



## Land Quality Assessment Desktop Study Report

### Land Surrounding Buildings 8F2 and 8F3B

AWE plc

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Prepared by:  
Christopher Warde

Authorised by:  
Robert Jones

St. Anne's House  
Oxford Square  
Oxford Street  
Newbury  
Berks  
RG14 1JQ

**Tel** 01635 279000  
**Fax** 01635 279050  
**Email** rpssw@rpsgroup.com

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RPS Planning and Development Ltd. Registered in England No. 02947164  
Centurion Court, 85 Milton Park, Abingdon, Oxfordshire, OX14 4RY  
A Member of the RPS Group Plc



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## **Appendices**

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**Appendix A            Previous Investigation Borehole Logs**

**Appendix B            Historic Aerial Photographs**

## Executive Summary

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*A Land Quality Assessment (LQA) Desk Study has been undertaken to assess parcels of land ('site areas') in support of the Project Mensa Development (AWE Burghfield (AWE (B))), which include an investigation of the land where Buildings 8F3B and 8F2 are located, and a small area of land near Building 8S5. Neither of these areas have been subjected to previous intrusive investigations.*

*The study included a review of a previous desk study and intrusive investigation reports undertaken in the vicinity and a site walkover of the two areas.*

*The study has identified that the site is likely to be underlain by Made Ground or topsoil (over Alluvium in the vicinity of Building 8F3B), with the following geological succession below; London Clay, Reading Beds and Chalk.*

*Groundwater levels are likely to be approximately 3 - 5 metres below Ground Level (mbGL) occurring within the sandier units of the London Clay, and the basal beds of the London Clay and underlying Reading Beds. Both units are considered to have some hydraulic continuity with each other. The shallow groundwater is considered to provide baseline flows to nearby surface watercourses. At depth, the Chalk forms a major aquifer, which is used locally for potable water supply.*

*The operations undertaken within and adjacent to the buildings associated with the site areas extended from up to the 1940's, and comprised production of and testing of weapons assemblies, component testing workshops, and working of rubbers and plastics.*

*Assessment of the laboratory analysis results from soil samples from previous intrusive ground investigations located less than 10 metres away from site, and boreholes groundwater samples less than 25 metres from site has been undertaken. The soil chemical analysis data assessed did not exceed Soil Guidelines Values (SGVs) or RPS derived Generic Assessment Criteria (GACs), and would not be considered to represent an unacceptable risk to human health on that basis. However marginal gross beta and total activity (combined gross alpha and gross beta activities) results above the AWE*



*threshold limits have been reported. Borehole groundwater samples identified some metal and hydrocarbon contamination. No definitive source for the contamination could be identified.*

*The anecdotal information and discussions with site personnel and onsite observations have not identified any significant contamination on the two site areas. Based on experience of other demolition and site clearance projects at AWE Burghfield it is possible that there are asbestos contaminated soils present in ground surrounding the buildings.*

*Potential receptors identified include construction staff, AWE staff and visiting personnel, groundwater and surface water, whilst potential sources of contamination identified include a variety of potential contaminants related to current and previous uses of the buildings which are, or were, present within the area of interest (such as explosives, hydrocarbons, radiological material, asbestos and metals).*

*In addition, potential pathways have been identified by which the sources could impact upon the receptors. These include migration of contaminants into groundwater (and potentially into water abstracted for human consumption), direct exposure of construction staff and AWE staff and site workers to contaminants and hazards (such as asbestos and explosives).*

*In light of the above and the potential contaminant sources identified, further intrusive investigation is recommended to determine the presence and extent of potential contamination in soils and groundwater within the site areas, and whether any risk is posed to human health and controlled waters based on the proposed use. This will also enable appropriate Safe Systems of Work (SSoW) to be developed by construction workers and identify the need for remediation.*

*Should the site be subject to a change in end use, the risk to human health and the environment may require re-assessment.*

# 1 Introduction

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## 1.1 Background

RPS Planning and Development (RPS) has been requested by AWE plc to undertake site investigation work in support of the Project Mensa Development at AWE Burghfield (AWE (B)). Part of this package of work includes the completion of a Land Quality Assessment (LQA) Desk Top Study of a number of parcels of land at AWE (B). For the purposes of this report “the site” or “site areas” shall refer to the following areas:

- land surrounding Buildings 8F3B and 8F2; and,
- a small area of land to the north of Building 8S5.

The site is shown on *Drawing JER3996-8F-003*.

The Project Mensa Development is a commercial / industrial development to provide a replacement warhead assembly, maintenance and disassembly facility including support facilities, plant building and associated infrastructure. The site is within the Mensa ‘Construction Enclave’ which will include activities such as material laydown, concrete batching plants and construction areas. Once the Mensa facility has been constructed, the 8F area will contain a permanent lorry park, vehicle inspection bay, gate house and access roads.

Although there have been many intrusive investigations carried out at AWE (B) in the past, including intensive investigation of the majority of the Project Mensa Development area, there have been no ground investigations of the land associated with Buildings 8F3B and 8F2. Further investigation of these areas is therefore required to identify contamination that requires remediation based on the proposed use.

## 1.2 Key Objectives

The key objectives of this study are to:

- Review the results of relevant previous investigation reports undertaken on surrounding areas and establish potential land contamination sources at the site;
- Develop an understanding of the geological, hydrogeological and hydrological environment at the site and their surroundings;
- Develop a Preliminary Conceptual Site Model based on available information to determine possible risks to future site users and environmental receptors at and adjacent to the site associated with potential contaminant sources; and,
- Determine the need or otherwise for intrusive ground investigations and risk assessments to refine the conceptual site model or to inform the need for remediation.

## 1.3 Report Structure

The remainder of the report is structured as follows:

*Section 2: Regulatory Context.* This section describes the current UK legislation with respect to radiological and non radiological contaminated land;

*Section 3: Environmental Risk Setting.* This section includes site descriptions, summaries of historical land use, previous site investigations and discusses the environmental sensitivity of the sites based on their risk setting;

*Section 4: Conceptual Site Model.* This section summarises the potential contaminant sources, receptors and pathways through which contamination could impact upon receptors. The section also discusses other key potential ground engineering development constraints;

*Section 5: Recommendations and Conclusions.* Based on available information, this section outlines the next steps for the sites; and,

*Section 6: References.*

## 2 Regulatory Context

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### 2.1 Introduction

The type of contamination that may be present at the site can be split into two broad types, radiological and non-radiological. Each of these types of contamination has different key legislation with which AWE plc must comply and the criteria applicable to both of these are used to assess the land quality at the site.

### 2.2 Non Radiological Contamination Legislation

#### 2.2.1 Environmental Protection Act 1990 (Part IIA)

Implementation of Section 57 of the Environment Act 1995 added Part IIA into the Environmental Protection Act (EPA) 1990. The application of this primary piece of legislation is via the Contaminated Land (England) Regulations 2006.

Under Part IIA 'Contaminated Land' is defined as

*"any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that -*

*"(a) **Significant Harm** is being caused or there is a **Significant Possibility of such harm** being caused; or*

*"(b) **Pollution of Controlled Waters** is being, or is likely to be, caused".*

In order to determine whether land is contaminated under Part IIA the concept of a 'Pollutant Linkage' is adopted. This means that a link between a contaminant source and receptor by means of a pathway must exist. Consequently in order for a risk to be present at the site three components must exist:

1. Contaminant(s) must be present at concentrations capable of causing adverse environmental effects (Source);
2. A receptor (human, controlled water etc) must be present, or one which can be exposed to the site or migrating contaminants (Receptor);

3. There must be an exposure pathway by which the receptor comes into contact with the environmental contaminant (Pollutant Linkage).

The source-pathway-receptor scenario is a useful means to generate a conceptual model, which can be used to identify critical pathways that a more detailed quantitative analysis may assess further if necessary. The first stage of the process was to determine the key contaminant(s) of concern (Source), followed by the most likely pathways that these contaminants would take in the environment and finally the potential receptors of concern.

### **2.2.2 Planning Policy Statement 23**

As the site is to be redeveloped the proposed site use must be permitted by the Local Planning Authority. Planning Policy Statement 23 (PPS23) (*Ref. 1*) provides guidance to the Local Planning Authority on ensuring that post development the site is suitable for use with respect to the presence of any land contamination.

PPS23 states that following development, the site should not be able to be 'determined' as 'contaminated land' under Part IIA of the Environmental Protection Act. The key principle of Planning Policy Statement 23 is that the opportunity should be taken to remediate contaminated land during development and PPS23 advocates the use of risk assessments to determine the need to undertake remediation.

Under the Town and Country Planning System the responsibility for providing information on whether a site is contaminated rests primarily with the developer. The Berkshire Contaminated Land Group, which comprises Local Authorities including West Berkshire, has produced a document entitled "The Berkshire Guide to Developing Potentially Contaminated Land" (*Ref. 2*). The assessment of land contamination for the proposed development had been undertaken according to these guidelines.

### **2.2.3 The Water Framework Directive**

The Water Framework Directive (WFD) (*Ref. 3*) consolidates a number of existing water-focused directives, and introduces new requirements on Member States. The objectives of the WFD are wide ranging across the fields of water use and management, and of water and ecosystem protection and restoration, and include:

1. Prevent deterioration and enhance status of aquatic ecosystems and associated wetlands;
2. Promote sustainable water use;
3. Reduce pollution from 'priority substances';
4. Prevent deterioration of status of groundwater bodies and progressively reduce groundwater pollution;
5. Contribute to mitigating the effects of floods and droughts.

The WFD applies to all surface freshwater bodies (including lakes, streams and rivers), groundwaters, groundwater dependant ecosystems, estuaries and coastal waters out to one mile from low-water. The WFD came into force in December 2000, and was transposed into UK law by December 2003.

## **2.3 Radiological Contamination**

### **2.3.1 Introduction**

Under UK law a specific definition of 'radioactively contaminated land' is outlined by the extension to Part IIA of the EPA in August 2006 to include radioactivity (*Ref.4*). The Part IIA definition of radioactively contaminated land does not apply to nuclear Licensed Sites, as radioactively contaminated land on these sites is regulated by the Health and Safety Executive (HSE) under the Nuclear Installations Act 1965 (as amended) (*Ref. 5*). The HSE's role extends to establishing remediation criteria when sites are being de-licensed. It is important to note that the Environment Agency (EA) is responsible for authorising radioactive waste disposal from nuclear Licensed Sites.

The other key pieces of legislation that apply to Nuclear Licensed Sites and the management of radioactive wastes are outlined below.

### **2.3.2 Nuclear Installations Act 1965 (as amended)**

Under the Nuclear Installations Act 1965 (as amended) (*Ref. 5*), no site may be used for the purposes of installing or operating nuclear facilities, unless a nuclear Site Licence has been granted by the HSE for that site. The Nuclear Safety Directorate (NSD), acting for HSE, sets out in conditions attached to the Site Licence, the general safety requirements to deal with the risks on a nuclear site. The Nuclear Installations Inspectorate (NII) section of HSE is responsible for regulating nuclear Site Licences.

It is the NII's view that radioactively contaminated ground on a nuclear licensed site represents an accumulation of radioactive waste. Thus such material should be managed and dealt with by the licensee. Several of the licence conditions relate to radiologically contaminated land namely LC4, LC14, LC23, LC25, LC32 and LC34. The conditions require the licensee to control and contain radioactive waste, record locations and amounts and demonstrate that adequate safety arrangements are in place using a safety case. Further information on the management of radioactively contaminated land can be found in the NSD's *Guidance for Inspectors on the Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites (Ref. 6)*.

### 2.3.3 Radioactive Substances Act 1993 (RSA93)

This key piece of legislation controls the keeping and use of radioactive materials, and the accumulation and disposal of radioactive waste. The RSA93 (*Ref. 7*) defines whether a material is radioactive as follows:

1. *Elements specified in Schedule 1 of Section 1 of the RSA93 which are present at specific activity levels greater than those listed in Table 2.1.*

**Table 2.1 Schedule 1 Specified Elements and Their Limiting Specific Activities**

Element	Solid (Bq/g)	Liquid (Bq/g)
Actinium	0.37	$7.4 \times 10^{-2}$
Lead	0.74	$3.7 \times 10^{-3}$
Polonium	0.37	$2.59 \times 10^{-2}$
Protactinium	0.37	$3.33 \times 10^{-2}$
Radium	0.37	$3.7 \times 10^{-4}$
Thorium	2.59	$3.7 \times 10^{-2}$
Uranium	11.1	0.74

2. *Any substances containing non-naturally occurring (man-made) radionuclides irrespective of its specific activity.*

Section 2 of the RSA specifies that 'radioactive waste' comprises waste which consists wholly or partly of:

- (a) *A substance or article which, if it were not waste, would be radioactive material,*
- (b) *A substance or article which has been contaminated in the course of the production, keeping or use of radioactive material, or by contact with or proximity to other waste falling within paragraph (a) (above) or this paragraph.*

#### **2.3.4 The Radioactive Substances (Substances of Low Activity) (SoLA) Exemption Order**

Under the SoLA Exemption Order (*Ref. 8*), solid radioactive waste is 'exempt' from some of the provisions of the RSA 93 (Section 13(1), (3) and (4)) provided that it is substantially insoluble in water and has an activity that does not exceed 0.4 Bq/g.

The SoLA Exemption Order can be applied to Naturally Occurring Radioactive Materials (NORM) (such as potassium) by subtracting the normal natural background level of a site from a measured sample concentration. The difference is then compared to the 0.4 Bq/g level.

For artificial radionuclides the SoLA Exemption Order level of 0.4 Bq/g is generally interpreted to be additional to the ubiquitous artificial background to account for low background levels of man made radionuclides, such as fall out from nuclear weapon testing and Chernobyl.

#### **2.3.5 The Radioactive Substances (Phosphatic Substances, Rare Earths etc) Exemption Order (1962)**

This order (*Ref. 9*) states that material that is radioactive solely because of the presence of one or more of the Schedule 1 elements and is substantially insoluble in water is unconditionally exempted from the provisions of the RSA 93 provided that the specific activity of each of the Schedule 1 elements present does not exceed 14.8 Bq/g.



### 2.3.6 Ionising Radiations Regulations 1999 (IRR1999)

The Ionising Radiations Regulations 1999 is the principal legislation relating to the protection of workers from exposure to ionising radiation (*Ref. 10*). The average individual radiation dose in the UK is 2.6mSv per year, mostly from natural and medical sources of radiation, 2.2 and 0.36 mSv per year respectively.

### 2.3.7 Radioactivity Assessment in Soils

AWE have adopted the following approach of comparing soil sample measurements with limiting values given in the RSA 93 and the appropriate Exemption Orders as an indication of potential contamination. AWE considers background levels of gross alpha and beta activity at AWE (B) to be 0.7 Bq/g alpha and 0.6Bq/g beta (*Ref. 11*).

- If artificial radionuclides are present, and the specific activity of the sample, less the mean background specific activity (0.7 Bq/g alpha or 0.6 Bq/g Beta), is below 0.4 Bq/g the sample is not considered to be radioactive.
- If only naturally occurring Schedule 1 radioelements are present, and the specific activity of the sample is below the Schedule 1 limit, the material is not considered to be radioactive.
- If only naturally occurring Schedule 1 radioelements are present, and the specific activity of the sample is above the Schedule 1 limit, but less than 14.8 Bq/g (or 4.9 Bq/g for radium, and 7.4 Bq/g for thorium), then the material, although radioactive, is exempt from RSA 93. This material can then be disposed of as exempt waste and in accordance with other properties.
- For naturally occurring radioelements not listed in Schedule 1, if the specific activity of the sample, less the mean background specific activity (0.7 Bq/g alpha, and 0.6Bq/g beta), is below 0.4 Bq/g then the sample is not considered to be radioactive.

AWE plc has adopted a soil background level of 0.7 Bq/g for alpha activity and 0.6 Bq/g for beta activity with respect to naturally occurring radioactivity at AWE Burghfield. Taking this into account and also the 0.4 Bq/g level given by the SoLA Exemption Order, a contamination “screening level” of 1.1 Bq/g and 1.0 Bq/g for gross alpha and gross beta respectively is adopted for sites within AWE Burghfield. Samples exhibiting gross alpha activity above 1.1 Bq/g or gross beta activity above

1.0 Bq/g do not necessarily indicate radiological contamination, but that further assessment and analysis is required. Typically, AWE analyse soil samples with elevated activity for gross alpha and beta, using radiochemical or gamma spectroscopy respectively.

### 2.3.8 Radioactivity Assessment in Groundwater

AWE plc have adopted 'Threshold Levels' for elevated gross alpha (40 Bq/m<sup>3</sup>) and gross beta (500 Bq/m<sup>3</sup>) in groundwater based on AWE's RSA93 arrangements for environmental monitoring for radioactivity within and around sites at AWE Burghfield. Exceedances of the gross alpha (40 Bq/m<sup>3</sup>) threshold triggers additional analysis for plutonium and uranium isotopes (Uranium-234, Uranium-235, Uranium-238, Plutonium-238, Plutonium-239 and Plutonium-240)).

For the purposes of this report, these activity levels (40Bq/m<sup>3</sup> alpha and 500Bq/m<sup>3</sup> beta) have been used to screen the data. The results of the specific testing can then be compared to the criteria set out in Schedule 1 of the RSA93 and also to the World Health Organisation (WHO) Drinking Water Quality (3<sup>rd</sup> Edition) Guideline Levels (*Ref. 12*) which are summarised in *Table 2.2*. These criteria are then used to gain a preliminary view of the order of magnitude of potential doses to individuals.

The table also lists the WHO guideline concentration for tritium, which is also tested for during the gross alpha and gross beta analysis by AWE. The UK Drinking Water Inspectorate uses a guideline level of 100 Bq/L for tritium, which although not mandatory, is recognised as an acceptable level for determining whether additional testing or remedial action is needed. These criteria are then used to gain a preliminary view of the order of magnitude of potential doses to individuals.

**Table 2.2 Summary of WHO Drinking Water Quality Guideline Levels (3rd Edition)**

Radionuclides	Guideline Level
Tritium (H-3)	10,000 Bq/L (10,000,000 Bq/m <sup>3</sup> )
Uranium -234	10Bq/L (10,000 Bq/m <sup>3</sup> )
Uranium-235	1 Bq/L (1,000 Bq/m <sup>3</sup> )
Uranium-238	10 Bq/L (10,000 Bq/m <sup>3</sup> )
Plutonium-238	1 Bq/L (1,000 Bq/m <sup>3</sup> )
Plutonium-239	1 Bq/L (1,000 Bq/m <sup>3</sup> )

The EA is notified if:

- The plutonium alpha activity exceeds 10 Bq/m<sup>3</sup>;
- The uranium alpha activity exceeds 50 Bq/m<sup>3</sup>;
- The tritium activity exceeds 50 KBq/m<sup>3</sup> at any of AWE's surface water discharge outfalls.

Additionally the Environment Agency regulates radioactive discharges to ensure that no member of the public receives an additional dose of more than 1mSv per year (*Ref. 13*), which is considered As Low As Reasonably Practicable (ALARP).

By way of comparison, the WHO Drinking Water Quality standard activity levels for gross alpha is 0.5 Bq/L (500 Bq/m<sup>3</sup>) and gross beta is 1 Bq/L (1000 Bq/m<sup>3</sup>), which are both higher and therefore less stringent than AWE 'Threshold Levels'.

## 3 Environmental Risk Setting

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### 3.1 Introduction

This section of the report summarises the environmental risk setting of the site, which includes a description of the site and its surroundings, its history, its regional geology, hydrogeology and hydrology. Available information including previous site investigation reports are reviewed and a summary of the site and surrounding land uses and their sensitivity to potential contaminants is discussed.

For the purpose of this report the 'site' shall mean the areas highlighted on *Drawing JER3996-8F-003*.

### 3.2 Data Sources

The following sources of data have been used to prepare this section:

1. Land Quality Assessment Phase 1 Desk Top Study at AWE Burghfield, Berkshire, May 2001, BAE Systems (*Ref. 14*).
2. Project Mensa Environmental Statement Vol.1, April 2008, RPS Planning and Development (*Ref. 15*).
3. Ground Conditions Technical Report, Project Mensa Development, AWE Burghfield, April 2008, RPS Planning and Development (*Ref. 16*).
4. Geophysics Report for Phase 2A Demolition Area, AWE Burghfield Berkshire, March 2005 (*Ref. 17*).
5. Sitescope Technical Report for AWE Burghfield, November 2003, Sitescope.co.uk (*Ref. 18*).
6. Abnormal Event Search carried out by AWE on behalf of RPS (August 2008); and,
7. Health Physics Monitoring Search carried out by AWE on behalf of RPS (August 2008).

### **3.3 Site Locations, Descriptions and History**

#### **3.3.1 General Description of AWE Burghfield and Surrounding Area**

AWE (B) is located approximately 0.5 km east of Burghfield village and 6 km to the south-west of Reading, 1 km south of the M4 motorway, and some 0.5 km west of the Reading Basingstoke railway line. The National Grid Reference for the centre of AWE (B) is approximately SU 680 680. AWE (B) is circa 264 acres and roughly rectangular in shape. The topography is relatively flat with general slope from south (46.5 mAOD) to north (42.5 mAOD).

Access to AWE (B) is from the north-west, via a road called 'The Mearings'. It is surrounded by a high security fence and is subject to strict security controls. The eastern, southern and western edges of AWE (B) are bounded by roads.

AWE (B) is mainly surrounded by open fields and woodland. A number of buildings, including farm buildings, a public house, hotels, shops and residential dwellings are located some 150 – 200 m to the south; isolated farms are located to the north and the east. Moores Farm gravel workings lie to the north east, adjacent to Burnthouse Land and Pingewood.

AWE (B) is operated by AWE plc to both produce explosives and explosive devices and to assemble and disassemble weapons in fulfillment of AWE's responsibility to maintain the UK nuclear deterrent. Consequently, some areas of AWE (B) are nuclear licensed.

A small stream, Burghfield Brook, flows along the southern and eastern edges of AWE (B), and an unnamed stream flows in an easterly direction immediately north of the AWE (B) security fence line.

Concrete roadways and paths allow access to the various buildings and structures. AWE Burghfield also comprises landscaped areas mainly with grass cover with interspersed trees.

#### **3.3.2 History of AWE Burghfield**

Based on historical information, it is understood that since 1940 to present day, AWE (B) has been used for the production of explosives and explosive devices. Historical aerial photographs of the site are included in *Appendix B*.

### **3.3.3 Building 8F2**

#### ***Current State***

Building 8F2 is located to the southeast of the centre of AWE (B), in the south eastern corner of the Mensa Application Site (location is shown on *Drawing JER3996-8F-003*). It is disused, and comprises a tall single storey brick building with a flat roof. The roof is felt covered with plastic guttering.

#### ***History***

The building is thought to have been constructed pre 1960's. A variety of activities are reported to have historically occurred within the building, including the fitting of explosives to warheads, testing of explosives components and the assembly and testing of various weapon assemblies (*Ref. 14*).

### **3.3.4 Building 8F3B**

#### ***Current State***

Building 8F3B is located to the southeast of the centre of AWE (B), in the south eastern corner of the Mensa Application Site (location is shown on *Drawing JER3996-8F-003*). It is a tall single storey brick building with a flat felt roof and plastic guttering. The recent use of the building has included resin and foam manufacture and storage.

#### ***History***

Building 8F3B was built in 1940 and has been used for the storage of high explosive (HE) components, resin manufacture, and storage and preparation of polyurethane mouldings. When the building was inspected in 2000 by BAE Systems the building was being used for polyurethane foam manufacture and moulding, and resin manufacture for adhesives production (*Ref. 14*).

### **3.3.5 Abnormal Events**

An Abnormal Events (AE) search was carried out on behalf of RPS by AWE plc, although the results of this search are not available to RPS in full due to their security classification. However, selected results deemed relevant by AWE were released and none were relevant to land contamination.

### 3.4 Geology

The British Geological Survey (BGS) 1:50,000 Sheet 268 geological map (*Ref. 19*), the 1:10,000 SU 66 NE geological map (*Ref. 20*), and previous investigation data indicate that the site is underlain by the geological sequence presented in *Table 3.4* below.

**Table 3.4 General Site Geological Sequence**

Soil Type	Typical Description	Likely Thickness
Made Ground	Made Ground generally comprises re-worked natural clay soils with rare brick and gravel.  Surface drainage typically comprising flint gravel.	Up to 1 - 2m,  Up to 1m
Alluvium (Building 8F3B only)	Silts, sands and clays deposited by Burghfield Brook that used to run through the centre of the site.	Up to 3m (along former course of Burghfield Brook only)
London Clay	Stiff grey clays overlying beds of silty sands, clayey sands, clays and sandy clays. Thin bands of mudstone and sandstone (hard bands)	4.4-13m
Reading Beds	Grey and brown sands and sandy clays, varying amounts of sand and gravel.	>12.5m
Upper Chalk	Soft white nodular chalk with flint seams.	90-130m

The geological maps show the presence of a thin strip of Alluvium stratum within the AWE (B) boundary. Alluvium was deposited along the original path of Burghfield Brook. Of the areas covered by this study Alluvium would only be expected in the north-west corner of the footprint of Building 8F3B. The former course of Burghfield Brook, and the estimated extent of the alluvium, is shown on *Drawing JER3996-8F-003*.

### 3.5 Hydrogeology and Groundwater Vulnerability

#### 3.5.1 Hydrogeological Units

According to the Environment Agency's Groundwater Vulnerability Map (Sheet 38) (*Ref. 21*) the soils beneath the site are classified as a non-aquifer, which relates to the London Clay.

During previous investigations groundwater strikes were encountered at 7.65 – 16.1mbGL (30.17 - 39.1m AOD) in nearby boreholes drilled beyond 10m depth (*Ref.*

22). The groundwater strike was typically encountered within the sandier units of the London Clay beneath the 6-8m thickness of overlying stiff grey clays. In most boreholes the water level was noted to rise by 1-2m within twenty minutes of the water strike. Groundwater strikes were only very rarely encountered in excavations less than 10mbGL.

Based on monitoring of the borehole wells, groundwater beneath the site generally occurs as two water bodies:

- A shallow groundwater body typically between 1 and 9mbGL within the Alluvium and Weathered London Clay wherein groundwater levels can vary greatly over short distances. This indicates that this is a perched water table. The direction of groundwater flow appear to vary locally but generally the overall direction across the site is from south west to east;
- A deeper groundwater body occurring within the basal beds of the London Clay and underlying Reading Beds with a water level of circa 10 to 12 mbGL. Groundwater levels are typically more consistent and the groundwater flow across the site is generally from north to south east (see *Drawings JER3058 –P2-SF001 to 003*).

It is considered that the London Clay acts as an aquitard between the shallow groundwater and the deeper aquifer of the Reading Beds/Upper Chalk. As there is likely to be some vertical movement of groundwater from the upper table to the lower within more permeable bands of the London Clay, it is considered that the London Clay should not strictly be regarded as an aquiclude. The London Clay deposit retards but does not preclude groundwater movement between the upper and lower water tables.

The underlying Harwich and Reading Bed Formations are described by the Environment Agency (EA) as a single groundwater unit known as the 'Basal Sands' aquifer, which is in hydraulic continuity with the Chalk below. (*Environment Agency 'The Physical Properties of Minor Aquifers in England and Wales', 2000*) (Ref. 23). The Harwich and Reading Bed Formations are defined as minor aquifers. It is considered that the lower groundwater table identified in previous investigations is the 'Basal Sands' aquifer.



The Chalk is classified as a major aquifer and based on the published data and borehole logs from the BGS, the top of the Chalk is between 6-15 mAOD (or 27.5-40.5 mbGL). The groundwater within the Chalk is under artesian pressure and the piezometric surface is at approximately 30 to 35 mAOD. The 1:100,000 Hydrogeological Map Sheet 7 of South West Chilterns, Berkshire and Marlborough Downs (*Ref. 24*), and previous investigations indicate that the regional groundwater flow within the Chalk at the site is south-south east towards the River Loddon.

### 3.5.2 Licensed Abstractions

There is only one licensed groundwater abstraction within 1 km of the AWE (B) site and this abstraction is operated by the Ministry of Defence. The abstraction licence is for groundwater abstractions at Burghfield Pumping Station located approximately 450m to the east of the site. It is understood that groundwater is abstracted from the chalk aquifer and is used in part for drinking water. Further details of the abstraction are summarised in *Table 3.1*.

The abstraction was developed in the 1940s, and comprised of 3 boreholes, although only one is now understood to be operational. It is located approximately 150m to the east of the AWE (B) fence boundary (approximately 450m from the site) and is licensed for the abstraction of approximately 700m<sup>3</sup>/d.

The groundwater is abstracted from the chalk aquifer and stored at AWE (B) in two 4500m<sup>3</sup> reservoirs ready for use on site after in-line chlorination treatment. It is understood that the water is used for drinking and other purposes. Information supplied by AWE suggests that the pumping rate is highly variable (*Ref. 15*).

**Table 3.1 Summary of Groundwater Abstraction Licenses**

Licence Holder	Licence Number	Source	Use	Approx. Distance and Direction from Site Boundary
Ministry of Defence	28/39/22/0546C	Thames groundwater (Chalk)	Industrial, commercial and public services including <b>drinking, cooking</b> , sanitary and washing	450m to east of eastern boundary of the Phase 2A Demolition Area,

### 3.5.3 Groundwater Source Protection Zones

AWE (B) lies within a Groundwater Source Protection Zone (SPZ), which are defined by the EA in order to control discharges in the vicinity of groundwater abstractions.

Potentially polluting activities within an SPZ, especially those within an Inner Protection Zone, are restricted by the Environment Agency to prevent pollution of the groundwater. The site is located within the 'Inner Protection' Zone of the SPZ.

The SPZ appears to have been defined in order to protect the groundwater abstraction borehole at Burghfield pumping station, licence 28/39/22/0546C, (see *Section 3.5.2*). Licence details identify that the abstractions are from the Chalk aquifer. *Drawing JER3860-GCTR-004c* illustrates the hydrogeological sensitivity of the site in more detail.

Previous investigations indicate that the direction of deep groundwater flow from the site is generally north to south with the exception of the north-eastern of the Mensa Application Site situated some 500m west of the pumping station and it is considered unlikely that any contaminants will migrate from the deeper groundwater body to the pumping station groundwater abstraction.

## **3.6 Hydrology**

### **3.6.1 Surface Water**

The original route of the Burghfield Brook ran from the south through the centre of AWE (B), and then eastwards leaving the site midway along the eastern boundary. Alluvial deposits are found along this route. It is understood that the brook was re-directed in the 1940s during the works to construct the Royal Ordnance Factory. It now flows close to the southern and eastern boundaries of AWE (B) in a man made channel. The Brook does not cross the site. The closest distance from the brook to the site is approximately 100m to the south east of Building 8F2. There is no other significant surface water feature at AWE (B).

Outside the perimeter of the site a number of field drains / surface water courses occur. A tributary of the Foundry Brook is present to the north of AWE (B) and it is thought likely that shallow groundwater in or near the north western boundary of the site may flow towards this tributary. To the south of AWE (B) more tributaries of the Foundry Brook are present but these are not thought to have a bearing on shallow groundwater which will typically flow to the northeast.

Six kilometres to the south-east the River Loddon flows in a north-westerly direction. This river cuts into the chalk and it is considered that the deeper groundwater at AWE (B) may flow towards this watercourse.

### 3.6.2 Site Drainage

Parts of the site currently comprise areas of landscaped grass. In order to drain the areas of hard standing and roads the site incorporates a surface water drainage system. Much of this comprises a network of French Drains and culverts, which flow eventually into Burghfield Brook under licensed Discharge Consents (CAWM.0080 and CAWM.0079) via a series of outfalls.

## 3.7 Previous Site Investigations

There have been no previous intrusive ground investigations of the areas covered in this study. However, previous investigations in the near vicinity have been used to inform this report as follows:

- *Section 3.7.1 to 3.7.3* assesses soil ground investigation data from sample locations less than 10 metres away from site boundaries and borehole groundwater sample data <25m from the site, both obtained from an investigation carried out by RPS in support of the Phase 2A demolition works (*Ref. 22*) (shown on *Drawing JER3996-8F-003*).
- *Section 3.7.4* outlines data obtained from BAE Systems building *reports (Ref. 14)* regarding potential contaminants utilised within Buildings 8F2 and 8F3B.
- *Section 3.7.5* discusses the results obtained from a previous RPS Geophysical Survey report (*Ref. 17*) which includes the site area.

### 3.7.1 Soil and Groundwater Assessment

Where appropriate, screening exercises have been completed which detail the contaminants encountered in soils and groundwater above the laboratory Limit of Detection (LOD) for key contaminants of concern based on the historical use of the site including those listed within the DEFRA CLR8 document (*Ref. 25*). Soil concentrations have been compared to published Soil Guideline Values (SGVs) and Generic Assessment Criteria (GACs) derived by RPS for commercial / industrial use. Groundwater analyses have been compared to UK Drinking Water Standards (DWS)

and Environmental Quality Standards (EQS) (Ref. 26 and 27 respectively), and in their absence WHO Drinking Water Standards (3<sup>rd</sup> Edition) (Ref. 28).

In the absence of site specific intrusive investigation soil and groundwater data, to provide an indication of potential soil and groundwater contamination within the site areas, soil sample analytical data was taken from investigation locations up to 10m away from the site boundary and groundwater samples from boreholes up to 25m away from the site areas.

### 3.7.2 Soil Analysis

A summary of ground conditions encountered within the investigation locations are shown in *Table 3.2*.

**Table 3.2 Summary of Ground Conditions Encountered**

Stratum	Description	Depth Range (m)	Thickness (m)
Topsoil	Soft to firm brown slightly sandy gravelly CLAY with some fine rootlets. Gravel is fine to coarse, subangular to subrounded	0.0 – 0.3	0.0 – 0.3
Made Ground	Stiff desiccated brown gravelly CLAY. Gravel is fine to coarse of subangular to subrounded flint, quartz and sandstone. Brick and concrete fragments	0.0 – 1.75	0.0 – 1.75
Gravel	Coarse flint GRAVEL in a matrix of beige sand. Sand is medium to coarse grained.	0.5 – 0.7	0.0 – 0.2
Drift	Stiff brown, grey and orange mottled CLAY with some pockets of orange sand and pockets of fine to medium subangular gravel. Occasional shell fragments	0.9 – >2.1	>0.8 – >1.1
London Clay	Firm brown orange and grey mottled locally sandy CLAY	0.7 – >2.1	>0.35 – >0.5

Unusual observations or materials encountered in Made Ground strata are summarised in *Table 3.3* and the borehole logs reproduced in *Appendix A*.

**Table 3.3 Observations and Summary of Artefacts Encountered**

Investigation Location Reference	Description of Contamination	Depth Encountered (mbGL)
B/G6	Coarse flint, concrete and brick fragments	0.0 – 0.2
B/G6	Ash and clinker	0.2 – 0.5
TP2A040	Occasional gravel and red brick	0.0 – 0.9
TP2A040	Red brick and red brick cobbles	0.9 – 1.3
TP2A040	Red brick and occasional ash and clinker	1.3 – 1.75
TP2A366	Occasional red brick fragments	0.0 – 0.35
TP2A525	Black ash and clinker	0.3 – 0.45
TP2A607	Metal rod	0.2
TP2A607	Patches of iron staining and occasional wood fragments	0.6 – 0.7

***Explosives***

Two soil samples were analysed for explosives. All results were below the laboratory limit of detection (LoD).

***Radioactivity***

The results of the gross alpha and gross beta analyses in soil are shown in *Table 3.4*.

**Table 3.4 Radiological Results of Soils above the Laboratory Limit of Detection**

Sample Reference	Top of Sample (mbGL)	Gross Alpha (Bq/g)	Gross Beta (Bq/g)	Total Activity (Bq/g)
B/G6	0.0	0.810	0.670	1.480
B/G6	0.6	1.070	0.880	<b>1.950</b>
B/G6	1.2	0.910	0.840	<b>1.750</b>
TP2A040	0.1	0.695	0.636	1.331
TP2A040	1.7	0.691	0.833	1.524
TP2A366	0.3	0.689	0.592	1.281
TP2A366	1.9	0.700	<b>1.102</b>	<b>1.802</b>
TP2A525	0.1	0.446	0.944	1.390
TP2A525	2.0	0.416	0.748	1.164
TP2A607	0.3	0.826	0.811	1.637
TP2A607	2.0	0.711	<b>1.024</b>	<b>1.735</b>

Figures in **bold** illustrate exceedances of the AWE Threshold Limits, either for gross alpha activity (1.1Bq/g), gross beta activity (1.0Bq/g) or total activity (1.7Bq/g). There are no exceedances of the gross alpha threshold, however exceedances over the gross beta threshold and total activity threshold were noted. The majority of exceedances are very marginal, and further analysis was not considered necessary and therefore not undertaken on any of these samples.

### ***Contaminants – Inorganic and Organic***

A summary of the results of the metals analyses are presented in *Table 3.5*. A total of 7 samples were submitted for each determinant.

Regarding organic contamination within soil samples, the following compounds have been focused on when assessing the results from the organics analyses: banded hydrocarbons, benzo(a)pyrene, BTEX (benzene, toluene, ethylbenzene, xylenes) and total gross range organics (GRO). Total PAH and Total TPH results were not available.

**Table 3.5 Contaminants Encountered in Soils above the Laboratory Limit of Detection**

Determinant	Conc <sup>n</sup> Range (mg/kg)	Max Value (mg/kg)	2 <sup>nd</sup> Value (mg/kg)	No. of Results > LOD	SGV/GAC	SGV/GAC Exceeded
<b><i>Inorganic Determinands</i></b>						
Arsenic	3.5 – 10.9	10.9 (B/G6)	10.3 (TP2A607)	7	500 (SGV)	N
Barium	47 – 75	75 (TP2A525)	64 (TP2A0040)	5	-	
Beryllium	LoD – 1.0	1.0 (TP2A525)	N/A	1	-	
Boron	LoD – 1.0	1.0 (B/G6)	0.9 (B/G6)	2	-	
Cadmium	LoD – 0.27	0.27 (TP2A607)	0.23 (TP2A040)	3	1400 (SGV)	N
Chromium	3.1 – 28.9	28.9 (TP2A366)	26.2 (TP2A040)	7	5000 (SGV)	N
Copper	6.1 – 19.5	19.5 (TP2A366)	14.7 (TP2A040)	7	-	
Lead	3.7 – 33.8	33.8 (TP2A607)	21.2 (TP2A040)	7	750 (SGV)	N
Manganese	245.9 – 440.0	440.0 (TP2A366)	284.3 (TP2A040)	5	-	
Mercury	LoD – 0.35	0.35 (B/G6)	0.11 (B/G6)	2	5000 (SGV)	N
Nickel	5.9 – 28.9	28.9 (TP2A366)	24.7 (TP2A040)	7	480 (SGV)	N

Determinant	Conc <sup>n</sup> Range (mg/kg)	Max Value (mg/kg)	2 <sup>nd</sup> Value (mg/kg)	No. of Results > LOD	SGV/GAC	SGV/GAC Exceeded
Zinc	6.7 – 70.7	70.7 (TP2A366)	70.1 (TP2A607)	7	-	
<b>Organic Determinands</b>						
Aliphatics >C16 – C21	LoD – 8.71	8.71 (TP2A607)	N/A	1	614000 (GAC)	N
Aliphatics >C21 – C35	LoD – 26.00	26.00 (TP2A607)	5.68 (TP2A525)	3	614000 (GAC)	N
Aromatics >C8 – C10	LoD – 1.71	1.71 (TP2A525)	N/A	1	106 (GAC)	N
Aromatics >C10 – C12	LoD – 0.704	0.704 (TP2A525)	N/A	1	608 (GAC)	N
Aromatics >C12 – C16	LoD – 1.86	1.86 (TP2A525)	N/A	1	12500 (GAC)	N
Aromatics >C16 – C21	LoD – 3.79	3.79 (TP2A525)	N/A	1	9210 (GAC)	N
Aromatics >C21 – C35	LoD – 8.82	32.7 (TP2A607)	8.82 (TP2A525)	2	9210 (GAC)	N

**Notes:**

- - - No suitable SGV / GAC available
- **Bold** - Value in bold denotes exceedance against SGV / GAC

GACs utilised are based on conservative 'worst case' scenario assumptions.

*It is important to note that the presence of an elevated concentration of a contaminant does not necessarily indicate a risk to human health or the environment.*

From inspection of the soil sample analytical results, they do not indicate that there is significant land contamination by metals or hydrocarbons that would represent unacceptable harm to human health or the environment in the vicinity of Buildings 8F2 and 8F3B.

### 3.7.3 Groundwater Analysis

The results of the gross alpha and gross beta analyses in borehole groundwater samples are provided in *Table 3.6*.

**Table 3.6 Radiological Results of Groundwater above the Laboratory Limit of Detection**

Sample Reference	Samples Taken	Gross Alpha Concentration Range (Bq/l)	Gross Beta Concentration Range (Bq/l)	Tritium Concentration Range (Bq/l)
BH2A016D	3	0.045 – 0.087	0.253 – 0.972	0.8 – 11.4
BH2A017S	3	0.010 – 0.635	0.844 – 1.210	0.0 – 0.9
BH2A018S	3	0.016 – 0.065	0.207 – 0.287	0.0 – 7.6
WS2A517M	2	0.193 – 0.429	0.212 – 0.743	0.0

Radiochemistry analysis was undertaken on three of these sample and the results of this are shown in *Table 3.7*. The results fall significantly below WHO guidelines and would not be considered to represent unacceptable risks.

**Table 3.7 Results of Gamma Spectrometry Analysis on Groundwater Samples**

Radionuclide	Activity Range (Bq/m <sup>3</sup> )
Pu-238	0.302 – 0.667
Pu-239/40	0.302 – 0.705
U-234	21.8 – 305.7
U-235	0.771 – 6.052
U-238	6.828 – 106.054

A summary of the results of the metal analyses are presented in *Table 3.8*. A total of 9 samples were analysed for each determinant. Some metals were found to have exceeded the DWS, whilst some hydrocarbons exceeded limits derived from WHO and EQS guidelines.



**Table 3.8 Contaminants Encountered in Groundwater above the Laboratory Limit of Detection**

Determinant	Conc <sup>n</sup> Range (ug/l)	Max Value (ug/l)	2 <sup>nd</sup> Value (ug/l)	No. of Results > LOD	DWS/EQS (ug/l)	DWS/EQS Exceeded
<b><i>Inorganic Determinands</i></b>						
Arsenic	LoD – 3.0	3.0 (BH2A016D)	2.0 (BH2A017S, BH2A018S)	7	10, 50	N
Barium	LoD – 60	60 (BH2A018S)	30 (BH2A016D, BH2A017S, BH2A018S)	8	1000	N
Boron	190 - 980	980 (BH2A017S)	910 (BH2A017S)	9	2000, 1000	N
Chromium	2 - 8	8 (BH2A018S)	3 (BH2A016D, BH2A017S)	9	5-250, 50	N
Copper	LoD – 4.0	4.0 (BH2A017S)	2.0 (BH2A016D, BH2A017S)	7	1-28, 2000	N
Mercury	LoD – 0.2	0.2 (BH2A016D)	0.1 (BH2A016D, BH2A017S)	4	1, 1	N
Nickel	4 - 54	54 (BH2A017S)	51 (BH2A017S)	9	50-200, 20	Y
Zinc	LoD - 147	147 (BH2A016D)	24 (BH2A017S)	5	8-500, 5000	Y
<b><i>Organic Determinands (mg/l)</i></b>						
Ethyl Benzene	LoD – 0.242	0.242 (BH2A018S)	N/A	1	0.002 (1)	Y
O-xylene	LoD – 1.21	1.21 (BH2A018S)	N/A	1	0.03 (2)	Y
M and p-xylene	LoD – 0.695	0.695 (BH2A018S)	N/A	1	0.03 (2)	Y
Total GRO	LoD – 2.1	BH2A018S	N/A	1	0.01 (3)	Y
TPH (GC)	LoD – 0.54	0.54 (BH2A016D)	0.4 (BH2A017S)	7	0.01 (3)	Y

(1) Utilising WHO guidelines which range from 0.002 – 0.2mg/l

(2) Utilised most conservative EQS value for Xylene

(3) DWS utilised for hydrocarbons / oils / hydrocarbons

### ***Explosives***

Explosive analysis on groundwater samples identified no results above the Limit of Detection (LoD) with the exception of Borehole BH2A018S, which had an isolated elevated result of 95mg/kg for HMX.

### ***Asbestos***

Due to historical uncontrolled tipping activities, asbestos has been found at various locations across this part of the site during previous intrusive site investigation works. Two samples were submitted for asbestos analysis (from TP2A040 and TP2A525). Neither sample had asbestos fibres present.

### ***Key Findings***

Key chemical contaminants of concern identified in soils within 10 metres of the site boundaries above LoD include metals and hydrocarbons, however, no soil contaminant concentrations were identified above the derived SGV or GAC for soil samples analysed.

Available soil radiological activity analytical data indicates the majority of soil activity noted did not exceed the AWE 'threshold level', and the few exceedances over the AWE threshold level were typically marginal.

Key contaminants of concern identified in boreholes groundwater samples above LoD included metals and organics, some of which exceeded their respective DWS/EQS/WHO guidelines. No radiological activity levels were identified that presented an unacceptable risk. One isolated concentration of explosive contamination was identified above the LoD.

It should be noted that no significant visual or olfactory contamination was noted from field observations for any of the exploratory hole sample locations included.

#### **3.7.4 Building Desk Top Studies**

BAE Systems building reports (*Ref. 14*) carried out in 2001 identified a number of potential sources of pollution present within buildings 8F2 and 8F3B either from the materials used in the construction of the buildings and associated infrastructure or from the operations that historically have taken place therein, as outlined in *Table 3.9*.

**Table 3.9 Potential Pollutant Sources**

Potential Contaminant Category	Building	Source/Detail
Explosives	8F2	EDC1, PETN, RDX/TNT, CompB3, Cyclotol
	8F3B	RDX/TNT, Barratol
Asbestos	8F2	Possibly in steam pipe lagging
	8F3B	No further detail
Organics	8F3B	Trimethyl propane (solid acid), resins – phenolic, polyurethane foam, isocyanates, alcohols, general hydrocarbons.

### 3.7.5 Geophysics

RPS have issued Geophysical survey reports for the land within the Phase 2A Demolition area (*Ref. 22*), which also cover the site areas in question. Surveys were conducted using magnetic and electromagnetic survey equipment. Generally geophysical surveys identified ferrous and non ferrous anomalies, some of which were notably clustered at locations of former building footprints. The exact nature of all of these anomalies is unknown but they could represent hazardous materials associated with the former buildings' uses.

Some anomalies were suggested to correspond to metallic objects within the ground or areas of ground with a differing density or permeability to its surroundings such as infilled / redundant drains / culverts, and also correlated with routes of known locations of buried services (water mains, telecoms, ducts etc). Areas of reinforced concrete were also identified.

The report considered there to be a low risk that the ferrous anomalies may represent small accumulations or individual items of buried ordnance and in conclusion, recommended that further intrusive investigation should be undertaken to identify their nature. However, no specific anomalies within the site area were identified.

## 4 Preliminary Conceptual Site Model

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### 4.1 Introduction

The following section sets out a Preliminary Conceptual Site Model based on the available information for the site. This qualitatively describes potential contaminant sources present within and around the site of Buildings 8F2 and 8F3B, receptors that contaminants could impact on, and also pathways that may exist to allow contaminants to impact upon the identified receptors. The model is based on the redevelopment of these areas with the proposed commercial / industrial end use of the site discussed in *Section 1.1*.

The Preliminary Conceptual Site Model has been developed using current UK guidelines including CLR11 (*Ref. 29*), BS10175 (*Ref. 30*) and best practice guidance provided by the Safegrounds Learning Network (*Ref. 31*). The model has been developed using the information provided in the previous sections which has in turn been obtained from the referenced reports.

The model is based on the site's proposed use, which can be summarised as permanent commercial/industrial.

### 4.2 Potential Contaminant Sources

Based on the data sources in *Section 3.7* it is considered that there is the potential for contamination to be present, and also the potential for the presence of as yet unidentified sources of contamination that could impact upon the site based on its proposed use and commercial / industrial end use scenario. The likelihood of the contaminant source being present on the site is provided in brackets:

- Radiological soil and groundwater contamination associated with current and former site activities (negligible to low likelihood);
- Asbestos contamination of soil associated with current and former site activities (low likelihood);
- Metal and hydrocarbon contamination of soil associated with current and former site activities (low likelihood);

- Explosive contamination of soil associated with current and former site activities (low to moderate likelihood);
- Metal and hydrocarbon contamination of shallow groundwater (negligible to low likelihood);

It is important to note that the site has not been included in detailed, site specific, previous ground investigation.

### 4.3 Receptors

Potential receptors to contamination based on the proposed use of the site include:

- AWE site staff and visitors to site;
- Construction workers;
- Future grounds workers (i.e. gardeners and underground service maintenance) from the occasional disturbance to subsurface soil, and potential contact with contaminated soil that may occur during maintenance work;
- Burghfield Brook and other surface waters potentially fed by groundwater (including the Foundry Brook Tributaries, and the 'unnamed stream' located immediately north of the AWE (B) fence boundary running in a west – east direction);
- Shallow groundwater; and,
- Deep groundwater including the chalk aquifer.

### 4.4 Potential Pollutant Linkages

Potential pollutant linkages along with their likelihood of occurring are qualitatively described in brackets based on the current site use, they include the following:

- Inhalation, dermal contact and ingestion of radiological and non radiological contaminants in soils by AWE site staff, visitors and other proposed users **(Low Risk)**;
- Inhalation, dermal contact and ingestion of radiological and non radiological contaminants in soils by construction staff **(Low to Moderate Risk)**;

- Inhalation, dermal contact and ingestion of radiological and non radiological contaminants in soils by future grounds workers (**Low to Moderate Risk**);
- Inhalation or accumulation of ground gases and volatile substances (**Low Risk**);
- Inhalation of asbestos by construction workers from asbestos contaminated soils (**Low to Moderate Risk**);
- Inhalation of asbestos by future site users from asbestos contaminated soils (**Low Risk**);
- Leaching of radiological and non radiological contaminants in soils by infiltrating rainfall and contaminants migrating into the shallow aquifer (**Low Risk**);
- Migration of radiological and non radiological contaminants in shallow groundwater into the Burghfield Brook and other surface water features (**Low Risk**);
- Radiological and non radiological contaminants migrating vertically into deeper aquifer (**Low Risk**);
- Surface runoff carrying contaminated fines into the Burghfield Brook (**Low Risk**);
- Radiological and non radiological contaminants in groundwater migrating into the nearby abstraction borehole (**Low Risk**);
- Buried ordnance exploding during ground excavations (**Low to Moderate Risk**); and,
- Explosion caused by explosively contaminated soils being disturbed during demolition or earthworks (**Low Risk**).

It is considered that no further investigation is required when the risk is considered negligible. Low risk scenarios would typically require less intrusive investigation, sampling and analysis compared to higher risk scenarios.

## 4.5 Summary of Conceptual Site Model

The potential for chemical, explosive, radiological and ground gas contaminants to be present within soils and groundwater underlying the site has been qualitatively identified. Several potential pollutant linkages between contaminant sources and sensitive receptors have been identified. Of the potential pollutant linkages summarised in *Section 4.4*, several have been identified as requiring additional investigation or assessment.

Based on RPS experience during previous ground investigations at AWE Burghfield, random historic tipping of asbestos has been encountered across the site, there is a noted possibility of construction workers encountering asbestos contaminated soils during ground preparatory works the site areas as part of the Project Mensa Development.

The majority of site areas within the Project Mensa Development will retain and add to the amount of hardstanding / impermeable cover that will minimise risks of future site users coming into contact with potentially contaminated soils. Hardstanding also results in very low infiltration rates which will subsequently minimise the risk of rainfall leaching contaminants into soils and impacting on the groundwater. The hardstanding will also prevent spillages entering the ground.

No abnormal events have been raised with regards to pollution incidents, and a review of health physics monitoring has not identified any sign of radiological contamination requiring decontamination. The likelihood of solid radiological waste entering or contaminating the ground, based on current information is considered low given the current and proposed operations.

Based on the soil analytical data assessed, no contaminant concentrations were identified as exceeding SGVs or derived GACs. The likelihood of the contamination identified representing a risk to human health is low. Based on the borehole groundwater data concentrations of some metal and hydrocarbon determinants were identified at levels greater than their respective EQS / DWS / WHO guidelines.

Due to the potential for encountering previously unidentified contamination and also the historical uses of buildings present on the site it is recommended that a ground investigation should be undertaken to ensure the health of future users and controlled waters are adequately protected.

## **5 Conclusions and Recommendations**

---

### **5.1 Conclusions**

There has been very limited ground investigation undertaken at the site to date, however there has been extensive investigation of the land surrounding some of the buildings covered by this Desk Top Study.

A wide variety of potential contaminants have been stored, manufactured or processed in the different buildings. However, the previous investigation did not encounter any significantly elevated concentrations of metals or organic contaminants, and no explosives were encountered.

This study has not identified categorically that contamination is present at the site, however, potential sources of contamination have been identified, based on the current and historical uses of the buildings on the site as well as intrusive investigations of nearby land areas. Consequently, potential pollutant linkages have been identified representing potential risk to site receptors. Further investigation is therefore required and it is recommended that mitigation measures are implemented to minimise the risks to construction workers from encountering contamination at the site (especially asbestos).

### **5.2 Recommendations**

#### **5.2.1 Further Investigation**

It is recommended that an intrusive ground investigation be carried out in order to characterise the areas covered by this study which have not yet been subject to investigation, assessment or any characterisation. It is envisaged that such an investigation would entail the excavation of hand and trial pits to enable soil sampling and analysis, and the drilling of shallow and deep boreholes to permit groundwater analysis and monitoring.

This would clarify whether any risks are posed to human health or the environment from the ground conditions based on the proposed commercial/industrial end use



scenario and enable any further assessment/remediation measures to be undertaken.

### **5.2.2 Mitigation of Construction Workers Contamination and Associated Risks**

Given the potential presence of asbestos, chemical and radiological contaminants in soils and groundwater, possible risks are posed to construction workers during development works. The CDM Regulations 2007 are considered the most appropriate mechanism to manage risks to construction workers, AWE staff and the general public. It is therefore recommended that appropriate safety briefings are provided on potential hazards at the site and appropriate PPE, health and safety and welfare measures are utilised during ground works. Such protocols should be set out in a Health and Safety Plan and a Safe System of Work. The Safe Systems of Work should also include procedures for managing the hazards associated with occurrence of previously unidentified contamination.

## 6 References

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## Drawings

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### LEGEND

- AWE Burghfield Fence Line
- Burghfield Brook (Current Course)
- - - Burghfield Brook (Former Course)
- - - Approximate Extent of Alluvium Boundary on BGS 1:10,000 Geology Map
- Mensa Application Area
- Phase 2A Demolition Area
- Buildings 8F2 & 8F3B (Investigation Area Extent)
- Mound 1

### Previous Investigation Locations

#### Gas Ring Main Investigation (2004)

- + Trial Pit

#### Phase 2A Demolition Area LQA (2005)

- + Borehole with Monitoring Well (Deep)
- + Borehole with Monitoring Well (Shallow)
- + Probehole with Monitoring Well (Shallow)
- + Trial Pit

Rev:	Date:	Amendment:	Name:	Checked:

■ Data Source: RPS 2008  
 Status: PRELIMINARY

RPS

Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP  
 T 01235 838200 F 01235 820351 E rps@rpsgroup.com W www.rpsplc.co.uk

■ Client: AWE Plc  
 Project: Mensa Additional Ground Investigation

Title: Site Location Plan

Scale: A3 @ 1:1,500  
 0 0.025 0.05km

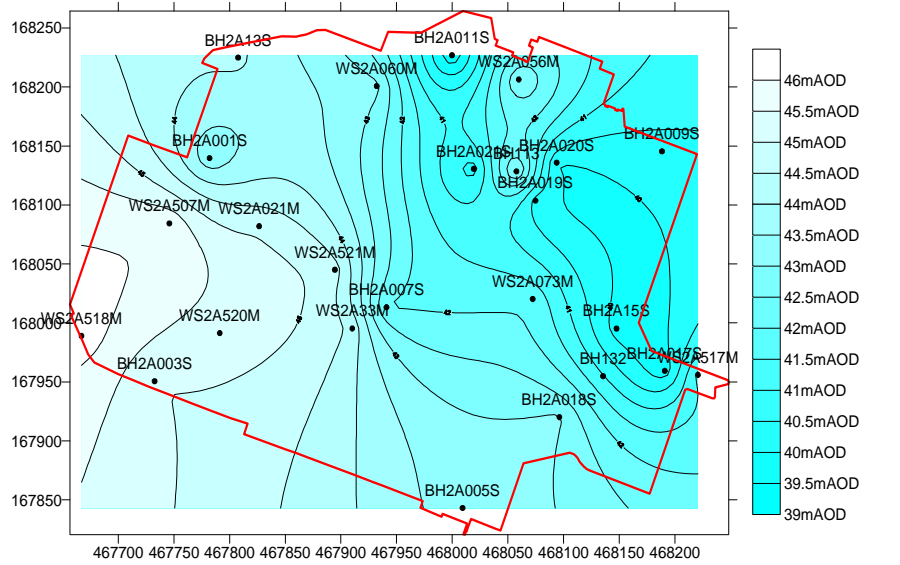
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■ Figure No: **JER3996-8F-003** Revision: -

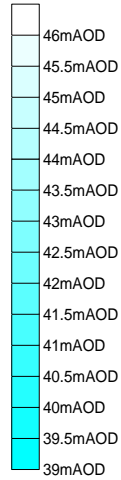
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Circa 2007

Project Ref: J:\Drawings\JER3996

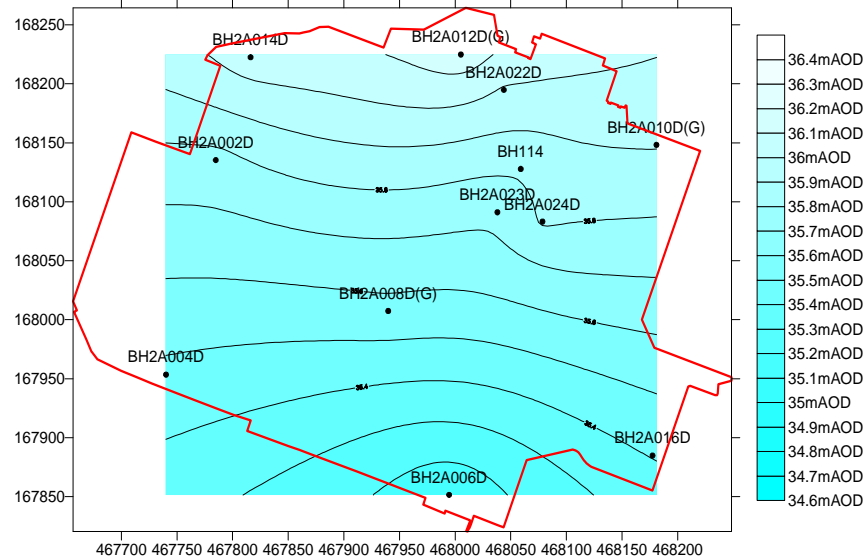
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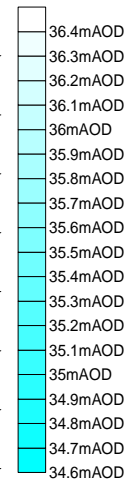
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## Deep Aquifer

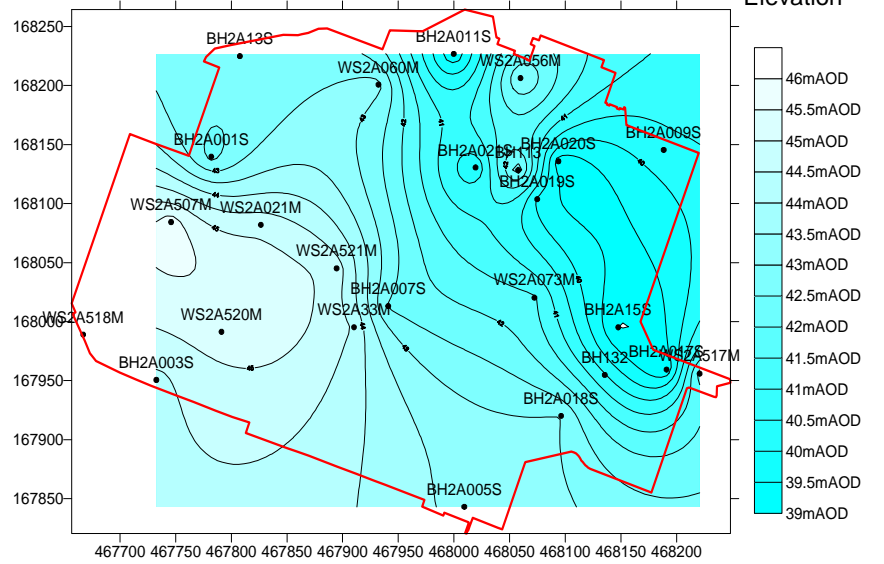


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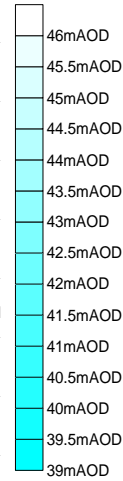


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Revision	
Author	Drawn
RB	sgc drawing
Drawn	009
RB	11/01/06
Client	
AWE plc	
Job	
AWE Burghfield	
Land Quality Assessment	
Drawing Title	
Groundwater Elevation in m AOD for July 2005	
Drawing Number	
JER3058-P2-SF00	

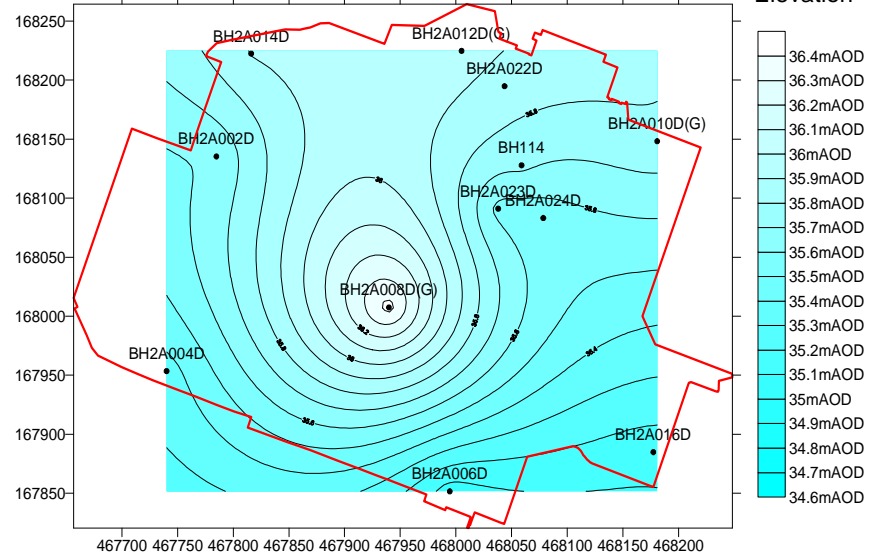
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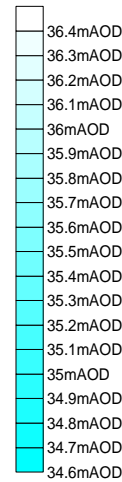
### Groundwater Elevation



## Deep Aquifer



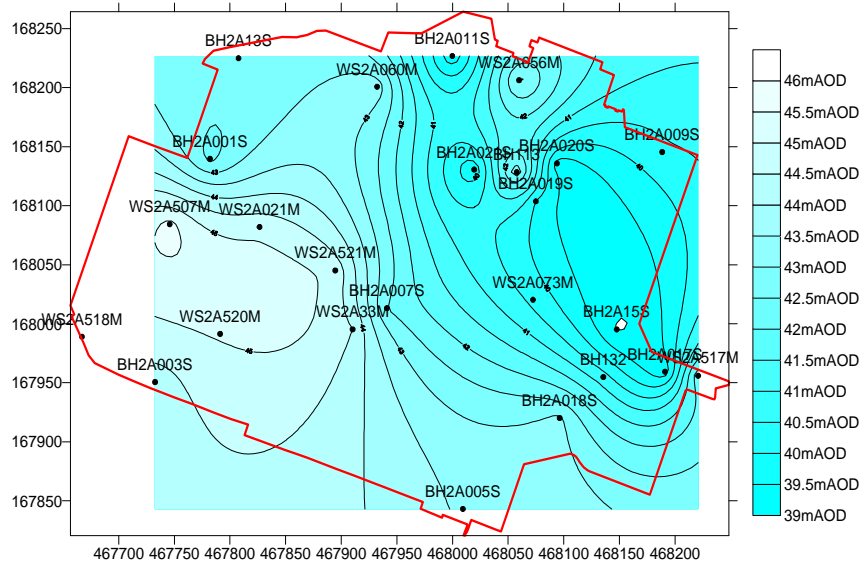
### Groundwater Elevation



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Revision	
Author RB	Date 11/01/06
Drawn RB	
Checked sgc drawing	
Date 11/01/06	
Project AWE plc	
Job AWE Burghfield Land Quality Assessment	
Drawing Title Groundwater Elevation in mAOd for August 2005	
Drawing Number JER3058-P2-SF00	

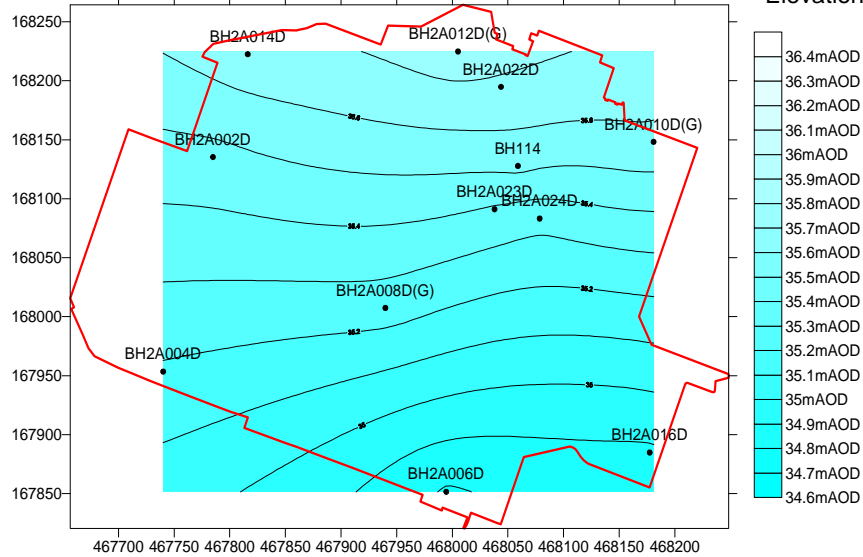
## Shallow Aquifer

Groundwater Elevation



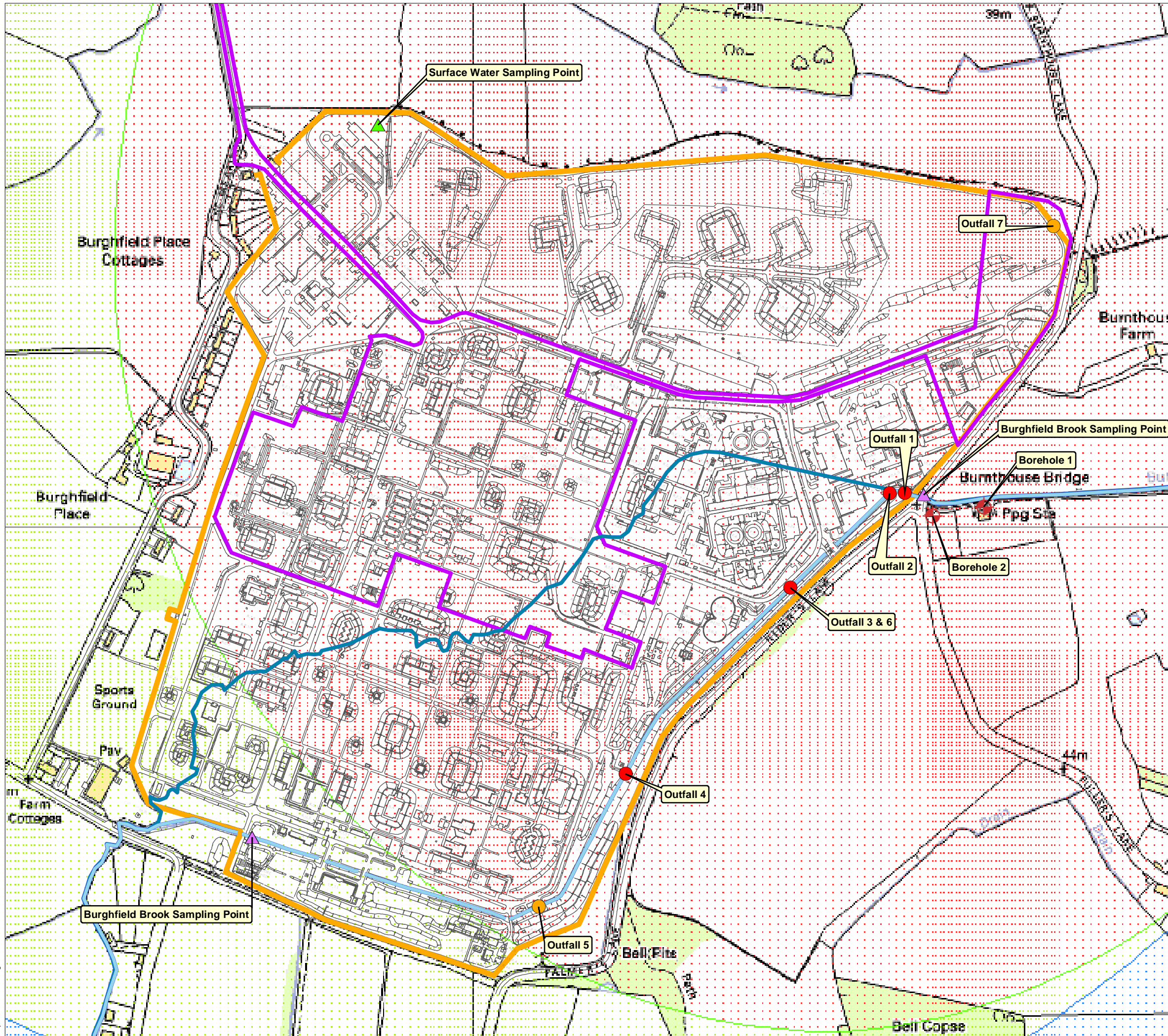
## Deep Aquifer

Groundwater Elevation



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Revised	
Revision	
Author	Drawn
RB	spe drawing
Drawn	11/01/06
Client	
AWE plc	
Job	
AWE Burghfield Land Quality Assessment	
Drawing Title	
Groundwater Elevation in mAO for September 2005	
Drawing Number	
JER3058-P2-SF00	





### Legend

- AWE Burghfield Fence Line
- Mensa Application Area
- Burghfield Brook - Current Course
- Burghfield Brook - Old Course
- Licensed Outfall
- Outfall Waiting Consent by EA
- AWE Burghfield Brook Sampling Point
- AWE Surface Water Sampling Point
- Groundwater Abstraction Borehole

### Source Protection Zone

- 1 Inner Zone
- 2 Outer Zone
- 3 Catchment

Rev:	Date:	Amendment:	Name:	Checked:
C	30/09/08	Revised Mensa Boundary	RJ	SJ
B	25/07/08	Revised Mensa Boundary	RJ	SJ
A	17/03/08	Revised Mensa Boundary	RJ	SJ

■ Data Source: RPS 2008

Status: PRELIMINARY



Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP  
 T 01235 838200 F 01235 820351 E rps@rpsgroup.com W www.rpsplc.co.uk

■ Client: AWE Plc  
 Project: Project Mensa

Title: Site Map Indicating Groundwater Source Protection Zones & AWE Water Monitoring Locations

Scale: A3 @ 1:5,000

0 0.1 0.2 km N

Date: 19/09/2007 Datum: OSGB36 Projection: BNG

Drawn: SRM Checked: AJC Job Ref: JER3860

■ Drawing No: JER3860-GCTR-004c Revision: C

## Appendices

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## **Appendix A**

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### **Previous Investigation Borehole Logs**

Project Name: Phase 2A Demolition Area	Coordinates	Drilling Method: Cable percussion	Hole Type Cable	
Project No. JER3058/P2A/L5	Northings: 468177.36	Start Date: 26/07/2005	Hole Details	
Location: AWE Burghfield	Eastings: 167884.89	End Date: 28/07/2005	Hole Diameter (mm)	Casing Depth (m)
Client: AWE plc	Ground Level: 44.000 m OD	Logged By: AP	Scale 1:50	

Well	Water Strikes	Samples & In Situ Testing			Level (m AOD)	Depth (m)	Legend	Description Of Strata
		Depth (m)	Type	Results				
		0.00-0.10	X1				Dark brown CLAY. (TOPSOIL)	
		0.30-0.40	D1		43.70	0.30		
					43.45	0.55		43.50
					43.30	0.70		
		0.80-0.90	D2		43.10	0.90		43.00
		0.90-1.00	X2					
					42.80	1.20		42.50
		1.90-2.00	D3					42.00
		1.90-2.00	X3					
		2.00	D4		41.80	2.20		
		2.00	R4					
		2.00	X4					
		2.00-2.50	B1		41.30	2.70		41.50
		3.00	D5					41.00
		3.00	R5					
		3.00	X5					
		3.00-3.50	B2					40.50
		4.00	D6					40.00
		4.00	R6					
		4.00	X6					
		4.00-4.50	B3					39.50
		5.00	D7					39.00
		5.00	R7					
		5.00	X7					
		5.00-5.50	B4					38.50
		6.00	R8		38.00	6.00		38.00
		6.00-6.50	B5					37.50
								37.00
		7.00-7.50	B6					36.50
								36.00
		8.00-8.50	B7					35.50
								35.00
		9.00-9.50	B9					34.50

Continued next sheet

Remarks: Hand dug starter pit to 1.2m. No obvious contamination observed. Groundwater medium inflow (driller's description). Gas and groundwater monitoring well installed.

Chiselling Details				Groundwater Notes		
Time Taken	Depth From (m)	Depth To (m)	Tool Used	Strike (m)	Casing Depth (m)	Level After 20 Mins (m)
				14.20	0.00	13.70



Project Name: Phase 2A Demolition Area	Coordinates	Drilling Method: Cable percussion		Hole Type Cable	
Project No. JER3058/P2A/L5	Northings: 468177.36	Start Date: 26/07/2005	Hole Details		
Location: AWE Burghfield	Eastings: 167884.89	End Date: 28/07/2005	Hole Diameter (mm)	Casing Depth (m)	Scale 1:50
Client: AWE plc	Ground Level: 44.000 m OD	Logged By: AP			

Well	Water Strikes	Samples & In Situ Testing			Level (m AOD)	Depth (m)	Legend	Description Of Strata		
		Depth (m)	Type	Results						
		10.00	D8		31.40	12.60		Stiff grey locally laminated CLAY with occasional lenses of sand and rare shell fragments. Sand is grey fine to coarse. (LONDON CLAY)	33.50	
		10.00	X8						33.00	
		10.00	R9						32.50	
		10.00-10.50	B10						32.00	
			11.00-11.50	B11		29.90	14.10		Soft dark grey slightly sandy CLAY with occasional shell fragments and rare crystals. Increasingly sandy with depth. (LONDON CLAY)	31.50
			12.00	R10						31.00
			12.00-12.50	B12		28.30	15.70		Dark grey clayey SAND (Loose with shell bands - driller's description). (LONDON CLAY) Damp from 14.3m.	30.50
			13.00-13.50	B13						29.50
			14.00	R11						29.00
			14.00-14.50	B14		27.45	16.55		Interbedded dark grey clayey SAND and soft to firm sandy CLAY. (LONDON CLAY)	28.50
			15.00-15.50	B15						28.00
			16.00	R12		26.00	18.00		Stiff grey slightly gravelly CLAY. Gravel is sub-angular to angular fine to medium with shells. (LONDON CLAY)	27.50
			16.00-16.50	B16						27.00
			17.00-17.50	B17		26.00	18.00		End of Borehole at 18.00 m	26.50
			18.00	D9						26.00
			18.00-18.50	B18						25.50
									25.00	
									24.50	

**Remarks:** Hand dug starter pit to 1.2m. No obvious contamination observed. Groundwater medium inflow (driller's description). Gas and groundwater monitoring well installed.

Chiselling Details				Groundwater Notes		
Time Taken	Depth From (m)	Depth To (m)	Tool Used	Strike (m)	Casing Depth (m)	Level After 20 Mins (m)
				14.20	0.00	13.70



Project Name: Phase 2A Demolition Area		Coordinates		Drilling Method: Berretta T41		Casing Details		Hole Type	
Project No: JER3058/P2A/L5		Northings: 468190.97		Start Date: 11/05/2005		Hole Diameter (mm)		RO	
Location: AWE Burghfield		Eastings: 167959.38		End Date: 19/05/2005		Casing Depth (m)		Scale	
Client: AWE plc		Ground Level: 43.740 m OD		Logged By: AP/PT				1:50	

Well	Water Strikes	Samples & In Situ Testing			Level (m AOD)	Depth (m)	Legend	Description Of Strata	
		Depth (m)	Type	Results					
		0.30		VOC 0.0 ppm	43.54	0.20		Brown to dark brown slightly sandy SILT (TOPSOIL)	
		0.30-0.50	D1					Light brown to brown occasionally red friable CLAY with occasional sand. (MADE GROUND)	43.24
		0.00-1.00	X1		43.04	0.70			
		0.90	D2	VOC 0.0 ppm	42.74	1.00		Brown gravelly CLAY. Gravel is of flint occasional brick and other mixed lithologies. (MADE GROUND)	42.74
		0.90-1.10	X2		42.59	1.15		Firm orange brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium of sub-rounded flint. (ALLUVIUM)	
		1.50		VOC 0.0 ppm					42.24
		1.50	D3					Stiff to very stiff orange mottled CLAY with mudstone bands recovered as gravel. (LONDON CLAY)	
		1.50	R3						41.74
		1.50	X3						
		2.50		VOC 0.0 ppm					41.24
		2.50	D4						
		2.50	R4						
		2.50	X4						
		2.50		VOC 0.0 ppm					40.74
		3.50		VOC 0.0 ppm	40.54	3.20		Stiff to very stiff blue grey SILT/CLAY with thin laminae of fine sand. (LONDON CLAY)	
		3.50	D5						40.24
		3.50	R5						
		3.50	X5						
		4.00		VOC 0.0 ppm					39.74
		4.00-4.50	D6						
		4.00-4.50	R6						
		4.00-4.50	X6						39.24
		5.00		VOC 0.0 ppm					38.74
		5.00-5.50	D7						
		5.00-5.50	R7						
		5.00-5.50	X7						38.24
					37.74	6.00		End of Borehole at 6.00 m	37.74
									37.24
									36.74
									36.24
									35.74
									35.24
									34.74
									34.24

<b>Remarks:</b> Hand dug starter pit to 1.2m. Window sample refusal at 4.0m. Rotary open hole follow on. No groundwater encountered. gas and groundwater monitoring well installed.	Chiselling Details				Groundwater Notes		
	Time Taken	Depth From (m)	Depth To (m)	Tool Used	Strike (m)	Casing Depth (m)	Level After 20 Mins (m)



File: BASE III (B17 308) Standard Borehole Log v1 dated 28th Mar 03

Project Name: Phase 2A Demolition Area	Coordinates	Drilling Method: Beretta T41	Casing Details		Hole Type
Project No: JER3058/P2A/L5	Northings: 468096.24	Start Date: 20/05/2005	Hole Diameter (mm)	Casing Depth (m)	RO
Location: AWE Burghfield	Eastings: 167920.18	End Date: -			Scale
Client: AWE plc	Ground Level: 43.910 m OD	Logged By: PT			1:50

Well	Water Strikes	Samples & In Situ Testing			Level (m AOD)	Depth (m)	Legend	Description Of Strata
		Depth (m)	Type	Results				
		0.00		VOC 0.0 ppm	43.81	0.10		Soft brown black slightly sandy slightly gravelly CLAY. Gravel is fine to medium sub-rounded flint and sub-angular brick. (TOPSOIL)
		0.40	D1		43.51	0.40		Firm orange brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium sub-angular brick and sub-rounded flint. (MADE GROUND)
		0.40	R1		43.11	0.80		
		0.40	X1		42.71	1.20		
		0.90	D2	VOC 0.0 ppm				Firm to stiff brown mottled slightly gravelly CLAY with iron staining. Gravel is fine to medium sub-rounded flint. (MADE GROUND)
		0.90	R2					Firm to stiff blue grey mottled red slightly gravelly SILT/CLAY with some wood fragments. Gravel is fine to medium of sub-angular to sub-rounded flint. (MADE GROUND)
		0.90	X2					
		1.00						
		2.00		VOC 0.0 ppm				Soft to firm grey green SILT with decomposing wood fragments. (ALLUVIUM)
		2.00	D3		41.71	2.20		Fine to medium sub-angular mudstone GRAVEL. (ALLUVIUM)
		2.00	R3		41.66	2.25		
		2.00	X3					Firm to stiff grey orange slightly gravelly CLAY. (LONDON CLAY)
		2.50	D4					
		2.50	X4					
		3.00	R4					
		3.50		VOC 0.0 ppm				
		3.50	D5					
		3.50	X5					
		4.00	R5					
		4.50		VOC 0.0 ppm				
		4.50	D6					
		4.50	X6					
		5.00		VOC 0.0 ppm				
		5.00	R6					
		5.00	D7					
		5.00-6.00	X7					
		6.00	R7		37.91	6.00		End of Borehole at 6.00 m

**Remarks:** Hand dug starter pit to 1.0m. Window sample to 2.5m with rotary open hole follow on. Gas and groundwater monitoring well installed.

Chiselling Details				Groundwater Notes		
Time Taken	Depth From (m)	Depth To (m)	Tool Used	Strike (m)	Casing Depth (m)	Level After 20 Mins (m)
				2.50	-	1.00



Project Name: Phase 2A Demolition Area (2005)		Coordinates		Drilling Method: Window sample			Hole Type <b>WS</b>
Project No. B04 - JER3058		Northings: 468220.71		Start Date: 11/05/2005		Hole Details	
Location: AWE Burghfield		Eastings: 167955.92		End Date: 09/06/2005		Hole Diameter (mm)	Casing Depth (m)
Client: AWE plc		Ground Level: 43.920 m OD		Logged By: AP/KM		Scale <b>1:50</b>	






Well	Water Strikes	Samples & In Situ Testing			Level (m AOD)	Depth (m)	Legend	Description Of Strata	
		Depth (m)	Type	Results					
		0.00-0.10	X		43.52	0.40		Brown to dark brown CLAY (TOPSOIL)	
		0.20-0.40	D			43.17		0.75	Brown occasionally orange slightly gravelly CLAY. (DRIFT)
		0.20-0.40	R			42.72		1.20	Brown gravelly CLAY. (DRIFT)
		1.00	D		40.92	3.00		Firm to stiff brown mottled orange brown and blue grey slightly sandy CLAY with occasional pockets of light grey fine angular mudstone gravel surrounded by light grey discolouration. (LONDON CLAY)  Slight seepage associated with a pocket of gravel at 1.82m.	
		1.00	X						
		1.50	D						
		1.50	X						
		2.00	R						
		2.50	D		End of Borehole at 3.00 m				
		2.50	X						
3.00	R								

<b>Remarks:</b> Hand dug starter pit to 1.2m. No obvious contamination observed. Gas and groundwater monitoring well installed.	<b>Chiselling Details</b>				<b>Groundwater Notes</b>		
	Time Taken	Depth From (m)	Depth To (m)	Tool Used	Strike (m)	Casing Depth (m)	Level After 20 Mins (m)
					1.82	-	-





Project Name: Gas Ring Main Investigation (2004)	Co-ords: N - 167941.81 E - 468245.28	Ground Level: -	Date: 21/04/2004
Project No. B02 - JER2763			
Location: AWE Burghfield	Weather:		Scale 1:25
Client: AWE plc	Equipment: Hand Dug Trial Pit		Logged by: RB

Samples & In Situ Testing				Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Ref	Results				
0.00-0.10	D	1					Made Ground comprising orange brown gravelly clay. Gravel is medium to coarse flint, concrete and brick fragments. Abundant roots to 0.05mbgl.
0.00-0.10	R	1		0.20			Made Ground comprising orange brown gravelly clay. Gravel is fine to coarse flint with concrete and brick fragments with pockets of ash and clinker.
				0.30			
				0.50			Made Ground comprising layer of ash and clinker with abundant coarse flint gravel at top of stratum becoming coarse flint gravel in a matrix of black cinders, ash and sand with depth.
0.60	D	2					
0.60	R	2		0.70			Coarse flint GRAVEL in a matrix of beige sand. Sand is medium to coarse grained.
							Stiff orange brown CLAY veined with blue grey clay occasional vegetative fragments and roots. Wider fractures also have fine grey sand and shell fragments.
1.20	D	3		1.20			
1.20	R	3					Trial Pit Complete at 1.20 m

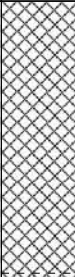

Stability: Unstable through coarse Made Ground

Groundwater:

Remarks:



Project Name: Phase 2A Demolition Area	Co-ords: N - 167889.90 E - 468132.97	Ground Level 44.790mOD	Date: 31/05/2005
Project No. JER3058/P2A/L5	Weather: Sunny and warm.		Scale 1:25
Location: AWE Burghfield	Equipment: JCB 3CX	Logged by: ADB	
Client: AWE plc			

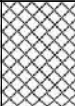

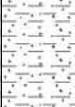
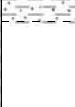
Samples & In Situ Testing				Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Ref	Results				
0.10	R	1		0.90	43.89		Turf over soft to firm brown CLAY with occasional gravel and very occasional red brick (MADE GROUND)
0.40 0.40	D X	1 1					Soft brown sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded and includes much red brick and red brick cobbles. (MADE GROUND)
1.00 1.00 1.00	D R X	2 2 2		1.75	43.04		Very gravelly with red brick and occasional ash and clinker below 1.30m.
1.70 1.70 1.70	D R X	3 3 3					Firm to stiff grey mottled brown CLAY. (LONDON CLAY)
				2.10	42.69		Trialpit Complete at 2.10 m

Stability: Stable

Remarks: Excavated in side of bund, log represents the back face of the pit.



Project Name: Phase 2A Demolition Area	Co-ords: N - 167920.46 E - 468188.40	Ground Level 43.870mOD	Date: 31/05/2005
Project No. JER3058/P2A/L5	Weather: Overcast.	Scale 1:25	
Location: AWE Burghfield	Equipment: JCB 3CX	Logged by: AOB	
Client: AWE plc			


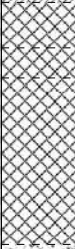
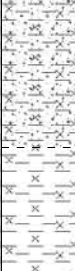

Samples & In Situ Testing				Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Ref	Results					
0.30	D	1		0.35	43.52		Turf over soft brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded and includes occasional red brick fragments. (MADE GROUND)	
0.30	R	1						
0.30	X	1						
1.00	D	2		0.90	42.97		Stiff blue grey mottled brown gravelly CLAY. Gravel is sub-angular to sub-rounded with occasional fine shell fragments. (DRIFT)	
1.00	R	2						
1.00	X	2						
1.40				1.40	42.47		Stiff blue grey mottled brown slightly gravelly CLAY with occasional small pockets of decayed vegetation and rootlets. Gravel is fine to coarse sub-angular to sub-rounded. (DRIFT)	
1.90	D	3		2.00	41.87			Slight seepage at 1.80m.
1.90	R	3						
1.90	X	3						
----- Trialpit Complete at 2.00 m -----								

Stability: Stable

Remarks: No obvious contamination observed.



Project Name: Phase 2A Demolition Area	Co-ords: N - 167868.94	Ground Level	Date: 31/05/2005
Project No. JER3058/P2A/L5	E - 468170.67	44.150mOD	
Location: AWE Burghfield	Weather: Sunny and warm.	Scale	1:25
Client: AWE plc	Equipment: JCB 3CX	Logged by: AOB	


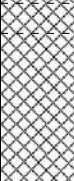

Samples & In Situ Testing				Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Ref	Results				
0.10	R	1					Turf over soft to firm brown slightly sandy slightly gravelly CLAY with some fine rootlets. Gravel is fine to coarse sub-angular to sub-rounded. (TOPSOIL)
0.30	D	1		0.30	43.85		Black ash and clinker and some gravel and cobble sized concrete. (MADE GROUND)
0.30	X	1		0.45	43.70		Soft brown sandy very clayey GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded. (MADE GROUND)
				0.55	43.60		Firm to stiff blue grey mottled brown CLAY with some pockets and layers of orange brown clay/silt and occasional gravel. Gravel is fine to coarse sub-angular to sub-rounded. (Possible made ground). (MADE GROUND)
1.00	D	2		1.10	43.05		Stiff blue grey mottled brown CLAY with some pockets of orange brown CLAY and pockets of fine to medium sub-angular gravel. (DRIFT)
1.00	R	2					
1.00	X	2		1.60	42.55		Stiff blue grey CLAY with occasional pockets of yellow CLAY and rare shell fragments. (DRIFT)
2.00	D	3		2.10	42.05		Trialpit Complete at 2.10 m
2.00	R	3					
2.00	X	3					

Stability:

Remarks:



Project Name: Phase 2A Demolition Area	Co-ords: N - 167897.98 E - 468113.34	Ground Level 43.670mOD	Date: 14/07/2005
Project No. JER3058/P2A/L5	Weather: Sunny and warm		Scale 1:25
Location: AWE Burghfield	Equipment: JCB	Logged by: MN	
Client: AWE plc			

Samples & In Situ Testing				Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Ref	Results				
0.30	D	1		0.60	43.07		Brown slightly sandy gravelly CLAY with occasional rootlets. Gravel is medium to coarse of rounded flint with brick fragments and concrete. (MADE GROUND)  Metal rod at 0.20m. Road way is 0.20m thick.
0.30	R	1					
0.30	X	1					
1.00	D	2		1.20	42.47		Brown orange mottled CLAY with patches of iron staining and occasional wood fragments. (MADE GROUND)  Green slightly sandy CLAY with organic odour. (MADE GROUND)
1.00	R	2					
1.00	X	2					
2.00	D	3		2.00	41.67		Stiff brown grey and orange mottled CLAY with occasional pockets of orange sand and occasional white fine to medium sub-rounded gravels. (DRIFT)
2.00	R	3					
2.00	X	3					
Trialpit Complete at 2.00 m							

Stability: Stable

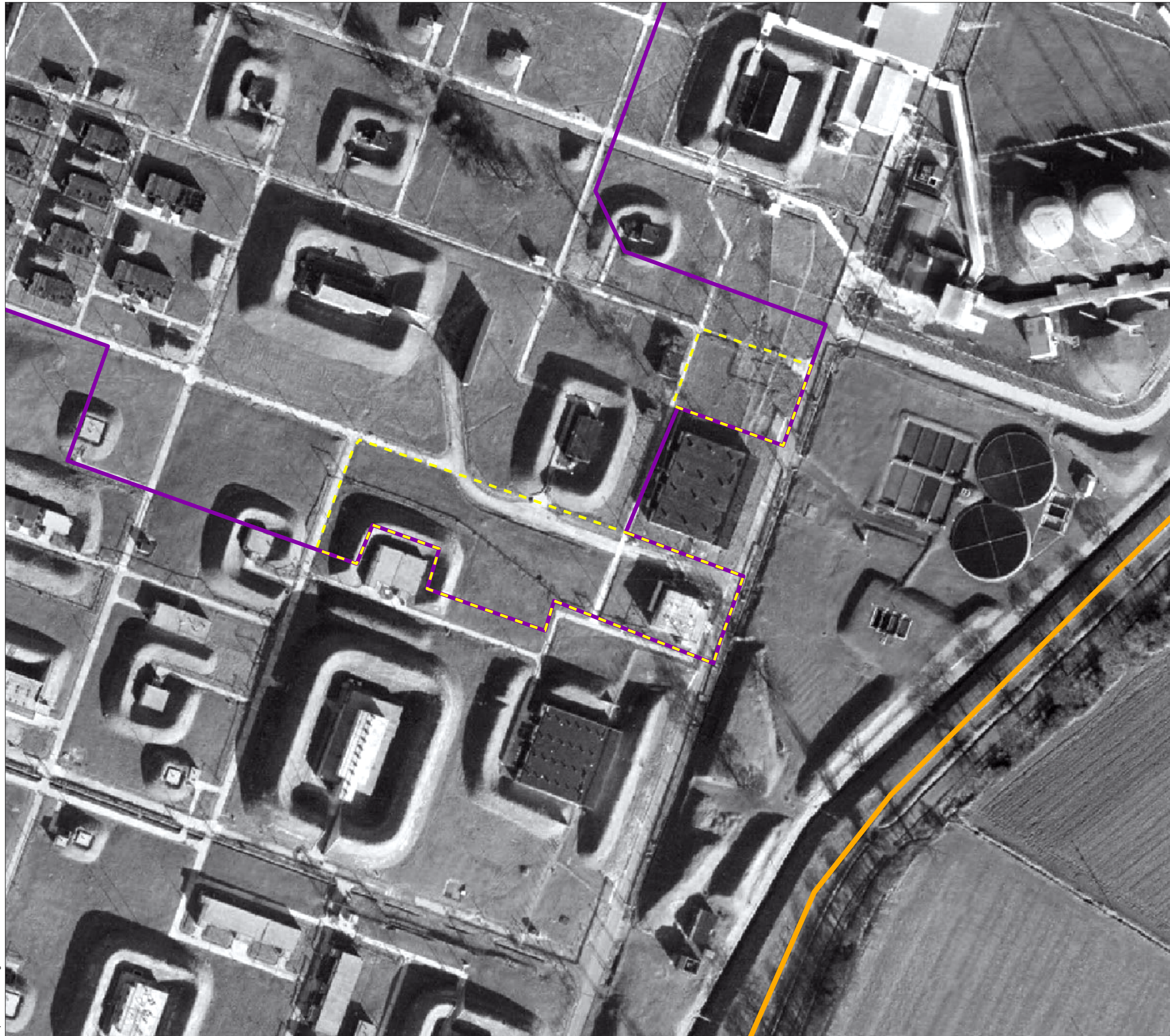
Remarks: Excavated adjacent to road way. Road build up is 0.20m thick. No groundwater encountered.



## **Appendix B**

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### **Historic Aerial Photographs**



### LEGEND

- AWE Burghfield Fence Line
- Mensa Application Area
- Buildings 8F2 & 8F3B  
(Investigation Area Extent)


Rev:	Date:	Amendment:	Name:	Checked:
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■ Data Source: RPS 2008

Status: PRELIMINARY

Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP  
 T 01235 838200 F 01235 820351 E rps@rpsgroup.com W www.rpsplc.co.uk

■ Client: AWE Plc

Project: Mensa Additional Ground Investigation

Title: Aerial Photograph - 1964

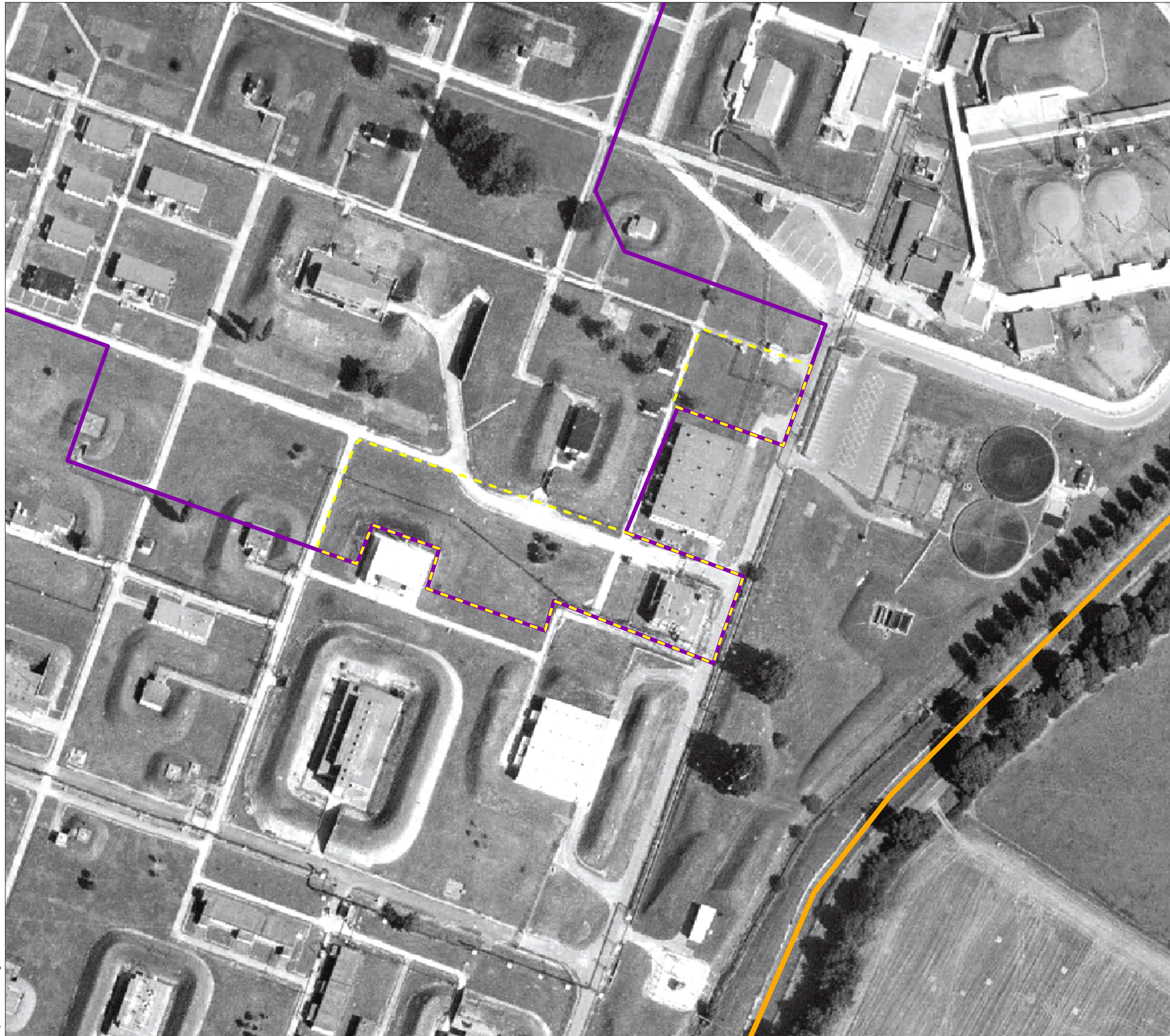
Scale: A3 @ 1:1,500

Date: 28/08/2008 Datum: OSGB36 Projection: BNG

Drawn: RJ Checked: SJ Job Ref: JER3996

■ Figure No: **JER3996-8F-1964** Revision: -

Project Ref: J:\Drawings\JER3996



### LEGEND

- AWE Burghfield Fence Line
- Mensa Application Area
- Buildings 8F2 & 8F3B  
(Investigation Area Extent)


Rev:	Date:	Amendment:	Name:	Checked:
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■ Data Source: RPS 2008  
 Status: PRELIMINARY



Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP  
 T 01235 838200 F 01235 820351 E rps@rpsgroup.com W www.rpsplc.co.uk

■ Client: AWE Plc  
 Project: Mensa Additional Ground Investigation

Title: Aerial Photograph - 1981

Scale: A3 @ 1:1,500  
 0 0.025 0.05km N

Date: 28/08/2008 Datum: OSGB36 Projection: BNG  
 Drawn: RJ Checked: SJ Job Ref: JER3996

■ Figure No: **JER3996-8F-1981** Revision: -

Project Ref: J:\Drawings\JER3996





### LEGEND

- AWE Burghfield Fence Line
- Mensa Application Area
- Buildings 8F2 & 8F3B  
(Investigation Area Extent)


Rev:	Date:	Amendment:	Name:	Checked:
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■ Data Source: RPS 2008  
 Status: PRELIMINARY

RPS

Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP  
 T 01235 838200 F 01235 820351 E rps@rpsgroup.com W www.rpsplc.co.uk

■ Client: AWE Plc  
 Project: Mensa Additional Ground Investigation

Title: Aerial Photograph - 1998

Scale: A3 @ 1:1,500  
 0 0.025 0.05km N

Date: 28/08/2008 Datum: OSGB36 Projection: BNG  
 Drawn: RJ Checked: SJ Job Ref: JER3996

■ Figure No: **JER3996-8F-1998** Revision: -

Project Ref: J:\Drawings\JER3996