathways such as service corridors or pile columns. We would recommend that additional monitoring be undertaken at the site in accordance with CIRIA C659 guidance. The additional monitoring will confirm

the need or other for gas protection measures and where required the level of the protection required.

We advise that the geotechnical data collected be forwarded to a specialist contractor in order to advise on ground improvement and piling solutions associated with site redevelopment.

Drawings

Appendices

Appendix A

Envirocheck Report

Appendix B

Plates

Appendix C

Exploratory Logs

Appendix D

Field Monitoring Results

Appendix E

Summary of Soil Chemical Results

Appendix F

Summary of Groundwater Chemical Results

Appendix G

Summary of Surface Water Chemical Results

Appendix H

Laboratory Analytical Certificates

Appendix I

Geotechnical Analytical Results

Appendix J

FES Intrusive Investigation Logs and Location Plan