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AWE Aldermaston HEFF Final



Defence Exempt
Environmental Appraisal
Volume II - Appendices
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Appendix A - Ground Conditions and Flood Risk Assessment

Environmental Appraisal
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Application No.
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DEVELOPMENT CONTROL

**Environmental Appraisal
Volume II**

1.0 INTRODUCTION

This document forms part of Appendix A to the HEFF Environmental Appraisal (EA), and contains additional information to support the Ground Conditions and Water Resources chapters of the EA Volume 1.

2.0 BACKGROUND INFORMATION

The Proposed Facility will be approximately 500 metres (m) from the eastern Site boundary of AWE Aldermaston, 700 m from the southern boundary and 850 m from the northern boundary.

Currently the Site is characterised by extensive grassed areas with patches of trees interspersed with a number of industrial buildings, roads and above ground services. No buildings will be demolished on the Site to accommodate the construction of the Proposed Facility.

The Proposed Facility consists of two buildings:

- HEFF Facility Building – a two-storey building with a mezzanine floor housing a plant room. The building is split into two distinct areas - the process block (measuring 61.3 m by 37.7 m), for explosives processing and an adjoining single storey support block (measuring 27.8 m by 24.6 m), which provides office space, control rooms, welfare and kitchen facilities, as well as stores and a workshop.
- HEFF Facility Mechanical and Electrical Services Compound - an external mechanical and electrical services building will be situated 40m from the main facility building measuring 26.5 m by 18.2 m. It will be of similar external appearance to the main facility and will house large items of equipment such as chillers, compressors and transformers, with a floor area of 482 m².

3.0 CONTAMINATED LAND BRIEFING NOTE

3.1 Town and Country Planning Acts

Land contamination is a material planning consideration within the planning regime. The Planning Authority has to consider the potential implications of contamination both when it is developing structure or local plans (or unitary development plans) and when it is considering individual applications for planning permission. Where contamination is suspected or known to exist on a site, a planning authority may require investigation before granting planning permission, or may include conditions in the permission requiring appropriate investigation and, if necessary, remediation. A further primary mechanism for contaminated land liability management is the Part IIa Contaminated Land regime described below.

3.2 Contaminated Land Regime

The Environment Act 1995 (Ref D-15) introduced a new Part IIa into the EPA 1990, which contains the legislative framework for the Contaminated Land regime. Under the regime, clean-up obligations are retrospective, i.e. liability can be incurred for actions occurring in the past. Local Authorities are the primary enforcing authority for determination of Contaminated Land, and the Environment Agency (EA) is the enforcing authority for any land designated as a 'Special Site' due to the nature of the contamination or that the site is already subject to EA regulation. As a nuclear site, AWE is designated as a 'Special Site'.

Part IIa of the Environmental Protection Act (EPA) 1990 (Ref. D-10) provides for remediation of contaminated land by service of a 'remediation notice' on persons who have caused or knowingly permitted the contaminating substances to be present. If no such person can be found, then a remediation notice can be served on the owner and/or occupier of the site.

The Government has issued statutory guidance on liability to respond to a remediation notice where several persons are all potentially liable. The intention is to apply a series of tests that may exclude one or more of the liable parties. The remainder will then all be liable, with the liability being apportioned between them in accordance with the rules indicated in the statutory guidance. The tests cannot be applied in a way that would exclude all members of the liability group. At least one party must be left with responsibility.

The Environment Act 1995 (Ref. D-15) introduced 'works notices'. Under these powers, the EA may serve a 'works notice' requiring appropriate remedial action, on anyone who caused or knowingly permitted any poisonous, noxious or polluting matter or any solid waste matter to be present at a place from which it is likely to enter any controlled waters, or to be actually present in any controlled waters.

There is potential liability under the Water Resources Act 1991 (Ref D-16) for any water pollution that is happening, or is threatened, as a result of existing contamination. However, subject to any contractual terms applying to a land acquisition, the 'works notice' powers may be exercised against some predecessor/or owner.

Under EPA Part II A (Ref. D-10), a purchaser of Contaminated Land will be potentially liable to deal with the historical contamination primarily as owner or occupier. The longer the time elapsed since the purchase, the more likely it is that the purchaser will become a "knowing permitter" and therefore liable in that capacity.

The implementation of the Contaminated Land regime means statutory nuisance provisions will no longer be applicable to "land in a contaminative state". The statutory nuisance provisions do not apply where Section 59 of the EPA 1990 (Ref. D-10) is applicable. Under Section 59, the occupier of land may be required to remove waste unlawfully deposited on it and to eliminate or reduce the consequences of the deposit. The occupier will escape liability if they can establish that they neither deposited nor knowingly caused or knowingly permitted the deposit - the burden of proof is therefore on the occupier. Where Section 59 applies, liability for contamination falls primarily on the causer. Where this does not apply subsequent "knowing permitters" and the current owner and/or occupier may also be held liable.

The Radioactive Substances Act 1960 (Ref. D-17), which has since been replaced by the Radioactive Substances Act 1993 (Ref. D-18), has meant that the use and disposal of radioactive substances has largely been controlled. Such activities with radioactive substances will be less likely to contaminate the land with radioactivity.

The Part II A Contaminated Land regime has recently been extended (in August 2006) to cover land contaminated by radioactive materials in England and Wales. This was done to put into place certain requirements of Directive 96/29/EURATOM (Ref. D-19) (referred to as the Basic Safety Standards Directive). The extended regime takes account of the special nature of radioactive contamination and the specific requirements of the Basic Safety Standards Directive.

The extension allows radioactive contaminated land to be identified and remediated. This is land that is causing harm or posing significant possibility of harm to human health as a result of radioactivity. 'Harm' relates to lasting exposure and the specific dose levels set out in the statutory guidance. It only applies in circumstances where the radioactivity is the result of a past practice or work activity, or the after-effects of a radiological emergency. This includes substances containing artificial radionuclides or processed natural radionuclides.

The extended regime (in England) does not apply to:

- Radioactivity on land causing significant harm to the wider environment or the pollution of controlled water. Controlled waters which act as a pathway for contaminants to reach human receptors has been included;

- Radon gas;
- Risks from changes in the way land contaminated with radioactivity is used. These risks are controlled under the Town and Country Planning system;
- Radioactivity on land within the boundary of a nuclear licensed site. **AWE Aldermaston is a Nuclear Licensed Site**; and
- The Nuclear Installations Inspectorate (NII) of the Health and Safety Executive (HSE) regulate nuclear licensed sites. They do this under the Nuclear Installations Act 1965 (NIA65) (Ref D-20), which allows them to control land contaminated with radioactivity via site licence conditions. Disposal of radioactive waste resulting from the management or remediation of land on nuclear sites contaminated with radioactivity is authorised under the RSA 1993 (Ref. D-18).

3.3 Assessment of Contaminated Land

Risks from land contamination have historically been addressed on a 'Suitable For Use' basis with most sites being assessed for their future use under the planning regime. With the introduction of the Contaminated Land Regime in 2000, an increased awareness by regulators and industry of the risks posed by historical land contamination has developed. In the context of Part IIa, action is necessary only where there are unacceptable risks to health or the environment, taking into account the current use of the land and its environmental setting.

Since the early days of Contaminated Land management, for example the ICRCL guidance (Inter-departmental Committee on the Redevelopment of Contaminated Land, UK – Department of Environment 1987) (Ref. D-21), Government has promoted a risk-based approach to the assessment and management of contaminated land. The National Society for Clean Air (NSCA) handbook (Ref D-22), states that the ICRCL 'approaches were insufficiently explicit about the derivation of guidance or the key elements of uncertainty encompassed in practice by 'professional judgement' and this led to a widespread misuse of early guidance as 'absolute standards' to be adhered to rather than adopted as useful guidelines to aid site assessments'.

The Contaminated Land regime has made more explicit the role of risk assessment in contaminated land decision-making. It establishes the role of the Conceptual Model through the source-pathway-receptor and significant pollutant linkages relationship. A tiered approach to risk assessment is used with defined stages and roles for risk screening, generic and detailed quantitative risk assessment as well as formalised options appraisal for risk management.

The main point of reference used for the assessment of soil and groundwater conditions are now defined by the Contaminated Land Report (CLR) series of documents as produced by the Department for Environment, Food and Rural Affairs (DEFRA) (Ref. D-11), as well as the EA R&D Report 20 (Publication 20 - the Methodology For The Derivation of Remedial Targets For Soil and Groundwater to Protect Water Resources - Marsland P A. & Carey M A 1999) (Ref. D-23a) and on buildings (EA, 2001) (Ref. D-23b). In addition, more general

guidance covers the development of soil and groundwater sampling strategies (EA, 2001) (Ref. D-24) and the communication of risk (SNIFFER, 1999) (Ref. D-25).

These supersede the historic Inter-departmental Committee for the Redevelopment of Contaminated Land (ICRCL) guidelines (Ref. D-21).

The CLR series of documents (Ref. D-11) are referred to the legislative regime in England, however similar arrangements apply in Scotland, Wales and Northern Ireland.

The CLR methodology (Ref. D-11) is solely related to the assessment of the suitability of the soil on a particular site for a particular use, ('Suitable For Use' approach), and do not incorporate evaluation of groundwater. The CLR methodology (Ref. D-11) has included the development and publication of Soil Guideline Values (SGVs). The primary purpose of the SGVs is to provide a set of "intervention values" for the more detailed assessment of human health risks in relation to land use. They are not binding standards, but are generic criteria intended to enable informed judgements about the requirement for action to mitigate against identified unacceptable risks.

SGVs are determined by the Government and based on the likely uptake of contaminants by various exposure routes to human receptors based on conceptual models for a particular land use and the toxicity of the determinand in question. Land use is assumed to fall into one of three categories:

- Residential with and without plant uptake;
- Allotments; and
- Commercial/industrial.

At present only limited toxicity data (and hence the standardised data for calculating SGVs) is available for selected determinands. It is intended that SGVs are calculated on a site-specific basis using the Contaminated Land Exposure Assessment Model (CLEA) as defined in the CLR reports (Ref. D-11). The SGVs are useful in the context of the planning regime and can be used to inform judgement about the need for action to ensure that a new use of land does not pose any unacceptable risks to the health of the intended users. They can also be used to inform the selection of remediation standards or target values of individual sites.

Where determinands exist that do not have SGVs calculated (or DEFRA toxicity data is not yet published), it is intended that alternative risk assessment packages be used to define acceptable exposure concentrations at the Site using site-specific criteria. However, it is intended that the toxicity evaluation be made using methodology consistent with that laid down in the CLR reports (Ref. D-11).

In the past, although they had no legal standing in the UK, the wide range of target and intervention values proposed under the Dutch clean up criteria (Ministry of Housing, Spatial Planning and the Environment guidelines (2000)) (Ref. D-26) for the evaluation of concentration levels of several determinands in soil and groundwaters) have been generally

accepted by UK regulators for guideline purposes. The use of Dutch values is still used in some circumstances as a screening tool however, the regulators now require a site-specific risk based assessment based on the UK regime to define remediation criteria.

For determinants where neither SGVs nor UK toxicological data exists, in accordance with CLR reports, alternative generic assessment criteria can be used. USEPA PRGs (Preliminary Remediation Goals) (Ref. D-27) can be utilised, which are risk based concentrations and are intended as initial screening levels, used for site screening and initial cleanup targets where applicable. PRGs are based on current human health toxicity values and standard exposure factors to estimate contaminant concentrations in soil, air and water that are considered (by the USEPA) to be protective of human health (including sensitive groups) over a lifetime. They are based on direct contact pathways (e.g. ingestion, inhalation and dermal contact) for specific land uses, and include both carcinogenic and non-carcinogenic substances.

In assessing whether pollution of controlled waters has occurred, or is likely to occur, it is common practice to compare against relevant water quality standards.

A number of water quality standards are available, but are typically based on the assumption of direct ingestion of affected waters by humans and aquatic organisms, which is not typically a key exposure pathway in the context of land contamination. Key exposure pathways in this context relates to the presence of contaminants in soils with exposure to humans via ingestion, inhalation or dermal contact. Water quality standards commonly used in the UK include:

- Environmental Quality Standard (EQS) for freshwater & saltwater as specified by the EC Dangerous Substances Directive, as stated in Ref. D-28;
- Water Supply (Water Quality) Regulations 2000 (Ref. D-29);
- EU Drinking Water Standards (98/83/EC) (Ref. D-30);
- World Health Organisation (WHO) Guidelines for Drinking Water Quality 1984 (Ref. D-31);
- The Surface Waters (Abstraction for Drinking Water)(Classification) Regulations 1996 (DWI) (Ref. D-32), and
- Ministry of Housing, Spatial Planning and the Environment guidelines (2000) for the evaluation of concentration levels of several pollutants in soil and groundwaters (Ref. D-26).

As no generic criteria are typically available for the UK for the screening of groundwater contamination, it is common practice to adopt one or more of the generic criteria defined by the documents above. Under Part II A, it is a requirement that an evaluation of possible Significant Pollutant Linkages is made with respect to a substances potential to cause pollution of controlled waters.

Planning and redevelopment of brownfield sites (historically contaminated sites) still represents the most cost-effective and beneficial way of dealing with such risks in the longer term. One of the likely benefits of Part II A is that its explicit approach to the assessment of

risks will raise the standards for such assessments under the planning regime, as its principles become more familiar among practitioners.

A description of the screening approach used for the data set evaluated as part of this EA can be found in Section 4.5.2.

4.0 CURRENT BASELINE

4.1 Introduction

The previous uses of the Proposed Facility and Construction Enclave have an important bearing on the potential for contamination. Details of the history of the Proposed Facility and Construction Enclave, and historical soil and groundwater chemical analysis results, have been drawn from previous reports and documents on the area.

4.2 Current Features of the Proposed HEFF Project Area and Surrounding Area

4.2.1 The Proposed HEFF Project Area

The Proposed Facility and the areas designated for 'Bulk Storage', 'Wheel Wash', 'Hardcore/Spoil' and 'Skip Storage' (i.e. the eastern part of the HEFF Construction Enclave) are located within B Area (the Explosives Area) of the AWE Aldermaston site. The area designated for 'contractors' temporary site accommodation' and Griffin Road (i.e. the western part of the HEFF Construction Enclave) are located outside of B Area, but within the AWE Aldermaston site boundary. The area of the proposed HEFF Construction Enclave is illustrated on Figure D-1.

The Proposed Facility is located in the area between buildings B2A3 (along Moyce Way) and the cluster of buildings lying to the north of B3A20 (note that B3A20 is contained within the 'red line boundary' of this planning application). The area of the Proposed Facility is relatively flat, gently undulating grassland with a number of young trees (mainly silver birch). Small areas of ponded water have been noted in low points during previous site visits, during periods of wet weather.

There is evidence of a possible old access road across the Proposed Facility area, aligned southeast-northwest from Silchester Way. The road is approximately 3 to 4 m wide and is raised (approximately 0.5 to 1 m) above the surrounding ground level. At the far north of the Proposed Facility area, small areas of tarmac hardsurfacing are present.

The area designated for 'Bulk Storage', 'Wheel Wash', 'Hardcore/Spoil' and 'Skip Storage' is currently a relatively flat area of grassland with a number of young trees. This area is also partially occupied by a services corridor (locally known as the Contractors' Corridor), bisecting B Area and linking the area of the Boiler House on Lakedale Road at the northeast of the site to the central area of site to the west. This corridor contains a number of underground and above ground services, including steam pipes, electricity cables, trade and foul drains, a water main, a gas main and site communications cables.

In addition to Griffin Road, Contractors' Road, and East Road, the area of the HEFF Construction Enclave outside of B Area is currently occupied by car parking space, small buildings, portacabins and shipping containers.

4.2.2 The Surrounding Area

The Proposed Facility area lies relatively central within B Area at AWE Aldermaston, therefore the surrounding area comprises similar features within the Explosives Area, as follows:

- North: explosives buildings clustered to the north and east of B3A19;
- East: Silchester Way, with above ground steam pipes following the route of the road;
- South: building B2A3 and Moyce Way; and
- West: The Contractor's Corridor area aligned northeast – southwest with above ground steam pipes to the west of the fence.

Topographically the area surrounding the Proposed Facility is relatively flat, gently undulating grassland.

The area designated for 'Bulk Storage', 'Wheel Wash', 'Hardcore/Spoil' and 'Skip Storage' is also within the Explosives Area of the AWE Aldermaston site and therefore the surrounding area comprises similar features to the Proposed Facility area, as follows:

- North: explosives buildings on Magazine Road and the reservoir compound (building F30.4) to the north west;
- East: the Contractor's Corridor leading to the Proposed Facility;
- West: Griffin Road and the central area of the AWE Aldermaston site comprising the Nuclear Storage and Processing Area (NSPA), also known as the 'Citadel'; and
- South: a cluster of explosives buildings off Moyce Way, the nearest being B2A4.

The portion of the HEFF Construction Enclave located outside the Explosives Area off Griffin Road, is surrounded by the following features:

- Northwest: the enclosed area of the Site Tip Compound;
- Northeast: Griffin Road then a cluster of explosives buildings within B Area, the nearest being B8C1;
- West: the NSPA; and
- South: the Radioactive Waste Treatment Plant (RAWTP), followed by the NSPA.

4.3 Environmental Setting

The near surface geology and hydrogeology on and around the Proposed Facility and HEFF Construction Enclave can bear a significant influence on the impact that any identified ground contamination can have on surface and groundwater receptors. This is because permeable strata such as sands and gravels represent pathways for contamination to migrate below ground level. Conversely, impermeable strata, such as clays, can inhibit the migration of contamination.

Similarly, the presence of watercourses on and around the proposed HEFF Project Area can exert a significant influence on the migration of any ground contamination present into sensitive surface water and groundwater receptors. This is because a watercourse can provide pathways for contamination to migrate.

A description of the geologic, hydrogeologic, and hydrologic environments on and around the proposed HEFF Project Area are therefore presented in the sections below.

4.3.1 Geology

The geological map for the area is the 1:50,000 sheet number 258 for Reading (Ref. D-33). The area is located towards the centre of a large plateau and the proposed HEFF Project Area is directly underlain by the Silchester Gravel. This formation is typically dense to very dense, orange-brown, sandy, clayey, fine to medium, angular to sub-rounded gravel (Ref. D-34).

The Silchester Gravel is overlain by a layer of Made Ground in the HEFF Project Area. Information in Ref. D-34 suggests the Made Ground is typically re-worked (and subsequently less compact) Silchester Gravel with the occasional Made Ground indicators such as fragments of concrete, tarmac, cable and ceramic.

The Silchester Gravel is underlain by the Bagshot Formation. This stratum comprises firm orange-brown, grading to grey and dark grey, sandy clay with layers of sand and silt. The interface between the Bagshot Formation and the underlying London Clay Formation is a gradational boundary and as such the exact position is difficult to determine (Ref. D-34). Hence, the on-Site name adopted for the Bagshot Formation is the Bagshot Beds/Transitional Zone.

The London Clay Formation is described as firm to stiff, grey brown clay and very dense slightly clayey sand. The base of the London Clay has not been proved in the proposed HEFF Project Area, but Ref. D-35 indicates that the London Clay Formation has a thickness of 55 to 100 m. The London Clay Formation is underlain by the Upper Chalk, which does not outcrop locally.

Table D-6 below summarises the geology for the proposed HEFF Project Area. This has been produced using data from the boreholes and trial pits that have been previously excavated in the area during previous ground investigations detailed in Section 4.4.1 below.

Table D-6: Geological Summary

Investigation		MG Thickness	Depth to SG Base/Top BB/TZ	SG Thickness	Depth to BB/TZ base/Top LC	BB/TZ Thickness
Atkins	Mean	0.48	4.30	3.65	13.40	9.10
	SD	0.12	-	-	-	-
Golder	Mean	0.64	3.99	3.35	11.83	7.68
	SD	0.35	0.69	0.68	1.88	2.12
FES 2003	Mean	0.27	4.54	4.27	13.36	8.79
	SD	0.28	0.37	0.41	0.21	0.48
FES 1994	Mean	1.50	7.30	5.80	-	-
	SD	-	-	-	-	-
Fugro (Gas Main)	Mean	0.55	4.20	3.20	-	-
	SD	0.29	-	-	-	-
Overall		0.50	4.42	3.90	12.85	8.44
		0.37	0.90	0.80	1.25	1.30

Notes:

Atkins: borehole ATK107 and trial pits TP101 to TP106.

Golder: boreholes BH0159, BH0159, BH0135, BH0477, BH0472, BH0473, BH0474, BH0507, BH0508, and BH0511.

FES 2003: boreholes HE1 to HE6 and HE3 to HE10 (HE7 and HE11 are Golder boreholes BH0513 and BH0413 respectively).

FES 1994: borehole BH25.

Fugro (Gas Main): borehole RIG385 and trial pits GM11 to GM14.

SD: Standard Deviation

MG: Made Ground

SG: Silchester Gravel

BB/TZ: Basaltic Brash/Transitional Zone

LC: London Clay

4.3.2 Hydrogeology

The Environment Agency Groundwater Vulnerability Map Number 38 (Ref. D-36) classifies the aquifer beneath the HEFF Project Area as a Minor Aquifer (variably permeable) overlain by soils of a high leaching potential. A Minor Aquifer is described as 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.

Beneath the Non-Aquifer of the London Clay Formation lies the Upper Chalk Major Aquifer. Any contaminants within the HEFF Construction Enclave area soil or shallow groundwater are unlikely to represent a significant risk to the Upper Chalk Major Aquifer, due to the thickness of the London Clay Formation (55 to 100 m).

Soils of high leaching potential are described as deep, permeable, coarse textured soils, which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential.

Figure D-3 shows groundwater elevation contours interpolated from groundwater level measurements in boreholes installed in the Silchester Gravels, taken in February 2007. On a regional scale, groundwater in the Silchester Gravels in the proposed Development Enclave appears to be generally flowing from a groundwater plateau in the central part of the

AWE Aldermaston Site towards the north and west. Figure D-3 also shows some localised variability in groundwater flow directions, particularly around Boreholes BH0513 and BH0335 in the Proposed Facility area, BH0501 in the NSPA, and BH325, BH326 and BH0392 in the reservoir compound (F30.4).

Figure D-4 shows groundwater elevation contours interpolated from groundwater level measurements in boreholes installed in the Bagshot Beds/Transitional Zone, taken in February 2007. Similarly to the Silchester Gravels, on a regional scale, groundwater in the Bagshot Beds/Transitional Zone in the HEFF Construction Enclave appears to be generally flowing from a groundwater plateau in the central part of the AWE Aldermaston site towards the north and northwest. Figure D-4 also shows some localised variability in groundwater flow direction around borehole EBH11A, off East Road.

Groundwater level is in the region of 0.98 m to 3.80 m below ground level (m bGL) in the Proposed Facility area.

The nearest groundwater abstraction to the proposed HEFF Construction Enclave is understood to be located within the Aldermaston Site at the small building (F30.5) adjacent to the reservoir, off Griffin Road. This is understood to comprise two boreholes installed to abstract groundwater from the Upper Chalk Aquifer. Due to the depth of these installations and the London Clay Formation aquitard, risk of any contamination from the area of the HEFF Construction Enclave is considered unlikely.

Further information relating to the proposed HEFF Construction Enclave hydrogeology can be found in Chapters 7 and 8.

4.3.3 Hydrology

No surface water courses are currently present within or in the immediate vicinity the proposed HEFF Construction Enclave. The nearest surface water bodies are North Ponds (approximately 280 m to the west of the area for the contractor's temporary site accommodation), Decoy Pond (approximately 330 m to the southeast of the Proposed Facility area), Stock Pond (approximately 480 m to the north of the Proposed Facility area) and Ladies Lake (approximately 480 m to the north of the area for bulk storage of materials and the wheel wash). Each of these water bodies are within the AWE Aldermaston site boundary.

Further information relating to the HEFF Construction Enclave hydrology can be found in Chapters 7 and 8.

4.4 Historical Land Uses

Information on the historical land use in the vicinity of the proposed HEFF facility area has been obtained from Reference 12.7, and is summarised below. It should be noted that no historical maps have been reviewed by Golder during the course of this EA.

The Ordnance Survey (OS) map of 1877 shows the Proposed Facility area to be located in a heavily wooded area within the Aldermaston Court Estate. The Proposed Facility area is to the east of the avenue to Aldermaston Court and south of a structure labelled 'Rifle Butts' and 'Target'. There is a possible small stream in the vicinity aligned northwest-southeast, towards Decoy Pond.

The 1900 OS map shows no change except the structures 'Rifle Butts' and 'Target' are no longer shown.

The OS maps from 1931 show no change to the area.

The Air Ministry drawing of 1945 shows that there is an old airfield roadway, connecting storage areas, aligned northeast-southwest at the northern end of the Proposed Facility area. This may be associated with the tarmac hardstanding observed in this area. Directly to the north of the Proposed Facility area is a structure labelled as 'HE FUZING POINT ULTRA HEAVY'. No further information was available regarding this structure.

The AWE drawing of 1975 shows no particular features in the area of the Proposed Facility. The road (Moyce Way) linking building H2A3 to Silchester Road is not shown on this drawing.

Ref D-8 shows the AWE designated 'no-dig' areas to be approximately 150 m to the north east of the Proposed Facility area. These are reported to be areas where items have been buried historically, the exact nature of which is uncertain.

4.5 Potential Sources of Contamination

4.5.1 Historical Investigations

Table D-7 below lists the historical site investigations that have been undertaken that include the Proposed Facility and HEFF Construction Enclave. Figure D-4 illustrates the exploratory hole locations and nomenclature referred to in both Chapters 7 and 8 and in this Technical Appendix for these locations.

From a land contamination perspective, SCRT 2 was the principal investigation for this area of AWE Aldermaston. Following a detailed desk study (Ref D-37), targeted boreholes and non-targeted boreholes (to fill in data and spatial gaps) were drilled across the remainder of the AWE Aldermaston site not assessed by the SCRT 1B Project including the HEFF Construction Enclave. The soil and groundwater data from this site investigation were assessed from a human health and groundwater perspective using a standard land contamination approach, where a quantitative Tier 2 Risk Assessment followed a qualitative Tier 1 Risk Assessment. The SCRT 2 land contamination investigation is documented in Ref D-37.

Table D-7: Historical Exploratory Investigations in the vicinity of the HEFF Construction Enclave

Report Title, Author, and Issue Date	Report Type	Purpose of Report	Study Area	Relevant Exploratory Location(s)		Total Relevant Exploratory Locations
				Within HEFF Boundary	Outside HEFF Boundary	
Hydrogeological Survey, Factual Report on-Site Investigation, Fugro Engineering Services (UK) Ltd, June 1995 (Ref. 7.14)	Borehole log only	Except for the borehole log for BH25, this report was not provided to Golder and its contents are not considered in this ES.	Unknown	Boreholes: BH25	N/A	1
SCRT B; Area 1: Investigation Report, AWE Aldermaston, Galke Associates (UK) Ltd, January 2002 (Ref. 7.15)	Factual and interpretative	Drilling of boreholes to determine soil and groundwater chemistry. Part of a site-wide targeted intrusive investigation. Tier 1 and Tier 2 Risk Assessment for groundwater and human health.	Area 1:	N/A	Boreholes: BH0120	1
SCRT B; Area 2: Investigation Report, AWE Aldermaston, Golder Associates (UK) Ltd, January 2002 (Ref. 7.16)	Interpretative		Area 2	N/A	Boreholes: BH0095-97, BH0181, BH0214	3
Hydrogeological Characterisation of AWE Aldermaston, Galke Associates (UK) Ltd, April 2002 (Ref. 7.17)	Factual and interpretative	Drilling of 41 boreholes to determine soil and groundwater chemistry. 11 rounds of groundwater sampling were undertaken on the 41 new and 16 existing boreholes. Interpretation of results and recommendations for further work	Entire AWE Site	Boreholes: BH0158, BH0159, EBH11, EBH1A, EBH19, ST15	Boreholes: BH0152-154, FBH10	10

Report Title, Author, and Issue Date	Report Type	Purpose of Report	Study Area	Relevant Exploratory Locations)		Total Relevant Exploratory Locations
				Within HEFF Boundary	Outside HEFF Boundary	
SCRT2: Exploratory Investigation Design Report, AWE Aldermaston, Golder Associates (UK) Ltd, May 2002 (Ref. 7-18)	Desk study	Desk study to collate information relating to historical and current processes and activities to identify potential or known sources of soil or groundwater contamination	B Area	N/A	N/A	0
Desk Study for Proposed New HE Laboratory, EDCG Consultants UK Ltd, December 2002 (Ref. 7-19)	Desk Study	Desk study of three locations at AWE(A) and one at AWE(B) to assess likely Ground Conditions and identify any features present that could affect construction of the new HE facility.	AWE(A) and AWE(B)	N/A	N/A	0
RAWTP Site 2 Aldermaston Foundation and Exploration Services, September 2002 (Ref. 7-20)	Factual	Exploratory investigation in the area of the Radioactive Waste Treatment plant (RAWTP).	RAWTP Site	N/A	Boreholes BH1-BH9	9
AWE Aldermaston New Gas Main Pipeline, Foundation and Exploration Services, August 2003 (Ref. 7-21)	Factual	Exploratory investigation in the area of the proposed new gas main pipeline	Route of new gas main through HEFT Construction Enclave	Boreholes: BHGM1A, BHGM2, BHGM4, Trial Pne GM11-15	Boreholes: BHGM1A, BHGM2, BHGM4, Trial Pne GM7-10	13

Report Title, Author, and Issue Date	Report Type	Purpose of Report	Study Area	Relevant Exploratory Location(s)		Total Relevant Exploratory Locations
				Within HEFF Boundary	Outside HEFF Boundary	
AWE Aldermaston Proposed New HE Laboratory, Factual Report on Ground Investigation for AWE Aldermaston Plc, Fugro Engineering Services (FES) Ltd, October 2003 (Ref. 7-22)	Factual	Drilling of cable boreholes to determine soil and groundwater chemistry and provide geotechnical information. Four rounds of groundwater sampling were undertaken.	HEFF Construction Enclosure	Boreholes: HE1-11 (HE7 and HE11 correspond to Golder SCRT2 boreholes BH0513 and BH0413, respectively)	N/A	11
SCRT2: Citadel South Area Exploratory Investigation Report AWE Aldermaston, Golder Associates (UK) Ltd, August 2005 (Ref. 7-23)	Factual and Interpretative		Citadel South	N/A	Boreholes: BH0504-0505	2
SCRT2: Citadel East Area Exploratory Investigation Report AWE Aldermaston, Golder Associates (UK) Ltd, September 2005 (Ref. 7-24)	Factual and Interpretative	Exploratory investigation. Drilling of boreholes to determine soil and groundwater chemistry. Three rounds of groundwater sampling were undertaken. Part of a site-wide targeted and non-targeted intrusive investigation. Tier 1 and Tier 2 Risk Assessment for groundwater and human health.	Citadel East	Boreholes: BH0324, BH0507	Boreholes: BH0421-424, BH0506	8
SCRT2: B Area North Exploratory Investigation Report AWE Aldermaston, Golder Associates (UK) Ltd, September 2005 (Ref. 7-25)	Factual and Interpretative		B Area	Boreholes: BH0508	Boreholes: BH0325-BH0326, BH0392-393, BH0395, BH0512	7
SCRT2: II Area South Exploratory Investigation Report AWE Aldermaston, Golder Associates (UK) Ltd, August 2005 (Ref 7-26)	Factual and Interpretative		B Area	Boreholes: BH0335, BH0411-413, BH0513	Boreholes: BH0327, BH0329, BH0336, BH0339, BH0345-346, BH0509	12

Report Title, Author, and Issue Date	Report Type	Purpose of Report	Study Area	Relevant Exploratory Location(s)		Total Relevant Exploratory Locations
				Within HEFF Boundary	Outside HEFF Boundary	
HEFF Additional Investigation at AWE Aldermaston, Golder Associates (UK) Ltd, October 2005 (Ref 7-27)	Factual	Provide supplementary information on Ground Conditions for the HEFF project by installation of one borehole, digging of eight surface scrapes, six trial pits and eight archaeological trenches.	HEFF Construction Enclave	Boreholes: ATK101, Surface Scrapes: SSI, SSJ-5, SSJ, SSB-10, Trial Pits: TP101-TP106	N/A	15
HEFF Geophysical Survey at AWE Aldermaston, Golder Associates (UK) Ltd, October 2005 (Ref 7-28)	Geophysical	Attempt to locate evidence of the Roman road suspected to run across the HEFF Project Area, and identify any other features of archaeological interest using an EM31 and GPR survey.	HEFF Construction Enclave	N/A	N/A	0
AWE High Explosives Fabrication Facility Geo-Environmental Interpretative Report, Taylor Woodrow and Atkins, October 2005 (Ref 7-29)	Factual	Identify constraints that may impact the HEFF project and provide geological interpretation and parameters for the design of the new building. Assessment of ground contamination and recommendations to deal with contamination by installation of one borehole and digging of six trial pits and eight surface scrapes.	HEFF Construction Enclave	Boreholes: ATK101, Surface Scrapes: SSI, SSJ-5, SSJ, SSB-10, Trial Pits: TP101-TP106	N/A	15

Report Title, Author, and Issue Date	Report Type	Purpose of Report	Study Area	Relevant Exploratory Locations(s)		Total Relevant Exploratory Locations
				Within HEFF Boundary	Outside HEFF Boundary	
Engineering Project HE Fabrication Facility Archaeological Desk-Based Assessment, AWE, October 2005 (Ref 7-30)	Desk Study	Desk study to evaluate whether any Listed Buildings, Scheduled Ancient Monuments (SAM), Conservation Areas, Historic Parks/Gardens or other designations relating to the historic use of the landscape will be affected by the HEFF project.	HEFF Construction Enclave	N/A	N/A	0
Archaeology Evaluation Report, Taylor Woodrow and Atkins Heritage, October 2005 (Ref 7-31)	Factual	Determine whether a Roman road lies within the HEFF Project Area by digging 5 archaeological trenches.	Exploratory investigation.	HEFF Construction Enclave	Archaeological Trenches: TR1, TR2, TR3, TR4, TR5, TR6, TR7 and TR8	N/A
Groundwater Sampling of Existing Boreholes, AWE Environmental Materials Analysis Group, August 2006 (Ref 7-32)	Factual	Groundwater monitoring. Six groundwater sampling rounds of five boreholes.	HEFF Construction Enclave	Boreholes: R474W (BHD158), R475W (BHD159), RU53W (EBH11A), R054W (EBH11)	Boreholes: R473W (BHD154)	5
SCRT3 Monitoring Data, ESIMS, Golder Associates (UK) Ltd, March 2003 to December 2006 (Ref 7-33)	Factual	Results of routine groundwater monitoring completed for SCRT3. Data obtained from the ESIMS database.	Area 2	Boreholes: ST15	Boreholes: ST6, ST14, ST16-17, BH1024, BH0126-1027	8
Clearance Survey Report, AWE Environmental Materials Analysis Group, January 2007 (Ref 7-34)	Factual	Collection and analysis of near surface soil samples from the proposed HEFF area primarily for alpha, beta, and tritium screening.	HEFF Construction Enclave	Surface Scraps: 56 locations (combined into 4 bulk samples)	N/A	56 (combined into 4 bulk samples)

Report Title, Author, and Issue Date	Report Type	Purpose of Report	Study Area	Relevant Exploratory Location(s)		Total Relevant Exploratory Locations
				Within HEFF Boundary	Outside HEFF Boundary	
HEFF Additional Site Investigation Results, Golder Associates (UK) Ltd. April 2007 (Ref. 7.35)	Factual	Additional exploratory investigation to address data gaps identified in the HEFF EIA existing ground conditions data set.	HEFF Construction Enclave	Boreholes: GABH1-4, GAGAS1-6, Trial pits: GATP1-8, Surface Scapes: GAS1-3	N/A	23

4.5.2 Tier 1 Screening Assessment

4.5.2.1 Requirement for Screening

The soil and groundwater data collected through the previous investigations listed in Table D-7 have been subjected to a Tier 1 Screening Assessment. The background to the criteria used in the assessment is provided in Section 3.0 of this Technical Appendix. The Tier 1 Screening Assessment has been undertaken, as some of the data for the HEFF Construction Enclave has not previously been assessed for its implications on groundwater and human health. Some of the data for the HEFF Construction Enclave has had the geoenvironmental risk quantitatively assessed (for example the SCRT 2 reports in Table D-7), whereas some soil and groundwater data was generated, for example, during archaeological work, and has not had the geoenvironmental risk quantitatively assessed.

All available soil and groundwater chemical analysis data for the HEFF Construction Enclave from the historical and recent site investigations and recent monitoring data have been collated and screened against recognised generic screening criteria in order to identify Areas of Potential Concern (APC) for the HEFF EA (see Table D-8 below). These Tier 1 Screening Values have been developed by Golder and AWE in the knowledge of the Environment Agency. The Tier 1 Screening Assessment has been undertaken with respect to both controlled waters and human health receptors as described below.

4.5.2.2 Human Health Screening Criteria and Assessment

Both soil and groundwater data has been screened for risks to human health. For soils, Golder has generated AWE Site-specific Soil Screening Values (SSV) using CLEA for all contaminants that have been identified within the soil at concentrations exceeding the laboratory method detection limit. The CLEA conceptual model used to generate the SSV is specific to the AWE Aldermaston site including the HEFF Construction Enclave. None of the determinants were identified at concentrations that exceeded the relevant SSV, and therefore no APC have been identified with respect to risks to human health from soil.

For groundwater, risks to human health can occur from vapours generating from determinants that have a Henry's Law constant greater than 10^3 atm-m³/mol. As such, initial APC have conservatively been identified where a determinant is present within the groundwater at concentrations that exceeded the laboratory method detection limit for that contaminant and the Henry's Law constant for that contaminant exceeded 10^5 atm-m³/mol.

For each Initial APC, reference has then been made to existing reports relevant to the HEFF Construction Enclave, as detailed in Table D-7, which contain Tier 2 Risk Screening and Assessment. Where quantitative Tier 2 screening has not been undertaken in previous reports for a particular initial APC, Golder has conducted qualitative Tier 2 screening taking

into account the type of contaminant, the concentration encountered, and other available screening criteria.

Initial APC that could not be screened out on the basis of this assessment have been carried forward to Chapter 7, where the significance of the identified potential source of contamination is discussed further.

4.5.2.3 Groundwater Screening Criteria and Assessment

Both soil and groundwater data has been screened for risks to groundwater. Groundwater results have been compared with the following recognised criteria in the following hierarchy:

- Environmental Quality Standards (EQS) Freshwater (EQS FW) - (Ref. D-28);
- European Drinking Water Standards (EUDWS) - (Ref. D-30);
- UK Drinking Water Standards (UK DWs) - (Ref. D-29);
- World Health Organisation (WHO) (Health) - (Ref. D-31); and
- USEPA PRG (tap water) - (Ref. D-27).

Groundwater at the AWE Aldermaston site is understood to discharge to springs and local off-Site water courses and therefore EQS FW are identified as the primary criteria for the assessment of groundwater results.

Initial APC with respect to controlled waters (groundwater and surface water) have been identified where groundwater concentrations within the HEFF Construction Enclave exceed the water quality screening criteria documented above. Initial APC with respect to soil impacts have been identified where exceedences of background soil concentrations and leachability criteria exist for metals, and where exceedences of the laboratory method detection limit and leachability criteria exist for organic and inorganic determinands. For each Initial APC, reference has then been made to the relevant reports, which contain quantitative Tier 2 screening assessments.

Where quantitative Tier 2 screening has not been undertaken in previous reports for a particular initial APC, Golder has conducted qualitative Tier 2 screening taking into account the type of contaminant, the concentration encountered, other available screening criteria, and the concentration of the contaminant within other media (e.g. for risks to groundwater from soil contamination, the concentration encountered in groundwater at a particular location or the results of leachate testing on samples containing similar contaminant concentrations have been considered).

Initial APC that could not be screened out on the basis of this assessment have been carried forward to Chapter 7, where the significance of the identified potential source of contamination is discussed further.

4.5.3 Areas of Potential Concern

Tables D-8a to D-8d below list the initial Areas of Potential Concern (APC) with respect to land and groundwater contamination that have been identified within the HEFF Construction Enclave. Table D-8 also summarises the qualitative Tier 2 screening that has been conducted where a particular APC has not been previously subjected to quantitative Tier 2 screening.

Table D-8a: Areas of Potential Concern – Risks to Human Health from Soil Contamination

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
1	Asbestos Chrysotile (white asbestos) was identified in two locations beneath the [HFR] Construction Enclosure (GATP2, TP[0]). Additional soil samples collected in the general area of these two trial pits, and across the HFR Construction Enclosure, did not contain asbestos fibres.	GATP2 TP[0]	Ref. 7-35 Ref. 7-29	Fibres Detected Fibres Detected	0.25-0.3 0.3-0.4 0.4	-
2	Carbon Dioxide Gas monitoring undertaken in borehole GABH2 identified methane concentrations exceeding the CIRIA trigger level of 5% v/v on one occasion from four monitoring events. GABH2 is not located near current or proposed future buildings.	GABH2 (Round 4)	Ref. 7-3	5.1% v/v	-	-
3	Oxygen Gas monitoring identified oxygen concentrations less than the CIRIA trigger level of 18% v/v. The identified oxygen concentrations could only present a potential issue in confined, below ground spaces, such as basements or excavations.	GAGASI (Round 2) GAGASI (Round 3) GAGAS6 (Round 3) GAGAS6 (Round 4) GAGAS6 (Round 3) GAGAS6 (Round 4) GABH1 (Round 3) GABH1 (Round 4) GABH2 (Round 2) GABH2 (Round 3) GABH2 (Round 4)	Ref. 7-35 Ref. 7-35	17.8% v/v 17.8% v/v 15.4% v/v 15.6% v/v 17.4% v/v 15.7% v/v - - - - - - - - - - - - - - - - -	- - - - - - - - - - - - - - - - - -	-

Table D-8b: Areas of Potential Concern – Risks to Groundwater from Soil Contamination

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
1	Antimony No background concentration exists for antimony in soils. Antimony concentrations were detected at the detection limit (1 mg/kg) in three samples. It is considered unlikely that antimony would pose a significant risk to groundwater quality at the concentrations measured. Antimony is not considered to be a contaminant of concern.	Red Area Green Area Blue Area	Ref 7-34 Ref 7-34 Ref 7-34	1 mg/kg 1 mg/kg 1 mg/kg	GL GL GL	-
2	Arsenic Arsenic marginally exceeded background concentrations (12 mg/kg) in two locations (TP105 and BHGM3). No leachate or groundwater analyses were completed on soil or water samples from TP105. Water samples collected from BHGM3 identified concentrations of arsenic of 5 ug/l, which is significantly below the WQS of 50 ug/l. Arsenic at similar concentrations has not been identified as a concern in the SCRT 2 Project following quantitative risk assessment. It is considered unlikely that the presence of arsenic in soil at the concentrations encountered would pose a significant risk to groundwater quality. Arsenic is not considered to be a contaminant of concern.	BHGM3 TP105	Ref 7-21 Ref 7-29	17 mg/kg 15 mg/kg	0.2 2.25	1

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sampler (m)
3	Barium No background concentration exists for barium. Barium concentrations marginally exceeded the detection limit in seventeen samples from GABH2, GABH3, GABH4, GASS1, GASS3, and GATP5, 6, 7, and 8. Barium did not exceed the WQS in any sample where groundwater samples were analysed (GABH2, 3, and 4). In addition, leachate testing undertaken on soil samples did not exceed the WQS. The concentrations encountered are considered to represent background concentrations. It is considered unlikely that barium would pose a significant risk to groundwater quality at the concentrations encountered. Barium is not considered to be a contaminant of concern.	GABH2 GABH2 GABH2 GABH3 GABH3 GABH4 GABH4 GABH4 GABH4 GASS1 GASS1 GASS3 GATP5 GATP5 GATP5 GATP6 GATP6 GATP7 GATP7 GATP8 GATP8 GATP8	Ref 7-15 Ref 7-15 Ref 7-15 Ref 7-15 Ref 7-15 Ref 7-15 Ref 7-15 Ref 7-15 Ref 7-15 Ref 7-29 Ref 7-29 Ref 7-29 Ref 7-35 Ref 7-35	40 mg/kg 22 mg/kg 25 mg/kg 35 mg/kg 32 mg/kg 38 mg/kg 29 mg/kg 53 mg/kg 44 mg/kg 37 mg/kg 29 mg/kg 39 mg/kg 1.8 mg/kg 25 mg/kg 31 mg/kg 52 mg/kg 22 mg/kg 0.8 mg/kg 1.0 mg/kg 0.5 mg/kg 0.4 mg/kg 0.7 mg/kg 0.5 mg/kg 0.5 mg/kg 0.6 mg/kg 0.6 mg/kg 0.7 mg/kg	0.0-0.1 2.0-2.2 5.0-5.1 5.0-5.1 1.0-1.1 3.0-3.1 3.0-3.1 1.0-1.1 4.0-4.1 0.03-0.05 0.04-0.05 0.95-1.05 2.9-3.0 2.9-3.0 2.9-3.0 2.9-3.0 2.9-3.0 2.9-3.0 2.9-3.0 2.9-3.0 3.0-3.1 4.0-4.1 -	2.0-2.2 5.0-5.1 3.0-3.1 -
4	Beryllium No background concentration exists for beryllium. Beryllium concentrations exceeded the detection limit in ten samples analysed. Maximum concentrations were encountered in GABH4 at a concentration of 1 mg/kg. Leachate testing conducted on soil samples did not identify beryllium concentrations exceeding the detection limit. In addition, groundwater samples from GABH3 and GABH4 did not contain detectable concentrations of beryllium. The concentrations encountered are considered to represent background concentrations. It is considered unlikely that beryllium would pose a significant risk to groundwater quality at the concentrations encountered. Beryllium is not considered to be a contaminant of concern.	GABH3 GABH4 GASS1 GATP5 GATP5 GATP6 GATP6 GATP7 GATP7 GATP8 GATP8 GATP8	Ref 7-35 Ref 7-35 Ref 7-29 Ref 7-35 Ref 7-35 Ref 7-35 Ref 7-35 Ref 7-35 Ref 7-35 Ref 7-35 Ref 7-35 Ref 7-35	0.8 mg/kg 1.0 mg/kg 0.5 mg/kg 0.4 mg/kg 0.7 mg/kg 0.5 mg/kg 0.5 mg/kg 0.6 mg/kg 0.6 mg/kg 0.7 mg/kg	3.0-3.1 4.0-4.1 0.03-0.05 0.95-1.05 2.9-3.0 2.9-3.0 2.9-3.0 2.9-3.0 2.9-3.0 2.9-3.0	-

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
5	Boron	BI0324	Ref. 7-24	3 mg/kg	0.3	-
	No background concentration exists for boron. Boron concentrations marginally exceeded the detection limit in thirty-one samples analysed from boreholes HE1, HE4, HE5, HE8, BI0324, BI0513, BI0413, BHGM3, SS1, SS5, SS7, SS8, SS9, SS10, TP101, TP102, TP103, TP104, TP105, TP106, GM11-4, and EMAG Arens Red, Yellow, Green and Blue. The maximum boron concentration encountered was 3 mg/kg (BI0324).	BI0413	Ref. 7-26	1 mg/kg	GL	4
	Water samples collected from HE4, BI0513, and BHGM3 and leachate samples from TP103 did not identify boron at concentrations exceeding 32 ug/l, which is significantly below the WQS of 2,000 ug/l. Water or leachate analyses were not completed at any of the other locations.	BHGM3	Ref. 7-26	1 mg/kg	5	-
	Is considered unlikely that the presence of boron in soil at the concentrations encountered would pose a significant risk to groundwater quality.	Blue Area	Ref. 7-21	1 mg/kg	1	-
	Boron is not considered to be a contaminant of concern.	GM11	Ref. 7-34	0.82 mg/kg	GL	-
		GM12	Ref. 7-21	0.51 mg/kg	0.1	-
		GM13	Ref. 7-21	0.19 mg/kg	0.1	-
		GM14	Ref. 7-21	0.27 mg/kg	0.1	-
		Green Area	Ref. 7-21	0.15 mg/kg	0.1	-
		HE3	Ref. 7-21	2 mg/kg	GL	-
		HE3	Ref. 7-22	1 mg/kg	0.5	2
		HE3	Ref. 7-22	1 mg/kg	2	-
		HE4	Ref. 7-12	2 mg/kg	GL	5
		HE5	Ref. 7-12	1 mg/kg	1	4
		HE8	Ref. 7-22	2 mg/kg	GL	0.5
		Red Area	Ref. 7-11	2 mg/kg	GL	-
		SS1	Ref. 7-29	1.5 mg/kg	6.2	-
		SS10	Ref. 7-29	0.68 mg/kg	0.2	-
		SS3	Ref. 7-29	0.34 mg/kg	0.3	-
		SS5	Ref. 7-29	0.64 mg/kg	0.2	-
		SS7	Ref. 7-19	0.86 mg/kg	0.4	-
		SS8	Ref. 7-29	0.57 mg/kg	0.2	-
		SS9	Ref. 7-29	0.99 mg/kg	0.2	-
		TP101	Ref. 7-29	0.67 mg/kg	0.4	2.2
		TP103	Ref. 7-29	0.41 mg/kg	0.2	0.4
		TP104	Ref. 7-29	0.37 mg/kg	2.4	0
		TP105	Ref. 7-29	0.6 mg/kg	1.4	2.25
		TP105	Ref. 7-29	0.72 mg/kg	2.25	-
		TP106	Ref. 7-29	1 mg/kg	0.1	0.5
		Yellow Area	Ref. 7-21	0.87 mg/kg	0.5	2.1
				2 mg/l g	GL	-

APC	Summary	Location	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
6	Copper Twenty-five samples exceeded the background concentration of 9 mg/kg. The maximum concentration of 540 mg/kg was encountered in TP101.	BH0335 BH0413 BH0413 BH0513 BH0513 BHGM3 BHGM3 Blue Area GABH2 GAHH2 GABH3 GATP5 GATP7 GATP8 GM12 GM13 GM14 HE1 HE10 HE6 HE8 Red Area SS8 TP101 TP101 TP105 TP105	Ref. 7-26; Ref. 7-22; Ref. 7-22; Ref. 7-22; Ref. 7-22; Ref. 7-21; Ref. 7-21; Ref. 7-34; Ref. 7-35; Ref. 7-35; Ref. 7-35; Ref. 7-35; Ref. 7-35; Ref. 7-35; Ref. 7-21; Ref. 7-21; Ref. 7-21; Ref. 7-21; Ref. 7-21; Ref. 7-34; Ref. 7-29; Ref. 7-29; Ref. 7-29; Ref. 7-29;	77 mg/kg; 11 mg/kg; 10 mg/kg; 76 ug/l; 19 mg/kg; 10 mg/kg; 13 mg/kg; 11 mg/kg; 13 mg/kg; 11 mg/kg; 15 mg/kg; 13 mg/kg; 17 mg/kg; 12 mg/kg; 12 mg/kg; 12 mg/kg; 11 mg/kg; 12 mg/kg; 12 mg/kg; 15 mg/kg; 11 mg/kg; 15 mg/kg;	GL; 4; GL; -; 0.2; -; -; -; 2.0-2.1; 5.0-5.1; 1.0-1.1; 0.95-1.05; 2.9-3.0; 0.95-1.05; 0.1; 0.1; 0.1; 5; -; -; -; -; -; -; -; -; -;
	Groundwater samples collected from BH0335 identified copper concentrations of between 1 and 8 ug/l. Groundwater samples from BHGM3 identified copper concentrations of 11 ug/l. No water copper analysis has been completed on samples from the other boreholes. However, copper soil concentrations have previously been identified as being a potential concern in relation to risks to groundwater [11] reports produced for the SCRT2 Project. The potential liability of copper soil contamination with respect to groundwater is being managed under the SCRT2 Project through ongoing (long-term) groundwater monitoring.				
	A soil sample collected from below the water table in BH0513 for leachate testing identified concentrations of 76 ug/l, which exceeds the WQS of 28 ug/l. However, further assessment for the SCRT 2 Project did not identify this to be an issue with respect to groundwater.				
	Copper in soil is considered to be a contaminant of concern, however, the potential risk to groundwater is being managed by AWE through a watching brief of groundwater monitoring.				

APC	Summary	Location	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
7	Cyanide No background concentration exists for cyanide. One sample exceeded the detection limit, with a concentration of 3.7 mg/kg (GM14).	GM14	Ref. 7.21 3.7 mg/kg	0.1	-
	Cyanide has not previously been assessed through quantitative risk assessment; however, it is considered unlikely that the presence of cyanide in soil at the location and concentration encountered would pose a significant risk to groundwater quality.				
8	Diesel Range Organics (DRO) and Mineral Oil (MO) No background concentration exists for DRO or Mineral Oil. These species exceeded the detection limit in a number of samples. Maximum concentrations were DRO 35 mg/kg (BH0513) and MO 232 mg/kg (HE8). Only maximum concentrations are shown in the columns to the right.	BH0513 HE8	Ref. 7.22 Ref. 7.22 3.5 mg/kg 23.2 mg/kg	GL 0.6-0.7 0.5	0.8-2.2
	The Taylor Woodrow report noted that no visual or olfactory evidence of contamination was noted during the excavation of borehole HE8, and attributed the concentrations encountered to the medium sampled (topsoil).				
	The analyses are bulk parameters, not specific contaminants of concern, and are therefore not considered to be a concern for groundwater. Reference should be made to APC 21 to APC 24 for details of detailed hydrocarbon analyses.				
9	Di-sec-octyl-phthalate No background concentration exists for di-sec-octyl-phthalate in soil. Samples from BH0335 contained concentrations of di-sec-octyl-phthalate up to 393 ug/kg.	BH0335	Ref. 7.26 Ref. 7.26 289 ug/kg 393 ug/kg	GL 0.8-1.2	0.8-1.2
	Di-sec-octyl-phthalate in soil has previously been assessed for risks to groundwater as part of the SCRT2 Project using the surrogate compound bis(2-ethylhexyl)phthalate and was not found to be a concern in groundwater.				
	Di-sec-octyl-phthalate is not considered to be a contaminant of concern.				

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
14	<p>Polyyclic Aromatic Hydrocarbons (PAH)</p> <p>No background criteria exists for speciated PAH in soil. Most samples analyzed contained one or more speciated PAH concentration that exceeded the detection limit although only low concentrations were encountered. Details of the maximum concentration identified for each PAH species are provided below. No water samples from HE6, HE8, or BHGM3 have been analyzed for speciated PAH. Routine monitoring conducted in BH0413 during 2006 did not identify any PAH species at concentrations exceeding the method detection limit (<10 ng/l).</p> <p>PAH soil concentrations have previously been identified as being of potential concern in relation to risks to groundwater if reports produced for the SCRT2 Project. The potential liability of PAH soil contamination with respect to groundwater is being managed under the SCRT2 Project through on-going long-term groundwater monitoring.</p> <p>Acenaphthene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP8)</p> <p>Acenaphthylene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP6, GATP7, GATP8)</p> <p>Anthracene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH4, GABH2, GATP5, GATP7, GATP8)</p> <p>Benzofluoranthene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8)</p> <p>Benzo(a)pyrene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8)</p> <p>Benzo(b)fluoranthene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8)</p>	BH0413 HE8 BHGM3 Green Area Green Area Green Area	Ref. 7-22 Ref. 7-22 Ref. 7-22 Ref. 7-34 Ref. 7-34	1.615 mg/kg 0.261 mg/g 1.6 mg/kg 7.4 mg/kg 5.7 mg/kg 5.3 mg/kg	GL GL GL GL GL GL	4.0 0.5 0.1 0.2 - -

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
	Benzofluoranthene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8)	Green Area	Ref. 7-34	9.5 mg/kg	GL	-
	Benzofluoranthene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP7, GATP8)	Green Area	Ref. 7-34	5.3 mg/kg	GL	-
	Chrysene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP7, GATP8)	Green Area	Ref. 7-34	6.7 mg/kg	GL	-
	Dibenzofluoranthene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8)	Green Area	Ref. 7-34	1.2 mg/kg	GL	-
	Fluoranthene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP7, GATP8)	Green Area	Ref. 7-34	8.9 mg/kg	GL	-
	Fluorene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP6, GATP7, GATP8)	BH0413	Ref. 7-22	1.151 mg/kg	GL	4.0
	Indeno[1,2,3-cd]perylene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8)	Green Area	Ref. 7-34	5.6 mg/kg	GL	-
	Naphthalene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP6, GATP7, GATP8)	HE8	Ref. 7-22	3.742 mg/kg	GL	0.5
	Phenanthrene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP6, GATP7, GATP8)	BHGM3	Ref. 7-21	5 mg/kg	0.1	0.2
	Pyrene (exceeded the detection limit in HE8, BH0413, BHGM3, HE6, TPGM14, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP7, GATP8)	BHGM3	Ref. 7-21	8.3 mg/kg	0.1	0.2

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
15	pH	BH0324	Ref. 7-24	9.06 pH units	0.3	1.1
	pH is outside the range normally encountered in natural soils in a number of samples.	BH0324	Ref. 7-24	5.16 pH units	1.1	-
	pH is a general quality indicator and does not represent a contaminant or concern for groundwater quality.	BH0335	Ref. 7-26	5.39 pH units	GL	0.8-1.2
		BH0335	Ref. 7-26	5.25 pH units	0.8-1.2	-
		BH0411	Ref. 7-26	5.1 pH units	2.0	-
		D110412	Ref. 7-26	5.83 pH units	0.0-0.1	1.5-1.7
		D110412	Ref. 7-26	4.7 pH units	1.5-1.7	-
		BH0413	Ref. 7-26	4.64 pH units	1.55	3.0
		BH0413	Ref. 7-26	5.3 pH units	3.0	4.0
		BH0507	Ref. 7-24	4.76 pH units	0.35-0.7	2.0
		D110507	Ref. 7-24	5.32 pH units	2.0	-
		BH10513	Ref. 7-22	4.26 pH units	5.0	-
		BH10513	Ref. 7-22	4.98 pH units	4.2	5.0
		BH0413	Ref. 7-12	5.33 pH units	4.0	-
		BH0413	Ref. 7-12	5.57 pH units	GL	1.55
		IE1	Ref. 7-12	5.54 pH units	1.0	5.0
		IE1	Ref. 7-12	4.55 pH units	5.0	-
		IE10	Ref. 7-12	5.11 pH units	1.0	3.0
		IE10	Ref. 7-12	5.87 pH units	3.0	-
		IE12	Ref. 7-12	5.13 pH units	GL	3.0
		IE12	Ref. 7-12	5.45 pH units	3.0	-
		IE12	Ref. 7-12	5.74 pH units	0.5	2.0
		IE13	Ref. 7-12	4.78 pH units	2.0	-
		IE13	Ref. 7-22	4.6 pH units	GL	5.0
		IE4	Ref. 7-22	5.64 pH units	5.0	-
		IE4	Ref. 7-22	5.69 pH units	1.0	4.0
		IE5	Ref. 7-22	9.24 pH units	0.0	-
		IE6	Ref. 7-22	5.25 pH units	2.0	5.0
		IE9	Ref. 7-22	5.64 pH units	5.0	-
		IE9	Ref. 7-22	4.9 pH units	0.2	-
		SS10	Ref. 7-29	4.5 pH units	0.2	-
		SS5	Ref. 7-29	4.5 pH units	0.2	-
		SS7	Ref. 7-29	4.5 pH units	0.4	-
		SS8	Ref. 7-29	4.7 pH units	0.2	-
		TP10	Ref. 7-29	5.6 pH units	2.2	-

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
19	Solvent Extractable Matter (SEM) SEM exceeds 2,000 mg/kg (indicative of non-natural conditions) in one location (HF8). The Taylor Woodrow report noted that no visual or olfactory evidence of contamination was noted during the Site works, and attributed the concentrations encountered to the medium sampled (topsoil).	HF8	Ref 7-22	1,510 mg/kg	GL	0.5
20	Thiocyanate No background concentration exists for thiocyanate in soil. Four samples contained concentrations of thiocyanate that exceeded the detection limit. The maximum concentration encountered was 3 mg/kg (HF8). Thiocyanate has not previously been assessed through quantitative risk assessment; however, it is considered unlikely that the presence of thiocyanate in soil at the locations and concentrations encountered would pose a significant risk to groundwater quality.	B10413 HF4 HF8 HF6	Ref 7-22 Ref 7-22 Ref 7-22 Ref 7-22	2 mg/kg 1 mg/kg 3 mg/kg 1 mg/kg	GL GL GL 0.05	0.35-0.45 5 0.5 0.6
21	Total Hydrocarbons C10-C12 See comments for Total TPH at APC 24 for further discussion of banded TPH analysis.	Blue Area Green Area Red Area Yellow Area	Ref 7-34 Ref 7-34 Ref 7-34 Ref 7-34	3 mg/kg 3 mg/kg 2 mg/kg 3 mg/kg	GL GL GL GL	-
22	Total Hydrocarbons C12-C16 See comments for Total TPH at APC 24 for further discussion of banded TPH analysis.	Blue Area GATPH Green Area Red Area Yellow Area	Ref 7-34 Ref 7-35 Ref 7-34 Ref 7-34 Ref 7-34	10 mg/kg 23 mg/kg 5 mg/kg 4 mg/kg 3 mg/kg	GL GL GL GL GL	-

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
23	Total Hydrocarbons C16-C21 See comments for Total TPH at APC 24 for further discussion of banded TPH analysis.	Blue Area GATP8 Green Area Red Area Yellow Area	Ref. 7-14 Ref. 7-35 Ref. 7-14 Ref. 7-34 Ref. 7-34 Ref. 7-34	4.3 mg/kg 2-140 mg/kg 9 mg/kg 10 mg/kg 6 mg/kg	GL 0.02-0.3 GL GL GL	-
24	Total Hydrocarbons C21-C35 No background concentration exists for TPH or banded TPH in soil. TPH concentrations were a maximum of 750 mg/kg in a sample from GATP8. The concentrations of TPH encountered in soil in all locations except GATP8 are considered low and unlikely to pose a significant risk to groundwater. The TPH encountered in the sample from GATP8 comprises generally aromatic compounds in the range C21-C35, which is likely to be representative of the presence of PAH. See APC 14 for details relating to the management of PAH in soil.	Blue Area GABH2 GABH3 GATP6 GATP8 Green Area Red Area Yellow Area	Ref. 7-34 Ref. 7-35 Ref. 7-35 Ref. 7-35 Ref. 7-35 Ref. 7-34 Ref. 7-34 Ref. 7-34	130 mg/kg 2.3 mg/kg 0.49 mg/kg 4.4 mg/kg 9.2-580 mg/kg 34 mg/kg 47 mg/kg 42 mg/kg	GL 1.0-1.1 1.0-1.1 0.95-1.05 0.02-0.3 GL GL GL	-
25	Total Non-Volatile Aromatics (TNVA) and Total Polycyclic Aromatic Hydrocarbons (PAH) No background concentrations exist for TNVA and PAH. TNVA and PAH concentrations were greater than the detection limit in various samples. Maximum concentrations are shown to the right. In addition, one sample of leachate from GABH1 exceeded the WQS of 0.1 ug/l.	DHT0411 H138 GABH1	Ref. 7-26 Ref. 7-22 Ref. 7-35	125 mg/kg (TNVA) 306 mg/kg (PAH) 0.3 ug/l (PAH)	GL GL 1.0-1.2	-

PAH soil concentrators were identified as being of potential concern within the SCRT 2 Project. However, it should be noted that PAH did not exceed the relevant WQS in groundwater in the HEFF Project Area. The potential liability of PAH soil concentrations with respect to groundwater is addressed and managed under the SCRT 2 Project through on-going (long-term) groundwater monitoring. See APC 14 for details relating to the management of PAH in soil.

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
26	Total Sulphate and Total Sulphur No background concentration exists for total sulphate or total sulphur in soil. Maximum concentrations encountered were sulphate 1,885 mg/kg (HE8) and sulphur 0.51% (BH0513).	HE8 BH0513	Ref. 7-22 Ref. 7-22	1,885 mg/kg 0.51%	GL 5	0.5
27	Sulphate and sulphur are not considered to be contaminants of concern for groundwater.	GABH2 GABE2 GABH2 GABH3 GABH3 GABH4 GABE4 GASS1 GASS3 GATP5 GATP5 GATP6 GATP6 GATP7 GATP7 GATP8 GATP8	Ref. 7-35 Ref. 7-35	36 mg/kg 22 mg/kg 29 mg/kg 49 mg/kg 1.5 mg/kg 38 mg/kg 3.6 mg/kg 41 mg/kg 34 mg/kg 44 mg/kg 39 mg/kg 53 mg/kg 20 mg/kg 37 mg/kg 38 mg/kg 50 mg/kg 25 mg/kg	0.0-0.1 2.0-2.1 5.0-5.1 1.0-1.1 3.0-3.1 1.0-1.1 4.0-4.1 0.0-0.05 0.03-0.05 0.95-1.05 2.9-3.0 0.95-1.05 2.9-3.0 0.95-1.05 2.9-3.0	2.0-2.1 5.0-5.1 1.0-1.1 3.0-3.1 1.0-1.1 4.0-4.1 0.0-0.05 0.03-0.05 0.95-1.05 2.9-3.0 0.95-1.05 2.9-3.0 0.95-1.05 2.9-3.0

APC	Summary	Location	Reference	Concentration (units as specified)	Depth (m)	Depth of Next Sample(m)
28	Zinc	HE8 BH0335 BH0413 BH0513 BHGM3 Blue Area Red Area	Ref. 7-22 Ref. 7-26 Ref. 7-22 Ref. 7-22 Ref. 7-21 Ref. 7-34 Ref. 7-34	124 mg/kg 81 mg/kg 58 mg/kg 54 mg/kg 237 mg/kg 160 mg/kg 58 mg/kg	GL GL 4 5 0.2 GL GL	0.5 0.8-1.2 - - - - -

Note: Green Area, Red Area, Yellow Area, and Blue Area are the sample descriptions given to composite samples collected by EMAG (Ref. 7-32).

Table D-8c: Areas of Potential Concern – Risks to Human Health from Groundwater Contamination

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
1	C₁₆-C₁₈ Carbon banding No Henry's Law constant applies to cover the carbon range reported by the laboratory. However, Henry's Law constants for the constituents (i.e. C10-C12, C12-C16) suggest that the determinand would be volatile. However, at the concentrations encountered, no significant vapour migration would be expected.	BH0413 BH0513 HE2 HE4	Ref. 7-26 Ref. 7-26 Ref. 7-22 Ref. 7-22	100 µg/l 80 µg/l 70 µg/l 70 µg/l
2	C₁₇-C₁₈ Carbon Banding See APC 1.	BH0413 BH0513 HE2 HE4	Ref. 7-26 Ref. 7-26 Ref. 7-22 Ref. 7-22	260 µg/l 190 µg/l 180 µg/l 170 µg/l
3	C₁₇-C₁₈ Carbon Banding See APC 1.	BH0413 BH0513 HE2 HE4	Ref. 7-26 Ref. 7-26 Ref. 7-22 Ref. 7-22	160 µg/l 120 µg/l 110 µg/l 100 µg/l
4	1,1-Dichloroethane Henry's Law constant for determinant suggests contaminant to be volatile although the concentrations encountered would be unlikely to produce significant quantities of vapour. In addition, borehole BH0324 is not situated in the vicinity of current buildings or the Proposed HEFF Facility. Contaminant does not represent a potential concern for human health.	BH0324	Ref. 7-24	4-8 µg/l
5	1,1-Dichloroethene Henry's law constant for determinant suggests contaminant to be volatile; however, borehole BH0324 is not situated within the SE corner of the HEFF study area in which development will be occurring. Contaminant does not represent a potential concern for human health.	BH0324	Ref. 7-24	3 µg/l
6	1,2-Dichloroethane The determinant was detected in one borehole on one occasion only, and all subsequent analyses recorded no further exceedences. Determinant not considered to be a concern for human health.	EBH11A (RO54W)	Ref. 7-17 & 7-32	0.82 µg/l

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
7	Acenaphthene Henry's Law constant for determined suggests contaminant to be volatile, most recent analyses record exceedences for some un-site boreholes only. The concentrations encountered would be unlikely to produce significant quantities of vapour	BH0158 BH0159 BH0335 BH0411 BH0413 BH0507 BH0513 BH0GM3 FRH11 EBH11A HE2 HE4 STL5	Ref. 7.17 & 7.32 Ref. 7.17 & 7.32 Ref. 7.26 Ref. 7.26 Ref. 7.26 Ref. 7.26 Ref. 7.24 Ref. 7.26 Ref. 7.24 Ref. 7.17 & 7.32 Ref. 7.17 & 7.32 Ref. 7.22 Ref. 7.22 Ref. 7.17	0.016-0.066 µg/l 0.013-0.072 µg/l 0.12 µg/l 0.078 µg/l 0.063-0.11 µg/l 0.052 µg/l 0.11 µg/l 0.016 µg/l 0.047-0.265 µg/l 0.026-0.07 µg/l 0.04 µg/l 0.11 µg/l 0.03 µg/l
8	Acenaphthylene See APC 8.	BH0159 BH0335 BH0507 BH0513 EBH11 HE2 HE4 BH0413	Ref. 7.17 & 7.32 Ref. 7.26 Ref. 7.24 Ref. 7.26 Ref. 7.17 & 7.32 Ref. 7.22 Ref. 7.22 Ref. 7.26	0.014 µg/l 0.05 µg/l 0.078 µg/l 0.05 µg/l 0.019 µg/l 0.03 µg/l 0.04 µg/l 0.06 µg/l

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
9	Anthracene See APC 8.	BH0158 BH0159 BH0335 BH0411 BH0413 BH0507 BH0513 EBH11 EBH1A HE2 HE4 ST15	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-24 Ref. 7-26 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-22 Ref. 7-22 Ref. 7-17	0.032 0.117-0.162 0.03 µg/l 0.014 µg/l 0.02-0.075 µg/l 0.03-0.077 µg/l 0.02 µg/l 0.021 µg/l 0.036 µg/l 0.07 µg/l 0.02 µg/l 0.02-0.022 µg/l
10	Benzo(b)Fluoranthene See APC 8.	BH0159 BH0507 ST15	Ref. 7-17 & 7-32 Ref. 7-24 Ref. 7-17	0.012 µg/l 0.06 µg/l 0.055 µg/l
11	Carbon Tetrachloride	EBH11 (ROSSW) EBH1A (ROSS4W)	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32	0.17-1.6 µg/l 0.13-1.5 µg/l
12	Chloroform	BH0324	Ref. 7-24	1 µg/l
13	Chrysene	BH0158 BH0159 BH0507 EBH1A ST15	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-24 Ref. 7-17 & 7-32 Ref. 7-17	0.015 µg/l 0.04 µg/l 0.03 µg/l 0.021 µg/l 0.029 µg/l
14	Diesel Range Organics (DRO) DRO represents a bulk chemical analysis parameter therefore no Henry's Law constant applies. See APC 1.	BH0513 HE2 HE4 BH0413	Ref. 7-26 Ref. 7-22 Ref. 7-22 Ref. 7-26	390 µg/l 360 µg/l 340 µg/l 520 µg/l

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
15	Ethyl Benzene Henry's Law constant for determinand suggests contaminant to be volatile, however, the boreholes are not situated within the SE corner of the HEFF study area in which development will be occurring. Contaminant does not represent a potential concern. See APC 8.	EBH11 (ROS3W) EBH11A (ROS4W)	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32	0.17 µg/l 0.34 µg/l
16	Fluoranthene See APC 8.	BH0158 BH0159 BH0335 BH0411 BH0413 BH0507 BH0511 EBH11 EBH11A ST15	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-24 Ref. 7-26 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-17 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32	0.078 µg/l 0.078-1.62 µg/l 0.02 µg/l 0.026-0.49 µg/l 0.012 µg/l 0.056-0.06 µg/l 0.01 µg/l 0.028 µg/l 0.028 µg/l 0.033 µg/l
17	Fluorene See APC 8.	BH0158 BH0159 HH0335 BH0411 BH0413 BH0507 BH0513 BHGM0 EBH11 EBH11A HE2 HE4 ST15	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-24 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-21 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-22 Ref. 7-22 Ref. 7-24	0.024-0.038 µg/l 0.011-0.193 µg/l 0.04 µg/l 0.022 µg/l 0.049-0.09 µg/l 0.165 µg/l 0.06 µg/l 0.025 µg/l 0.069-0.117 µg/l 0.04 µg/l 0.05 µg/l 0.03 µg/l 0.03 µg/l
18	Methyl Chloroform Henry's Law constant for determinand suggests contaminant to be volatile, however, borehole BH0324 is not situated within the SE corner of the HEFF study area in which development will be occurring. Contaminant does not represent a potential concern.	BH0324	Ref. 7-24	6.2-98 µg/l

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
19.	Naphthalene See APC 8.	BH0158 BH0159 BH0335 BH0411 BH0507 BH0511 BHGM03 EBH11A HE2 HE4 ST15 BH0411A	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-24 Ref. 7-26 Ref. 7-12 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-22 Ref. 7-22 Ref. 7-17 Ref. 7-26 Ref. 7-17	0.031-0.1 $\mu\text{g/l}$ 0.127-8.174 $\mu\text{g/l}$ 3.59 $\mu\text{g/l}$ 0.223 $\mu\text{g/l}$ 0.21-0.364 $\mu\text{g/l}$ 0.5 $\mu\text{g/l}$ 0.352 $\mu\text{g/l}$ 0.061-0.161 $\mu\text{g/l}$ 0.077-4.385 $\mu\text{g/l}$ 0.17 $\mu\text{g/l}$ 0.81 $\mu\text{g/l}$ 0.028-0.57 $\mu\text{g/l}$ 0.64 $\mu\text{g/l}$ 15 $\mu\text{g/l}$
20	o-Xylene Although Henry's Law constant for determined suggests conutaminant to be volatile, most recent analyses for ST15 record no exceedences of the detection limit. Determinant not considered to be a concern	ST15	Ref. 7-17	
21	Petroleum Range Organics (PRO) $C_e C_{in}$ See APC 1.	BH0124 ST15	Ref. 7-24 Ref. 7-17	88-192 $\mu\text{g/l}$ 15-21 $\mu\text{g/l}$
22	Pyrene See APC 8.	BH0158 BH0159 BH0335 BH0411 BH0413 BH0507 BH0513 EBH11 EBH11A ST15	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-17	0.012-0.065 $\mu\text{g/l}$ 0.16-0.794 $\mu\text{g/l}$ 0.01 $\mu\text{g/l}$ 0.029 $\mu\text{g/l}$ 0.015 $\mu\text{g/l}$ 0.044-0.056 $\mu\text{g/l}$ 0.01 $\mu\text{g/l}$ 0.021 $\mu\text{g/l}$ 0.042 $\mu\text{g/l}$ 0.035 $\mu\text{g/l}$

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
23	Solvent extractable matter (SEM) See APC 1.	BH0324 BH0335 BH0507 BH0508 (BHGm1) BH0513 ST15	Ref. 7-24 Ref. 7-26 Ref. 7-24 Ref. 7-21 & 7-24 Ref. 7-26 Ref. 7-17	2000 $\mu\text{g/l}$ 1000-2000 $\mu\text{g/l}$ 1000-2000 $\mu\text{g/l}$ 1000-2000 $\mu\text{g/l}$ 1000 $\mu\text{g/l}$ 1000-2000 $\mu\text{g/l}$
24	Tetrachloroethene	EBII1 (RO53W)	Ref. 7-17 & 7-32	0.27-2.92 $\mu\text{g/l}$
	Henry's Law constant for determinant suggests contaminant to be volatile; however, the boreholes are not situated within the southeast corner of the HEPF study area in which development will be occurring. Contaminant does not represent a potential concern.	EBII1A (RO54W) BH0324	Ref. 7-17 & 7-32 Ref. 7-24	0.17-2.71 $\mu\text{g/l}$ 2 $\mu\text{g/l}$
25	Toluene	EBII1 (RO53W)	Ref. 7-17 & 7-32	2.2 $\mu\text{g/l}$
	Although Henry's Law constant for determinant suggests contaminant to be volatile, most recent analyses record no exceedances of the detection limit. Determinant not considered to be a concern.	EBII1	Ref. 7-17 & 7-32	0.143 $\mu\text{g/l}$
26	Total 19 SSPh PAHs	BHC024	Ref. 7-24	61 $\mu\text{g/l}$
	This determinant is a bulk chemical analysis parameter, therefore no Henry's Law constant applies. Not an individual determinant of concern. Refers to individual PAHs for risk to human health.	BH0158 BH0159 BHG035 BH0411 BH0413 BH0507 BH0508 (BHGm1) EBII1 EBII1A ST15	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-26 Ref. 7-26 Ref. 7-26 Ref. 7-24 Ref. 7-21 & 7-24 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-17	0.062-0.556 $\mu\text{g/l}$ 0.011-9.707 $\mu\text{g/l}$ 4.06-1000 $\mu\text{g/l}$ 0.458 $\mu\text{g/l}$ 0.498 $\mu\text{g/l}$ 0.76-1.043 $\mu\text{g/l}$ 0.432 $\mu\text{g/l}$ 0.208-0.754 $\mu\text{g/l}$ 0.158-5.491 $\mu\text{g/l}$ 0.479-0.69 $\mu\text{g/l}$
28	Total Polycyclic Hydrocarbons			
	This determinant is a bulk chemical analysis parameter, therefore no Henry's Law constant applies. Not an individual determinant of concern. Refer to individual PAHs for risk to human health.			

APC	Summary	Boreholes	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
29	trans-1,2-Dichloroethene Although Henry's Law constant for determinand suggests contaminant to be volatile, most recent analyses record no exceedences of the detection limit. BH0324 is also not located in the southeast corner of the HEFF project area in which development will be occurring. Determinand not considered to be a concern.	BH0324	Ref. 7-24	3 µg/l (BH0324)
30	Trichloroethane Although Henry's Law constant for determinand suggests contaminant to be volatile, most recent analyses record no exceedences of the detection limit. Determinand not considered to be a concern.	EBH11 (RO53W) EBH11A (RO54W)	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32	0.35-5.7 µg/l 0.25-5.62 µg/l
31	Trichloroethene Although Henry's Law constant for determinand suggests contaminant to be volatile, boreholes EBH11, EBH11A, BH324, and ST15 are not located within the SE corner of the HEFF study area in which development is to take place and are therefore not of concern. Borehole BH0158 (R474W) record no exceedences above detection for the most recent analysis. Determinand does not represent a concern.	BLD058 (R474W) EBH11 (RO53W) EBH11A (RO54W) BH0324 ST15	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-24 Ref. 7-17	0.57 µg/l 0.2-27.7 µg/l 0.21-23.7 µg/l 170-408 µg/l 5-11 µg/l

Table D-8d: Areas of Potential Concern – Risks to Groundwater/Surface Water from Groundwater Contamination

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
1	pH pH was recorded outside the range normally encountered in groundwater. pH is a general water quality parameter and as such does not represent a contaminant of concern.	BH0158 (R474W) BH0335 ST15 EBH11 (R053W)	Ref.7-17 & 7-32 Ref.7-26 Ref.7-33 Ref.7-17 & 7-32 Ref.7-17 & 7-32	4.70-5.2 pH units 5.7 pH units 5.4-6.0 pH units 5.36-5.9 pH units
2	Alkalinity Alkalinity was recorded above the detection limit at five boreholes. No screening value currently exists for acidity. Acidity is a general water quality parameter and as such does not represent a contaminant of concern.	BH0158 BH0159 BH0507 EBH11 EBH11A	Ref.7-17 & 7-32 Ref.7-26 Ref.7-17 & 7-32 Ref.7-17 & 7-32	80000-470000 µg/l 90000-104000 µg/l 50000 µg/l 20000-73000 µg/l
3	Ammoniacal Nitrogen Ammoniacal Nitrogen exceeded the UK DWS of 300 µg/l in groundwater in seven boreholes. The concentrations encountered appear to be indicative of background groundwater quality. Ammoniacal nitrogen is not considered to represent a contaminant of concern as concentrations are indicative of background groundwater quality	BH0158 BH0159 EBH11 EBH11A BH0515 HE4 BH0413	Ref.7-17 & 7-32 Ref.7-17 & 7-32 Ref.7-17 & 7-32 Ref.7-17 & 7-32 Ref.7-17 & 7-32 Ref.7-26 Ref.7-22 Ref.7-26	200 - 1700 µg/l 200 - 1500 µg/l 500-1800 µg/l 500-1100 µg/l 400 µg/l 600 µg/l 500 µg/l
4	Biological Oxygen Demand (BOD) BOD exceeded the screening value of 2000 µg/l in six boreholes. Values for BOD across the Aldermaston site range from <1 mg/l (limit of detection) to 69 mg/l (BH0227). The presence of elevated BOD values up hydraulic gradient of the HETT Construction Enclave (BH0053, BH0078, BH0087 and BH0090) suggests these results are indicative of background groundwater quality. The measured BOD concentrations are below the levels that would be expected for impact from raw sewage (~600 mg/l) or impact from industrial waste (up to 25,000 mg/l). Determination is not a concern.	BH0158 BH0159 HE4 EBH11 (R053W) EBH11A (R054W) BH0413	Ref.7-17 & 7-32 Ref.7-17 & 7-32 Ref.7-22 Ref.7-17 & 7-32 Ref.7-17 & 7-32 Ref.7-17 & 7-32 Ref.7-26	14000 µg/l 1000-3000 µg/l 97000 µg/l 500-10200 µg/l 300-3000 µg/l 60,000 µg/l

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
5	C_r-C_a Carbon banding C _r -C _a carbon banding exceeded the taste/odour threshold criteria (10 µg/l) in groundwater in six boreholes. Carbon banding falls within range of DRC (1-25-243 µg/l). Refer to comments for APC 9.	BH0413 BH0513 HE2 HE4 BH0124 ST15	Ref. 7-26 Ref. 7-26 Ref. 7-22 Ref. 7-22 Ref. 7-24 Ref. 7-23	100-260 µg/l 80-190 µg/l 70-80 µg/l 70-79 µg/l 61-192 µg/l 15-21 µg/l
6	Chemical Oxygen Demand (COD) COD exceeded the screening value of 20 mg/l in groundwater in eight boreholes. Values for COD across the Aldermaston site range from <10 mg/l (limit of detection) to 1210 mg/l (EBH113). The presence of elevated COD values up hydraulic gradient of the HEFF Construction Enclave (BH0053, BH0078, BH0087 and BH0089) suggests these results are indicative of background groundwater quality.	BH0158 BH0159 BH0513 EBH11 EBH11A HE4 BH0413 BH0513	Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-26 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32 Ref. 7-22 Ref. 7-26 Ref. 7-26	10-68 mg/l 0-61 mg/l 595 mg/l 6-61 mg/l 1-44 mg/l 3860 mg/l 2365 mg/l 595 mg/l
7	The groundwater COD values across the AWE Aldermaston site and below the HEFF Construction Enclave suggest the presence of greater quantities of organic and inorganic material susceptible to oxidation than would be found in unpolluted surface water, but below COD values attributable to significant impact from industrial effluents, industrial wastewaters may have COD values of up to 60,000 mg/l. Although elevated above the concentrations identified in EBH113, the COD concentrations in boreholes BH0413 and HE4 are of a similar order of magnitude. Determinand is therefore not a concern.	EBH11 (R053W)	Ref. 7-17 & 7-32	32 µg/l
	Copper exceeded the screening value of 28 µg/l in groundwater in one borehole. Subsequent analyses record no further exceedences. However, copper in groundwater has previously been assessed in the SCRT2 Project and was found to be a concern. The potential liability of groundwater contamination by copper is being managed under the SCRT2 Project through on-going (long-term) groundwater monitoring.			

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
8	Cyanide	BH0158	Ref 7.17 & 7.32	9.70 $\mu\text{g/l}$
	Cyanide exceeded the screening value of 50 $\mu\text{g/l}$ in groundwater in one borehole on one occasion during 2001. No previous assessment has been undertaken; however, all subsequent analyses record no further exceedences with concentrations reported at the detection limit. Cyanide does not represent a concern.			
9	Diesel Range Organics (DRO)	BH0413 BH0513 HE2 HE4	Ref 7.26 Ref 7.26 Ref 7.22 Ref 7.22	5.20 $\mu\text{g/l}$ 396 $\mu\text{g/l}$ 360 $\mu\text{g/l}$ 340 $\mu\text{g/l}$
	DRO exceeded the faster/outdoor threshold (10 $\mu\text{g/l}$) in groundwater in four boreholes. Up gradient boreholes also exhibit elevated DRO (>10 to 1377 $\mu\text{g/l}$) indicating a potential up gradient source. DRO concentrations that exceeded the threshold were also recorded down gradient (north) of the HEFF Construction Enclave.			
	The groundwater risk assessment undertaken for the SCRT2 Project concluded that there was no risk to groundwater at the downgradient site boundary from DRO where biodegradation is taken into account. A five yearly monitoring programme for DRO was recommended as is being implemented.			
10	Dissolved Oxygen	BH0158 BH0159 EBH11A	Ref 7.17 & 7.32 Ref 7.17 & 7.32 Ref 7.17 & 7.32 Ref 7.17 & 7.32	4000 - 16600 $\mu\text{g/l}$ 100 - 16300 $\mu\text{g/l}$ 5-15900 $\mu\text{g/l}$ 6-18000 $\mu\text{g/l}$
	Dissolved oxygen is outside the range normally encountered in groundwater. Dissolved oxygen is a general water quality parameter and therefore is not a concern.			
11	Hydrocarbon Oil	EBH11 (R053W) EBH11A (R054W)	Ref 7.17 & 7.32 Ref 7.17 & 7.32	53-100 $\mu\text{g/l}$ 48-100 $\mu\text{g/l}$
	Hydrocarbon oil exceeded the screening value of 10 $\mu\text{g/l}$ in two boreholes during 1998 and 1999; however, subsequent analyses on groundwater from both boreholes recorded no further exceedences between 1999 and 2006. Determinand not of concern.			
12	Manganese	BH0158 BH0159 EBH11 EBH11A	Ref 7.17 & 7.32 Ref 7.17 & 7.32 Ref 7.17 & 7.32 Ref 7.17 & 7.32	105-160 $\mu\text{g/l}$ 210-348 $\mu\text{g/l}$ 1192-1377 $\mu\text{g/l}$ 121 $\mu\text{g/l}$
	Manganese exceeded the screening value of 50 $\mu\text{g/l}$ in groundwater in four boreholes. The concentrations encountered are considered to be indicative of background concentrations. Determinand is not a concern.			
13	Mercury	EBH11 (R053W)	Ref 7.17 & 7.32	2.1 $\mu\text{g/l}$
	Mercury exceeded the screening value of 1 $\mu\text{g/l}$ in only one borehole on one occasion. Subsequent monitoring recorded no further exceedences. Mercury is therefore not considered to be a contaminant of concern.			

APC	Sundry	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
14	Nitrite Nitrite exceeded the screening value of 500 µg/l in groundwater in two locations. Subsequent monitoring recorded no further exceedences. Determinand is not considered a concern.	BH0158 (R474W) BH0159 (R475W)	Ref 7-17 & 7-32 Ref 7-17 & 7-32	739 µg/l 535 µg/l
15	PAH - Benzo(a)pyrene Benzo(a)pyrene exceeded the screening value of 0.01 µg/l in groundwater in three boreholes. Refer to APC 18 for further discussion	ST1.5 BH0507 EBIIIA (R054W)	Ref 7-33 Ref 7-24 Ref 7-17 & 7-32	0.052 µg/l 0.04 µg/l 0.027 µg/l
16	PAH - Dibenz(a,h)anthracene Dibenz(a,h)anthracene marginally exceeded the screening value in groundwater in one borehole. Refer to APC 18 for groundwater monitoring. Refer to APC 30 for further discussion.	BH0507	Ref 7-24	0.01 µg/l
17	PAH - Benzo(g,h,i)perylene There is currently no available criterion for benzo(g,h,i)perylene; however, concentrations above the limit of detection were reported for two boreholes. Refer to APC 18 for further discussion.	BH0507 ST1.5	Ref 7-24 Ref 7-33	0.05 µg/l 0.109 µg/l
18	PAH - Total Total PAH (Sum of benzofluoranthene, benzo(a)fluoranthene, benzo(a,h)perylene and indeno(1,2,3- <i>cd</i>)pyrene), exceeded the screening value in groundwater in two boreholes. The potential liability of PAH contamination in groundwater is addressed and managed under the SCRT 2 Project through groundwater monitoring.	BH0507 ST1.5	Ref 7-24 Ref 7-33	0.18 µg/l 0.251 µg/l
19	Selenium Selenium exceeded the screening value on one occasion in one borehole. Selenium has been previously assessed as part of the SCRT 2 Project and was found not to be of concern at the site boundary. Determinand not of concern for groundwater.	BTIGM3	Ref 7-24	12 µg/l
20	Solvent extractable matter (SEM) SEM was recorded above the limit of detection in six boreholes. No screening criterion currently exists for solvent extractable matter; however, SEM is a bulk chemical analysis parameter, not an individual determinant of concern. See APC 9 for further discussion.	BH0324 BH0335 BH0507 BH0508 BH0513 ST1.5	Ref 7-24 Ref 7-26 Ref 7-24 Ref 7-22 Ref 7-26 Ref 7-33	2000 µg/l 1000-2000 µg/l 1000-2000 µg/l 1000-2000 µg/l 1000 µg/l 1000-2000 µg/l

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
21	Sulphide Sulphide exceeded the screening value in groundwater from four boreholes. Sulphide concentrations appear to be indicative of background groundwater quality. Sulphide does not represent a contaminant of concern with concentrations indicative of background.	BH0155 BH0159 EBH11 EBH11A	Ref 7-17 & 7-32 Ref 7-17 & 7-32 Ref 7-17 & 7-32 Ref 7-17 & 7-32	0.05 - 0.07 mg/l 0.05 mg/l 0.03-0.09 mg/l 0.03-0.05 mg/l
22	Total Dissolved Solids (TDS) This determined was recorded above the detection limit in four boreholes. No screening criterion currently exists for TDS; however, it is a general water quality parameter and as such does not represent a contaminant of concern.	BH0158 BH0159 EBH11 EBH11A	Ref 7-17 & 7-32 Ref 7-17 & 7-32 Ref 7-17 & 7-32 Ref 7-17 & 7-32	4,7000-64000 µg/l 84000-118000 µg/l 220000-277000 µg/l 144000-166000 µg/l
23	Total Suspended Solids (TSS) This determined was recorded above the detection limit in four boreholes. No criterion currently exists for TSS; however, it is a general water quality parameter and as such does not represent a contaminant of concern.	BH0158 BH0159 EBH11 EBH11A	Ref 7-17 & 7-32 Ref 7-17 & 7-32 Ref 7-17 & 7-32 Ref 7-17 & 7-32	25000-810000 µg/l 31000-352000 µg/l 5000-194000 µg/l 6000-101000 µg/l
24	Total Organic Carbon (TOC) Total Organic Carbon exceeded criteria in groundwater in eight boreholes. The concentrations encountered appear to be indicative of background groundwater quality, and therefore is not a concern.	BH0158 BH0159 BH0159 BH0159 BH0159 HE2 HE4 EBH11 EDH11A	Ref 7-17 & 7-32 Ref 7-17 & 7-32 Ref 7-26 Ref 7-26 Ref 7-22 Ref 7-22 Ref 7-17 & 7-32 Ref 7-17 & 7-32	0 - 10,000 µg/l 0 - 8,000 µg/l 9,000 µg/l 6,000 µg/l 3,000 µg/l 4,000 µg/l 20,000-40000 µg/l 70000 µg/l
25	Total Oxidised Nitrogen No screening criterion currently exists for total oxidised nitrogen. It is noted that this determinant is not included in the Environmental Agency's List I and List II substances. It is therefore not considered to represent a contaminant of concern. Refer to APC 14 for nitrite.	BH0158 BH0159 EBH11	Ref 7-17 & 7-32 Ref 7-17 & 7-32 Ref 7-17 & 7-32 Ref 7-17 & 7-32	300-700 µg/l 600 µg/l 360-1300 µg/l

APC	Summary	Borehole(s)	Reference	Range of Concentrations Exceeding Screening Value (units as specified)
26	Total Phenol Total phenol exceeded the screening value in one borehole on three occasions during 2004. The determinant has not previously been highlighted as of concern in the SCRT2 Project. However, subsequent analyses undertaken during 2005 and 2006 recorded concentrations below the screening value, with the most recent analyses recording concentrations below the limit of detection. Phenol concentrations do not represent a potential concern.	ST15	Ref. 7-33	50-3470 µg/l
27	Trichloroethene (TCE) Trichloroethene exceeded the screening value of 10 µg/l in four boreholes. The potential liability of groundwater contamination by TCE has been previously highlighted in the SCRT2 Project and is being managed through on-going groundwater monitoring.	BH0324 ST15 EBH11 (R051W) EBH11A (R054W)	Ref. 7-24 Ref. 7-33 Ref. 7-17 & 7-32 Ref. 7-17 & 7-32	170-408 µg/l 11 µg/l (2.55-27.7 µg/l) 10.48-23.7 µg/l
28	Zinc Zinc exceeded the FW EQS (500 µg/l) in one borehole. Zinc has previously been assessed as part of the SCRT2 Project as was not found to be a concern at the site boundary. Determinant is not of concern for groundwater.	BHGM3	Ref. 7-24	1369 µg/l
29	Gross Alpha Radiactivity The determinant exceeded AWE "trigger" levels for further analysis in groundwater. Radiochemical analysis for Pu and U isotopes did not exceed AWE criteria, therefore do not represent a concern.	BH0158	Ref. 7-17 & 7-32	56 Bq/m ³

7.0 GLOSSARY OF TERMS

This Glossary of Terms is for all Golder/AWE Reports.

I,I-DCA	I,I Dichloroethane
I,I,I-TCA	Trichloroethane
1A	No visual or olfactory evidence of contamination
2B	Slight visual and olfactory evidence of contamination
3C	Definite visual and olfactory evidence of contamination
4D	Visual and olfactory evidence of gross contamination
A12Q1	An area to the northwest of the AWE Site and the location of an historical solvent evaporation pit
Abstraction	Licensed and unlicensed use of surface water/groundwater
ACEC	Aggressive Chemical Environment for Concrete
AE	Abnormal Event
AEA Technology	Atomic Energy Authority Technology, who undertook the drilling of the AEA series boreholes in A12Q1 and the SCRT IA Project
Aerobic groundwater	Groundwater that contains dissolved oxygen in concentrations greater than about 0.5 milligrams per litre (mg/l)
ALC	Agricultural Land Classification
Amber List	Birds of Conservation Interest under the 'Amber List' are those whose population or range has declined moderately in recent years (by more than 25% but less than 50% in 25 years), those whose population has declined historically but recovered recently, rare breeders (fewer than 300 pairs), those with internationally important populations in the UK, those with localised populations, and those with an unfavourable conservation status in Europe
Anaerobic groundwater	Groundwater that contains dissolved oxygen in concentrations less than 0.5 mg/l - 1 mg/l
AOO	Above Ordnance Datum
APC	Area of Potential Concern
Aquifer	A permeable geological stratum or formation that is capable of both storing and transmitting water in significant amounts
AST	Aboveground Storage Tank
Atkins SSV	Atkins Soil Screening Value
Attenuation	Reduction in contaminant concentration through biological, chemical and physical processes as it passes through a medium
AWE	Atomic Weapons Establishment
BAP	Biodiversity Action Plan
BB/TZ	Bagshot Beds/Transitional Zone
BBOWT	Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust
BDS	British Dragonfly Society
BG	Background
BH	Borehole
Biodegradation	The transformation of a substance or chemical by micro-organism, resulting in a change in chemical structure mass within the environment
BNFL	British Nuclear Fuels Limited
BOD	Biochemical Oxygen Demand

BP RISC	BP's Risk Integrated Software for Cleanups (BP RISC) is an MS Windows-based software package that can be used to assess human exposure to determinants from soil and groundwater. The model can estimate risk from 14 pathways and includes fate and transport algorithms that allow the user to assess exposure to determinants that have migrated into air and groundwater from a contaminated soil source. It also models determinant uptake from soil into garden produce. Measured soil, air and groundwater concentrations may be input directly into the programme to assess their risk, or used as an input in the fate and transport models. RISC has a database of 87 chemicals. Physical, chemical and toxicological properties of each chemical are derived from published sources. Properties can be changed by the user and additional user defined chemicals can be added. RISC has default input parameters describing exposure pathways and receptors. Many of the default parameters are based on conservative US statistics. RISC is flexible and all inputs can be changed to reflect site or country specific criteria. The model can therefore be adapted to ensure consistency with DEFRA/EA approaches as set out in Contaminated Land Report CLR 10
BRE	Building Research Establishment
Bq/g	Becquerels per gram
BT	British Telecom System
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
Bulk Parameters	Generic groups of chemicals represented during modelling using surrogates. Bulk parameters include mineral oils, PRO, DRO, chlorinated solvents and PAHs. Surrogates chosen typically illustrate a range of properties including differing solubilities, mobilisations and recalcitrance
CAT	Cable Avoidance Tool
CatOx	Catalytic oxidation burner
CBA	Cost Benefit Analysis
CCAS	Comprehensive Chemical Analysis Suite – includes, metals, PRO (including BTEX), DRO, PAH by TLC, VOC, SVOC. Please note that for soil samples PRO and VOC would have only been undertaken where field headspace results were greater than 25 ppm
CCTV	Closed Circuit Television
CH ₄	Methane
CIRIA	Construction Industry Research and Information Association
Cis 1,2-DCE	cis 1,2-Dichloroethylene

CLEA	<p>Contaminated Land Exposure Assessment Model - Human Health Risk Assessment Tool</p> <p>The CLEA model estimates determinand intake from soil as a function of the determinand concentration and the potential exposure of adults and children living, working and playing on contaminated land. It derives Soil Guideline Values by comparing the calculated intake with the TDI or Index Dose. The model, its key assumptions, and the underpinning conceptual model for each land-use are described in detail in Contaminated Land Report 10. The CLEA model assumes that land-use falls into one of the following three categories, the first having two sub-categories: Residential with and without plant uptake, allotments and commercial/industrial. Thus, the Soil Guideline Values derived using CLEA are dependent on exposure in a specified land-use, in accordance with the "suitable for use" approach. Soil Guideline Values have been derived using CLEA for several determinants. The Soil Guideline Values depend on a number of assumptions (for example, relating to the soil conditions, the particular behaviour and type of determinants, the existence of pathways, the land-use patterns, and the availability of receptors. With regards to the Aldermaston Site, the Industrial/Commercial CLEA conceptual model is applicable.</p>
CLR	Contaminated Land Reports - A series of reports produced on behalf of DfTRA which cover how contaminated land should be dealt with under the present UK legislation, including the use of the CLEA model and Soil Guideline Values
Cm	centimetres
CMP	Construction Management Plan
CN Cr	Cyanide
COD	Chemical Oxygen Demand
COB	Change of Direction
ConSim	<p>ConSim Version 2.02 has been used throughout the SCRT 2 project. ConSim is a risk assessment model that examines, and aids in the assessment of, the impact of contaminated land on groundwater. ConSim was developed by Golder on behalf of the Environment Agency. The model was developed to deal with Site data uncertainty. The input parameters to the model's analytical equations can be ranges of possible values (based on defensible probability density functions (PDFs)) rather than single values. To deal with this, the model uses the 'Monte Carlo approach' in which calculations are carried out many times, with input parameters selected randomly from within the specified range. In this project each model's result reflects 1001 iterations. The modelling results therefore reflect data uncertainty, the results of a range of the input parameters/Site conditions and therefore Site heterogeneity. The uncertainty with respect to data or parameter values is not (necessarily) analogous to poor Site characterisation. Rather, it allows natural variation and data uncertainty to be modelled in a way that avoids taking an overly pessimistic "worst-case" type analyses, which is rarely justifiable.</p> <p>ConSim follows a level approach, including Levels 1, 2 and 3. Level 1 deals with the concentrations from the source zone, and carries out a holistic leach test, thus creating a range of results in µg/l, the 95th percentile of which is compared to an appropriate</p>

	<p>criteria. If the result exceeds the criteria then a Level 2 assessment is undertaken. Level 2 assesses the migration of determinand concentrations from a source zone, through an unsaturated zone, with various processes occurring, for example retardation. The 95th percentile result is compared to the criteria, and if it continues to exceed then a Level 3 assessment is undertaken. Level 3 assesses determinand concentrations migration through an aquifer to a receptor, in this case groundwater quality at the Site boundary. Again the 95th percentile of the results is compared to a given criteria. Processes such as biodegradation and retardation can be included within the modelling at this level. If determinand groundwater concentration at the Site boundary exceed the criteria within a particular time period (in the case of AWE within 1000 years), the determinand is deemed to be a risk to the receptor. Level 3A has many similarities to a Level 3, though it is a stand alone assessment, assessing the implications of determinand groundwater concentrations on groundwater quality at the Site boundary.</p>
ConSim Level 3A	A modelling option in ConSim which allows simulation of the migration of a fixed concentration aqueous source in groundwater by simulation of the processes of dilution, advection, retardation, dispersion and biodegradation.
Control PID	Control Process Indication Drawing
Controlled Waters	Controlled waters are defined as relevant territorial waters (extending 3 miles seawards from baseline), coastal waters (water inland of baseline), inland waters, surface water and groundwater (for the purposes of Part II A within the saturated zone).
COSHH	Control of Substances Hazardous to Health
CP	Cone Penetration
CP	Condensate Main
CPREA	Construction Project Register of Environmental Aspects
CPT	Cone Penetration Test
CRI	Criticality Cable
CROW Act	Countrywide Rights of Way Act 2000
cSAC	candidate Special Area of Conservation
CSPS	Contract Section Particular Specification (from SCRT III)
CSPS 13	Boreholes in the vicinity of B Area TCE Contaminated Ground Source Depletion Project
CSR	Construction Site Rule
CT	Carbon Tetrachloride
CTF	Chemical Technology Facility
D	Deep well in a dual installation borehole.
Daughter product	A compound that results directly from the degradation of another. For example, cis 1,2-dichloroethene (cis 1,2-DCE) and vinyl chloride are daughter products of the reduction of trichloroethene (TCE).
DBA	1,2-Dibromoethane
DCA	Dichloroethane
DCE	Dichloroethene (Dichloroethylene)
DCLG	Department for Communities and Local Government
DCM	Dichloromethane
DEFRA	Department of the Environment, Food and Rural Affairs
DELCD	Dry Electrolytic Conductivity Detector

Dense non-aqueous phase liquid (DNAPL)	A liquid immiscible with water that has a density greater than water and so sinks in water.
Determinand	Defined by the Environment Agency as a general name for a characteristic aspect of water quality. In terms of the SCRT 2 suite of reports, a determinand is an aspect of soil and groundwater quality.
DETR	Department for Environment, Transport and the Regions
DG	Data Gap
Diffusion	Migration of substances by natural movements of their particles
Dilution	Reduction in concentration brought about by the addition of water
Dispersion	Irregular spreading of solutes due to aquifer heterogeneities at pore-grain scale (mechanical dispersion) or at field scale (macroscopic dispersion).
Dispersivity	A property that quantifies the physical dispersion of a solute being transported in a porous medium.
DIV	Dutch Intervention Value
dL	Laboratory detection limit
DM	Demineralised Water
DMVEX	Dual Media Vacuum Extraction pump, which extracts both groundwater and soil vapour.
DO	Dissolved Oxygen
DoE	Department of the Environment
DP	Decoy Pond
DPVE	Dual Phase Vacuum Extraction
DQRA	Detailed Quantitative Risk Assessment
DRO	Diesel Range Organics
DS	Design Sulphate
DTC	Depth to Crown
DU	Depleted Uranium
Dutch I	Dutch Intervention
DWS	Drinking Water Standard
EA	Environment Agency
FAL	Environmental Assessment Level – given that for many substances which are released to air EQSs have not been defined, the Environment Agency has adopted interim values known as EALs. These are non-statutory benchmarks of concentration for a substance after dispersion into the receiving environment, set at a level below which no harm is likely.
EC	European Council
Eh	Redox Potential
EIA	Environmental Impact Assessment
Electron acceptor	A compound capable of accepting electrons during oxidation-reduction reactions. Micro-organisms obtain energy by transferring electrons from electrons donors such as organic compounds (or sometimes reduced inorganic compounds such as sulphide) to an electron acceptor. Electron acceptors are compounds that are relatively oxidised and include oxygen, nitrate, Fe (III), Mn (IV), sulphate, carbon dioxide, or in some cases the chlorinated aliphatic hydrocarbons such as perchloroethene (PCE), TCE, DCE and vinyl chloride.

Electron donor	A compound capable of supplying (giving up) electrons during oxidation-reduction reactions. Micro-organisms obtain energy by transferring electrons from electron donors such as organic compounds (or sometimes reduced inorganic compounds such as sulphide) to an electron acceptor. Electron donors are compounds that are relatively reduced and include fuel hydrocarbons and native organic carbon.
EMAG	Environmental Monitoring and Assessment Group (formerly EMG) also Environmental Materials and Analysis Group
EMG	Environmental Monitoring Group
EMP	Electromagnetic Pulse Facility
EMP	Environmental Monitoring Plan
EN	English Nature
EPA	Environmental Protection Act
EQS	Environmental Quality Standard
EQSFW	Environmental Quality Standards for Freshwater environments
ES	Environmental Statements
ESH	Environmental, Safety and Health (Plan)
ESIIMS	AWE Environmental Site Investigation Information Management System
ESSPH	Essential Services Supply Plant House
EU	European Union
EUDWS	European Union Drinking Water Standards
Exploratory Investigation	Exploratory Investigations usually involve only limited intrusive/analytical work in which relatively few samples are collected for identification/confirmation purposes or for prioritisation of sites. They may play a role in establishing the potential for short-term exposure or other immediate risks to health and the environment, and they may be used to generate preliminary gas, vapour and water quality data.
Fe	Iron
FER	Facility Environmental Representative
FES	Foundation and Exploration Services (now Fugro Engineering Services)
FF	Fire Fighting Water Main
FID	Flame Ionisation Detector
FM	Facility Manager
FOC, Foc or foc	Fraction of Organic Carbon
FRTR	Federal Remediation Technologies Roundtable
FT	Foul Trade Waste Drain
FW	Freshwater
GAC	Granular Activated Carbon
GAC	Generic Assessment Criteria
GASIDB	Golder Associates Site Investigation Database
GC-FID	Gas Chromatography Flame Ionisation Detector
GCMS	Gas Chromatography Mass Spectrometry
GL or gl	Ground level
GM	Existing Gas Main
Golder	Golder Associates (UK) Limited
GQA	General Quality Assessment
GQRA	Generic Quantitative Risk Assessment
GRO	Gasoline Range Organics (equivalent to PRO)

Groundwater	(Regulations 1(2) EC Groundwater Directive.) All water that is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.
Groundwaters	Any waters contained in underground strata (s104, WRA, 1991)
Ha	Hectare
HCP	Hydrogeological Characterisation Project - Undertaken by Golder between 2000 and 2002 looking at the overall hydrogeological regime at AWE Aldermaston.
HDPE	High-density polyethylene
HEFF	High Explosives Fabrication Facility
HEFF Construction Enclave	Includes the construction site, and associated temporary areas including the construction site access road, the contractors' compound, and the contractors' compound overflow.
HEFF Proposed Facility	The actual location of where the HEFF Development will be situated, including the process building, supporting building, and associated permanent access routes.
HEFF Project Area	The planning application site area within the 'red line boundary' supplied by AWE (Atkins) in Appendix B (Assessment Plan) of 'Information for ES Technical Authors, Reference EDMS1, Draft Issue, December 2006'.
HHRA	Human Health Risk Assessment
HRC	Hydrogen Release Compound
H/S	Headspace – Field testing technique for VOCs
HSE	Health and Safety Executive
HV	High Voltage Electrical Cable
HVE	High Vacuum Extraction, also called High Vacuum Soil Vapour Extraction
Hydraulic conductivity	A coefficient of proportionality describing the rate at which water can move through a permeable medium. The density and kinematic viscosity of the water must be considered in determining hydraulic conductivity.
Hydraulic gradient	The change in total head with a change in distance in a given direction. The direction is that which yields a maximum, rate of decrease in head.
IBC	Intermediate Bulk Container
ICRCL	Inter-departmental Committee on the Redevelopment of Contaminated Land
ID	Index Dose
IEEM	Institute for Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
Impact	Potential changes which can occur to sensitive receptors due to a range of circumstances (e.g. a pollution incident, new development etc.)
Impact Significance	Consideration of the nature and scale of impact characteristics, combined with the importance/sensitivity of receptors to produce a judgement of overall significance
Importance/Sensitivity	The means by which the status of receptors when considering the potential significance of impacts is judged.
IMS	Information Management System
ITRC	Interstate Technology and Regulatory Council
IUCN	International Union for the Conservation of Nature and Natural Resources
K-40	Potassium - 40
Kd	Partition coefficient

Koc	Organic carbon absorption coefficient
km	Kilometres
LC	London Clay
LC1	London Clay (upper clay horizon)
LC2	London Clay (water bearing silty sand/sandy silt horizon)
Lepidoptera	An order of insects characterised by the possession of a spiral proboscis, and of four large more or less scaly wings; includes butterflies and moths.
LEoP SI	Leading Edge of Plume Site Investigation – Additional boreholes drilled to characterize and further define the leading edge of the TCE plume associate with B Area.
LNAPL	Light Non-Aqueous Phase Liquid. A liquid immiscible with water that has a density less than water and so floats on water.
LOD	Level of Detection
LPA	Local Planning Authority
LV	Low Voltage Electrical Cable
m aOD	Metres above Ordinance Datum
m bGL	Metres below Ground Level
m OD	Meters Ordinance Datum
m	Metres
MCP	Motor Control Panel
m/s	Metres Per Second
mm	Millimetres
m/y	Metres Per Year
MAFF	Ministry for Agriculture, Fisheries and Food
MBH	Main Boiler House
MCB	Modular Circuit Breaker
Metals	Standard Suite - As, Cd, Cr, Pb, Hg, B, Se, Cu, Ni, Zn
MEW	Machining and Engineering Workshop
MG	Made Ground
MH	Manhole (a prefix)
Mineral Oil	Compounds with the carbon number C ₁₀ – C ₄₀ which are not retained when passed through a silica column using a non-polar solvent. Chemically this consists of aliphatics (n-alkanes, iso-alkanes and cyclo-alkanes).
MIP	Membrane Interface Probe
Mitigation	Actions to reduce the nature, scale, duration or geographical extent of significant impacts
MNA	Monitored Natural Attenuation. Monitoring of groundwater to confirm whether NA processes are acting at a sufficient rate to ensure that the wider environment is unaffected and that the remediation objectives will be achieved within a reasonable time-scale; typically less than one generation or 30 years.
Model Surrogates	Individual determinants of bulk parameters represented in modelling by the use of surrogate compounds.
MTBE	Methyl tert butyl ether – petrol additive
Multi-Staged	With reference to the Non-Targeted aspect of the SCRT 2 Exploratory Investigation, a contingency of twenty boreholes was established in the contract to allow for real-time reaction to the potential presence of contamination in planned boreholes. The additional reactive boreholes would be used to aid in the delineation of contamination or to assess the extent of migration towards a receptor, (such as groundwater quality at the Site boundary).

NA	Natural Attenuation. The effect of naturally occurring physical, chemical and biological processes, or any combination of those processes to reduce the mass, toxicity, mobility, volume or concentration of polluting substances in groundwater. For natural attenuation to be effective as a remedial action, the rate at which those processes occur must be sufficient to prevent polluting substances entering identified receptors and to minimise expansion of pollutant plumes into currently unpolluted groundwater. Dilution within a receptor (such as a river or borehole) is not natural attenuation.
NA	Nitrogen and Argon Pipe
NAPL	Non-aqueous phase liquid. Liquids that are immiscible with water and so form a separate phase.
NASP	Natural Attenuation Screening Protocol
NGR	National Grid Reference
NII	Nuclear Installations Inspectorate
NNR	National Nature Reserve
Non-Targeted	Systematic, stratified, variable density and multi staged aspect of the SCRT 2 investigation.
NoPD	Notice of Proposed Development
NREMB	Non Routine Environmental Monitoring Borehole
NSCA	National Society for Clean Air and Environmental Protection
NSO/Resins	Nitrogen, Sulphur, Oxygen/Resins
NSPA	Nuclear Storage and Processing Area
NTS	Non-Targeted Suite – including Metals, PAH by TLC, PRO, VOC Screen, Phenol, Sulphur, Sulphide and Sulphate, Total Cu, pH and DRO. Please note that for soil samples PRO and VOC would have only been undertaken where headspace results were greater than 25 ppm.
Odonata	One of the insect groups, comprising the dragonflies and damselflies
ODPM	Office of the Deputy Prime Minister
O & M	Operation and Maintenance
OH	Hydroxyl Radical
OS	Ordnance Survey
P1	The shallow installation of a dual installation
P2	The deep installation of a dual installation
PAH	Polycyclic Aromatic Hydrocarbon. Also known as Poly Aromatic Hydrocarbon.
Pathway	A route along which water or contaminant moves through the environment and comes into contact with, or otherwise affects, a receptor.
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene, Tetrachloroethylene, Perchloroethylene, (= 1,1,2,2 – Tetrachloroethylene)
pdf or PDF	Probability Density Function
pH	Measure of acidity/alkalinity - pH value, the activity of H ⁺ in aqueous solution
PID	Photo-Ionisation Detector (used for identifying VOC by soil headspace analysis in the field). Also called an OVM, Organic Vapour Meter.

Pollution of groundwater	The discharge by man, directly or indirectly, of substances or energy into groundwater, the results of which are such as to endanger human health or water supplies, harm living resources and the aquatic ecosystem or interfere with other legitimate uses of water (Groundwater Directive 80/68/EEC).
Porosity	The ratio of the volume of void spaces in rock or sediment to the total volume of the rock or sediment.
PLC	Programmable Logic Control
PP	Pangbourne Pipeline
ppb or PPB	Parts Per Billion
PPC	Pollution Prevention and Control Regulations 2000
PPE	Personal Protective Equipment
PPG	Planning Policy Guidance
PPG16	Planning and Archaeology
PPG9	Nature Conservation
PPG25	Development and Flood Risk
PPL	Pangbourne Pipeline
ppm or PPM	Parts Per Million
PPS	Planning Policy Statement
PPS9	Biodiversity and Geological Conservation
PPS23	Planning and Pollution Control
PRB	Permeable Reactive Barrier
PRG	Preliminary Remediation Goal
PRO	Petrol Range Organics
PSD	Particle size distribution
pSPA	proposed Special Protection Area
PTS	(inter-laboratory) Proficiency Testing Schemes
PWD	Portable Water Drainage
QA	Quality Assurance
RA	Chemical analysis for radioactivity. In the first instance gross alpha, gross beta and tritium analysis. This analysis is undertaken by AWE's internal laboratories. Where elevated results are identified AWE undertake speciation analysis, primarily alpha spectrometry to identify concentrations of uranium and plutonium isotopes.
RA	Radiological Assessment
RA	Risk Assessment
RAMSAR	The Ramsar Convention on Wetlands of International Importance
RAWTP	Radioactive Waste Water Treatment Plant
RCD	Residual Current Device
RD	Re-drill, a borehole that required re-drilling
RD	Reductive Dechlorination
R&D	Research and Development
Receptor	An entity, such as human, animal, controlled waters, plant, building or the atmosphere, which is vulnerable to the adverse effects of a hazardous substance, agent or action (e.g. development) and can receive benefit from positive effects.
Red List	Birds of Conservation Concern Red List species are those that are globally threatened, whose population or range has declined rapidly in recent years (more than 50% in 25 years), or which have declined historically and not recovered.
Redox	Reduction-oxidation

Redox potential	The electrochemical potential of an oxidation-reduction half reaction under prevailing conditions measured with respect to the standard reduction potential of the hydrogen gas/proton redox couple, which is defined as zero.
Residual Impacts	Impacts remaining following the implementation of mitigation
Retardation	A measure of the reduction in solute velocity relative to the velocity of the advecting groundwater caused by processes such as adsorption.
RIGS	Regionally Important Geological Sites
Risc Human	Risc Human 3.1 is a proprietary human health risk assessment software model designed for the Site-specific risk assessment of a Site using calculations based on the CSOIL, VOLASOIL and SEDISOIL submodels developed by the Dutch "National Institute of Public Health and Environmental Protection (RIVM)". The CSOIL submodel was used to derive the "Intervention Values" for the Netherlands. The CSOIL model uses exposure routes and default values of parameters relevant in residential areas with gardens. The application of this to the Aldermaston Site is therefore conservative. CSOIL assumes equilibrium between determinand concentrations in soil, soil water and soil air to calculate the concentration in the three soil phases. A flux of determinand from the soil air and water towards the soil surface is assumed to occur. The determinand will evaporate from the surface level. Determinands found in soil water are assumed to be able to permeate through synthetic surface pipes and can be taken up by grass. Exposure via direct contact with contaminated soil is also possible. Based on Site-specific data, the model output can contribute to an assessment of possible human health risk. Exposure to soil, soil air and soil water via key exposure routes is used to assess the degree of risk associated with the Site. It should be noted that Risc Human does not incorporate the effects of natural attenuation and dilution during transport in the calculations which adds another layer of conservatism.
ROI	Radius of influence
RPD	Radiation Physics Department or Relative Percentage Difference
RPG	Regional Planning Guidance
RPG9	Regional Planning Guidance for the South-East
RSA	Radioactive Substances Act
RT	Route Termination
S	The shallow installation of a dual installation
SAC	Special Area of Conservation
SAFEGROUNDS	<p>The SAFEGROUNDS (SAFety and Environmental Guidance for the Remediation of Nuclear and Defence Sites) project began in 1998 when nuclear industry committees sponsored by the Department of Trade and Industry (DTI) were discussing the difficulties of estimating and managing the liabilities posed by contaminated land on nuclear sites. A feasibility study was carried out by CIRIA, The Environment Council and WS Atkins to investigate whether and how best practice guidance could be established. The study resulted in the proposal to undertake a three-year project, to be known as SAFEGROUNDS that would:</p> <ul style="list-style-type: none">• Establish a learning network, to be funded by the nuclear industry and others;• Use the network to produce, by consensus amongst a wide range of stakeholders, good practice guidance on the health,

	<p>safely and environmental aspects of managing contaminated land on civil nuclear sites and on defence sites; and</p> <ul style="list-style-type: none">• Evolve into a self-standing learning network to maintain and improve the guidance in the light of experience in using it, and taking into account regulatory and other developments. <p>The proposal was approved and SAFEGROUNDS proper began in mid-1999. Since then the project has been managed by CIRIA, with support from The Environment Council, on behalf of the DTI Liability Management Group Safety Issues Task Force (SITF). Until 2001, WS Atkins was also part of the management team. SAFEGROUNDS was developed to:</p> <ul style="list-style-type: none">• Support good practice in the health, safety and environmental aspects of managing contaminated land on civil nuclear sites and defence sites• Address radioactively contaminated land, chemically (non-radioactively) contaminated land, and land with both radioactive and chemical contamination. <p>Stakeholder dialogue processes, a website, meetings of a steering group, meetings of a project management team, and contracts for particular pieces of work, have been used to produce good practice guidance that is agreed by all stakeholders. The guidance was developed primarily for site owners, site operators and their contractors, but it was intended to be useful to others, including regulators and groups within the public.</p>
SAM	Scheduled Ancient Monument (now known as Scheduled Monument – see below)
SCM	Source Conceptual Model
SM	Scheduled Monument
Saturated zone	The zone in which the voids of the rock or soil are filled with water at the pressure greater than atmospheric. The water table is the top of the saturated zone in an unconfined aquifer.
Scale (in relation to impacts)	The predicted deviation from the Baseline in terms of magnitude of an effect
SCRT	Soil, Chemical, Radiological and Toxin survey
SCRT 2	Soil, Chemical, Radiological and Toxin survey Phase 2
SCRT 2 Design	Soil, Chemical, Radiological and Toxin survey Phase 2 – Represents the desk study, environmental audit and design which was undertaken by Golder between March and May 2002.
SCRT 2 Exploratory Investigation	Soil, Chemical, Radiological and Toxin survey Phase 2 – Represents the Exploratory Investigation and the series of reports of which this is one.
SCRT IA	Soil, Chemical, Radiological and Toxin survey Phase IA (undertaken by AEAT)
SCRT IB	Soil, Chemical, Radiological and Toxin survey Phase IB (undertaken by Golder) between 1999 and 2002. Assessing 15 client determined, discrete areas of Site.
SCRT III	Soil, Chemical, Radiological and Toxin survey Phase III – Represents the groundwater monitoring project which Golder began in 2003 and is ongoing. Year 1 ran between March 2003 and March 2004, Rounds 1-13. Year 2 ran between June/July 2004 and March 2005, Rounds 14-22. Year 3 ran between June 2005 and April 2007.

SCWM	Steam, Condensate and Water Main
SD	Secure Duct
SDSP	Site Development Strategy Plan
SEM	Solvent Extractable Matter
SFS	Standard Field Suite (Temperature, conductivity and pH). Insufficient groundwater for dissolved oxygen and redox potential readings.
SG	Silchester Gravels
SGVs	Soil Guideline Values – a generic value, produced using the CLEA 2002 software package, used for the assessment of the implications of contaminated land on human health.
SI	Statutory Instrument
SI	Site Investigation
SL	Street Lighting Cable
SM	Steam Main
SMR	Sites and Monuments Record
SNIFFER	Scotland and Northern Ireland Forum for Environmental Research
SOD	Soil Oxidative Demand
SOM	Soil Organic Matter
Sorption	Absorption and adsorption considered jointly.
Source	A hazardous substance or agent (e.g. a determinand that is capable of causing harm).
Source Area	The area delineated by the potential presence of NAPL contamination.
Source Zone	Defined as the area where non aqueous phase liquid (NAPL) is deemed to be present
SPA	Special Protection Area
SPT	Standard Penetration Test
SPZ	Source Protection Zone
SRI	Safety Related Incident
SSSI	Site of Special Scientific Interest. Under the Wildlife and Countryside Act 1981 (amended in 1985), the Government has a duty to notify as an SSSI any land which it considers to be of special interest because of its flora, fauna, geological or geographical features.
SSV	Soil Screening Value
Stakeholders	Interested parties including regulators, public, NGOs etc.
Stratified	With reference to the Non-Targeted aspect of the SCRT 2 Exploratory Investigation, the SCRT 2 design was such that a grid was overlaid on the Site and a borehole located into each grid square. The borehole could be located anywhere within the square.
SUDS	Sustainable Urban Drainage Systems
SVOC	Semi-Volatile Organic Compounds (PAHs/Phenols/Organotins)
SW	Surface Water Drain
Systematic	With reference to the Non-Targeted aspect of the SCRT 2 Exploratory Investigation, the SCRT 2 design followed a system.
Taste/odour threshold	The taste/odour threshold for hydrocarbons is 0.1 mg/l. The criteria for hydrocarbons
TBT0	Tributyl Tin Oxide
ICA	Trichloroethane
TCE	Trichloroethylene
TCM	Trichloromethane (Chloreform)
TCPA	Town and Country Planning Act

TDS	Total Dissolved Solids
TDSI	Tolerable Daily Soil Intake
TIC	Tentatively Identified Compound
TLC	Thin Layer Chromatography
TNVA	Total Non-Volatile Aromatics (a measurement of PAHs)
TOC	Total Organic Carbon
TOM	Total Organic Matter
TPH	Total Petroleum Hydrocarbons (PRO and DRO)
TPHCWG	Total Petroleum Hydrocarbons Criteria Working Group
TVERC	Thames Valley Environmental Record Centre
-TW	Trade Waste
U100	An undisturbed sample recovered in a 100 mm diameter sample tube
ug/l	Micrograms per litre
UKDWS	United Kingdom Drinking Water Standards
UN	Unknown
UPS Duct	Uninterruptible Power Supply Duct
URS	URS Corporation
USEPA	United States Environmental Protection Agency
USEPA PRG	United States Environmental Protection Agency Preliminary Remediation Goals. These are risk-based tools for evaluating and cleaning up contaminated sites. They combine current EPA toxicity values with "standard" exposure factors to estimate determinand concentrations in environmental media (soil, air and water) that are considered protective of humans. They are generic and calculated without Site specific information. Exceeding a PRG suggests further evaluation of the potential risks that may be posed by Site determinants is appropriate. PRG concentrations are based on exposure pathways for which generally accepted methods, models and assumptions have been developed (i.e. ingestion, dermal contact and inhalation) for specific land-use conditions. PRGs for tap water can be used to quantitatively, but conservatively, assess groundwater results. PRGs for industrial soil have been applied to soil data.
UZ	Unsaturated Zone
Variable Density	With reference to the Non-Targeted aspect of the SCRT 2 Exploratory Investigation, the variable density grid system used across the Site was based on our existing knowledge of Site, intensity of land-use and likely frequency of potential determinand sources.
VC	Vinyl Chloride
VOC	Volatile Organic Compounds
VWT	Vibrating Wire Transducer
WaCA	Wildlife and Countryside Act 1981
WBC	West Berkshire Council
WFD	Water Framework Directive
WHO (health)	World Health Organisation
WMG	Waste Management Group
WP	Water - Potable
WQS	Water Quality Standards
WRA	Water Resources Act
WRC	Water Resources Council
XTF	Explosives Technology Facility
Xylene (p/m)	The p and m isomers of xylene.

TABLES

Table A: HEFF Project Area Baseline Conditions Chemical Tables – Soil Determinants

Determinant	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
1,1,1,2-Tetrachloroethane	ug/kg	<1	N/D	N/D	N/D	N/D
1,1,1-Trichloroethane	ug/kg	<1	N/D	N/D	N/D	N/D
1,1,2,2-Tetrachloroethane	ug/kg	<1	N/D	N/D	N/D	N/D
1,1,2-Trichloroethane	ug/kg	<1	N/D	N/D	N/D	N/D
1,1-Dichloroethane	ug/kg	<1	N/D	N/D	N/D	N/D
1,1-Dichloroethene	ug/kg	<1	N/D	N/D	N/D	N/D
1,1-Dichloropropene	ug/kg	<1	N/D	N/D	N/D	N/D
1,2,3-Trichlorobenzene	ug/kg	<1	N/D	N/D	N/D	N/D
1,2,3-Trichloropropane	ug/kg	<1	N/D	N/D	N/D	N/D
1,2,4,5-Tetrachlorobenzene	mg/kg	<1	N/D	N/D	N/D	N/D
1,2,4-Trichlorobenzene	ug/kg	<100	N/D	N/D	N/D	N/D
1,2,4-Trimethylbenzene	ug/kg	<1	N/D	N/D	N/D	N/D
1,2-Dibromo-3-chloropropane	ug/kg	<1	N/D	N/D	N/D	N/D
1,2-Dibromoethane	ug/kg	<1	N/D	N/D	N/D	N/D
1,2-Dichlorobenzene	ug/kg	<1	N/D	N/D	N/D	N/D
1,2-Dichloroethane	ug/kg	<1	N/D	N/D	N/D	N/D
1,2-Dichloropropane	ug/kg	<1	N/D	N/D	N/D	N/D
1,2-Diphenylhydrazine	mg/kg	<1	N/D	N/D	N/D	N/D
1,3,5-Trimethylbenzene	ug/kg	<1	N/D	N/D	N/D	N/D
1,3-Dichlorobenzene	ug/kg	<100	N/D	N/D	N/D	N/D
1,3-Dichloropropane	ug/kg	<1	N/D	N/D	N/D	N/D
1,4-Dichlorobenzene	ug/kg	<100	N/D	N/D	N/D	N/D
1,3-Dichlorotoluene	ug/kg	<1	N/D	N/D	N/D	N/D
1-Naphthylamine	mg/kg	<1	N/D	N/D	N/D	N/D
2,2-Dichloropropane	ug/kg	<1	N/D	N/D	N/D	N/D
2,3,4,6-Tetrachloropheno	mg/kg	<1	N/D	N/D	N/D	N/D
2,4,5-Trichlorophenol	ug/kg	<100	N/D	N/D	N/D	N/D

Determinand	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
2,4,6-Trichlorophenol	ug/kg	<100	N/D	N/D	N/D	N/D
2,4-Dichlorophenol	ug/kg	<100	N/D	N/D	N/D	N/D
2,4-Dimethylphenol	ug/kg	<100	N/D	N/D	N/D	N/D
2,4-Dinitrophenol	mg/kg	<1	N/D	N/D	N/D	N/D
2,4-Dinitrotoluene	ug/kg	<100	N/D	N/D	N/D	N/D
2,6-Dichlorophenol	mg/kg	<1	N/D	N/D	N/D	N/D
2,6-Dinitrotoluene	ug/kg	<100	N/D	N/D	N/D	N/D
2-Chloronaphthalene	ug/kg	<100	N/D	N/D	N/D	N/D
2-Chlorophenol	ug/kg	<100	N/D	N/D	N/D	N/D
2-Chlormtoluene	ug/kg	<1	N/D	N/D	N/D	N/D
2-Methylnaphthalene	ug/kg	<100	N/D	N/D	N/D	N/D
2-Methylphenol	ug/kg	<100	N/D	N/D	N/D	N/D
2-Naphthylamine	ug/kg	<1	N/D	N/D	N/D	N/D
2-Nitroaniline	ug/kg	<100	N/D	N/D	N/D	N/D
2-Nitrophenol	ug/kg	<100	N/D	N/D	N/D	N/D
2-Picoline	mg/kg	<1	N/D	N/D	N/D	N/D
3-Nitroaniline	ug/kg	<100	N/D	N/D	N/D	N/D
4-Bromophenyl phenylether	ng/kg	<100	N/D	N/D	N/D	N/D
4-Chloro-3-methylphenol	ug/kg	<100	N/D	N/D	N/D	N/D
4-Chloroaniline	ug/kg	<100	N/D	N/D	N/D	N/D
4-Chlorophenyl phenylether	ug/kg	<100	N/D	N/D	N/D	N/D
4-Chlormtoluene	ug/kg	<1	N/D	N/D	N/D	N/D
4-Isopropyltoluene	ug/kg	<1	N/D	N/D	N/D	N/D
4-Methylphenol	ug/kg	<100	N/D	N/D	N/D	N/D
4-Nitroaniline	ug/kg	<100	N/D	N/D	N/D	N/D
4-Nitrophenol	ug/kg	<100	N/D	N/D	N/D	N/D
Acenaphthene	ug/kg	<34-1613	106000000	-	LOD	HE8, BH0413, BHGM3, LU6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP8
Acenaphthene (leachate)	mg/L	<0.00002	N/D	N/D	N/D	N/D

Determinand	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
Aceanaphthalene	ug/kg	<5-261	1010	-	LOD	HE8, BH0413, BHGM3, HE6, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP6, GATP7, GATP8
Acenaphthylene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Acetophenone	mg/kg	<1	N/D	N/D	N/D	N/D
Acid Soluble Sulphide	mg/kg	<5	N/D	N/D	N/D	N/D
Aniline	mg/kg	<1	N/D	N/D	N/D	N/D
Anthanthrene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Anthracene	ug/kg	<9-1600	70900000	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, G92GASS1, GASS3, GABH4, GABH2, GATP5, GATP7, GATP8
Anthracene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Aminimony	mg/kg	<1-1	9340	-	LOD	Red Area, Green Area, Blue Area
Arsenic	mg/kg	<1-17	633	-	12	BHGM3, TP105
Arsenic (leachate)	ug/l	<1-2	N/A	N/A	30	-
Asbestos (fibres)	fibres	N/D-Detected	LOD	GATP2	N/D	N/D
Azobenzene	ug/kg	<100	N/D	N/D	N/D	N/D
Barium	mg/kg	18-53	7440	-	LOD	GABH2, GABH3, GABH4, GASS1, GASS3, GATP5, GATP6, GATP7, GATP8
Barium (leachate)	ug/l	1-3	N/A	N/A	1000	-
Benzene	ug/kg	<10	N/D	N/D	N/D	N/D
Benz(a)anthracene	ug/kg	<12-7400	355000	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH4, GABH2, GATP5, GATP7, GATP8
Benz(a)anthracene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D

Determinand	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
Benzo(a)pyrene	ug/kg	<12-5700	37500	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8
Benzo(a)pyrene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Benzo(b)fluoranthene	ug/kg	<16-5300	355000	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GATP7, GATP8
Benzo(b)fluoranthene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Benzo(e)pyrene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Benzo(ghi)perylene	ug/kg	<10-9500	33200000	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8
Benzo(ghi)perylene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Benzo(k)fluoranthene	ug/kg	<25-5300	355000	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GATP7, GATP8
Benzo(k)fluoranthene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Benzoic Acid	mg/kg	<1	N/D	N/D	N/D	N/D
Benzyl Alcohol	mg/kg	<1	N/D	N/D	N/D	N/D
Beryllium	mg/kg	<0.4-1	No criteria	N/A	LOD	GABH3, GABH4, GASS1, GATP5, GATP6, GATP7, GATP8
Beryllium (leachate)	ug/l	<1	N/D	N/D	N/D	N/D
Bis(2-chloroethoxy)methane	ug/kg	<100	N/D	N/D	N/D	N/D
Bis(2-	mg/kg	<1	N/D	N/D	N/D	N/D

May 2007

HEFF Project Area EA

Version B.0

07514240011.501

Final

Determinant	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
chloroethyl ether						
Bis(2-chloroisopropyl)ether	mg/kg	<1	N/D	N/D	N/D	N/D
Boron	mg/kg	<1-3	202000	-	LOD	HE3, HE4, HE5, HE8, BH0513, BH0413, BHGM3, SS1, 3, 5, 7, 8, 9, 10, TP101, 103, 104, 105, 106, GM11, 12, 13, 14, Red Area, Yellow Area, Green Area, Blue Area
Boron (leachate)	ug/l	<1-18	N/A	N/A	2000	-
Bromobenzene	ug/kg	<1	N/D	N/D	N/D	N/D
Bromoethane	ug/kg	<1	N/D	N/D	N/D	N/D
Bromodichloromethane	ug/kg	<1	N/D	N/D	N/D	N/D
Bromoform	ug/kg	<1	N/D	N/D	N/D	N/D
Bromomethane	ug/kg	<1	N/D	N/D	N/D	N/D
Butyl benzyl phthalate	ug/kg	<100	N/D	N/D	N/D	N/D
Cadmium	mg/kg	<1-1	1570	-	1	-
Cadmium (leachate)	ug/l	<0.4	N/D	N/D	N/D	N/D
Carbazole	ug/kg	<100	N/D	N/D	N/D	N/D
Carbon Dioxide (gas)	% v/v	<0.1-5.1	5	1	N/A	N/A
Carbon Disulphide	ug/kg	<1	N/D	N/D	N/D	N/D
Carbon Tetrachloride	ug/kg	<1	N/D	N/D	N/D	N/D
Catechols (leachate)	mg/l	<0.0005	N/D	N/D	N/D	N/D
Chloride (leachate)	mg/l	<1-21	N/A	N/A	250	-
Chlorobenzene	ug/kg	<1	N/D	N/D	N/D	N/D
Chlorodibromomethane	ug/kg	<1	N/D	N/D	N/D	N/D
Chloroethane	ug/kg	<1	N/D	N/D	N/D	N/D
Chloroform	ug/kg	<1	N/D	N/D	N/D	N/D
Chloroacetane	ug/kg	<1	N/D	N/D	N/D	N/D
Chromium	mg/kg	7-37	4450	-	38	-
Chromium (leachate)	ug/l	<1-15	N/A	N/A	250	-
Chromium VI	mg/kg	<0.3-1.9	4450	-	38	-

Determinand	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
Chrysene	ug/kg	<10-5700	355000	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GAHH2, GABH4, GATP5, GATP7, GATP8
Citrysent (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
cis-1,2-Dichloroethene	ug/kg	<1	N/D	N/D	N/D	N/D
cis-1,3-Dichloropropene	ug/kg	<1	N/D	N/D	N/D	N/D
Complex Cyanide (leachate)	mg/l	<0.50	N/D	N/D	N/D	N/D
Copper	mg/kg	5-540	65500	-	9	HE8, BH0335, HE10, BH0413, BHGM3, HE1, HE6, SSR, TP101, TP105, GM12, 13, 14, Red Area, Blue Area, GABH2, GABH3, GATP5, GATP7, GATP8, BH0513
Copper (leachate)	ug/l	<1-76	N/A	N/A	28	BH0513
Cresols (leachate)	mg/l	<0.0005	N/D	N/D	N/D	N/D
Cumene	ug/kg	<1	N/D	N/D	N/D	N/D
Cyanide	mg/kg	<1-3.7	14300	-	LOD	GM14
Cyanide (leachate)	ug/l	<0.05	N/D	N/D	N/D	N/D
Cyclopentadienylpyrene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Dibenz(a,h)anthracene	ug/kg	<8-1200	35500	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8
Dibenz(ab)anthracene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Dibenzofuran	ug/kg	<100	N/D	N/D	N/D	N/D
Dibromochloromethane	ug/kg	<1	N/D	N/D	N/D	N/D
Dibromomethane	ug/kg	<1	N/D	N/D	N/D	N/D
Dichlorodifluoromethane	ug/kg	<1	N/D	N/D	N/D	N/D
Dichloroethyl ether	ug/kg	<100	N/D	N/D	N/D	N/D
Dichloromethane	ug/kg	<1	N/D	N/D	N/D	N/D

Determinand	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
Diesel Range Organics	mg/kg	2-35	B/P	B/P	B/P	B/P
Diethyl phthalate	ug/kg	<100	N/D	N/D	N/D	N/D
Dimethyl phthalate	ug/kg	<100	N/D	N/D	N/D	N/D
Di-n-butylphthalate	ug/kg	<100	N/D	N/D	N/D	N/D
Di-n-octylphthalate	ug/kg	<100	N/D	N/D	N/D	N/D
Di-sec-octyl phthalate	ug/kg	<100-393	1490000	-	LOD	BH0335
Easily liberated Cyanide (leachate)	mg/l	<0.50	N/D	N/D	N/D	N/D
Ethyl Benzene	ug/kg	<10	N/D	N/D	N/D	N/D
Fluoranthene	ug/kg	<25-8900	22000000	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP7, GATP8
Fluoranthene (leachate)	mg/l	<0.000032	N/D	N/D	N/D	N/D
Fluorene	ug/kg	<12-1151	70600000	-	LOD	HE8, RH0413, BHGM3, HE6, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP6, GATP7, GATP8
Fluorene (leachate)	mg/l	<0.000032	N/D	N/D	N/D	N/D
Gross Alpha	Bq/g	0.4-1	1.1	-	N/A	N/A
Gross Beta	Bq/g	0.35-0.68	1	-	N/A	N/A
Hexachlorbutadiene	ug/kg	<1	N/D	N/D	N/D	N/D
Hexachlor-1,3-butadiene	ug/kg	<1	N/D	N/D	N/D	N/D
Hexachlorobenzene	ug/kg	<100	N/D	N/D	N/D	N/D
Hexachlorobutadiene	ug/kg	<100	N/D	N/D	N/D	N/D
Hexachlorocyclo pentadiene	ug/kg	<100	N/D	N/D	N/D	N/D
Hexachloroethane	ug/kg	<100	N/D	N/D	N/D	N/D

Determined	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
Indeno(1,2,3-cd)pyrene	ug/kg	<11-5600	353000	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Blue Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP7, GATP8
Indeno(1,2,3-cd)pyrene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Iron (leachate)	ug/l	50-380	N/A	N/A	1000	-
Isophorone	ug/kg	<100	N/D	N/D	N/D	N/D
Isopropylbenzene	ug/kg	<1	N/D	N/D	N/D	N/D
Lead	mg/kg	3-107	750	-	23	HE8, BH0413, BHGM3, SS5, SS8, SS9, SS10, TP101, GM13, 14, Red Area, Yellow Area, Blue Area, Green Area, GASS3, GATP8
Lead (leachate)	ug/l	<1-5	N/A	N/A	250	-
Mercury	mg/kg	<0.1-2	608	-	LOD	BH0335, SS8, SS9, GM14
Mercury (leachate)	ug/l	<0.05	N/D	N/D	N/D	N/D
Methane (gas)	% v/v	<0.1-0.3	1	-	N/A	N/A
Mineral Oil / Paraffin	mg/kg	<10-232	B/P	B/P	B/P	B/P
Molybdenum	mg/kg	<1	N/D	N/D	N/D	N/D
MTBE	ug/kg	<10	N/D	N/D	N/D	N/D
Naphthalene	ug/kg	<10-3742	30300	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP5, GATP6, GATP7, GATP8
Naphthalene (leachate)	mg/l	<0.00002-0.00004	N/A	N/A	0.01	-
n-Butylbenzene	ug/kg	<1	N/D	N/D	N/D	N/D
Nickel	mg/kg	6-27	2030	-	10	HE4, BH0335, BH0513, HE10, BH0413, TP103, TP105, GM12, GM13, GABH2, GABH3, GABH4, GATP8

Determinand	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
Nickel (leachate)	ug/l	<1-4	N/A	N/A	200	-
Nitrate	mg/l	1.6	N/A	N/A	50	-
Nitrobenzene	ug/kg	<100	N/D	N/D	N/D	N/D
n-Nitrosodibutylamine	mg/kg	<1	N/D	N/D	N/D	N/D
n-Nitrosodi-n-propylamine	ug/kg	<100	N/D	N/D	N/D	N/D
o-Nitrosopipendine	mg/kg	<1	N/D	N/D	N/D	N/D
o-Propylbenzene	ug/kg	<1	N/D	N/D	N/D	N/D
NSO / Resins	mg/kg	27-2972	B/P	R/P	B/P	B/P
Oxygen (gas)	% v/v	13.3-21.1	<18	10	N/A	N/A
o-Xylene	ug/kg	<1	N/D	N/D	N/D	N/D
p/m-Xylene	ug/kg	<1	N/D	N/D	N/D	N/D
PCB	mg/kg	<0.1	N/D	N/D	N/D	N/D
Pentachlorophenol	ug/kg	<100	N/D	N/D	N/D	N/D
Petrol Range Organics	ug/kg	<10	N/D	N/D	N/D	N/D
pH	pH	4.26-9.24	B/P	B/P	B/P	B/P
Phenanthrene	ug/kg	<21-5000	70600000	-	LOD	HE8, BH0413, BHGM3, HE6, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP3, GATP6, GATP7, GATP8
Phenanthrene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
Phenol	ug/kg	<10-220	974500000	-	LOD	HE2, HE4, HE8, HE9, BH0507, HE10, BH0413, HE6, BHGM3
Phenol (leachate)	mg/l	<0.0005	N/D	N/D	N/D	N/D
Propylbenzene	ug/kg	<1	N/D	N/D	N/D	N/D
Pyrene	ug/kg	<22-8300	117000	-	LOD	HE8, BH0413, BHGM3, HE6, GM14, Red Area, Yellow Area, Green Area, Blue Area, GASS1, GASS3, GABH2, GABH4, GATP3, GATP7, GATP8
Pyrene (leachate)	mg/l	<0.00002	N/D	N/D	N/D	N/D
sec-Butylbenzene	ug/kg	<1	N/D	N/D	N/D	N/D
Selenium	mg/kg	<1-3	9980	-	2	HE8
Selenium	ug/l	<1-4	N/A	N/A	10	-

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HEFF Project Area EA

Version B.0

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Final

Determined	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
(leachate)						
Solvent Extractable Matter	mg/kg	52-3510	B/P	B/P	B/P	B/P
Styrene	ug/kg	<1	N/D	N/D	N/D	N/D
Sulphate (leachate)	mg/l	<1-292	N/A	N/A	400	-
Sulphide	mg/kg	5-16	N/A	N/A	LOD	HE3, BH0513, HE1, GM14
Sulphur	%	<0.01-0.51	N/C	N/C	N/C	N/C
tert-Butyl methyl ether	ug/kg	<1	N/D	N/D	N/D	N/D
tert-Butylbenzene	ug/kg	<1	N/D	N/D	N/D	N/D
Tetrachloroethylene	ug/kg	<1	N/D	N/D	N/D	N/D
Thiocyanate (leachate)	mg/l	0.1-0.18	N/A	N/A	1.8	-
Thiocyanate	mg/kg	<1-3	4100	-	LOD	HE4, HE8, BH0413, HE6
Toluene	ug/kg	<1	N/D	N/D	N/D	N/D
Total Ammonium (leachate)	mg/l	<0.65	N/D	N/D	N/D	N/D
Total Cyanide (leachate)	mg/l	<0.50	N/D	N/D	N/D	N/D
Total Non-volatile Aromatics	mg/kg	<10-125	B/P	B/P	B/P	B/P
Total PAH (leachate)	ug/l	<0.027-0.3	N/A	N/A	0.1	GABIII, HE8
Total Phenols (leachate)	mg/l	<0.0025	N/D	N/D	N/D	N/D
Total PAH	mg/kg	<0.025-306	B/P	B/P	B/P	B/P
Total Sulphate	mg/kg	50-1885	-	-	-	-
Total Xylenes	ug/kg	<1	N/D	N/D	N/D	N/D
TPH (bulk analysis only)	ug/kg	<50	N/D	N/D	N/D	N/D
TPH (C12-C16)	mg/kg	<0.01-23	14900	-	LOD	Red Area, Yellow Area, Green Area, Blue Area, GATP8
TPH (C16-C21)	mg/kg	<0.01-130	11200	-	LOD	Red Area, Yellow Area, Green Area, Blue Area, GATP8
TPH (C21-C35)	mg/kg	<0.01-580	11200	-	LOD	Red Area, Yellow Area, Green Area, Blue Area, GATP8, GABH2, GABH3, GATP6
TPH (C8-C10)	mg/kg	<0.01	N/D	N/D	N/D	N/D
TPH (C10-C12)	mg/kg	<0.01-3	27	-	LOD	Red Area, Yellow Area, Green Area, Blue Area
TPH (leachate)	mg/l	<0.1	N/D	N/D	N/D	N/D
trans-1,2-Dichloroethene	ug/kg	<1	N/D	N/D	N/D	N/D

Determinant	Units	Range	Human Health Risk Screening Value	Samples Exceeding Screening Value	Groundwater Risk Screening Value	Samples Exceeding Screening Value
trans-1,3-Dichloropropene	ug/kg	<1	N/D	N/D	N/D	N/D
Trichloroethene	ug/kg	<1	N/D	N/D	N/D	N/D
Trichlorofluoromethane	ug/kg	<1	N/D	N/D	N/D	N/D
Trimethylphenol (leachate)	mg/l	<0.0005	N/D	N/D	N/D	N/D
Tritium Activity	Bq/g	0.17-0.62	AWE Trigger Levels	-	-	-
Vanadium	mg/kg	15-53	12000	-	LOD	GABH2, GABH3, GABH4, GASS1, GASS3, GATPS, GATP6, GATP7, GATP8
Vanadium (leachate)	ug/l	<1-4	N/A	N/A	60	-
Vinyl Chloride	ug/kg	<1	N/D	N/D	N/D	N/D
VOC (gas)	ppm	<0.1-8.6	10	-	-	-
Xylene	ug/kg	<10	N/D	N/D	N/D	N/D
Xylenols & Ethylphenols (leachate)	mg/l	<0.0005	N/D	N/D	N/D	N/D
Zinc	mg/kg	7-237	192000	-	52	HFX, HHFTVS, BH0513, BH0413, BHGM3, Red Area, Blue Area
Zinc (leachate)	ug/l	<3-41	N/A	N/A	500	-

Notes to Accompany Table A

(1): Human health risk screening values are Golder AWE Soil Screening Values, which have been generated using CLEA for a conservative AWE-specific conceptual model.

(2): Groundwater risk screening values comprise various water quality standards chosen in accordance with the hierarchy presented in Section 4.5.2.3 of this Technical Appendix (for leachate data) or background concentrations/detection limit (for soil data).

B/P: Bulk Parameter. The determinand is a bulk parameter and does not have a relevant screening value. These are considered within Tables 3a and 3b of this Technical Appendix but are excluded from tables within Chapter 7 of this ES.

N/A: Not Applicable. Leachate analysis from soils has been completed to facilitate the assessment of risks to groundwater. As such, human health screening values have not been specified.

N/D: Not Detected. The determinand was not detected in any sample analysed and therefore the screening value has not been specified.

LOD: Limit of Detection. Where background concentrations are not available for soil contaminants, the LOD has been used as the value for screening for risks to groundwater.

Table B: HEFF Project Area Baseline Conditions Chemical Tables – Groundwater Determinants

Determinant	Units	Range			Groundwater Risks			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding criteria/LDN On-site	Screening Criteria	Source of HHC	Boreholes Exceeding LDN and HHC Onsite
>C10-C12 Aliphatics (FC=1)	ug/l	<10	<10	<10-1349	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
>C12-C16 Aliphatics (FC=14)	ug/l	<10-996	<10	<10	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
>C16-C21 Aliphatics	ug/l	<10-2134	<10	<10	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
>C21-C25 Aliphatics	ug/l	<10-268	<10	<10	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
>C6-C8 Aliphatics	ug/l	<10	<10	<10	N/D	N/D	N/D	N/D	N/D	N/D
>C7-C8 Aromatics	ug/l	<10	<10	<10	N/D	N/D	N/D	N/D	N/D	N/D
>C8-C10 Aliphatics (BC=9)	ug/l	<10-488	<10	<10	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
>EC10-EC12 Aromatics	ug/l	<10-2023	<10	<10	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
>EC12-EC16 Aromatics	ug/l	<10-107	<10	<10	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
>EC16-EC21 Aromatics	ug/l	<10-362	<10	<10	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
>EC21-EC35 Aromatics	ug/l	<10-208	<10	<10-20	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
>EC36-EC10 Aromatics	ug/l	<10-733	<10	<10	10	DEFRA	N/D	LOE and >10-5 atm-m3/mol	TPHCWGS	N/D
1,1,1,2-Tetrachloroethane	ug/l	<1	<1	<1	N/E	N/D	N/D	N/D	N/D	N/D
1,1,1-Trichloroethane	ug/l	<1	<1	<1-24	100	FWQS*	N/D	LOE and >10-5 atm-m3/mol	EA Draft Tech Report PS-079/IRI	N/D
1,1,2,2-Tetrachloroethane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
1,1,2-Trichloroethane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
1,1-Dichloroethane	ug/l	<1	<1-8	<1	810	US EPA PRG	*	LOE and >10-5 atm-m3/mol	Mackay et al BH0324	
1,1-Dichloroethene	ug/l	<1	<1-3	<1	30	WHO	*	LOE and >10-5 atm-m3/mol	Mackay et al BH0324	
1,1-Dichloropropene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
1,2,3-Trichlorobenzene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
1,2,3-Trichloropropane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
1,2,4-Trichlorobenzene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D

Determinant	Units	Range		Down Gradient	Screening Value	Groundwater Risks		Human Health Risks	
		Up Gradient	On Site			Boreholes Exceeding Criteria/LOD On-site	Screening Criteria	Source of HLC	Boreholes Exceeding LOD and HLC On-site
1,2,4-Trimethylbenzene	ug/l	<1-22	<1	<1	12	US LPA PRG	N/D	LOD and >10-5 am/m ³ /mol	Mackey et al
1,2-Dibromo-3-chloropropane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
1,2-Dibromoethane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
1,2-Dichlorobenzene	ug/l	<1	<1	<0.5-0.82	<1	FW EQS	-	LOD and >10-5 am/m ³ /mol	Mackey et al
1,2-Dichloropropane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
1,3,5-Trimethylbenzene	ug/l	<1-56	<1	<1	12	US EPA PRG	N/D	LOD and >10-5 am/m ³ /mol	Mackey et al
1,3-Dichlorobenzene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
1,3-Dichloropropane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
1,4-Dichlorobenzene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
1,4-Dichloropropane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2,2-Dichloropropane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2,4,5-Trichlorophenol	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2,4,6-Trichlorophenol	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2,4-Dichlorophenol	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2,4-Dimethylphenol	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2,4-Dinitrotoluene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2,6-Dinitrotoluene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2-Chloronaphthalene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2-Chlorophenoxy	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2-Chlorotoluene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2-Methylnaphthalene	ug/l	<1-3	<1	<1	No criteria	-	N/D	LOD and >10-5 am/m ³ /mol	Mackey et al
2-Methylphenol	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2-Nitroaniline	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
2-Nitrophenol	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
3-Nitroaniline	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
4-Bromophenylphenylether	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
4-Chloro-3-methylphenol	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D

Determinant	Limits	Range			Groundwater Risky			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding criteria/LOD	Screening Criteria	Source of HLC	Boreholes Exceeding LOD and HLC On-site
4-Chloroaniline	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
4-Chlorophenyl phenylether	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
4-Chlorotoluene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
4-Chloro-3-methyl phenol	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
4-nitrobenzylbenzene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
4-Methylphenol	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
4-Nitroaniline	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
4-Nitropheno	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Aceanaphthene	ug/l	<0.01- 5.35	<0.01- 0.265	<0.01-4.985	370	US EPA PRG	-	LOD and >10-5 atm-m ³ /mol	EA Draft Tech Report IP- 079/TR1	BH0158 BH0159 BH0335 BH0411 BH0413 BH0507 BH0513 B1G/MJ EBII EBIII HE2 HE4 ST15
Acenaphthylene	ug/l	<0.01- 2.007	<0.01- 0.078	<0.01-0.425	0.1	EU DWS (Criteria for total PAH)	-	LOD and >10-5 atm-m ³ /mol	EA Draft Tech Report IP- 079/TR1	BH0159 BH0335 BH0507 BH0513 EBH1 HE2 HE4 BH0413
Acidity	mg/l	<5.58	-	-	No criteria	N/D	N/D	N/A	N/D	N/D
Aldrin	ug/l	<0.01	<0.01	<0.01	N/D	-	-	N/D	N/D	N/D
Alkalinity Total	ug/l	<2000-	<2000-	<2000-	DL	-	BH0158	N/A	-	-

Determination	Units	Range			Groundwater Risks			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding criteria/LOD On-site	Screening Criteria	Source of HI/C	Boreholes Exceeding LOD and HI/C On-site
alpha-HCH (Lindane)	µg/l	<0.01	<0.01	<0.01	N/D	N/D	BH0159 BH0507 EBH11 EBH11A	N/D	N/D	N/D
Aluminum	µg/l	-	-	<3-161	No criteria	-	BH0158 BH0159 EBH11A BH0513 HE4 BH0413	N/A	N/A	N/D
Ammonium Nitrogen as NH4-N	µg/l	<200-1800	<200-1800	<200-3600	390	UK DWS	-	-	-	-
Ammonium	µg/l	<300-3000	<10-207	-	500	EU DWS	-	N/A	-	-
Anthracene	µg/l	<0.01-0.029	<0.01	<0.01-0.025	No criteria	-	N/D	LOD and <10-5 atm-m³/mol (not considered volatile)	N/D	N/D
Antimony	µg/l	<0.01-2.305	<0.01-0.162	<0.01-0.83	1800	US EPA PRG	-	-	SRC 2005 PHYSPROP database	BH0158 BH0159 BH0335 BH0411 BH0413 BH0507 BH0513 EBH11 HE2 HE4 ST15
Arsenic	µg/l	<1-10	<1-6	<1-50	50	FW EQS	-	N/A	-	-
Atrazine	µg/l	-	<0.04-0.1	<0.04	2	FW EQS	-	N/A	-	-
Azimuthos ethyl	µg/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Azimuthos methyl	µg/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Azobenzene	µg/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D

Determinant	Units	Ranges			Groundwater Risks		Human Health Risks		Boreholes Exceeding LOD and HLC On-site
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding criteria/LOD On-site	Screening Criteria	
Barium	ug/l	-	<1-172	1000	EU DWS	N/A	N/A	N/A	-
Benzofluoranthene	ug/l	<0.01-2.627	<0.01-0.07	<0.01-0.142	0.1	EU DWS (Criteria for total PAH)	-	LOD and <10-5 atm-m3/mol (not considered volatile)	-
Benzene	ug/l	<1-2	<1	<1-4	30	EW PQS	N/D	LOD and >10-5 atm-m3/mol	EA Draft Tech Report PS-079/TRI N/D
Benzofluoranthene	ug/l	<0.01-1.964	<0.01-0.052	<0.01-0.247	0.01	EU DWS BH0507 EBH11A (RO54W)	STL5	LOD and <10-5 atm-m3/mol (not considered volatile)	-
Benzofluoranthene	ug/l	<0.01-2.192	<0.01-0.06	<0.01-0.268	0.092	US EPA PRG	-	LOD and >10-5 atm-m3/mol	US EPA OSWER BH0159 BH0507 STL5
Benzofluoranthene	ug/l	<0.01-0.035	<0.01-0.04	<0.01-0.011	0.1	EU DWS (Criteria for total PAH)	-	LOD and <10-5 atm-m3/mol (not considered volatile)	-
Benzoguaiacol	ug/l	<0.01-1.535	<0.01-0.109	<0.01-0.292	DL	-	HH0507 STL5	LOD and <10-5 atm-m3/mol (not considered volatile)	-
Benzofluoranthene	ug/l	<0.01-1.556	<0.01-0.036	<0.01-0.196	0.02	US EPA PRG	-	LOD and <10-5 atm-m3/mol (not considered volatile)	-
Beryllium	ug/l	-	<1-2	<1	73	US EPA PRG	-	N/A	-
beta-HCH(1-indane)	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Rivological Oxygen Demand (BOD)	ug/l	2000	<1000-97000	<1000-34000	>2000	Water quality assessment document	BH0158 BH0159 HE4 BH0413 EBH11 (RO53W) EBH11A (RO54W)	N/D	N/D

Determination	Units	Range			Groundwater Risks			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding Criteria/LD50 On-site	Screening Criteria	Source of HLC	Boreholes Exceeding LD50 and HLC On-site
Bis(2-chloroethoxy)methane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Boron	ug/l	<10-100	<10-135	<10-90	2000	FW EQS	N/A	N/A	N/D	N/D
Bromobenzene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Bromoform	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Bromochloromethane	ug/l	<1-8	<1	<1	0.18	US EPA PRG	N/D	LOD and >16.5 atm-m3/ml	Maskey et al	N/D
Bromofom	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Bromomethane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Butyl benzyl phthalate	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
C10-C40	ug/l	<10-1200	<10	<10	10	DEFRA	N/D	Refer to specific fractions above	-	N/D
C4-C12	ug/l	<1-0.4593	<10	<10	10	DEFRA	N/D	Refer to specific fractions above	-	N/D
C5-C35 Aliphatics	ug/l	<10-3338	<1	<10	10	DEFRA	N/D	Refer to specific fractions above	-	N/D
C6-C35 Aliphatics/Arenatics	ug/l	<0.4954	<10	<10-20	10	DEFRA	N/D	Refer to specific fractions above	-	N/D
C5-C6 Aliphatics (EC=5.5)	ug/l	<10	<10	<10	N/D	N/D	N/A	N/A	N/D	N/D
C6-C7 Arenatics	ug/l	<10-2860	<10	<10-20	10	DEFRA	N/D	Refer to specific fractions above	-	N/D
C6-C7 Arenatics	ug/l	<10	<10	<10	N/D	N/D	N/A	N/A	N/D	N/D
C10-20 Carbon Bonding	ug/l	-	70-100	-	10	DEFRA	BH0413 BH0513 HE2	Refer to specific fractions above	BH0413 BH0513 HE2	N/D
(C2)-10 Carbon Bonding	ug/l	-	170-260	-	10	DEFRA	BH0413 BH0513 HE2	Refer to specific fractions above	BH0413 BH0513 HE2	N/D
C3-C40 Carbon Bonding	ug/l	-	100-160	-	10	DEFRA	BH0413 BH0513 HE2	Refer to specific fractions above	BH0413 BH0513 HE2	N/D

Determined	Units	Range			Groundwater Risks			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding criteria/Op On-site	Screening Criteria	Source of HLC*	Boreholes Exceeding LQD and HLC Onsite
Cadmium	$\mu\text{g/l}$	<0.4-0.8	<0.4-4.8	<0.4-4.5	5	FW EQS	-	N/A	-	-
Calcium	$\mu\text{g/l}$	1470-55320	4.12-48.16	7.25-10.500	250000	EU DWS	-	N/A	-	-
Carbazole	$\mu\text{g/l}$	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Carbon Disulfide	$\mu\text{g/l}$	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Carbon Tetrachloride	$\mu\text{g/l}$	<0.1	<0.1-1.6	<0.1-1.4	12	FW EQS	-	LQD and >0.5 atm.m ^{3/mol}	EA Draft Tech Report PS-079/TR]	EBH11 (RO53W) EBH11A (RO54W)
Carboxymethionine	$\mu\text{g/l}$	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Chemical Oxygen Demand (COD)	mg/l	<10-944	<10-386	<10-139	>20	Groundwater literature in unpolluted surface water SCRTR	BH0158 BH0159 BH0513 EBH11 EBH11A HE4 BH0413	N/A	-	-
Chlorfenpropophos	$\mu\text{g/l}$	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Chloride	$\mu\text{g/l}$	500-10800	500-14100	800-55000	250000	EU DWS	-	N/A	-	N/D
Chlorobenzene	$\mu\text{g/l}$	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Chlorodibromomethane	$\mu\text{g/l}$	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Chloroethane	$\mu\text{g/l}$	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Chloroform	$\mu\text{g/l}$	<1-1.57	<1-1	<1	12	FW EQS	-	LQD and >0.5 atm.m ^{3/mol}	WHO & ATSDR	BH0324
Chloroethylene	$\mu\text{g/l}$	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Chlorotoluene	$\mu\text{g/l}$	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Chlortrifos	$\mu\text{g/l}$	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Chloroaclos-methyl	$\mu\text{g/l}$	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Clorotriazin	$\mu\text{g/l}$	<1-1.3	<1-1.78	<1-1.13	250	FW EQS	-	N/A	-	-
Chromatium V1	$\mu\text{g/l}$	<30	<30	<30	N/D	N/D	N/D	N/D	N/D	N/D
Chrysene	$\mu\text{g/l}$	<0.01-	<0.01-	<0.01-	<0.01-149	9.2	US EPA	-	LQD and >0.5 atm.m ^{3/mol}	EA Draft Tech BH0158

Determinant	Units	Range			Groundwater Risks			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding criteria/LQD On-site	Screening Criteria	Source of HLC	Boreholes Exceeding LQD and HLC On-site
cis,1,2-Dichloroethene	µg/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
cis-1,3-Dichloropropene	µg/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Complex Cyanide	ug/l	<50	<50	<50	N/D	N/D	N/D	N/D	N/D	N/D
Copper	ug/l	<1-8	<1-12	<1-12	28	PW EQS (R053W)	EBH11	N/A	-	-
Cyanide	ug/l	<1-3	<1	<1	660	US EPA PRG	N/D	LDP and >0.5 atm-m/meto	ECB RA report LINICS No 202-704.5	N/D
Cyanide - Free	ug/l	<50	<50,000	<50	N/D	FLUDWS	BU0158	N/A	-	-
Cyclopentadihydronaphthalene	ug/l	<0.01-0.018	<0.01	<0.01	No criteria	N/D	N/D	N/D	No HLC available	N/D
Diazinon (Dimpylate)	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Dibenzofuranthracene	µg/l	<0.01-0.75	<0.01-0.048	<0.01-0.048	0.0092	US EPA PRG	BU0507	1.00 and <10.5 atm-m/mol (not considered volatile)	-	-
Dibenzofuran	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Dihalomethane	µg/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Dibromoethane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Dichlorodifluoromethane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Dichloromethyl ether	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Dichloromethane	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Dieldrin	µg/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Diesel Range Organics	ug/l	<10-25243	<10-520	<10-356	10	DEFRA	BU0413	Refer to specific fractions above	HE2 HE4	HE2 HE4
Diethylphthalate	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D

Determinant	Units	Range		Groundwater Risks			Human Health Risks		Boreholes Exceeding LOD and HLC On-site
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding criteria/LOD On-site	Screening Criteria	
Dimethoate	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Dimethyl phthalate	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
Di-n-butylphthalate	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
Di-n-octyl phthalate	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
Di-sec-octyl phthalate	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
Dissolved Oxygen	ug/l	1400-10900	1100-11300	910	-	-	BH0158 BH0159 EBH11 EBH11A	N/A	-
Electrical Conductivity	mS/cm	-	0.16-0.57	0.092-0.505	No criteria	-	-	N/A	-
Endosulfan I	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Endosulfan II	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Endosulfan Sulphate	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Erdman	*	ug/l	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
EPH	ug/l	<10	<10	<10	N/D	N/D	N/D	N/D	N/D
Ethion	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Ethyl Benzene	ug/l	<1-128	<0.1-0.34	<1	300	WHO	-	LCID and >10-5 atm-m/Mol	-
Fenpropidin	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Fenpropathrin	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Fenthion	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Fluoranthene	ug/l	<1-5.79	<1-1.62	<0.01-0.3	1500	US EPA PRG	-	LCID and >10-5 atm-m/36mol	EA Draft Tech Report P5-079/TR1
									BH0158 BH0159 BH0335 BH0411 BH0413 BH0507 BH0513 EBH11

Determinant	Units	Up Gradient	On Site	Down Gradient	Ground/water Risks			Source of H.C	Human Health Risks	Boreholes Exceeding LOD and HLC On-site
					Screening Value	Source	Boreholes Exceeding criterial LOD On-site			
Fluorene	ug/l	<0.01-7.408	<0.01-0.193	<0.01-2.76	240	US EPA PRG	-	-	EA Draft Tech Report P5-W9/TR1	BH0158 BH0159 BH0335 BH0411 BH0413 BH0507 BH0513 BHGM3 EBH1 EBH1A HE2 HE4 ST15
Free sulphur Water	ug/l	<100	<100	<100	N/D	N/D	N/D	N/D	N/D	N/D
Gamma-HICR(Lindane)	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Gross Alpha	Bq/m ³	<5-55	-	-	40 (Bg/m ³)	AWE trigger levels ^a	BH0158	N/A	-	N/A
Gross Beta	Bq/m ³	-	10-179	-	500 (Bg/m ³)	AWE trigger levels ^a	-	N/A	-	N/A
Hepachlor	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Hepachlor Epoxyde	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Hexachloro-1,3-butadiene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Hexachlorobenzene	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Hexachlorobutadiene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Hexachlorocyclopentadiene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Hexachloroethane	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Hydrocarbon oil	ug/l	-	<50-100	-	10 UK DWS	EBH1	N/A	-	N/D	-

Determined	Units	Range		Down Gradient	Screening Value	Groundwater Risks		Human Health Risks	Source of HHC	Boreholes Exceeding LND and HHC On-site
		Up Gradient	On Site			Source	Boreholes Exceeding criterion On-site			
benzene(1,2,3 ediphenic)	ug/l	<0.01*	<0.01*	<0.01-0.161	0.092	US EPA PRG	-	LOD and <10.5 atm m3/mol (not considered volatile)	-	-
Iron	ug/l	<5.943	1.228	<1-1.06	<1-4291	1000	FW EQS	-	N/A	-
Iron II	ug/l	<50-350	<50	<50-4300	1000	FW EQS	N/D	N/A	-	-
Iron III	ug/l	<50-940	<50	<50-1500	1000	FW EQS	N/D	N/A	-	-
Ketophorone	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Isopropylbenzene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Lead	ug/l	<1-4	<1-8	<1-5	250	FW EQS	-	N/A	-	-
Lithium	ug/l	*	*	<10-25	*	130	US EPA PRG	-	N/A	*
Magnesium	ug/l	3300-1320-	90960	2240-4240	500000	UK DWS	-	N/A	-	-
Manganese	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Manganese	ug/l	867	10-1377	<37-1480	50	EU DWS	BJ10158 BH0159 EBH11A	N/A	-	-
Mercury	ug/l	<0.05-0.64	<0.05-2.1	<0.05-0.13	1	FW EQS	(RO3W)	EBH11	N/A	-
Mercury Low Dutch Target AA	ug/l	<0.05	<0.05	<0.05-0.14	1	FW EQS	-	N/A	-	-
Methyl chloroform	ug/l	<1	<1-98	<1	100	FW EQS	-	LOD and >10.5 atm m3/mol	EA Draft Tech Report P5-079/TR1	BH0124
Methyl Parathion	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Methylphos	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Naphthalene	ug/l	<1-2944	<1-8174	<1-96.1	10	FW EQS	-	LOD and >10.5 atm m3/mol	EA Draft Tech Report P5-079/TR1	BH0158 BH0159 BH0335

Determinant	Units	Range			Groundwater Risks			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding Criteria/LOD On-site	Screening Criteria	Source of HLC	Boreholes Exceeding LOD and HLC On-site
n-Butylbenzene	ug/l	<1.27	<1	<1	240	US EPA PRG	N/D	LOD and >10.5 atm-m/Mol	Mackey et al	N/D
Nickel	ug/l	<1.72	<1.36	<1.80	200	EW EQS	-	N/A	-	-
Nitrate	ug/l	300-6400	13600-	<300-27000	50000	EU DWS	-	N/A	-	-
Nitrite	ug/l	<50	<50-739	<50	300	EU DWS	BHO158 (R474W) BHO159 (R475W)	N/A	-	-
Nitrobenzene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Nitrogen	ug/l	<200-800	-	No criteria	-	-	-	N/A	-	-
N-nitrodi-k-propylamine	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
n-Propylbenzene	ug/l	<1.4	<1	<1	240	US EPA PRG	N/D	LOD and >10.5 atm-m/Mol	Mackey et al	N/D
o,p-DDC	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
o,p-DDT	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
o,p-Methosychlor	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
o,p-TDF	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	R&D Publication	ST15
o-Xylene	ug/l	<0.57	<0.15	<0.14	30	EW EQS	N/D	LOD and >10.5 atm-m/Mol	SGV §	-
p,p-DDC	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
p,p-DDT	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D

Determination	Units	Range			Groundwater Risks			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding criteria/LOQ On-site	Screening Criteria	Source of HLC	Boreholes Exceeding LOD and HLC On-site
E.P-Methoxychlor	µg/l	<0.01	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
E.P-TDE/DDD	µg/l	<0.01	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
p/m-Nitro	µg/l	<1.38	<1	<1	<1	30	FW EOS	N/D	1.0CF and >0.5 atm-m ³ /mol	R&D Publication SGV18
Parathion	µg/l	<0.01	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
PCB	µg/l	<1	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
Pentachloroalrin	µg/l	<0.01	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Pentachlorophenol	µg/l	<1	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
Pentachloro	µg/l	<0.01	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Pentachloro Organics	µg/l	<10	<10	<10	<10	N/D	N/D	N/D	N/D	N/D
Petrol Range Organics C4-C13	µg/l	<10	<10	<10	<10	N/D	N/D	N/D	N/D	N/D
pH	pH Units	3.51-8.64	4.7-8.49	3.87-8.58	<6, >9	FW EOS	BH0158 (3474W) BH0335 ST13 EBH11 (RGSJW)	N/A	-	-
Phenanthrene										
Phenol	µg/l	<0.01	<0.01	<0.01	<0.01-1.318	<0.01-3.24	No criteria	-	Refer to total PAH (sum of 4) in APC table for GW	-
Phosalone	µg/l	<1	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
Phosphorus	µg/l	<0.01	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Pirimiphos methyl	µg/l	<1(=2060	<1(=	<1(=	<1(=	400	EU DWS	N/A	-	-
Platinum	µg/l	<0.01	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Plutonium ²³⁸⁺²⁴⁰	Bq/m ³	-	<0.04-0.4	-	No criteria	-	-	N/A	-	-
Plutonium ²³⁸	Bq/m ³	<0.56	<0.56	<0.56	<0.56	N/D	N/D	N/D	N/D	N/D
Polonium	Bq/m ³	<0.43	<0.43	<0.43	<0.43	N/D	N/D	N/D	N/D	N/D
Potassium	µg/l	-	-400-2700	7000-3100	10000	EU DWS	N/A	Refer to specific fractions above	-	-
PRO C10-C12	µg/l	<1(=3217	<10	<10	<10	UE/RA	N/D	Refer to specific fractions above	-	N/D
PRO C4-C10	µg/l	<1(=19832	<1(=192	<10-94	10	DIFRA	BH0324 ST13	Refer to specific fractions above	-	BH0324 ST13

Determinant	Units	Range			Screening Value	Source	Groundwater Risks		Human Health Risks	
		Up Gradient	On Site	Down Gradient			Boreholes Exceeding criteria/LOD On-site	Screening Criteria	Source of HLC	Boreholes Exceeding LOD and HLC On-site
Prometryn	$\mu\text{g/l}$	<0.04	<0.04	<0.04	N/D	N/D	N/D	N/D	N/D	N/D
Propazine	$\mu\text{g/l}$	<0.04	<0.04	<0.04	N/D	N/D	N/D	N/D	N/D	N/D
Propenazin	$\mu\text{g/l}$	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Propylbenzene	$\mu\text{g/l}$	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Pyrene	$\mu\text{g/l}$	<0.01-5.126	<0.01-0.794	<0.01-0.29	No criteria	-	-	-	EA Draft Tech Report 75-0794(R1)	BH0158
Quintozene (PCNNB)	$\mu\text{g/l}$	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	BH0159
Redox Potential	millivolt	+41-448	-	90-265	No criteria	-	-	-	BH0335	BH0411
sec-Butylbenzene	$\mu\text{g/l}$	<1-13	<1	<1	240	US EPA PRG	N/D	N/D	N/A	ST15
Selenium	$\mu\text{g/l}$	<1-5	<1-12	<1-4	10	EU DWS	BHGMD	N/A	N/A	N/D
Simazine	$\mu\text{g/l}$	-	<0.04-0.1	<0.04	2	FW EQS	-	N/A	N/A	-
Sodium	$\mu\text{g/l}$	1700-92000	8300-45000	1700000	FW EQS	-	-	N/A	-	-
Solvent Extractable Matter	$\mu\text{g/l}$	0.0-33000	<1080-2000	<1000-60000	DL	-	BH0324 BH0335 BH0507 BH0508 BH0513 ST15	N/A	Mackey et al	N/D
Styrene	$\mu\text{g/l}$	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Sulphate	$\mu\text{g/l}$	12000-100000	110000-121000	24000-114000	400000	FW EOS	-	N/A	-	-

Determinant	Units	Range			Groundwater Risks			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding criteria/LOD On-site	Screening Criteria	Source of HLC	Boreholes exceeding LOD and HLC On-site
Sulphide	$\mu\text{g/l}$	50-120	30-90	50-90	0.25	FW EQS	N/A	BH0158 EBH11 EBH1A	-	-
Sulphur	$\mu\text{g/l}$	<50	<50	<50	N/D	N/D	N/D	N/D	N/D	N/D
Sum DNT+TEX	$\mu\text{g/l}$	<10	<10	<10	N/D	N/D	N/D	N/D	N/D	N/D
Sum of m&p and o-Xylene	$\mu\text{g/l}$	<10	<10	<10	N/D	N/D	N/D	N/D	N/D	N/D
Tantatoni	$\mu\text{g/l}$	-	<0.01-0.4	No criteria	-	-	N/A	-	-	-
Teniazene	$\mu\text{g/l}$	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Tributaryn	$\mu\text{g/l}$	<0.04	<0.04	<0.04	N/D	N/D	N/D	N/D	N/D	N/D
Tributylzaine	$\mu\text{g/l}$	<0.04	<0.04	<0.04	N/D	N/D	N/D	N/D	N/D	N/D
tert-Butyl methyl ether	$\mu\text{g/l}$	<1-3	<1	<1	US EPA PRG	N/D	LOD and >10-5 atm.-m ³ /mol	EU RA Report	-	-
tert-Butylbenzene	$\mu\text{g/l}$	<1-2	<1	<1	240	US EPA PRG	N/D	LOD and >10-5 atm.-m ³ /mol	Mackey et al.	-
Tetraethylorthocarbonate	$\mu\text{g/l}$	<1	<0.1-2.92	<1-11	10	FW EQS	-	LOD and >10-5 atm.-m ³ /mol	EA Draft Tech Report P5-079/TR	EBH11 (RO53W) EBH1A (RO54W) BH0324
Thiocyanate	$\mu\text{g/l}$	-	<50	<50-80	1800	US EPA PRO	N/D	N/A	-	-
Thiium	$\mu\text{g/l}$	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Toluene	$\mu\text{g/l}$	<1-7	<1-2.2	<1-13	50	FW EQS	-	LOD and >10-5 atm.-m ³ /mol	EA Draft Tech Report P5-079/TR	EBH11 (RO53W)
Total 19-SSP1 PAH's	$\mu\text{g/l}$	<0.01-0.53	0.143	<0.01-0.32	No criteria	-	Refer to total PAH (sum of 4) in APC table for CW	Refer to individual PAH's	-	EBH11
Total Dissolved Solids	$\mu\text{g/l}$	-	47000-270000	74000-126000	DL	-	BH0158 BH0159	N/A	-	-

Determinant	Units	Range			Groundwater Risks			Human Health Risks		
		Up Gradient	On Site	Down Gradient	Screening Value	Source	Boreholes Exceeding critical LOD On-site	Screening Criteria	Source of HLC	Boreholes Exceeding LOD and HLC On-site
Total GRO (C4-C11)	ug/l	<10	<0.5	<10	10	DEFRA	H40324	Refer to specific fractions above	-	BH0324
Total Hydrogen Cyanide	ug/l	<50	<50	<50	N/D	N/D	N/D	N/D	N/D	N/D
Total Non-volatile Aromatic	ug/l	<1000-10000	<1000	<1000	No criteria	-	-	Refer to individual PAH's	-	N/D
Total OCP	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Total Organic Carbon	ug/l	3000-35000	<1000-10000	1000-10000	DL	-	BH0158 BH0159 BH0413 DH0513 HC2-HC4 EBH11 EBH11A	N/A	-	-
Total Oxidised Nitrogen	ug/l	400-5500	300-1300	-	DL	-	BH0158 BH0159 EBH11	N/A	-	-
Total PAH	ug/l	<0.01-2.0875	<0.01-1000	<0.01-5000	No criteria	-	Refer to total PAH (sum of 4) in APC table for GW	Refer to individual PAH's	-	BH0158 BH0159 BH0335 BH0411 BH0413 BH0507 BH0508 (BHGM3) EBH11 EBH11A ST15
Total Petro Range Organics	ug/l	<10	<10	<10	N/D	N/D	N/D	N/D	N/D	N/D

Determinant	Units	Range		Groundwater Risks			Human Health Risks		Boreholes Exceeding LD and HLC On site
		Up Gradient	On Site	Boron Gradient	Screening Value	Source	Boreholes Exceeding Criteria/LD On-Site	Screening Criteria	
Total Phenol	µg/l	<10.80	<10.3470	<10.20	30	FW EQS	ST15	LD and <10.5 atm-min/mol (not considered volatile)	
Total Polychlorinated Biphenyls	µg/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
Total Suspended Solids	µg/l	-	<10000-40000	<10000-413500	DL*	*	BH0158 BH0159 EBH11 EDIT11A	N/A	N/D
Total xylenes	µg/l	<1.364	<1	<10	30	FW EQS	N/D	Refer to individual浪条	
THI Screen C8-C40	µg/l	<50	<50	<50-296	10	DL/IA	N/D	Refer to specific fractions above	
trans-1,2-Dichloroethene	µg/l	<1	<1.3	<1	50	WHO	-	LD and >10.5 atm-min/mol	Mackay et al BH0324
trans-1,3-Dichloropropene	µg/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D
m,p,p'-trinitrophenol	µg/l	<0.05	<0.05	<0.05	N/D	N/D	N/D	N/D	N/D
m,p,p'-trinitrophenol	µg/l	<0.05	<0.05	<0.05	N/D	N/D	N/D	N/D	N/D
p,p'-trichlorodibenzo-p-dioxin	µg/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Triellane	µg/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Titanophyll	µg/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D
Trichloroethylene	µg/l	-	<0.1-5.74	-	100	FW EQS T1.1-TCA*	-	LD and >0.5 atm-min/mol	EA Draft Tech Report P5-079/TR1
							BT0124		
							ST15 EBH11 (RO53W) EBH11A (RO54W)		
Trichloroethene	µg/l	<1-1.	<1-48	<1-174	10	FW EQS	EBH11 (RO53W) EBH11A (RO54W)	LD and >10.5 atm-min/mol	EA Draft Tech Report P5-079/TR1
							BT0158 (R474W) EBH11A (RO53W) EBH11A (RO54W) BH0324 ST15		

Determination	Units	Range			Screening Value	Source	Groundwater Ranks		Human Health Risk*	
		Up Gradient	On Site	Down Gradient			Boreholes Exceeding criteria/LOD On-site	Screening Criteria	Source of HLC	Groundwater Ranks
Trichloroethylene	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Tricloro-	ug/l	<0.04	<0.04	<0.04	N/D	N/D	N/D	N/D	N/D	N/D
Trihaloeth	ug/l	<0.01	<0.01	<0.01	N/D	N/D	N/D	N/D	N/D	N/D
Trifluor	ug/m³	-	-	-	500000 (Bq/m³)	EA notification level for AWE	EA	N/A	N/A	-
Uranium ²³⁴	Bq/m³	-	0.23	-	30 (Bq/m³)	EA notification level for AWE	EA	N/A	N/A	-
Uranium ²³⁵	Bq/m³	-	<0.49	-	N/D	N/D	N/D	N/D	N/D	N/D
Uranium ²³⁸	Bq/m³	-	<0.4	-	N/D	N/D	N/D	N/D	N/D	N/D
Vinyl Chloride	ug/l	<1	<1	<1	N/D	N/D	N/D	N/D	N/D	N/D
Volatile Screen	ug/l	<1.0-1620	<10	<10	10	FW EQS	N/D	N/A	N/D	-
Water Soluble Sulfate	ug/l	7000-203000	10000-146000	<3000-128000	400000	FW FQS	-	N/A	-	-
Xylene	ug/l	<0.1	<0.1	<0.1	N/D	N/D	N/D	N/D	N/D	N/D
Zinc	ug/l	<3.750	<3.1169	<3.111	500	FW EQS	RHOM3	N/A	N/A	-

Notes for Table B:

HCL = Henry's Law constant, N/D= Not Detected, LOD = Detection Limit

Note - upper limits apply to AWE for concentrations with range of criteria

Note- boreholes followed by brackets refer to data from EMAG report reference 7-32

* indicates lowest value for FW EQS used (most conservative)

References for Table B:

- US EPA OSWER: US EPA (2002) OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). Reference number: EPA 530-D-02-004
- DEFRA: DEFR A (2004) Water Quality: A Diffuse Pollution Review
- Water Quality Assessment document: UNESCO, WHO and UNEP. Water Quality Assessments. A guide to the use of biora, sediments and water in environmental monitoring. Chapman and Hall.
- ECB RA report EINECS No. 202-704-5: European Chemical Bureau Risk Assessment Report EINECS No. 202-704-5 <http://ecb.jrc.ec.europa.eu/index.php?PGM=ara>
- WHO & ATSDR: World Health Organisation and The Agency for Toxic Substances and Disease Registry
- EA Draft Tech Report P5-079/TR1: Environment Agency (2003) Review of the Fate and Transport of Selected Contaminants in the Soil Environment. Draft Tech Report P5-079/TR1
- R&D Publication SGV18: <http://www.environment-agency.gov.uk/>
- SRC 2005 PHYSPROP database: Syracuse Research Corporation (2005) Physprop database <http://www.syrres.com/easophysprop.htm>
- Groundwater literature in unpolluted surface water SCRT1B: Golder Associates (UK) Ltd (2002) SCRT1B: Area II Investigation Report, AWE Aldermaston
- TPHCWGS: Total Petroleum Hydrocarbon Criteria Working Group Series (1997) Selection of representative TPH Fractions Based on Fate and Transport Considerations, Volume 3
- Mackay et al.: Mackay, D., Shiu, W Y., and Ma, K.C. (2000) Physical-Chemical Properties and Environmental Fate Handbook. Chapman and Hall



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REPORT ON

HIGH EXPLOSIVES FABRICATION FACILITY DEVELOPMENT SITE FLOOD RISK ASSESSMENT AWE ALDERMASTON

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1.0 INTRODUCTION

1.1 Report Background

Golder Associates (UK) Ltd (Golder) has been commissioned by Atkins Nuclear to complete the Water Resources chapter for the forthcoming update to the Environmental Statement for the proposed construction of the High Explosives Fabrication Facility (HEFF) Development at the AWE Aldermaston Site. This Flood Risk Assessment (FRA) provides information for the Water Resources chapter.

1.2 Report Objectives

The objective of this report is to provide an assessment of flood risk in line with the precautionary principle and in accordance with the guidance given in Planning Policy Statement 25 (PPS25): Development and Flood Risk (Ref. 1) and the accompanying Practice Guide (Ref. 2).

The HEFF site (the Site) considered for the purposes of this report is shown in Figure 1. This includes the areas covered by the contractors' compound, the overflow contractors' compound, the construction site, the site access road and the HEFF development site, as defined by AWE (Ref. 3). This assessment does not include other areas of the HEFF construction site or HEFF Project Area such as the temporary access routes or contractors' compounds associated with the construction of the HEFF development.

1.3 Report Structure

This report is structured as follows:

- Background information on which flood risk has been assessed;
- Assessment of the likely sources of flooding;
- Calculation of flood risk relating to each source of flooding identified;
- Recommendations and mitigation measures; and
- Assumptions used for calculations.

2.0 BACKGROUND INFORMATION

2.1 Site Location

AWE Aldermaston is in West Berkshire, approximately 15 km southwest of Reading and 13 km southeast of Newbury. The Site is located within B Area (the Explosives Area) towards the centre of AWE Aldermaston. The Site location is presented in Figure 1.

2.2 Existing Site Description

The existing Site is relatively flat, gently undulating grassland with a number of young trees (mainly silver birch) (Ref. 4). There is one existing building, B3A18, within the Site, an area of hardstanding associated with this, and an existing access road (TPS Drawing No. AL20(01)03, presented in Appendix 1).

2.3 Proposed Site Description

The proposed works on the Site are shown on TPS Drawing No. AL20(01)03, presented in Appendix 1. For the purposes of this FRA, the Site has been divided into four areas, for which surface water runoff will be assessed separately. These areas, shown on Figure 2, are as follows:

- 1 – HEFF development area;
- 2 – Bulk storage area;
- 3 – Contractors' compound; and
- 4 – Road.

The HEFF development area comprises a process building, a support building, a substation and M & E building, existing building B3A18, areas of hardstanding and drainage ponds (N247-00-CI00-XA0012-6D, included in Appendix 1).

2.4 Geology and Hydrogeology

The geology beneath the Site consists of Silchester Gravel underlain by the Bagshot Beds / Transitional Zone underlain by London Clay. Golder (Ref. 4) reports that the HEFF Development Site is directly underlain by a layer of Made Ground that is typically re-worked Silchester Gravel with the occasional Made Ground indicator such as fragments of concrete, tarmac, cable and ceramic. The geology of the Site is discussed in Taylor Woodrow (Ref. 5).

Groundwater beneath the HEFF development area is reported as being typically 2 metres below ground level (mbgl) (approximately 100.7 m above ordnance datum (m AOD)) (Ref. 5). Groundwater level hydrographs for monitoring of piezometers BH0158 and BH0159 from

2001 gave a range of groundwater levels between 100.5 m AOD in August, and 102.2 m AOD in February (Ref. 4). The location of these boreholes is shown on Figure 1 of Golder (Ref. 4).

Groundwater is likely to be perched above the London Clay.

Hydraulic conductivity of the Silchester Gravel has been estimated from a series of soakaway tests carried out by Golder in January 2007. These tests gave a range of hydraulic conductivities between 1.1×10^{-7} m/s and 6.5×10^{-7} m/s (Ref. 4).

2.5 Topography

Information on the topography of the Site was not made available for this assessment. It is assumed, however, that the ground is relatively flat, without any significant sudden changes in topography, and that the ground level of the site is approximately 102.7 m AOD across the Site, following statements of ground water depth in Taylor Woodrow (Ref. 5).

2.6 Hydrology

No surface water features are present within, or near to, the Site. The AWE Aldermaston site is located on an upland plateau between the subcatchments of the River Enbourne and Foudry Brook, both of which are tributaries of the River Kennet. The River Kennet flows northeasterly approximately 2 km north of the AWE Aldermaston Site boundary (Ref. 6).

3.0 FLOOD RISK

3.1 Surface Water Runoff (Pluvial)

The primary risk of flooding at the Site is posed by surface water runoff generated during an extreme rainfall event. The increase in low permeability surfaces, e.g. hardstanding, across the Site during the construction and operational phases of the development will result in increased surface water runoff on the Site. The impact of the development on surface water runoff volumes will be assessed in Section 4 of this report.

3.2 Other Sources

The Site is located outside the Environment Agency's (the Agency) 1 in 100 year and 1 in 1000 year return period flood zones (RPS Drawing No. JER3526-FRA-001, presented in Appendix 1). The site is therefore located within Flood Zone 1, and not considered to be at risk from fluvial or tidal flooding.

Groundwater levels recorded in 2001 (Ref. 4) indicate that groundwater did not reach ground level even following the extreme rainfall events during early 2001. It is not however possible to establish return periods for high groundwater levels from the data gathered in 2001. The maximum recorded groundwater levels in 2001 were 0.5 m bgl. Groundwater at this level could infiltrate deep drainage infrastructure and offset any storage provided on Site to attenuate increases in surface water runoff.

Although it is considered unlikely that high groundwater levels would coincide with a high return period surface runoff event, in the interest of conservatism, Section 5 will assess such an eventuality.

4.0 SURFACE WATER DRAINAGE ASSESSMENT

4.1 Current Surface Water Drainage Strategy

The existing site drainage is summarised in Golder (Ref. 7). Existing surface water drainage at the Site comprises a French drain along the west side of Silchester Way, approximately 25 m from the support building and adjacent to the substation building. There is a section of French drain and a surface water soakaway which serve Building B3A18 that is indicated as being covered by hardstanding in the new development (N247-00-C100-XA0012-6D, included in Appendix 1) (Ref. 4).

The Site is located along the boundary between a number of existing surface water catchments (AWE Drawing: AWE Aldermaston - HEFF - Surface Water Catchment Boundaries and Drains, presented in Appendix 1). These indicate that surface water from the Site is currently directed away from the area.

Small areas of ponded water have been noted on the existing site during periods of wet weather (Ref. 4). It is understood that roadways are drained by linear French drains, and that rainfall run-off from the HEFF project area may enter the AWE Aldermaston Site surface water drainage system via this route. Surface water run-off from Building BA320 is directed to the AWE Aldermaston Site surface water drainage system and a soakaway (Ref. 7).

4.2 Proposed Surface Water Drainage Strategy

A proposed surface water drainage strategy for the HEFF development area is detailed in the Surface Water Drainage Design Report (Ref. 8) and shown on AWE Drawing No. N247-00-C100-XA0012-6D, presented in Appendix 1. The design involves the use of a number of storage areas connecting into the existing surface water drainage system, with hydrobrakes being used to control the discharge to the Greenfield runoff rate of 18.1 l/s per Ha.

The proposed storage areas incorporate two wet type ponds adjacent to the HEFF process and support buildings, infiltration trenches along the HGV access road, and permeable block paving overlying an underground storage area (Ref. 8). The proposed permeable pavement does not allow infiltration of surface runoff. This type of pavement is classified as Type C in the SUDS Manual (Ref. 9), providing underground storage with an outfall into the surface water drainage system. The storage volumes provided in each of these locations, as detailed in emails from Atkins Global to Golder dated 2 and 3 October 2007, are provided in Table 1.

Table 1 - Storage volumes available in the HEFF development area post development

Storage Location	Storage Volume (m ³)
Northern SUDS pond	120
Southern SUDS pond	300
Permeable block paving sub-base void	560
Infiltration trench for main HGV access to Process building	43
Total	1023

4.3 Surface Water Runoff Assessment

In accordance with PPS25 (Ref. 1), Golder has assessed the potential for generation of additional surface water runoff as a direct result of development at the Site.

The surface water runoff assessment has been carried out separately for each of the four areas defined previously in Section 2.3 of this report.

4.3.1 Methodology

The Rational Method was used to consider the maximum volume of water which can be generated by runoff during a storm event within the curtilage of the Site. The method was used to predict runoff generated for pre-development (baseline conditions), during development, and post development scenarios. The maximum storage volume required on-Site during a storm event can then be calculated (i.e. the post development volume minus the baseline volume).

Rainfall events of different durations with return periods of 100 years, the 100 year event increased by 30% (to account for climate change), and 200 years have been used in the Rational Method. The allowance for climate change is in line with the recommendations provided in PPS25 (Ref. 1) and is also used in the design of the surface water drainage system for the HEFF (Ref. 8). Rainfall data have been generated using FEH (Ref. 10).

The Rational Method requires that a runoff coefficient be determined for different types of ground surface. Runoff coefficients imply a number of parameters for different ground surfaces e.g. infiltration, evaporation and depression storage. Coefficients have been estimated with guidance taken from Kellagher (Ref. 11).

The catchments for each area post development have been divided into different surface types which have been assigned appropriate runoff coefficients. Areas of hardstanding and/or building have been assigned a runoff coefficient of 1 (100% of rainfall = runoff). Areas of grassland have been assigned a runoff coefficient of 0.6 (60% of rainfall = runoff). The proposed SUDS ponds have been assigned a runoff coefficient of 1 (100% of rainfall = runoff). Areas of pervious pavement (Ref. 8) have been assigned a runoff coefficient of 1.

(100% of rainfall = runoff), because no infiltration occurs. Areas of 6F2 product (compacted broken concrete) have been assigned a runoff coefficient of 0.9 (90% of rainfall = runoff). The areas designated as each surface type are indicated on Figures 2, 3 and 4 for pre, during and post development scenarios respectively. The assumptions involved in the calculations of those areas are detailed in Section 6.

The Rational Method calculates peak volumes from the Site surface runoff for rainfall events using the following equation:

$$V = ICA$$

Where:

V = Surface water runoff storage volume required (m^3)

I = Peak rainfall for a 24 hour event with a 1% probability of occurring every year (m)

C = Runoff coefficient (ground surface specific, dimensionless)

A = Area of the Site (m^2)

The surface water drainage system proposed in the HEFF Site Surface Water Drainage Philosophy (Ref. 12), presented in Appendix 1, states that a greenfield runoff rate of 3 l/s per Ha should be adopted. This is not considered to be appropriate. Atkins Limited (Ref. 8) calculated a Greenfield runoff rate of 18.1 l/s per Ha for a 1 Ha area within the HEFF development area. This value was calculated using regional growth curves and it is considered appropriate for use across the area considered within this FRA.

4.3.2 Attenuation Requirements

The complete results of the calculations are shown in Appendix 2. Tables 2, 3 and 4 summarise the storage volumes required for rainfall events with 100 year, 100 year plus 30% and 200 year return periods respectively. 1 in 200 year return period results are not formally part of the Rational Method and have been included for information only.

The attenuation requirements during the development of the Site have been determined using a 1 in 100 year return period event. Golder consider this to be a conservative assessment of a development with a two year design life, the proposed duration of the development phase, falling within the criteria recommended by PPS25 (Ref. 1).

The attenuation requirements post development have been assessed using a 1 in 100 year return period event plus 30 %, allowing for climate change. This criterion is inline with that

used for the design of the drainage system for HEFF (Ref. 8) and constitutes a conservative assessment.

Table 2 Storage volumes required during a 1 in 100 year rainfall event

Area	Maximum runoff volume produced in excess of the Greenfield discharge rate (m^3)			Additional storage required due to development (m^3)	
	Pre Development	During Development	Post Development	During Development	Post Development
HEFF Development Area	733	952	966	219	233
Bulk Storage Area	629	1001	829	172	0
Contractors' Compound	358	415	358	57	0
Road	689	689	689	0	0

Table 3 Storage volumes required during a 1 in 100 year rainfall event plus 30%

Area	Maximum runoff volume produced in excess of the Greenfield discharge rate (m^3)			Additional storage required due to development (m^3)	
	Pre Development	During Development	Post Development	During Development	Post Development
HEFF Development Area	1012	1311	1331	299	319
Bulk Storage Area	1140	1379	1140	239	0
Contractors' Compound	493	567	493	74	0
Road	941	941	941	0	0

Table 4 Storage volumes required during a 1 in 200 year rainfall event

Area	Maximum runoff volume produced in excess of the Greenfield discharge rate (m ³)			Additional storage required due to development (m ³)	
	Pre Development	During Development	Post Development	During Development	Post Development
HEFF Development Area	951	1221	1239	270	288
Bulk Storage Area	1073	1285	1073	212	0
Contractors' Compound	459	529	459	70	0
Road	878	878	878	0	0

4.3.2.1 During Development

Table 2 shows that the maximum storage required in the HEFF development area and bulk storage area during a 1 in 100 year rainfall event was calculated as 219 m³ and 172 m³ respectively during the development phase. It is understood from a telephone conversation between Halcrow and Golder on 5 October 2007 that there is insufficient space to allow the construction of temporary storage ponds. Golder therefore recommends that these storage volumes are provided by a temporary drainage ditch located alongside the southern fence line of the Site connected into the existing surface water drainage system. Discharge into the surface water drainage system should be controlled to the Greenfield runoff rate of 18.1 l/s per Ha, possibly through the use of a hydrobrake.

Topographical information on the Site was not available, but it is understood that the Site drains from north to south, which would allow natural drainage to direct surface water runoff into the ditch. Assuming a bank gradient of 1:2.5 m (vertical:horizontal) and a depth of 0.5 m, the lengths of ditch needed to meet the storage requirements are 350.5 m in the HEFF development area and 275.5 m in the bulk storage area.

A storage volume of 57 m³ is required in the contractors' compound during development, as shown on Table 2. Golder recommends that this is provided through the use of a temporary storage pond or ditch, connected into the existing surface water drainage system with a controlled discharge rate of 18.1 l/s per Ha. The chosen option should be positioned in an area of low topography to allow surface water runoff to drain naturally into it.

No additional storage is required in the road area during the development phase, because it is assumed that the runoff properties of the ground surface remain unchanged.

4.3.2.2 Post Development

Table 3 shows that the storage volume required in the HEFF development area post development has been calculated as 319 m³. The total storage provided post development in the HEFF development area (1023 m³), as shown in Table 1, more than compensates for this storage requirement and leads to no net loss of floodplain storage during a rainfall event. Golder recommends that, during detailed design, the final topography within the HEFF development area is designed to allow natural drainage and distribution of surface water runoff into these storage areas.

The results presented in Table 3 show that no additional storage is required in the bulk storage area and the contractors' compound post development, as it is assumed that the areas are restored to their pre development surface.

No additional storage is required in the road area post development, because it is assumed that the runoff properties of the ground surface do not change.

5.0 RECOMMENDATIONS AND CONCLUSIONS

It will be necessary to provide additional storage in the HEFF development area, bulk storage area and contractors' compound for the duration of the development phase. Temporary drains or storage areas should be provided with a controlled discharge into the existing surface water drainage system of 18.1 l/s per Ha.

The surface water runoff assessment indicates that, post development, the proposed storage areas in the HEFF development area are of sufficient size to accommodate the increased runoff produced from the HEFF development area due to the development. The final topographical profile of the area should be designed to allow natural drainage of surface water runoff into these storage areas. Storage areas in the bulk storage area and contractors' compound will not be required post-development if the areas are returned to their pre-development surface types.

Routine maintenance of all drainage and storage areas should be carried out to ensure that conveyance and storage can be provided throughout the construction and operational phases.

Based on a maximum groundwater level of 0.5 mbgl, if the base of the infiltration ponds are set to a level of no lower than 0.5 mbgl, significant groundwater seepage should not occur into the ponds. Storage volumes provided for changes in surface water runoff regime should therefore not be compromised.

Key activity 4 of the AWE (A) Surface Water Drainage Strategy (Ref. 13) is the creation of site-specific rainfall profiles for the Aldermaston site. Following completion of this, AWE should consider updating the surface water runoff assessment using these values.

6.0 ASSUMPTIONS USED IN SURFACE WATER RUNOFF ASSESSMENT

6.1 HEFF Development Area

- Pre development surface is grassland with the exception of building B3A18 (AWE aerial photograph, included in Appendix 1);
- Post development surface is defined by AWE Drawing No. N247-00-C100-XA0012-6D, included in Appendix 1;
- The surface areas of the process and M & E buildings were calculated from the relevant roof levels plans (AWE Drawing Nos. N247-00-PL00-XA1012-1D and N247-00-PL00-XA1022-1D, included in Appendix 1);
- The surface area of the support building was approximated using AWE Drawing No. N247-00-PL00-XA1001-3D, included in Appendix 1;
- The surface areas of the proposed wet ponds and the storage volumes provided in the ponds, permeable pavement sub-base void and infiltration trenches were provided in emails from Atkins Global to Golder dated 2 and 3 October 2007;
- Areas not covered by hardstanding, permeable pavement, buildings or the proposed wet ponds are assumed to have been restored to grassland post development; and
- During development surface consists of 6F2 product for the areas of the access road, skips (as shown on TPS Drawing No. AL20(01)03,) and the post development footprint of the HEFF facility and wet ponds, with the exception of the footprint of the process, support and M & E buildings. The footprint of the process, support and M & E buildings are assumed to be concrete.

6.2 Bulk Storage Area

- Pre development surface is grassland with the exception of hardstanding in the area of the northern proposed bulk store (TPS Drawing No. AL20(01)03, included in Appendix 1);
- During development, the hardcore / spoil storage shown on TPS Drawing No. AL20(01)03, included in Appendix 1, forms an area of hardstanding in addition to the pre development hardstanding. The access road and bulk storage area bounded by it consists of 6F2 product; and
- The area is restored to its original pre development surface following completion of construction.

6.3 Contractors' Compound

- Pre development surface is hardstanding, with the exception of the areas of grassland shown on Figure 2;
- During development, the entire area is covered by hardstanding; and
- The area is restored to its original pre development surface following completion of construction.

6.4 Road

- It is assumed the road assessment area is entirely hardstanding for all three scenarios (AWE aerial photograph, included in Appendix 1).

7.0 REFERENCES

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FIGURES

D-4

Figure

Groundwater Contours within the Bagshot Beds/Transitional Zone in the HEFF Construction Enclave and Proposed Facility (February 2007)

Date: 9/11/2007
Plot No.: 07514240011
Owner: A.R.
File No.: E2270621



Scale (m)
0 10 20 30 40

LEGEND
 — 100 — Groundwater Contour
 — 100 — Boundary used to Generate Contours
 • AWE Alderman Station Site Boundary
 — HEFF Project Area
 — HEFF Construction Enclave and Proposed Facility

LEGEND

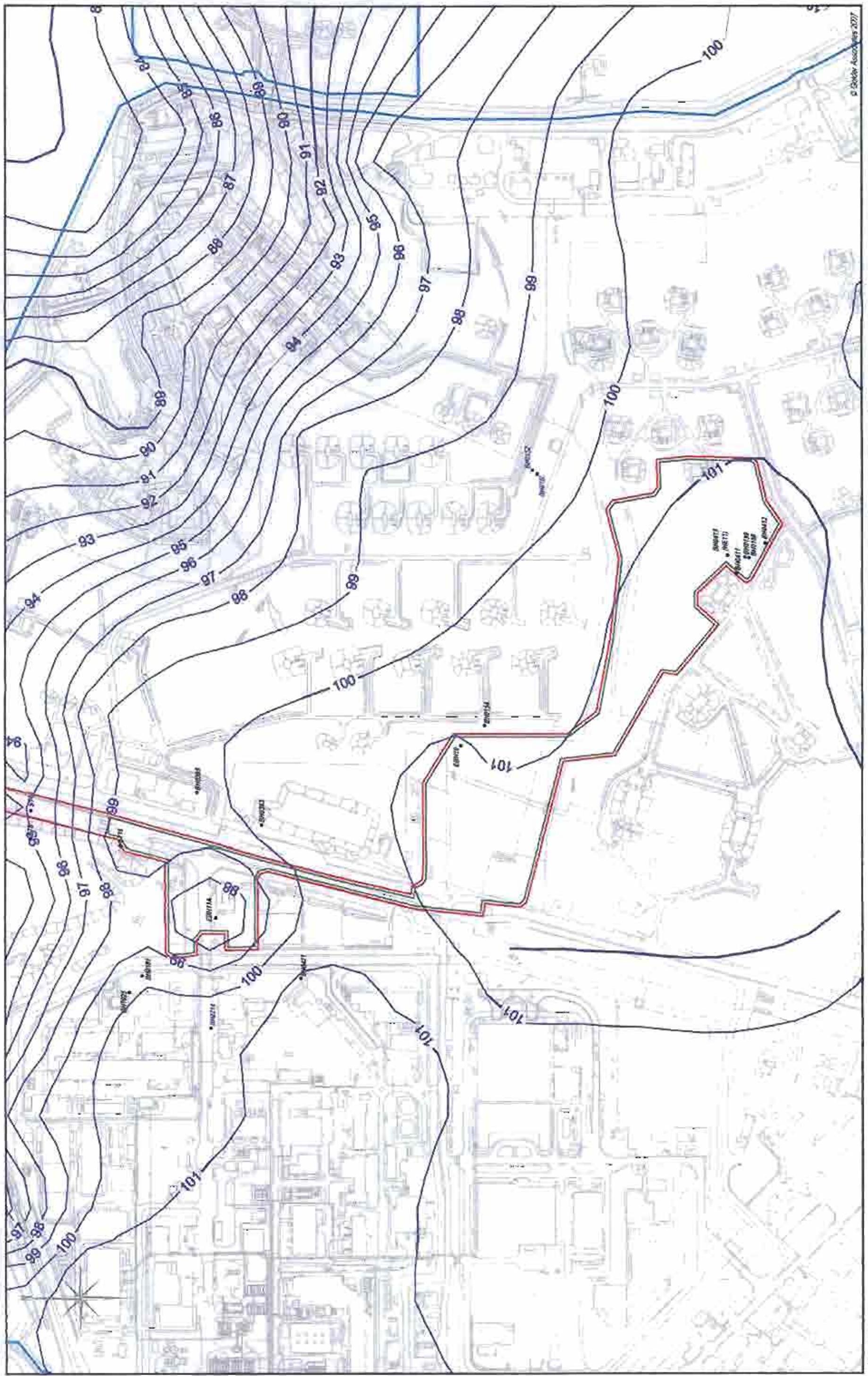


Figure D-5

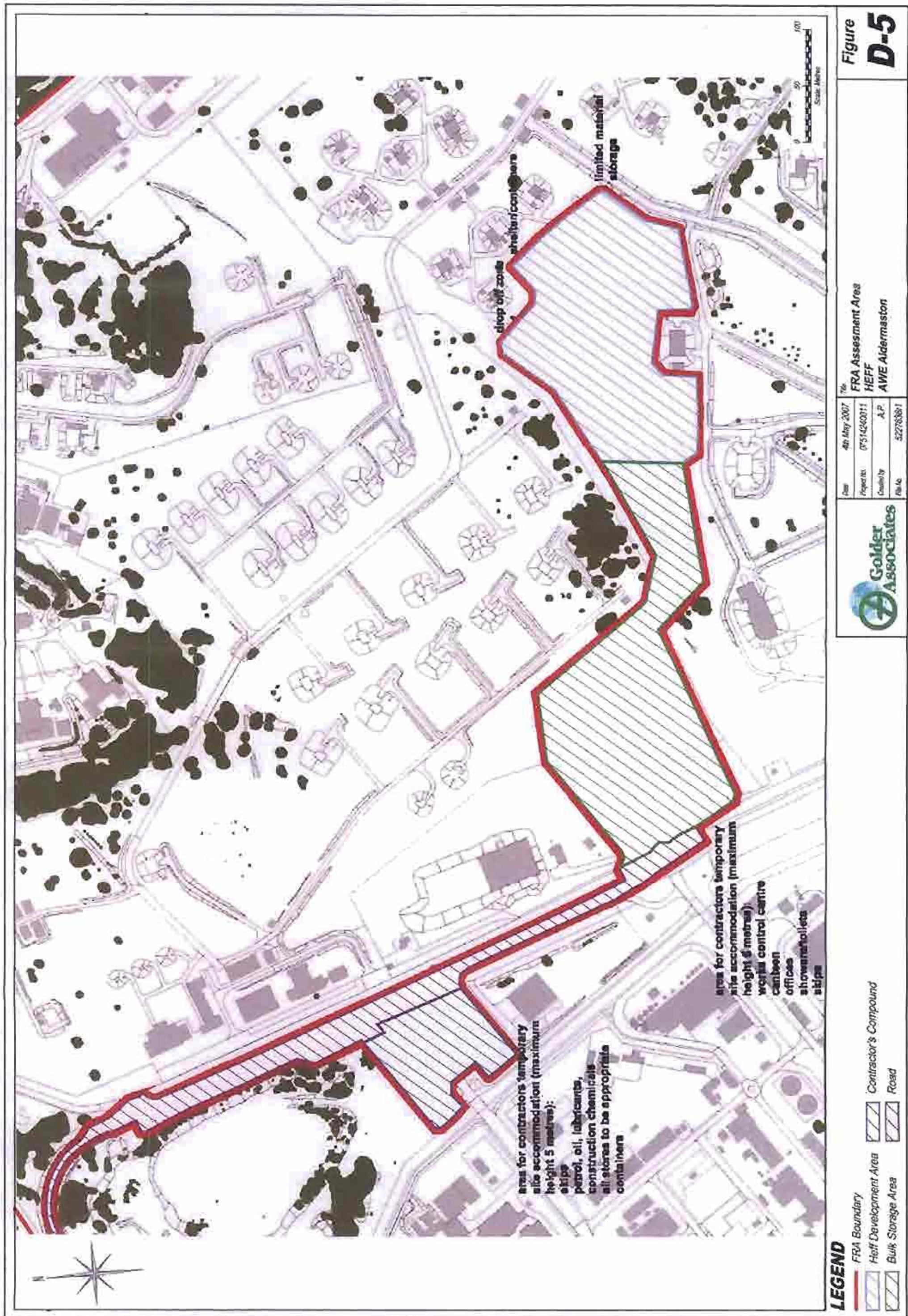
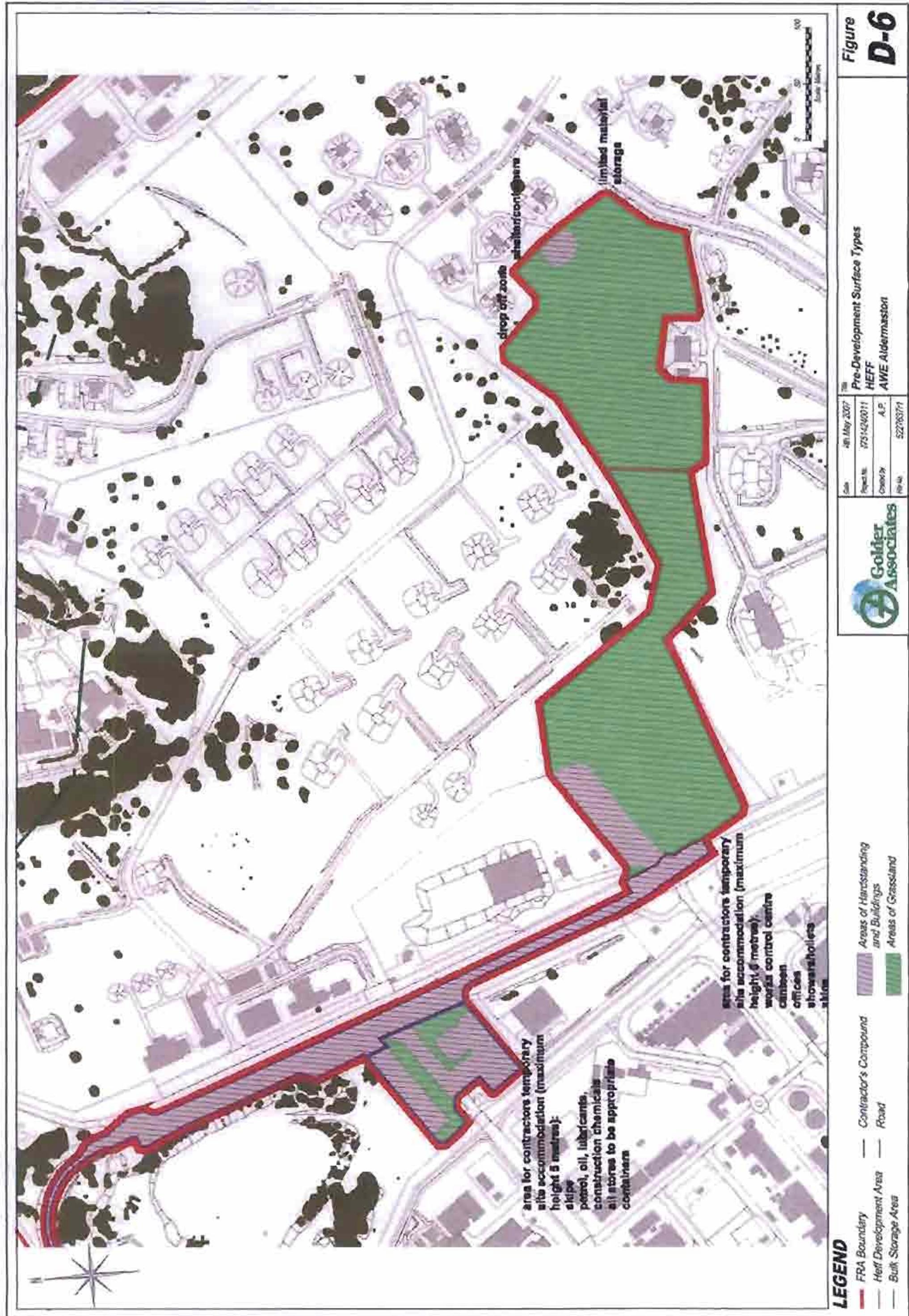
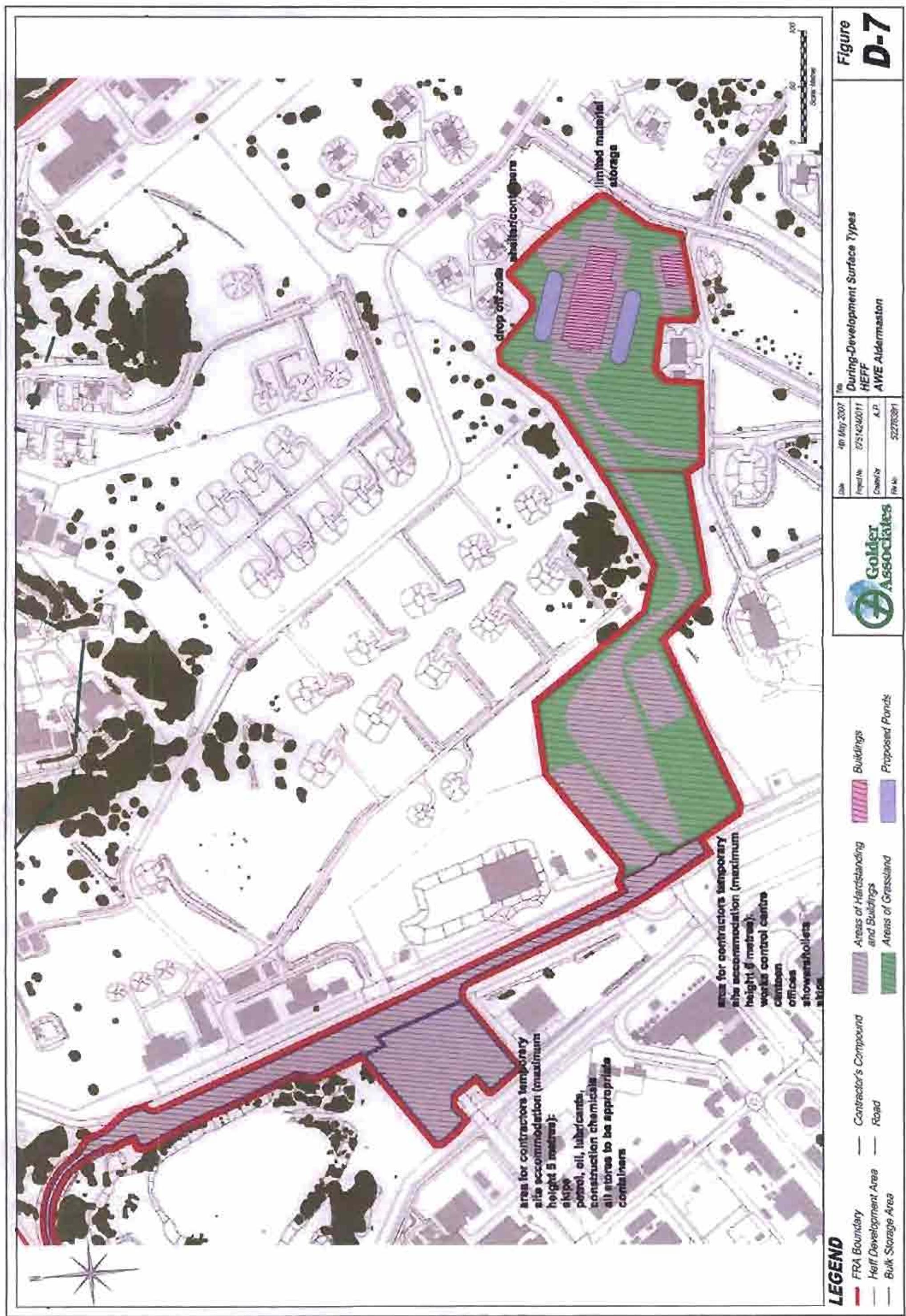
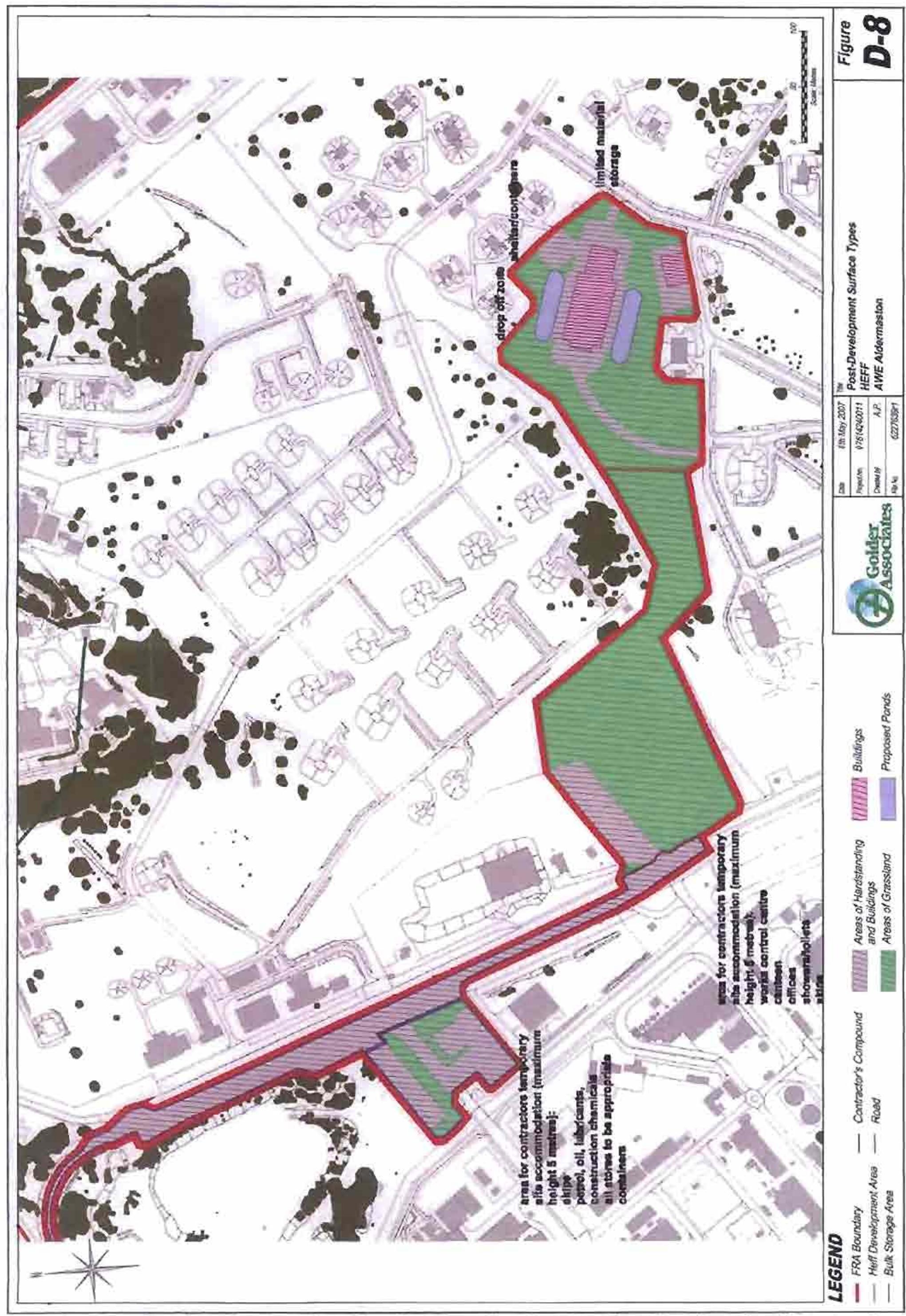


Figure
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**Figure
D-8**



ANNEX:
SURFACE WATER RUNOFF ASSESSMENT



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100 Year return period	Return value from 100 year period	Probability of exceeding return value in 100 years	Probability of exceeding return value in 100 years		Probability of exceeding return value in 100 years	Probability of exceeding return value in 100 years
			1000 m	500 m		
10	10.4	0.0001	0.0001	0.0001	0.0001	0.0001
20	4.62	0.0002	0.0001	0.0001	0.0001	0.0001
30	3.33	0.0003	0.0002	0.0001	0.0001	0.0001
40	2.52	0.0005	0.0003	0.0002	0.0001	0.0001
50	2.04	0.0007	0.0005	0.0003	0.0002	0.0001
60	1.67	0.001	0.0007	0.0004	0.0003	0.0002
70	1.39	0.0013	0.0009	0.0005	0.0004	0.0003
80	1.16	0.0016	0.0011	0.0007	0.0005	0.0004
90	1.00	0.0019	0.0013	0.0008	0.0006	0.0005
100	0.89	0.0022	0.0015	0.001	0.0008	0.0006
120	0.73	0.0028	0.002	0.0013	0.001	0.0008
150	0.59	0.0038	0.0027	0.0017	0.0013	0.001
200	0.39	0.0068	0.0045	0.0027	0.0018	0.0013
300	0.24	0.011	0.0075	0.0045	0.0027	0.0018
500	0.14	0.022	0.015	0.0085	0.0045	0.0027
1000	0.08	0.044	0.03	0.017	0.0085	0.0045
2000	0.04	0.088	0.06	0.035	0.017	0.0085
5000	0.02	0.22	0.15	0.075	0.035	0.017
10000	0.01	0.44	0.3	0.15	0.075	0.035

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100 year return period = 30%	return time period (years)	Increasing hazard			decreasing hazard			return time period (years)
		0.1	1	10	0.1	1	10	
0.1 (open return period)	return time period (years)							
1	1	1.4	4.2	9.9	11.6	13.1	14.2	15.2
2	2	2.7	4.6	10.1	9.1	8.7	8.0	7.9
5	5	5.5	5.6	14.3	16.1	9.6	12.4	12.4
10	10	8.2	6.1	12.9	20.8	9.4	10.6	10.6
20	20	10.5	7.0	10.5	14.9	9.6	11.2	11.2
50	50	12.8	7.4	22.8	4.3	10.0	14.1	13.4
100	100	13.7	8.1	85.3	2.7	10.9	10.1	9.7
200	200	13.7	8.9	131.7	2.3	10.9	4.9	4.6
500	500	13.7	9.5	131.7	2.0	10.9	2.1	2.0
1000	1000	13.7	9.9	131.7	1.9	10.9	1.7	1.7
Max	Max	13.7	9.9	131.7	1.9	10.9	1.7	1.7

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Number of years selected + 30%	Number of years selected	Projected savings (millions) (\$C/m ²)		Volume of consumption millions m ³	Savings per year millions (\$C)	Savings per year (\$C/m ²)	Total energy required (\$C/m ²)
		100 year return value added	100 year return value added + 30%				
10	10	4.27	4.3	1.4	56	41	11.4
20	20	8.57	49	3.1	382	125	12.1
30	30	12.77	16	5.3	524	250	12.9
40	40	17.07	60	8.2	673	362	13.6
50	50	21.37	61	11.4	823	484	14.2
60	60	25.67	10.8	11	973	605	14.9
70	70	30.07	61	22.9	1123	726	15.6
80	80	34.37	61	43	1273	847	16.2
90	90	38.67	90	88.8	1423	1068	16.9
100	100	43.07	90	21.1	1573	1289	17.5
110	110	47.37	90	42.2	1723	1510	18.1
120	120	51.67	90	84.4	1873	1831	18.7
130	130	56.07	90	168.8	2023	2052	19.3
140	140	60.37	90	337.7	2173	2203	19.9
150	150	64.67	90	675.5	2323	2353	20.5
160	160	69.07	90	1351.3	2473	2503	21.1
170	170	73.37	90	2675.1	2623	2653	21.7
180	180	77.67	90	5350.1	2773	2803	22.3
190	190	82.07	90	10700.1	2923	2953	22.9
200	200	86.37	90	21400.1	3073	3103	23.5
210	210	90.67	90	42800.1	3223	3253	24.1
220	220	95.07	90	85600.1	3373	3403	24.7
230	230	99.37	90	171200.1	3523	3553	25.3
240	240	103.67	90	342400.1	3673	3703	25.9
250	250	108.07	90	684800.1	3823	3853	26.5
260	260	112.37	90	1369600.1	3973	4003	27.1
270	270	116.77	90	2739200.1	4123	4153	27.7
280	280	121.07	90	5478400.1	4273	4303	28.3
290	290	125.47	90	10956800.1	4423	4453	28.9
300	300	129.77	90	21913600.1	4573	4603	29.5
310	310	134.17	90	43827200.1	4723	4753	30.1
320	320	138.47	90	87654400.1	4873	4903	30.7
330	330	142.87	90	175308800.1	5023	5053	31.3
340	340	147.17	90	350617600.1	5173	5203	31.9
350	350	151.47	90	701235200.1	5323	5353	32.5
360	360	155.87	90	1402470400.1	5473	5503	33.1
370	370	160.17	90	2804940800.1	5623	5653	33.7
380	380	164.57	90	5609881600.1	5773	5803	34.3
390	390	168.87	90	11219763200.1	5923	5953	34.9
400	400	173.27	90	22439526400.1	6073	6103	35.5
410	410	177.57	90	44879052800.1	6223	6253	36.1
420	420	181.97	90	89758105600.1	6373	6403	36.7
430	430	186.27	90	179516211200.1	6523	6553	37.3
440	440	190.67	90	359032422400.1	6673	6703	37.9
450	450	194.97	90	718064844800.1	6823	6853	38.5
460	460	199.37	90	1436129689600.1	6973	7003	39.1
470	470	203.77	90	2872259379200.1	7123	7153	39.7
480	480	208.17	90	5744518758400.1	7273	7303	40.3
490	490	212.57	90	1148903751200.1	7423	7453	40.9
500	500	216.97	90	2297807502400.1	7573	7603	41.5
510	510	221.37	90	4595615004800.1	7723	7753	42.1
520	520	225.77	90	9191230009600.1	7873	7903	42.7
530	530	230.17	90	18382460019200.1	8023	8053	43.3
540	540	234.57	90	36764920038400.1	8173	8203	43.9
550	550	238.97	90	73529840076800.1	8323	8353	44.5
560	560	243.37	90	147059680153600.1	8473	8503	45.1
570	570	247.77	90	294119360307200.1	8623	8653	45.7
580	580	252.17	90	588238720614400.1	8773	8803	46.3
590	590	256.57	90	1176477441228800.1	8923	8953	46.9
600	600	260.97	90	2352954882457600.1	9073	9103	47.5
610	610	265.37	90	4705909764915200.1	9223	9253	48.1
620	620	269.77	90	9411819529830400.1	9373	9403	48.7
630	630	274.17	90	18823639059660800.1	9523	9553	49.3
640	640	278.57	90	37647278119321600.1	9673	9703	49.9
650	650	282.97	90	75294556238643200.1	9823	9853	50.5
660	660	287.37	90	15058911277286400.1	9973	10003	51.1
670	670	291.77	90	30117822554572800.1	10123	10153	51.7
680	680	296.17	90	60235645109145600.1	10273	10303	52.3
690	690	300.57	90	12047129021829200.1	10423	10453	52.9
700	700	304.97	90	24094258043658400.1	10573	10603	53.5
710	710	309.37	90	48188516087316800.1	10723	10753	54.1
720	720	313.77	90	96377032174633600.1	10873	10903	54.7
730	730	318.17	90	19275406434926400.1	11023	11053	55.3
740	740	322.57	90	38550812869852800.1	11173	11203	55.9
750	750	326.97	90	77101625739705600.1	11323	11353	56.5
760	760	331.37	90	15420325147941200.1	11473	11503	57.1
770	770	335.77	90	30840650295882400.1	11623	11653	57.7
780	780	340.17	90	61681300591764800.1	11773	11803	58.3
790	790	344.57	90	12336260118352800.1	11923	11953	58.9
800	800	348.97	90	24672520236705600.1	12073	12103	59.5
810	810	353.37	90	49345040473411200.1	12223	12253	60.1
820	820	357.77	90	98690080946822400.1	12373	12403	60.7
830	830	362.17	90	19738016089364800.1	12523	12553	61.3
840	840	366.57	90	39476032178729600.1	12673	12703	61.9
850	850	370.97	90	78952064357459200.1	12823	12853	62.5
860	860	375.37	90	157904128749118400.1	12973	13003	63.1
870	870	379.77	90	315808257498236800.1	13123	13153	63.7
880	880	384.17	90	631616514996473600.1	13273	13303	64.3
890	890	388.57	90	126323302998194400.1	13423	13453	64.9
900	900	392.97	90	252646605996388800.1	13573	13603	65.5
910	910	397.37	90	505293211992777600.1	13723	13753	66.1
920	920	401.77	90	1010586423985552000.1	13873	13903	66.7
930	930	406.17	90	2021172847971104000.1	14023	14053	67.3
940	940	410.57	90	4042345695942208000.1	14173	14203	67.9
950	950	414.97	90	8084691391884416000.1	14323	14353	68.5
960	960	419.37	90	1616938278376880000.1	14473	14503	69.1
970	970	423.77	90	3233876556753760000.1	14623	14653	69.7
980	980	428.17	90	6467753113507520000.1	14773	14803	70.3
990	990	432.57	90	1293550622701504000.1	14923	14953	70.9
1000	1000	436.97	90	2587101245403008000.1	15073	15103	71.5

TABLE D-10: INVESTMENT DATA

4% Nominal

Annual Interest

Golder Associates

Prepared by:

Project Number 0713404611

October 2001

Estimated 4% per annum
Nominal (not compounded)

Interest

Golder
AssociatesEstimated 4% per annum
Nominal (not compounded)

Interest

Golder
Associates200 year
return
period

Interest

Golder
Associates

Return period	Interest rate per annum Nominal (not compounded)	Investment period		Interest rate per annum Nominal (not compounded)	Investment period	Interest rate per annum Nominal (not compounded)	Investment period
		100	50				
10	10.0%	10.0%	10.0%	8.7%	8.7%	8.7%	8.7%
20	9.5%	9.5%	9.5%	8.2%	8.2%	8.2%	8.2%
30	9.2%	9.2%	9.2%	7.9%	7.9%	7.9%	7.9%
40	9.0%	9.0%	9.0%	7.7%	7.7%	7.7%	7.7%
50	8.8%	8.8%	8.8%	7.5%	7.5%	7.5%	7.5%
60	8.6%	8.6%	8.6%	7.3%	7.3%	7.3%	7.3%
70	8.4%	8.4%	8.4%	7.1%	7.1%	7.1%	7.1%
80	8.2%	8.2%	8.2%	6.9%	6.9%	6.9%	6.9%
90	8.0%	8.0%	8.0%	6.7%	6.7%	6.7%	6.7%
100	7.8%	7.8%	7.8%	6.5%	6.5%	6.5%	6.5%
110	7.6%	7.6%	7.6%	6.3%	6.3%	6.3%	6.3%
120	7.4%	7.4%	7.4%	6.1%	6.1%	6.1%	6.1%
130	7.2%	7.2%	7.2%	5.9%	5.9%	5.9%	5.9%
140	7.0%	7.0%	7.0%	5.7%	5.7%	5.7%	5.7%
150	6.8%	6.8%	6.8%	5.5%	5.5%	5.5%	5.5%
160	6.6%	6.6%	6.6%	5.3%	5.3%	5.3%	5.3%
170	6.4%	6.4%	6.4%	5.1%	5.1%	5.1%	5.1%
180	6.2%	6.2%	6.2%	4.9%	4.9%	4.9%	4.9%
190	6.0%	6.0%	6.0%	4.7%	4.7%	4.7%	4.7%
200	5.8%	5.8%	5.8%	4.5%	4.5%	4.5%	4.5%

Cost of Investment - based on 4% per annum interest rates and constant 2000

200 year
return
period

Interest

Golder
Associates200 year
return
period

Interest

Golder
Associates200 year
return
period

Interest

Golder
Associates200 year
return
period

Interest

Golder
Associates

Return period	Interest rate per annum Nominal (not compounded)	Investment period		Interest rate per annum Nominal (not compounded)	Investment period	Interest rate per annum Nominal (not compounded)	Investment period
		100	50				
10	10.0%	10.0%	10.0%	8.7%	8.7%	8.7%	8.7%
20	9.5%	9.5%	9.5%	8.2%	8.2%	8.2%	8.2%
30	9.2%	9.2%	9.2%	7.9%	7.9%	7.9%	7.9%
40	9.0%	9.0%	9.0%	7.7%	7.7%	7.7%	7.7%
50	8.8%	8.8%	8.8%	7.5%	7.5%	7.5%	7.5%
60	8.6%	8.6%	8.6%	7.3%	7.3%	7.3%	7.3%
70	8.4%	8.4%	8.4%	7.1%	7.1%	7.1%	7.1%
80	8.2%	8.2%	8.2%	6.9%	6.9%	6.9%	6.9%
90	8.0%	8.0%	8.0%	6.7%	6.7%	6.7%	6.7%
100	7.8%	7.8%	7.8%	6.5%	6.5%	6.5%	6.5%
110	7.6%	7.6%	7.6%	6.3%	6.3%	6.3%	6.3%
120	7.4%	7.4%	7.4%	6.1%	6.1%	6.1%	6.1%
130	7.2%	7.2%	7.2%	5.9%	5.9%	5.9%	5.9%
140	7.0%	7.0%	7.0%	5.7%	5.7%	5.7%	5.7%
150	6.8%	6.8%	6.8%	5.5%	5.5%	5.5%	5.5%
160	6.6%	6.6%	6.6%	5.3%	5.3%	5.3%	5.3%
170	6.4%	6.4%	6.4%	5.1%	5.1%	5.1%	5.1%
180	6.2%	6.2%	6.2%	4.9%	4.9%	4.9%	4.9%
190	6.0%	6.0%	6.0%	4.7%	4.7%	4.7%	4.7%
200	5.8%	5.8%	5.8%	4.5%	4.5%	4.5%	4.5%

Cost of Investment

Return period	Interest rate per annum Nominal (not compounded)	Investment period		Interest rate per annum Nominal (not compounded)	Investment period	Interest rate per annum Nominal (not compounded)	Investment period
		100	50				
10	10.0%	10.0%	10.0%	8.7%	8.7%	8.7%	8.7%
20	9.5%	9.5%	9.5%	8.2%	8.2%	8.2%	8.2%
30	9.2%	9.2%	9.2%	7.9%	7.9%	7.9%	7.9%
40	9.0%	9.0%	9.0%	7.7%	7.7%	7.7%	7.7%
50	8.8%	8.8%	8.8%	7.5%	7.5%	7.5%	7.5%
60	8.6%	8.6%	8.6%	7.3%	7.3%	7.3%	7.3%
70	8.4%	8.4%	8.4%	7.1%	7.1%	7.1%	7.1%
80	8.2%	8.2%	8.2%	6.9%	6.9%	6.9%	6.9%
90	8.0%	8.0%	8.0%	6.7%	6.7%	6.7%	6.7%
100	7.8%	7.8%	7.8%	6.5%	6.5%	6.5%	6.5%
110	7.6%	7.6%	7.6%	6.3%	6.3%	6.3%	6.3%
120	7.4%	7.4%	7.4%	6.1%	6.1%	6.1%	6.1%
130	7.2%	7.2%	7.2%	5.9%	5.9%	5.9%	5.9%
140	7.0%	7.0%	7.0%	5.7%	5.7%	5.7%	5.7%
150	6.8%	6.8%	6.8%	5.5%	5.5%	5.5%	5.5%
160	6.6%	6.6%	6.6%	5.3%	5.3%	5.3%	5.3%
170	6.4%	6.4%	6.4%	5.1%	5.1%	5.1%	5.1%
180	6.2%	6.2%	6.2%	4.9%	4.9%	4.9%	4.9%
190	6.0%	6.0%	6.0%	4.7%	4.7%	4.7%	4.7%
200	5.8%	5.8%	5.8%	4.5%	4.5%	4.5%	4.5%

Bethelches, Ariz.
Oil Refinery

Golder Associates
Produced by Natural Worldwide
Project Number 0751420011
October 2001

Estimated water diversion
Excess water diversion
Product Utilization

1000000000 m³
1000000 m³

Estimated water diversion
Excess water diversion
Product Utilization

1000000000 m³
1000000 m³

Estimated water diversion
Excess water diversion
Product Utilization

1000000000 m³
1000000 m³

100 year return period	surface water runoff coefficient	runoff volume 1000 m ³	runoff rate 1000 m ³ / hr			volume of runoff 1000 m ³	discharge M generated rate 1000 m ³ /hr	Storage rate 1000 m ³ /hr	Storage capacity 1000 m ³	Total storage required using green field rates (yr)
			1	2	3					
10	0.10	20.44	0.11	0.14	0.17	0.73	0.17	0.17	0.17	7.97
20	0.16	33.67	0.14	0.17	0.21	1.03	0.23	0.23	0.23	1.12
30	0.20	50.59	0.16	0.19	0.21	1.46	0.30	0.30	0.30	0.92
50	0.32	84.67	0.11	0.14	0.17	1.66	0.25	0.25	0.25	0.64
70	0.42	112.02	0.10	0.13	0.16	1.86	0.20	0.20	0.20	0.56
100	0.53	160.53	0.09	0.12	0.15	2.06	0.15	0.15	0.15	0.51
200	0.72	321.07	0.08	0.11	0.14	2.26	0.10	0.10	0.10	0.48
300	0.82	421.42	0.07	0.10	0.13	2.46	0.08	0.08	0.08	0.46
500	0.92	521.77	0.06	0.09	0.12	2.66	0.06	0.06	0.06	0.44
700	0.95	562.12	0.05	0.08	0.11	2.86	0.05	0.05	0.05	0.43
1000	0.98	592.47	0.04	0.07	0.10	3.06	0.04	0.04	0.04	0.42
1500	1.02	622.82	0.03	0.06	0.09	3.26	0.03	0.03	0.03	0.41
2000	1.05	653.17	0.02	0.05	0.08	3.46	0.02	0.02	0.02	0.40
3000	1.12	713.52	0.01	0.04	0.07	3.86	0.01	0.01	0.01	0.39
5000	1.22	813.87	0.005	0.03	0.06	4.26	0.005	0.005	0.005	0.38
7000	1.27	854.22	0.003	0.02	0.05	4.66	0.003	0.003	0.003	0.37
10000	1.32	914.57	0.002	0.01	0.04	5.06	0.002	0.002	0.002	0.36
15000	1.38	1034.92	0.001	0.005	0.03	5.46	0.001	0.001	0.001	0.35
20000	1.42	1175.27	0.0005	0.002	0.02	5.86	0.0005	0.0005	0.0005	0.34
30000	1.48	1562.62	0.0002	0.001	0.01	6.26	0.0002	0.0002	0.0002	0.33
50000	1.55	2343.97	0.0001	0.0005	0.005	6.66	0.0001	0.0001	0.0001	0.32
70000	1.60	2755.32	0.00005	0.0002	0.002	7.06	0.00005	0.00005	0.00005	0.31
100000	1.65	3266.67	0.00002	0.0001	0.001	7.46	0.00002	0.00002	0.00002	0.30
150000	1.72	4900.02	0.00001	0.00005	0.0005	7.86	0.00001	0.00001	0.00001	0.29
200000	1.77	5800.37	0.000005	0.00002	0.0002	8.26	0.000005	0.000005	0.000005	0.28
300000	1.85	8700.57	0.000002	0.00001	0.0001	8.66	0.000002	0.000002	0.000002	0.27
500000	1.92	14500.87	0.000001	0.000005	0.00005	9.06	0.000001	0.000001	0.000001	0.26
700000	1.98	18501.22	0.0000005	0.000002	0.00002	9.46	0.0000005	0.0000005	0.0000005	0.25
1000000	2.04	23301.57	0.0000002	0.000001	0.00001	9.86	0.0000002	0.0000002	0.0000002	0.24
1500000	2.12	35002.37	0.0000001	0.0000005	0.000005	10.26	0.0000001	0.0000001	0.0000001	0.23
2000000	2.18	43302.72	0.00000005	0.0000002	0.000002	10.66	0.00000005	0.00000005	0.00000005	0.22
3000000	2.25	65003.57	0.00000002	0.0000001	0.000001	11.06	0.00000002	0.00000002	0.00000002	0.21
5000000	2.32	102005.32	0.00000001	0.00000005	0.0000005	11.46	0.00000001	0.00000001	0.00000001	0.20
7000000	2.38	139006.67	0.000000005	0.00000002	0.0000002	11.86	0.000000005	0.000000005	0.000000005	0.19
10000000	2.44	186008.02	0.000000002	0.00000001	0.0000001	12.26	0.000000002	0.000000002	0.000000002	0.18
15000000	2.52	279010.37	0.0000000005	0.000000005	0.00000005	12.66	0.0000000005	0.0000000005	0.0000000005	0.17
20000000	2.58	346012.72	0.0000000002	0.000000001	0.00000001	13.06	0.0000000002	0.0000000002	0.0000000002	0.16
30000000	2.65	519015.37	0.0000000001	0.0000000005	0.000000005	13.46	0.0000000001	0.0000000001	0.0000000001	0.15
50000000	2.72	796018.02	0.00000000005	0.0000000002	0.000000002	13.86	0.00000000005	0.00000000005	0.00000000005	0.14
70000000	2.78	1073020.37	0.00000000002	0.0000000001	0.000000001	14.26	0.00000000002	0.00000000002	0.00000000002	0.13
100000000	2.84	1450022.72	0.00000000001	0.00000000005	0.0000000005	14.66	0.00000000001	0.00000000001	0.00000000001	0.12
150000000	2.91	2173035.37	0.000000000005	0.00000000002	0.0000000002	15.06	0.000000000005	0.000000000005	0.000000000005	0.11
200000000	2.97	2850047.72	0.000000000002	0.00000000001	0.0000000001	15.46	0.000000000002	0.000000000002	0.000000000002	0.10
300000000	3.04	4273070.37	0.000000000001	0.000000000005	0.00000000005	15.86	0.000000000001	0.000000000001	0.000000000001	0.09
500000000	3.11	6410092.72	0.0000000000005	0.000000000002	0.00000000002	16.26	0.0000000000005	0.0000000000005	0.0000000000005	0.08
700000000	3.17	8180115.37	0.0000000000002	0.000000000001	0.00000000001	16.66	0.0000000000002	0.0000000000002	0.0000000000002	0.07
1000000000	3.23	10950137.72	0.0000000000001	0.0000000000005	0.000000000005	17.06	0.0000000000001	0.0000000000001	0.0000000000001	0.06
1500000000	3.31	16420200.37	0.00000000000005	0.0000000000002	0.000000000002	17.46	0.00000000000005	0.00000000000005	0.00000000000005	0.05
2000000000	3.37	22190222.72	0.00000000000002	0.0000000000001	0.000000000001	17.86	0.00000000000002	0.00000000000002	0.00000000000002	0.04
3000000000	3.44	33280345.37	0.00000000000001	0.00000000000005	0.0000000000005	18.26	0.00000000000001	0.00000000000001	0.00000000000001	0.03
5000000000	3.51	50450567.72	0.000000000000005	0.00000000000002	0.0000000000002	18.66	0.000000000000005	0.000000000000005	0.000000000000005	0.02
7000000000	3.57	68220790.37	0.000000000000002	0.00000000000001	0.0000000000001	19.06	0.000000000000002	0.000000000000002	0.000000000000002	0.01
10000000000	3.64	86090912.72	0.000000000000001	0.000000000000005	0.00000000000005	19.46	0.000000000000001	0.000000000000001	0.000000000000001	0.00
15000000000	3.71	12914115.37	0.0000000000000005	0.000000000000002	0.00000000000002	19.86	0.0000000000000005	0.0000000000000005	0.0000000000000005	0.00
20000000000	3.77	17826137.72	0.0000000000000002	0.000000000000001	0.00000000000001	20.26	0.0000000000000002	0.0000000000000002	0.0000000000000002	0.00
30000000000	3.84	26739160.37	0.0000000000000001	0.0000000000000005	0.00000000000005	20.66	0.0000000000000001	0.0000000000000001	0.0000000000000001	0.00
50000000000	3.91	40108242.72	0.00000000000000005	0.0000000000000002	0.00000000000002	21.06	0.00000000000000005	0.00000000000000005	0.00000000000000005	0.00
70000000000	3.97	56181365.37	0.00000000000000002	0.0000000000000001	0.00000000000001	21.46	0.00000000000000002	0.00000000000000002	0.00000000000000002	0.00
100000000000	4.04	72154487.72	0.00000000000000001	0.00000000000000005	0.00000000000005	21.86	0.00000000000000001	0.00000000000000001	0.00000000000000001	0.00
150000000000	4.11	10823120.37	0.000000000000000005	0.00000000000000002	0.00000000000002	22.26	0.000000000000000005	0.000000000000000005	0.000000000000000005	0.00
200000000000	4.17	15234142.72	0.000000000000000002	0.00000000000000001	0.00000000000001	22.66	0.000000000000000002	0.000000000000000002	0.000000000000000002	0.00
300000000000	4.24	22851215.37	0.000000000000000001	0.000000000000000005	0.00000000000005	23.06	0.000000000000000001	0.000000000000000001	0.000000000000000001	0.00
500000000000	4.31	34777337.72	0.0000000000000000005	0.000000000000000002	0.00000000000002	23.46	0.0000000000000000005	0.0000000000000000005	0.0000000000000000005	0.00
700000000000	4.37	47694460.37	0.0000000000000000002	0.000000000000000001	0.00000000000001	23.86	0.0000000000000000002	0.0000000000000000002	0.0000000000000000002	0.00
1000000000000	4.44	64011582.72	0.0000000000000000001	0.0000000000000000005	0.00000000000005	24.26	0.0000000000000000001	0.0000000000000000001	0.0000000000000000001	0.00
1500000000000	4.51	91018705.37	0.000000000000000							

Rain Gauge Area

GRI Return

Zones: Uniform Considerations

62500 100000

Estimated area downstream
Favreille area post overflow point

31950 m²
31950 m²

DEM 2D Discharge Data

DEM 3D Discharge Data

Golder Associates
Produced by Nalini Horstland
Project Number: 07581426011
October / 2023



DEM 2D Discharge Data

DEM 3D Discharge Data

100 year return period + 30%	Surface cover (mm)	Intercepting drainage area (m ²)	Volume of Runoff (m ³)	Discharge at gauging point (m ³ /s)	Volume of Runoff (m ³)	Discharge at gauging point (m ³ /s)	Storage capacity (m ³)	Total surface runoff generated (m ³)
15	54.27	170	1.6	165	65.7	16.7	53.4	299
30	98.53	183	16.0	182	97.3	9.4	90.0	1700
45	167.71	218	21.0	197	110.0	8.4	114.6	1130
60	281.19	226	32.4	222	130.0	10.0	125.0	1130
75	481.13	260	49.5	201	137.7	12.0	137.7	1130
90	90.34	361	129.5	171	133.8	11.8	44.0	63.4
105	152.27	381	213.6	342	170.0	23.9	-8.2	-26.2
120	113.26	268	510.2	1421	185.0	44.6	-20.4	-20.4
144.0	813.84	517	765.2	2670	514.0	44.6	-44.6	-44.6

Detailed Discharge - estimated to be informed downstream flow & corrected areas.

DEM 3D Discharge Data

DEM 2D Discharge Data

100 year return period + 30%	Surface cover (mm)	Intercepting drainage area (m ²)	Volume of Runoff (m ³)	Discharge at gauging point (m ³ /s)	Volume of Runoff (m ³)	Discharge at gauging point (m ³ /s)	Storage capacity (m ³)	Total surface runoff generated (m ³)
15	94.27	251	8.0	262	94.8	2.9	23.0	470
30	141.07	254	15.9	264	62.0	16.1	56.0	482
45	211.77	312	21.3	222	78.4	11.3	54.0	1204
60	311.25	346	47.6	236	104	11.4	54.0	44.0
75	511.75	312	201.0	200	618	36.8	56.0	1375
90	80.12	446	101.3	203	672	30.1	100.0	1200
105	131.74	503	362.0	120	616	126.5	50.0	1117
120	112.77	517	765.2	2670	514.0	44.6	-44.6	-44.6
144.0	813.84	517	765.2	2670	514.0	44.6	-44.6	-44.6

Detailed Discharge

DEM 2D Discharge Data

100 year return period + 30%	Surface cover (mm)	Intercepting drainage area (m ²)	Volume of Runoff (m ³)	Discharge at gauging point (m ³ /s)	Volume of Runoff (m ³)	Discharge at gauging point (m ³ /s)	Storage capacity (m ³)	Total surface runoff generated (m ³)
15	51.37	118	3.4	165	80.1	4.7	44.7	929
30	64.07	183	13.0	182	93.0	9.3	90.0	1031
45	65.77	218	21.0	197	120	10.6	104.0	1140
60	70.73	226	32.4	232	121	26.0	0.0	1130
75	80.13	260	65.8	201	127	32.0	10.0	1130
90	60.74	311	141.4	171	145.9	119.8	44.0	61.1
105	102.77	341	200.6	152	170	72.9	-72.9	-72.9
120	113.75	378	816.2	1421	815.0	44.6	-44.6	-44.6
144.0	813.84	517	765.2	2670	514.0	44.6	-44.6	-44.6

Detailed Discharge

DEM 3D Discharge Data

Bank Storage Area

Bivariate Volume Calculations

159000 16/251

Probability area (m²) 31003 m²

Maximum area (m²) 31003 m²

Groundwater table

Water table (m)

M. T. Water level

Goldfarb Associates
Produced by Natalie Hornefield
Project Number 0751424011
October 2017



200 year return period	surface area (m²)	Bank storage (m³)	Volume of Runoff (mm)	Discharge rate (mm/hr)	grassland		Total storage capacity using groundwater (m³)
					Volume of Runoff (mm)	Discharge rate (mm/hr)	
15	18,018	185	185	0.4	881	46.4	8,114
20	23,027	188	188	0.5	904	113.3	8,775
30	35,037	207	207	0.6	1074	160.5	10,623
50	69,471	221	216	0.8	1174	188.5	13,173
70	89,471	221	224	1.0	1143	205.3	15,124
100	144,422	247	94.9	1.2	1279	302.0	19,913
150	162,123	256	129.1	1.4	1479	311.8	24,454
200	192,882	268	126.0	1.6	1695	320.7	28,895
300	310,251	291	120.3	1.8	1741	347.5	37,211
500	510,251	321	119.3	2.0	1741	347.5	41,773

Surface Discharge and Groundwater Storage Summary

200 year return period	surface area (m²)	Bank storage (m³)	grassland		Total product (m³)
			Volume of Runoff (mm)	Discharge rate (mm/hr)	
10	90,365	245	6.0	237	630
20	115,371	214	15.9	250	939
30	162,417	326	21.9	244	116.3
50	318,344	326	47.8	350	174.4
70	398,344	326	51.6	384	220.0
100	74,417	334	81.2	317	348.9
150	83,112	337	91.2	600	410.7
200	102,531	454	92.4	73	1,044
300	167,531	454	95.2	3010	3,710
500	267,531	454	95.2	1083	2161.0

Groundwater

200 year return period	surface area (m²)	Bank storage (m³)	grassland		Total product (m³)
			Volume of Runoff (mm)	Discharge rate (mm/hr)	
10	56,138	704	8.4	181	161
20	72,221	102	10.4	180	113.2
30	92,471	209	21.8	190	160.8
50	65,598	221	32.4	162	188.7
70	106,432	247	84.8	132	207.0
100	81,112	217	67.9	160	162.4
150	92,323	217	67.9	160	162.4
200	103,533	217	67.9	160	162.4
300	163,533	217	67.9	160	162.4
500	243,533	217	67.9	160	162.4

200 year return period	surface area (m²)	Bank storage (m³)	grassland		Total product (m³)
			Volume of Runoff (mm)	Discharge rate (mm/hr)	
10	18,018	185	185	46.4	8,114
20	23,027	188	188	46.4	8,775
30	35,037	207	207	46.4	10,623
50	69,471	221	216	46.4	13,173
70	89,471	221	224	46.4	15,124
100	144,422	247	94.9	46.4	19,913
150	162,123	256	129.1	46.4	24,454
200	192,882	268	126.0	46.4	28,895
300	310,251	291	120.3	46.4	37,211
500	510,251	321	119.3	46.4	41,773

Site Inventory Compound

Site Reference:

Golder Associates
Produced by Natalie Hartfield
Project Number 07084240011
October 2007

Estimated total site dimensions:
Circumference 100' x 100'

3000' x 100'

3000' x 100'

Estimated UTM coordinates:
X: 1417460.00
Y: 34111.00
Z: elevation



Soil characteristics

100 year return period	Surface cover	Soil thickness (cm)	Impermeability Rating (1 to 11) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low
10	Grass	20-40	7.0	21.3	1.3	65	1.3	81	1.3	101	1.3
10	Grass	44-60	7.0	21.3	1.3	95	1.3	92	1.3	138	1.3
60	Grass	50-59	3.0	43.0	10.0	90	17.1	63	13.7	267	1.3
60	Grass	54-63	3.0	58.0	12.3	86	23.7	60	13.7	366	1.3
60	Grass	61-70	4.1	130.4	25.2	27	51.3	44	25.7	112	1.3
300	Grass	62-72	4.6	145.0	28.0	146	52.2	47	21.0	112	1.3
300	Grass	70-80	5.0	132.0	31.0	176	50.3	47	21.0	112	1.3
300	Grass	87.50	5.0	864.0	46.0	386	81.0	77.3	21.0	77.3	1.3
300	Grass	87.50	5.0	864.0	46.0	386	81.0	77.3	21.0	77.3	1.3

Bottom Disposition - Assessments to be conducted prior to site remediation.

100 year return period	Surface cover	Soil thickness (cm)	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low
10	Grass	20-40	7.0	32.2	18.0	1.1	0.1	0.1	36	1.3
10	Grass	44-60	7.0	43.1	41.0	0	0.3	0.3	36	1.3
60	Grass	50-59	3.0	95.9	41.9	0	0.0	0.0	29	1.3
60	Grass	54-63	3.0	187.8	20.0	0	0.0	0.0	29	1.3
60	Grass	61-70	4.1	382.1	25.8	0	0.0	0.0	29	1.3
60	Grass	70-80	5.0	729.7	31.1	0	0.0	0.0	48	1.3
60	Grass	87.50	5.0	1454.5	46.1	0	0.0	0.0	48	1.3
300	Grass	87.50	5.0	1454.5	46.1	0	0.0	0.0	48	1.3

Total Estimated:

100 year return period	Surface cover	Soil thickness (cm)	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low	Volume of Soil (m ³)	Drainage impermeability (1 to 10) 1 = very low
10	Grass	20-40	7.0	32.2	1.2	0.1	0.1	0.1	36	1.3
10	Grass	44-60	7.0	43.1	4.0	0.1	0.1	0.1	42	1.3
60	Grass	50-59	3.0	95.9	41.9	0	0.0	0.0	36	1.3
60	Grass	54-63	3.0	187.8	20.0	0	0.0	0.0	36	1.3
60	Grass	61-70	4.1	382.1	25.8	0	0.0	0.0	36	1.3
60	Grass	70-80	5.0	729.7	31.1	0	0.0	0.0	42	1.3
60	Grass	87.50	5.0	1454.5	46.1	0	0.0	0.0	42	1.3
300	Grass	87.50	5.0	1454.5	46.1	0	0.0	0.0	42	1.3

Total Estimated:

Storage Yields and Crop Rotation

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G.Gilzer & Associates
Produced by Rostala Borghfeld
Project Number 07534340211
October 2007



Number of years in the period + 30%	Interstanding rate (%)		Interest rate on bonds (%)		Interest rate on bank loans (%)		Interest rate on equities (%)	
	100% return in the period	100% return in the period + 30%	100% return in the period	100% return in the period + 30%	100% return in the period	100% return in the period + 30%	100% return in the period	100% return in the period + 30%
10	10.27	3.47	10.3	3.51	11	4.3	74	4622
20	10.07	3.08	11.3	2.66	11	4.6	11	4429
30	10.17	4.10	11.3	4.06	10.8	87.1	36	4623
40	10.75	4.72	10.3	4.03	11.1	75.1	166	4623
50	10.12	5.20	10.3	4.03	10.6	61.2	71	4719
60	10.64	6.06	10.9	3.43	10.9	102.5	46	3815
70	10.22	6.65	10.9	3.43	10.2	74.3	42	121
80	11.34	7.59	10.6	3.33	9.75	410.5	221	515

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Number of years in investment period + 30%	Number of years in investment period	Annual return % (with annual interest)		Annual return % (without annual interest)		Annual return % (with annual interest)		Annual return % (without annual interest)		Annual standard deviation (with annual interest)	Annual standard deviation (without annual interest)
		With interest rate of 10.0%	Without interest rate of 10.0%	With interest rate of 10.0%	Without interest rate of 10.0%	With interest rate of 10.0%	Without interest rate of 10.0%	With interest rate of 10.0%	Without interest rate of 10.0%		
10	7	51.77	34.9	19.9	33.1	31	31	4.3	7.0	40.9	44.9
20	17	26.07	20.5	21.5	20.5	27	27	5.5	5.5	16.1	16.1
30	27	16.77	12.5	12.5	12.5	17.1	17.1	6.6	6.6	10.0	10.0
40	37	11.77	8.7	8.7	8.7	12.7	12.7	7.6	7.6	8.7	8.7
50	47	8.77	6.7	6.7	6.7	11.1	11.1	8.1	8.1	7.0	7.0
60	57	6.77	5.2	5.2	5.2	10.0	10.0	6.1	6.1	5.7	5.7
70	67	5.27	4.2	4.2	4.2	9.3	9.3	5.1	5.1	5.0	5.0
80	77	4.27	3.4	3.4	3.4	8.8	8.8	4.1	4.1	4.7	4.7
90	87	3.47	2.7	2.7	2.7	8.3	8.3	3.6	3.6	4.0	4.0
100	97	2.77	2.2	2.2	2.2	7.8	7.8	3.2	3.2	3.5	3.5
110	107	2.27	1.8	1.8	1.8	7.3	7.3	2.8	2.8	3.2	3.2
120	117	1.87	1.5	1.5	1.5	6.8	6.8	2.5	2.5	2.8	2.8
130	127	1.57	1.2	1.2	1.2	6.3	6.3	2.2	2.2	2.5	2.5
140	137	1.27	0.9	0.9	0.9	5.8	5.8	1.9	1.9	2.2	2.2
150	147	1.02	0.7	0.7	0.7	5.3	5.3	1.7	1.7	1.9	1.9
160	157	0.77	0.5	0.5	0.5	4.8	4.8	1.5	1.5	1.7	1.7
170	167	0.57	0.3	0.3	0.3	4.3	4.3	1.3	1.3	1.5	1.5
180	177	0.37	0.2	0.2	0.2	3.8	3.8	1.1	1.1	1.3	1.3
190	187	0.27	0.1	0.1	0.1	3.3	3.3	0.9	0.9	1.1	1.1
200	197	0.17	0.05	0.05	0.05	2.8	2.8	0.7	0.7	0.9	0.9
210	207	0.07	0.02	0.02	0.02	2.3	2.3	0.5	0.5	0.6	0.6
220	217	0.02	0.01	0.01	0.01	1.8	1.8	0.3	0.3	0.4	0.4
230	227	-0.05	-0.01	-0.01	-0.01	1.3	1.3	0.1	0.1	0.2	0.2
240	237	-0.15	-0.02	-0.02	-0.02	0.8	0.8	0.0	0.0	0.1	0.1
250	247	-0.25	-0.05	-0.05	-0.05	0.3	0.3	-0.1	-0.1	0.0	0.0
260	257	-0.35	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1
270	267	-0.45	-0.15	-0.15	-0.15	-0.7	-0.7	-0.7	-0.7	-0.4	-0.4
280	277	-0.55	-0.2	-0.2	-0.2	-1.2	-1.2	-1.2	-1.2	-0.7	-0.7
290	287	-0.65	-0.25	-0.25	-0.25	-1.7	-1.7	-1.7	-1.7	-1.0	-1.0
300	297	-0.75	-0.3	-0.3	-0.3	-2.2	-2.2	-2.2	-2.2	-1.3	-1.3
310	307	-0.85	-0.35	-0.35	-0.35	-2.7	-2.7	-2.7	-2.7	-1.6	-1.6
320	317	-0.95	-0.4	-0.4	-0.4	-3.2	-3.2	-3.2	-3.2	-1.9	-1.9
330	327	-1.05	-0.45	-0.45	-0.45	-3.7	-3.7	-3.7	-3.7	-2.2	-2.2
340	337	-1.15	-0.5	-0.5	-0.5	-4.2	-4.2	-4.2	-4.2	-2.5	-2.5
350	347	-1.25	-0.55	-0.55	-0.55	-4.7	-4.7	-4.7	-4.7	-2.8	-2.8
360	357	-1.35	-0.6	-0.6	-0.6	-5.2	-5.2	-5.2	-5.2	-3.1	-3.1
370	367	-1.45	-0.65	-0.65	-0.65	-5.7	-5.7	-5.7	-5.7	-3.4	-3.4
380	377	-1.55	-0.7	-0.7	-0.7	-6.2	-6.2	-6.2	-6.2	-3.7	-3.7
390	387	-1.65	-0.75	-0.75	-0.75	-6.7	-6.7	-6.7	-6.7	-4.0	-4.0
400	397	-1.75	-0.8	-0.8	-0.8	-7.2	-7.2	-7.2	-7.2	-4.3	-4.3
410	407	-1.85	-0.85	-0.85	-0.85	-7.7	-7.7	-7.7	-7.7	-4.6	-4.6
420	417	-1.95	-0.9	-0.9	-0.9	-8.2	-8.2	-8.2	-8.2	-4.9	-4.9
430	427	-2.05	-0.95	-0.95	-0.95	-8.7	-8.7	-8.7	-8.7	-5.2	-5.2
440	437	-2.15	-1.0	-1.0	-1.0	-9.2	-9.2	-9.2	-9.2	-5.5	-5.5
450	447	-2.25	-1.05	-1.05	-1.05	-9.7	-9.7	-9.7	-9.7	-5.8	-5.8
460	457	-2.35	-1.1	-1.1	-1.1	-10.2	-10.2	-10.2	-10.2	-6.1	-6.1
470	467	-2.45	-1.15	-1.15	-1.15	-10.7	-10.7	-10.7	-10.7	-6.4	-6.4
480	477	-2.55	-1.2	-1.2	-1.2	-11.2	-11.2	-11.2	-11.2	-6.7	-6.7
490	487	-2.65	-1.25	-1.25	-1.25	-11.7	-11.7	-11.7	-11.7	-7.0	-7.0
500	497	-2.75	-1.3	-1.3	-1.3	-12.2	-12.2	-12.2	-12.2	-7.3	-7.3
510	507	-2.85	-1.35	-1.35	-1.35	-12.7	-12.7	-12.7	-12.7	-7.6	-7.6
520	517	-2.95	-1.4	-1.4	-1.4	-13.2	-13.2	-13.2	-13.2	-7.9	-7.9
530	527	-3.05	-1.45	-1.45	-1.45	-13.7	-13.7	-13.7	-13.7	-8.2	-8.2
540	537	-3.15	-1.5	-1.5	-1.5	-14.2	-14.2	-14.2	-14.2	-8.5	-8.5
550	547	-3.25	-1.55	-1.55	-1.55	-14.7	-14.7	-14.7	-14.7	-8.8	-8.8
560	557	-3.35	-1.6	-1.6	-1.6	-15.2	-15.2	-15.2	-15.2	-9.1	-9.1
570	567	-3.45	-1.65	-1.65	-1.65	-15.7	-15.7	-15.7	-15.7	-9.4	-9.4
580	577	-3.55	-1.7	-1.7	-1.7	-16.2	-16.2	-16.2	-16.2	-9.7	-9.7
590	587	-3.65	-1.75	-1.75	-1.75	-16.7	-16.7	-16.7	-16.7	-10.0	-10.0
600	597	-3.75	-1.8	-1.8	-1.8	-17.2	-17.2	-17.2	-17.2	-10.3	-10.3
610	607	-3.85	-1.85	-1.85	-1.85	-17.7	-17.7	-17.7	-17.7	-10.6	-10.6
620	617	-3.95	-1.9	-1.9	-1.9	-18.2	-18.2	-18.2	-18.2	-10.9	-10.9
630	627	-4.05	-2.0	-2.0	-2.0	-18.7	-18.7	-18.7	-18.7	-11.2	-11.2
640	637	-4.15	-2.05	-2.05	-2.05	-19.2	-19.2	-19.2	-19.2	-11.5	-11.5
650	647	-4.25	-2.1	-2.1	-2.1	-19.7	-19.7	-19.7	-19.7	-11.8	-11.8
660	657	-4.35	-2.15	-2.15	-2.15	-20.2	-20.2	-20.2	-20.2	-12.1	-12.1
670	667	-4.45	-2.2	-2.2	-2.2	-20.7	-20.7	-20.7	-20.7	-12.4	-12.4
680	677	-4.55	-2.25	-2.25	-2.25	-21.2	-21.2	-21.2	-21.2	-12.7	-12.7
690	687	-4.65	-2.3	-2.3	-2.3	-21.7	-21.7	-21.7	-21.7	-13.0	-13.0
700	697	-4.75	-2.35	-2.35	-2.35	-22.2	-22.2	-22.2	-22.2	-13.3	-13.3
710	707	-4.85	-2.4	-2.4	-2.4	-22.7	-22.7	-22.7	-22.7	-13.6	-13.6
720	717	-4.95	-2.45	-2.45	-2.45	-23.2	-23.2	-23.2	-23.2	-13.9	-13.9
730	727	-5.05	-2.5	-2.5	-2.5	-23.7	-23.7	-23.7	-23.7	-14.2	-14.2
740	737	-5.15	-2.55	-2.55	-2.55	-24.2	-24.2	-24.2	-24.2	-14.5	-14.5
750	747	-5.25	-2.6	-2.6	-2.6	-24.7	-24.7	-24.7	-24.7	-14.8	-14.8
760	757	-5.35	-2.65	-2.65	-2.65	-25.2	-25.2	-25.2	-25.2	-15.1	-15.1
770	767	-5.45	-2.7	-2.7	-2.7	-25.7	-25.7	-25.7	-25.7	-15.4	-15.4
780	777	-5.55	-2.75	-2.75	-2.75	-26.2	-26.2	-26.2	-26.2	-15.7	-15.7
790	787	-5.65	-2.8	-2.8	-2.8	-26.7	-26.7	-26.7	-26.7	-16.0	-16.0
800	797	-5.75	-2.85	-2.85	-2.85	-27.2	-27.2	-27.2	-27.2	-16.3	-16.3
810	807	-5.85	-2.9	-2.9	-2.9	-27.7	-27.7	-27.7	-27.7	-16.6	-16.6
820	817	-5.95	-2.95	-2.95	-2.95	-28.2	-28.2	-28.2	-28.2	-16.9	-16.9
830	827	-6.05	-3.0	-3.0	-3.0	-28.7	-28.7	-28.7	-28.7	-17.2	-17.2
840	837	-6.15	-3.05	-3.05	-3.05	-29.2	-29.2	-29.2	-29.2	-17.5	-17.5
850	847	-6.25	-3.1	-3.1	-3.1	-29.7	-29.7	-29.7	-29.7	-17.8	-17.8
860	857	-6.35	-3.15	-3.15	-3.15	-30.2	-30.2	-30.2	-30.2	-18.1	-18.1
870	867	-6.45	-3.2	-3.2	-3.2	-30.7	-30.7	-30.7	-30.7	-18.4	-18.4
880	877	-6.55	-3.25	-3.25	-3.25	-31.2	-31.2	-31.2	-31.2	-18.7	-18.7
890	887	-6.65	-3.3	-3.3	-3.3	-31.7	-31.7	-31.7	-31.7	-19.0	-19.0
900	897	-6.75	-3.35	-3.35	-3.35	-32.2	-32.2	-32.2	-32.2	-19.3	-19.3
910	907	-6.85	-3.4	-3.4	-3.4	-32.7	-32.7	-32.7	-32.7	-19.6	-19.6
920	917	-6.95	-3.45	-3.45	-3.45	-33.2	-33.2	-33.2	-33.2	-19.9	-19.9
930	927	-7.05	-3.5	-3.5	-3.5	-33.7	-33.7	-33.7	-33.7	-20.2	-20.2
940	937	-7.15	-3.55	-3.55	-3.55	-34.2	-34.2	-34.2	-34.2	-20.5	-20.5
950	947	-7.25	-3.6	-3.6	-3.6	-34.7	-34.7	-34.7	-34.7	-20.8	-20.8
960	957	-7.35	-3.65	-3.65	-3.65	-35.2	-35.2	-35.2	-35.2	-21.1	-21.1
970	967	-7.45	-3.7	-3.7	-3.7	-35.7	-35.7	-35.7	-35.7	-21.4	-21.4
980	977	-7.55	-3.75	-3.75	-3.75	-36.2	-36.2	-36.2	-36.2	-21.7	-21.7
990	987	-7.65	-3.8	-3.8	-3.8	-36.7	-36.7	-36.7	-36.7	-22.0	-22.0
1000	997	-7.75	-3.85	-3.85	-3.85	-37.2	-37.2	-37.2	-37.2	-22.3	-22.3

Sediment Generation

Ground Water Calculations

999999 100209

Estimated units per calculation
Calculated units per statement

0001 m³6021 m³

Groundwater flow

12.1 155.0 m

Flow distribution

200 year return period	surface area mm²	runoff coefficient	runoff mm	runoff mm	precipitation		runoff mm
					Volume of Runoff (m³)	Change in groundwater level (m)	
10	50.00	0.30	15.0	10.9	327	0.0	7.0
20	50.30	0.30	20.7	21.6	523	0.0	8.6
30	52.43	0.30	41.1	43.5	874	0.0	11.1
40	50.54	0.30	48.2	46.2	1060	0.0	12.7
50	48.43	0.30	63.9	62.6	1365	0.0	14.0
60	46.30	0.30	75.7	79.4	1712	0.0	15.2
70	43.13	0.30	81.2	81.0	1941	0.0	15.5
80	40.93	0.30	82.9	82.0	2040	0.0	15.7
90	38.70	0.30	84.6	84.5	2045	0.0	15.8
100	36.43	0.30	86.3	86.2	2046	0.0	15.8
110	34.13	0.30	88.0	87.9	2047	0.0	15.8
120	31.80	0.30	89.7	89.6	2048	0.0	15.8
130	29.43	0.30	91.4	91.3	2049	0.0	15.8
140	27.00	0.30	93.1	93.0	2050	0.0	15.8
150	24.53	0.30	94.8	94.7	2051	0.0	15.8
160	22.00	0.30	96.5	96.4	2052	0.0	15.8
170	19.43	0.30	98.2	98.1	2053	0.0	15.8
180	16.80	0.30	99.9	99.8	2054	0.0	15.8
190	14.13	0.30	101.6	101.5	2055	0.0	15.8
200	11.43	0.30	103.3	103.2	2056	0.0	15.8
210	8.70	0.30	105.0	104.9	2057	0.0	15.8
220	6.00	0.30	106.7	106.6	2058	0.0	15.8
230	3.27	0.30	108.4	108.3	2059	0.0	15.8
240	0.53	0.30	110.1	109.9	2060	0.0	15.8
250	-2.13	0.30	111.8	111.6	2061	0.0	15.8
260	-4.47	0.30	113.5	113.3	2062	0.0	15.8
270	-6.80	0.30	115.2	115.0	2063	0.0	15.8
280	-9.13	0.30	116.9	116.7	2064	0.0	15.8
290	-11.43	0.30	118.6	118.4	2065	0.0	15.8
300	-13.70	0.30	120.3	119.9	2066	0.0	15.8
310	-16.00	0.30	122.0	121.6	2067	0.0	15.8
320	-18.27	0.30	123.7	123.3	2068	0.0	15.8
330	-20.43	0.30	125.4	125.0	2069	0.0	15.8
340	-22.60	0.30	127.1	126.7	2070	0.0	15.8
350	-24.73	0.30	128.8	128.4	2071	0.0	15.8
360	-26.80	0.30	130.5	130.1	2072	0.0	15.8
370	-28.83	0.30	132.2	131.8	2073	0.0	15.8
380	-30.80	0.30	133.9	133.5	2074	0.0	15.8
390	-32.73	0.30	135.6	135.2	2075	0.0	15.8
400	-34.63	0.30	137.3	136.9	2076	0.0	15.8
410	-36.50	0.30	139.0	138.6	2077	0.0	15.8
420	-38.33	0.30	140.7	140.3	2078	0.0	15.8
430	-40.13	0.30	142.4	141.9	2079	0.0	15.8
440	-41.93	0.30	144.1	143.6	2080	0.0	15.8
450	-43.70	0.30	145.8	145.3	2081	0.0	15.8
460	-45.43	0.30	147.5	147.0	2082	0.0	15.8
470	-47.13	0.30	149.2	148.7	2083	0.0	15.8
480	-48.80	0.30	150.9	150.4	2084	0.0	15.8
490	-50.43	0.30	152.6	152.1	2085	0.0	15.8
500	-52.00	0.30	154.3	153.8	2086	0.0	15.8
510	-53.53	0.30	156.0	155.5	2087	0.0	15.8
520	-55.00	0.30	157.7	157.2	2088	0.0	15.8
530	-56.43	0.30	159.4	158.9	2089	0.0	15.8
540	-57.80	0.30	161.1	160.6	2090	0.0	15.8
550	-59.13	0.30	162.8	162.3	2091	0.0	15.8
560	-60.43	0.30	164.5	164.0	2092	0.0	15.8
570	-61.70	0.30	166.2	165.7	2093	0.0	15.8
580	-63.00	0.30	167.9	167.4	2094	0.0	15.8
590	-64.27	0.30	169.6	169.1	2095	0.0	15.8
600	-65.47	0.30	171.3	170.8	2096	0.0	15.8
610	-66.60	0.30	173.0	172.5	2097	0.0	15.8
620	-67.73	0.30	174.7	174.2	2098	0.0	15.8
630	-68.80	0.30	176.4	175.9	2099	0.0	15.8
640	-69.83	0.30	178.1	177.6	2100	0.0	15.8
650	-70.80	0.30	179.8	179.3	2101	0.0	15.8
660	-71.73	0.30	181.5	181.0	2102	0.0	15.8
670	-72.60	0.30	183.2	182.7	2103	0.0	15.8
680	-73.43	0.30	184.9	184.4	2104	0.0	15.8
690	-74.20	0.30	186.6	186.1	2105	0.0	15.8
700	-75.00	0.30	188.3	187.8	2106	0.0	15.8
710	-75.73	0.30	190.0	189.5	2107	0.0	15.8
720	-76.43	0.30	191.7	191.2	2108	0.0	15.8
730	-77.13	0.30	193.4	192.9	2109	0.0	15.8
740	-77.80	0.30	195.1	194.6	2110	0.0	15.8
750	-78.43	0.30	196.8	196.3	2111	0.0	15.8
760	-79.00	0.30	198.5	198.0	2112	0.0	15.8
770	-79.53	0.30	200.2	199.7	2113	0.0	15.8
780	-80.00	0.30	201.9	201.4	2114	0.0	15.8
790	-80.43	0.30	203.6	203.1	2115	0.0	15.8
800	-80.80	0.30	205.3	204.8	2116	0.0	15.8
810	-81.13	0.30	207.0	206.5	2117	0.0	15.8
820	-81.43	0.30	208.7	208.2	2118	0.0	15.8
830	-81.70	0.30	210.4	209.9	2119	0.0	15.8
840	-82.00	0.30	212.1	211.6	2120	0.0	15.8
850	-82.27	0.30	213.8	213.3	2121	0.0	15.8
860	-82.50	0.30	215.5	215.0	2122	0.0	15.8
870	-82.73	0.30	217.2	216.7	2123	0.0	15.8
880	-83.00	0.30	218.9	218.4	2124	0.0	15.8
890	-83.27	0.30	220.6	219.9	2125	0.0	15.8
900	-83.50	0.30	222.3	221.6	2126	0.0	15.8
910	-83.73	0.30	224.0	223.3	2127	0.0	15.8
920	-84.00	0.30	225.7	224.9	2128	0.0	15.8
930	-84.27	0.30	227.4	226.6	2129	0.0	15.8
940	-84.50	0.30	229.1	228.3	2130	0.0	15.8
950	-84.73	0.30	230.8	229.9	2131	0.0	15.8
960	-85.00	0.30	232.5	231.6	2132	0.0	15.8
970	-85.27	0.30	234.2	233.3	2133	0.0	15.8
980	-85.50	0.30	235.9	234.9	2134	0.0	15.8
990	-85.73	0.30	237.6	236.6	2135	0.0	15.8
1000	-86.00	0.30	239.3	238.3	2136	0.0	15.8
1010	-86.27	0.30	241.0	240.0	2137	0.0	15.8
1020	-86.50	0.30	242.7	241.6	2138	0.0	15.8
1030	-86.73	0.30	244.4	243.3	2139	0.0	15.8
1040	-87.00	0.30	246.1	245.0	2140	0.0	15.8
1050	-87.27	0.30	247.8	246.6	2141	0.0	15.8
1060	-87.50	0.30	249.5	248.3	2142	0.0	15.8
1070	-87.73	0.30	251.2	250.0	2143	0.0	15.8
1080	-88.00	0.30	252.9	251.6	2144	0.0	15.8
1090	-88.27	0.30	254.6	253.3	2145	0.0	15.8
1100	-88.50	0.30	256.3	255.0	2146	0.0	15.8
1110	-88.73	0.30	258.0	256.6	2147	0.0	15.8
1120	-89.00	0.30	259.7	258.3	2148	0.0	15.8
1130	-89.27	0.30	261.4	260.0	2149	0.0	15.8
1140	-89.50	0.30	263.1	261.6	2150	0.0	15.8
1150	-89.73	0.30	264.8	263.3	2151	0.0	15.8
1160	-90.00	0.30	266.5	265.0	2152	0.0	15.8
1170	-90.27	0.30	268.2	266.6	2153	0.0	15.8
1180	-90.50	0.30	269.9	268.3	2154	0.0	15.8
1190	-90.73	0.30	271.6	270.0	2155	0.0	15.8
1200	-91.00	0.30	273.3	271.6	2156	0.0	15.8
1210	-91.27	0.30	275.0	273.3	2157	0.0	15.8
1220	-91.50	0.30	276.7	274.3	2158	0.0	15.8
1230	-91.73	0.30	278.4	276.3	2159	0.0	15.8
1240	-92.00	0.30	280.1	278.0	2160	0.0	15.8
1250	-92.27	0.30	281.8	279.3	2161	0.0	15.8
1260	-92.50	0.30	283.5	281.0	2162	0.0	15.8
1270	-92.73	0.30	285.2	282.6	2163	0.0	15.8
1280	-93.00	0.30	286.9	284.2	2164	0.0	15.8
1290	-93.27	0.30	288.6	286.0	2165	0.0	15.8
1300	-93.50	0.30	290.3	287.6	2166	0.0	15.8
1310	-93.73	0.30	292.0	289.0	2167	0.0	15.8
1320	-94.00	0.30	293.7	290.3	2168	0.0	15.8
1330	-94.27	0.30	295.4	291.6	2169	0.0	15.8
1340	-94.50	0.30	297.1	292.8	2170	0.0	15.8

Road

Storage Volume Calculations

Grid Reference

459000 184230

Golder Associates

Produced by Natalie Horsfield

Project Number 07514240011

October 2007

Estimated area pre development: 15436 m²
 Estimated area post development: 15436 m²

Greenfield Discharge rate	18.1 l/s/m ²
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Pre development

100 year return period	surface cover area runoff coefficient	hardstanding 15436 m ²		
Duration (minutes)	rainfall (mm)	Volume of Runoff (m ³)	Discharge at greenfield rate (m ³ /s)	Storage req'd (m ³)
15	39.44	609	25	584
30	44.67	690	50	639
60	50.59	781	101	680
90	54.42	840	151	688
180	61.63	951	302	630
360	69.6	1077	603	474
720	79.05	1220	1207	13
1440	87.51	1351	2414	-1063
			Maximum	689

During development

100 year return period	surface cover area runoff coefficient	hardstanding 15436 m ²		
Duration (minutes)	rainfall (mm)	Volume of Runoff (m ³)	Discharge at greenfield rate (m ³ /s)	Storage req'd (m ³)
15	39.44	609	25	584
30	44.67	690	50	639
60	50.59	781	101	680
90	54.42	840	151	688
180	61.63	951	302	630
360	69.6	1077	603	474
720	79.05	1220	1207	13
1440	87.51	1351	2414	-1063
			Maximum	689

Post development

100 year return period	surface cover area runoff coefficient	hardstanding 15436 m ²		
Duration (minutes)	rainfall (mm)	Volume of Runoff (m ³)	Discharge at greenfield rate (m ³ /s)	Storage req'd (m ³)
15	39.44	609	25	584
30	44.67	690	50	639
60	50.59	781	101	680
90	54.42	840	151	688
180	61.63	951	302	630
360	69.6	1077	603	474
720	79.05	1220	1207	13
1440	87.51	1351	2414	-1063
			Maximum	689



Road

Storage Volume Calculations

Grid Reference

459400 104250

Golder Associates

Produced by Natalie Horsfield

Project Number 07514240011

October 2007

Estimated area pre development

15436 m²

Estimated area post development

15436 m²

Greenfield Discharge rate	16.1 l/s/Ha
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Pre development

100 year return period + 30%	surface cover area	hardstanding 15436 m ²	1		
			Duration (minutes)	rainfall (mm)	Volume of Runoff (m ³)
15	51.27	791	25.1	766	
30	58.07	896	50.3	846	
60	65.77	1015	100.6	915	
90	70.76	1092	150.9	941	
180	80.12	1237	301.7	935	
360	90.74	1401	603.5	797	
720	102.77	1586	1207.0	379	
1440	113.76	1758	2413.9	-656	
			Maximum		941

During development

100 year return period + 30%	surface cover area	hardstanding 15436 m ²	1		
			Duration (minutes)	rainfall (mm)	Volume of Runoff (m ³)
15	51.27	791	25.1	766	
30	58.07	896	50.3	846	
60	65.77	1015	100.6	915	
90	70.76	1092	150.9	941	
180	80.12	1237	301.7	935	
360	90.74	1401	603.5	797	
720	102.77	1586	1207.0	379	
1440	113.76	1758	2413.9	-656	
			Maximum		941

Post development

100 year return period + 30%	surface cover area	hardstanding 15436 m ²	1		
			Duration (minutes)	rainfall (mm)	Volume of Runoff (m ³)
15	51.27	791	25.1	766	
30	58.07	896	50.3	846	
60	65.77	1015	100.6	915	
90	70.76	1092	150.9	941	
180	80.12	1237	301.7	935	
360	90.74	1401	603.5	797	
720	102.77	1586	1207.0	379	
1440	113.76	1758	2413.9	-656	
			Maximum		941



Road

Storage Volume Calculations

Grid Reference

459100 164760

Golder Associates
Produced by Natalie Horsfield
Project Number 07514240011
October 2007

Estimated area pre development 15436 m²
Estimated area post development 15436 m²

Greenfield Discharge rate	18.1 l/s/m ²
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Pre development

200 year return period	surface cover area runoff coefficient	hardstanding 15436 m ²		
Duration (minutes)	rainfall (mm)	Volume of Runoff (m ³)	Discharge at greenfield rate (m ³ /s)	Storage req'd (m ³)
15	50.06	773	25	748
30	55.93	863	50	813
60	62.47	964	101	864
90	68.64	1029	151	872
120	74.42	1149	202	847
180	83.12	1283	303	680
360	92.83	1433	1207	226
720	101.33	1564	2414	-850
Maximum				878

During development

200 year return period	surface cover area runoff coefficient	hardstanding 15436 m ²		
Duration (minutes)	rainfall (mm)	Volume of Runoff (m ³)	Discharge at greenfield rate (m ³ /s)	Storage req'd (m ³)
15	50.06	773	25	748
30	55.93	863	50	813
60	62.47	964	101	864
90	68.64	1029	151	872
120	74.42	1149	202	847
180	83.12	1283	303	680
360	92.83	1433	1207	226
720	101.33	1564	2414	-850
Maximum				878

Post development

200 year return period	surface cover area runoff coefficient	hardstanding 15436 m ²		
Duration (minutes)	rainfall (mm)	Volume of Runoff (m ³)	Discharge at greenfield rate (m ³ /s)	Storage req'd (m ³)
15	50.06	773	25	748
30	55.93	863	50	813
60	62.47	964	101	864
90	68.64	1029	151	872
120	74.42	1149	202	847
180	83.12	1283	303	680
360	92.83	1433	1207	226
720	101.33	1564	2414	-850
Maximum				878

