

Defence Estates

HMS Daedalus Land Quality Assessment

Phase Two: Intrusive Investigation
DE Project No 05002

Final Technical Note

3 May 2007

Prepared by Entec UK Limited for the
Ministry of Defence, under commission
DE11/4471



DE

DEFENCE ESTATES

Delivering Estate Solutions to Defence Needs

Report for

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HMS Daedalus Land Quality Assessment

1. Introduction

This Technical Note has been produced to accompany the Phase Two Land Quality Assessment Report for HMS Daedalus (Entec reference 17275RR038i2) and should be read in conjunction with that report.

This note summarises the conclusions on liabilities arising from identified contamination on the site and, where necessary, proposes management options and remediation measures to mitigate these liabilities.

The Defence Estates (DE) Directive covering this project is presented in Annex A.

2. Summary of Environmental Risk Assessment

2.1 Summary of Contamination

The findings of the Phase Two LQA indicate that the majority of HMS Daedalus is generally free from significant contamination. However, areas of localised contamination (approximately 2% of the site area) were identified as detailed below:

Area 1 - Solvents in Technical Area

Dissolved phase contamination by chlorinated solvents was identified in shallow groundwater in the Technical Area in a location largely occupied by hangars and workshops. The source of the contamination is likely to be historical solvent use in hangars and workshops, although a shallow soil source has not been identified to date.

Area 2 - Hydrocarbons in MT Section

Hydrocarbon contamination was identified at the former MT section with the central southern area of the Technical Area. This MT section was formerly used for fuel storage and dispensing. Gasoline Range Organics (GRO) contamination in groundwater was encountered above the screening value (Dutch Intervention Value) in EBH309.

Area 3 - Metals in Victorian Tip Area

Made ground comprised ashy soils in part of the northern area of the airfield. This area was suspected of being used as a former Victorian tip. Elevated concentrations of metals were encountered at this location (ETP311) to above screening value concentrations for residential end use.

Area 4 - Metals in Former Firing Range

Made ground comprised ashy soils in part of the western area of the airfield at the location of a former firing range. Elevated concentrations of metals were encountered at this location to above screening value concentrations for residential end use.

Area 5 - Asbestos in Made Ground

A fragment of cement bonded asbestos was encountered in Made Ground in EBH310 within the east of the Technical Area. It is possible that further asbestos fragments derived from building demolition waste are present in this area of the site.

Sources of contamination are illustrated on Figure 1. No further significant contamination was identified on site.

However, it should be noted that the site investigation was designed on a risk based approach. This approach identifies areas more likely to have been impacted by contamination given the historic uses on site. It is therefore possible that further contamination exists on site that has not been identified within the scope of the present investigation.

2.2 Summary of Environmental Risks

Given that the site is secure and access is restricted to personnel and site workers on business, the risks to current users are generally assessed as LOW. The most significant risk to site users is due to inhalation of volatile contamination.

Shallow soil contamination by metals which exceed industrial/commercial guideline values is generally in areas of low usage within the site. The risks to site users under current commercial/industrial use are therefore assessed as LOW with respect to metals in soils.

Risks to construction workers are generally assessed as MODERATE in areas of contamination, including areas known to have chlorinated solvent, hydrocarbon, metals and asbestos contamination. Risks can be mitigated through suitable safe systems of work and personal protective equipment resulting in a LOW assessment.

For commercial/industrial end use the risk to site users would be generally LOW with similar pathways/working practices as are currently used, although this depends in part upon the layout of the proposed development.

For residential end-use, in areas known to have chlorinated solvent, hydrocarbons, metals and asbestos contamination, a MODERATE risk is present if residential gardens are located on these areas.

The site is underlain by a Minor Aquifer. The risk to groundwater is assessed as HIGH with respect to chlorinated solvent and hydrocarbon contamination, given that these contaminants have been detected in shallow groundwater at the site. The risks to groundwater in areas of metal contamination in soil (tip area, metalliferous Made Ground), are LOW given that metals do not appear to be readily leachable from shallow soils to groundwater. The Brickearth Deposits present throughout the site are generally fine grained cohesive soils, and will provide some protection to the underlying groundwater-bearing Terrace Deposits.

It is likely that groundwater beneath the site forms the base flow for the nearby River Alver to the east of the site, and may be in connectivity with the Solent. Dilution and attenuation of contamination in the groundwater is likely to occur along these routes. The River Alver is a poor quality surface water in any case. Groundwater below the Technical Area appears to flow in a west/south west direction towards the Solent. Previous investigations have indicated that only shallow groundwater below the eastern fringe of the airfield flows towards the River Alver to the east of the site. The risk to surface waters from site contamination is therefore considered to be LOW to MODERATE.

Risks to buildings and buried services manifest as either damage through direct leaching or vapour migration, the latter of which occurs where fuel hydrocarbons or solvents are contaminants of concern. Throughout the majority of the site, the risks to buildings and services are assessed as LOW. In areas of chlorinated solvent and hydrocarbon impact, risks may rise to MODERATE due to the potential for penetration of water services.

Vegetation may be impacted by uptake of and direct contact with contamination. Large areas of the airfield are grassed. There was no evidence of distressed vegetation or die back observed during the site investigation and subsequently the risk is considered to be LOW.

The nearest sensitive ecological receptors to the site are those associated with the Solent. The main pathway from the site is via groundwater flow. Dilution of contaminants on entry to this ecological receptor results in a LOW risk assessment for the site.

2.3 Liability Assessment

The factors used to rank the potential liability for the various pollutant linkages is summarised in Table 2.1. Table 2.2 shows the pollutant linkages previously identified in the Phase Two Land Quality Assessment and assigns a liability classification to each linkage.

Table 2.1 Liability Classification

A	Immediate significant risk of health hazard occurring
A1	Health hazard during demolition or construction
B	Immediate significant risk of unacceptable damage to the environment
B1	Significant risk to the environment during demolition or construction
C	Large remediation liability
D	Minor remediation liability
E	Minor significance, no remediation required
F	No effect on re-use option or site value

Table 2.2 Summary of Environmental Risks and Liabilities

Area/ Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source- Receptor Linkage	Significance: Risk Classification	Liability Classification
Hangars, Workshops & BFI	Chlorinated solvents	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low	D
		Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate Any future groundworks may encounter contamination.	D, A1
	Humans (Future Users Commercial/ Industrial)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low	Low Volatiles may potentially enter buildings	D
		Humans (Future Users Residential)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate Volatiles may potentially enter buildings	D/C
		Groundwater (Minor Aquifer)	Leaching Migration	Groundwater Contamination	Moderate	Almost Certain	High Dissolved phase contaminants present in shallow groundwater	C

Table 2.2 (continued) Summary of Environmental Risks and Liabilities

Area/ Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source- Receptor Linkage	Significance: Risk Classification	Liability Classification
		Surface Water (River Alver/Solent)	Runoff to drainage ditches	Water Pollution	Moderate	Possible	Low-Moderate No apparent flow towards Alver from Impacted area	E
		Buildings and Buried Services	Groundwater	Degradation	Moderate	Unlikely	Low No shallow soil source identified	D/E
		Vegetation	Uplake Direct Contact	Toxic	Low	Unlikely	Low	E
Fuel Storage Areas, MT Section	Hydrocarbons	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low Impact on site users unlikely under current use	D/E
		Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate Future groundworks may encounter contamination	D, A1
		Humans (Future Users, Commercial/ Industrial)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low Voiatiles may enter buildings	D/E

Table 2.2 (continued) Summary of Environmental Risks and Liabilities

Area/ Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source- Receptor Linkage	Significance: Risk Classification	Liability Classification
		Humans (Future Users: Residential)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate Volatiles may enter and accumulate in buildings	D
	Groundwater (Minor Aquifer)		Leaching Migration	Groundwater Contamination	Moderate	Almost Certain	High Encountered in shallow groundwater	D
	Surface Water (River Alver/Solent)		Runoff to drainage ditches	Water Pollution	Moderate	Possible	Low-Moderate Attenuation likely given distance to river	E
	Buildings and Buried Services		Groundwater Vapour mitigation	Degradation Hazardous vapour	Moderate	Possible	Low-Moderate Localised Impact possible close to sources	E
	Vegetation		Uptake Direct Contact	Toxic	Low	Unlikely	Low No impact observed	E

Table 2.2 (continued) Summary of Environmental Risks and Liabilities

Area/ Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source- Receptor Linkage	Significance: Risk Classification	Liability Classification
Burning Grounds/ Tips	Ash containing metals	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low Impacted area largely disused under current use	D
		Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate Future groundworks may encounter contamination	D, A1
		Humans (Future Users, Commercial/ Industrial)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low Future industrial/ commercial users unlikely to encounter localised contamination	D
		Humans (Future Users: Residential)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate Future residential users could encounter localised contamination in gardens	C/D

Table 2.2 (continued) Summary of Environmental Risks and Liabilities

Area/ Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source- Receptor Linkage	Significance: Risk Classification	Liability Classification
		Groundwater (Minor Aquifer)	Leaching Migration	Groundwater Contamination	Moderate	Unlikely	Low Metals/ PAHs not readily leachable	E
		Surface Water (River Alver/Solent)	Runoff to drainage ditches	Water Pollution	Moderate	Unlikely	Low Unlikely given distance to Alver	E
		Buildings and Buried Services	Groundwater	Degradation	Moderate	Unlikely	Low Non volatiles unlikely to impact buildings and structures	E
		Vegetation	Uptake Direct Contact	Toxic	Low	Unlikely	Low No impact observed	E
Burning Grounds/ Tips	Ash containing PAHs	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low Impacted area largely disused under current use	D
		Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate Future groundworks may encounter contamination	D, A1

Table 2.2 (continued) Summary of Environmental Risks and Liabilities

Area/ Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source- Receptor Linkage	Significance: Risk Classification	Liability Classification
		Humans (Future Users, Commercial/ Industrial)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low Future industrial/ commercial users unlikely to encounter localised contamination	D
		Humans (Future Users: Residential)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate Future residential users could encounter localised contamination in gardens	C/D
		Groundwater (Minor Aquifer)	Leaching Migration	Groundwater Contamination	Moderate	Unlikely	Low Metals/ PAHs not readily leachable	E
		Surface Water (River Aver/Solent)	Runoff to drainage ditches	Water Pollution	Moderate	Unlikely	Low Unlikely given distance to AVer	E
		Buildings and Buried Services	Groundwater	Degradation	Moderate	Unlikely	Low Non volatiles unlikely to impact buildings and structures	E

Table 2.2 (continued) Summary of Environmental Risks and Liabilities

Area/ Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source- Receptor Linkage	Significance: Risk Classification	Liability Classification
		Vegetation	Uplake Direct Contact	Toxic	Low	Unlikely	Low No impact observed	D/E
Former Firing Range	Metals	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low Impacted area largely disused under current use	D
		Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate Future groundworks may encounter contamination	D, A1
		Humans (Future Users, Commercial/ Industrial)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Unlikely	Low Future industrial/ commercial users unlikely to encounter localised contamination	D

Table 2.2 (continued) Summary of Environmental Risks and Liabilities

Area/ Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source- Receptor Linkage	Significance: Risk Classification	Liability Classification
		Humans (Future Users: Residential)	Dermal Contact Ingestion Inhalation	Toxic Health Impact	Moderate	Possible	Moderate	D
		Groundwater (Minor Aquifer)	Leaching Migration	Groundwater Contamination	Moderate	Unlikely	Low Metals not readily leachable	E
		Surface Water (River Aiver/Solent)	Runoff to drainage ditches	Water Pollution	Moderate	Unlikely	Low Unlikely given distance to Aiver	E
		Buildings and Buried Services	Groundwater	Degradation	Moderate	Unlikely	Low No metals impact to buildings	E
		Vegetation	Uptake Direct Contact	Toxic	Low	Unlikely	Low No impact observed	E

Table 2.2 (continued) Summary of Environmental Risks and Liabilities

Area/ Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source- Receptor Linkage	Significance: Risk Classification	Liability Classification
Asbestos in Soils nr demolished buildings	Asbestos fibres	Humans (Site Users)	Inhalation	Asbestosis	Moderate	Unlikely	Low Contact with buried asbestos fragments unlikely	E
		Humans (Redevelopment Workers)	Inhalation	Asbestosis	Moderate	Possible	Moderate* Future groundworks may encounter contamination	D, A1
		Humans (Future Users- Commercial)	Inhalation	Asbestosis	Moderate	Unlikely	Low Future ind/comm users unlikely to encounter buried asbestos	D, A1

+ Risks to redevelopment workers may be managed by planning and availability of suitable Personal Protective Equipment (PPE) during excavation or other works.

Note: Risk classifications are based on the current commercial/industrial site use. The risk to future users is based on commercial/industrial site use or residential use as stated.

3. Liability Appraisal in Regulatory Context

There are a number of ways in which liabilities can arise from the presence of soil and groundwater contamination on a site. Of particular importance are:

- i) Statutory liability for clean-up of contaminated land;
- ii) Statutory liability for clean-up of water pollution;
- iii) Liability to third parties for damage caused by contamination.

3.1 Contaminated Land Liability

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

The definition of contaminated land has previously been introduced in Section 5 of the LQA Report. For a liability to exist a 'pollutant linkage' must exist which presents a risk to humans, to the environment or to controlled waters.

With regard to the known hydrocarbon contamination at the former generator tanks area, a significant pollutant linkage (SPL) has been established with respect to groundwater contamination, resulting in a potential statutory liability which will require management.

In apportioning liability for remediation the enforcing authority will wherever possible follow the 'polluter pays' principle. This will identify the 'appropriate person' under the act who 'caused or knowingly permitted' the contamination to be present. There are two different categories of Appropriate Person:

Class A Person: The person who caused or knowingly permitted the contamination (i.e. the polluter). This has to be considered for each pollutant linkage.

Class B Person: The owner or occupier, where no Class A person can be found.

In most circumstances the MOD will be the Class A person unless the liabilities are transferred as part of any sale or lease agreement. The statutory guidance provides a basis for identifying liability groups, apportioning liability and exclusion tests for Class A persons where liability has been transferred e.g. 'payments have been made for remediation' or where the site has been 'sold with information' or other test.

It should be noted that in the event of change of site use it is likely that any issue of land quality would be addressed through the planning regime rather than Part IIA of the EPA.

3.2 Water Pollution Liability

Under Section 161 of the Water Resources Act 1991 (WRA) the Environment Agency has the power to take action to prevent or remedy the pollution of controlled waters by issuing a 'works notice' to any person who has 'caused or knowingly' permitted the pollutant or potential pollutant to be present. There is overlap between these powers and the Part IIA contaminated land regime.

The hydrocarbon and solvent contamination in groundwater on the site presents a potential liability under both the WRA and Part IIA of the EPA.

Liability may also arise resulting in prosecution under Section 85, if a site owner fails to take adequate precautions to prevent unauthorised discharging of pollutants into controlled waters. In addition to unauthorised discharges direct into controlled waters, companies are held liable for unauthorised discharges to controlled waters occurring via surface water drains, or by discharge onto the land.

3.3 Civil Liability to Third Parties

If contamination on a site damages or unreasonably interferes with the use of a neighbouring property the owner/occupier may have a right for damages under private nuisance. For example, this can include damage to the right to extract groundwater from an aquifer, or damage to crops as a result of contaminant migration into groundwater abstracted for spray irrigation.

Nuisance can apply to isolated escapes from land even where the site owner has taken all possible precautions to prevent an escape (strict liability), however, there may be exceptions to this where the event was 'unforeseeable'.

There is little likelihood of the contamination identified giving rise to a civil liability from third parties. However, it should be noted that solvent contamination in groundwater may cross the site boundary in the south west possibly under residential properties which should be taken into account in managing the contamination.

3.4 Other Sources of Liability

3.4.1 Health and Safety

The Health and Safety at Work Act (1974) is concerned with risks to the public and employees at premises. Risks of this kind could arise from contamination, and from physical hazards such as buried ordnance. A number of Regulations have been made under the Act, all of which have a largely risk-based approach, requiring potential hazards to be identified and assessed, and control measures put in place to minimise all risks as far as is reasonably possible. These include:

- Management of Health and Safety at Work Regulations 1999;
- Control of Substances Hazardous to Health Regulations 2002;
- Control of Asbestos at Work Regulations 2002;
- Construction (Health, Safety and Welfare) Regulations 1996.

Most remedial works will be covered by the provisions of the Construction (Design and Management) Regulations 1994 (CDM), which specifies several roles with health and safety responsibilities for the project. These include a Planning Supervisor to co-ordinate designing health and safety during the construction phase. CDM requires notification of relevant works to the Health and Safety Executive (HSE) prior to commencement.

The Control of Asbestos at Work Regulations 2002 (CAWR 2002) establishes the duty to manage risks from asbestos in non-domestic premises by undertaking suitable assessments to determine the location and condition of all asbestos containing materials. This assessment is then used to manage the risks from asbestos to site users. The regulator is the Health and Safety Executive (HSE). It is considered that there is no current liability for the built estate under these regulations, as an asbestos register is maintained for the site, and sampling asbestos surveys have been undertaken. However, the localised asbestos within infill material, poses a risk to redevelopment workers and to users of the site post redevelopment and may have implications under these regulations.

3.4.2 Planning and Development Control

Since the Planning and Compulsory Purchase Act 2004 came into force in May 2005, the Crown and its subsidiary departments such as the MOD are now bound by planning control. However, enforcement action cannot be taken against the Crown without its consent.

Engineering works are likely to require planning permission, unless they are on such a small scale as to not warrant consideration (*de minimus* principle). This would include many remedial actions.

Land contamination is a 'material consideration' for the purpose of the Planning Regime. Where it is proposed to change the use of land, as part of granting planning permission, the Planning Authority should satisfy itself that the potential for contamination is properly assessed and the development incorporates any necessary remediation. Planning permission should therefore include site investigation and remediation conditions, or Section 106 agreements, to ensure that the land is made suitable for its new use.

Annex 2 to Planning Policy Statement PPS23 Development on land affected by contamination, released in 2004, requires risks from contamination to be assessed in accordance with Part IIA principles, and, after carrying out the development and commencement of its use, the land should not be capable of being determined as contaminated land under Part IIA. For land use planning purposes, what constitutes an unacceptable risk is wider than for Part IIA purposes, since planning is concerned with proposed development and future use, and thus with both existing and new risks. In addition, the range of receptors is wider than under Part IIA and includes, for example, general fauna and flora, landscape and amenity. From August 2006 the Part IIA regime was extended to include radioactivity in Circular 01/2006.

Dependent upon the form and layout of any proposed development, all of the contamination issues identified in this report may require management under this legislation.

3.4.3 Building Regulations

The Building Regulations 1991 may require measures to be taken to protect the fabric of new buildings and their occupants from the effects of contamination. In most cases enforcement will be through planning conditions and building control.

Hydrocarbon and solvent contamination can degrade and penetrate plastic pipes resulting in contamination of drinking water. There will therefore be a liability with respect to using suitable construction materials.

3.4.4 Radioactivity

From August 2006 the Part IIA contaminated land regime was extended to include radioactivity in Circular 01/2006. Where harm is attributable to radioactivity, the definition of contaminated land has been modified by regulation 4(a) of the Modification Regulations as:

“any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

- Harm is being caused, or
- There is a significant possibility of such harm being caused.”

The principal legislation governing radioactivity is the Radioactive Substances Act 1993, which regulates the keeping and disposal of radioactive substances, administered by the Environment Agency. In addition the Ionising Radiation Regulations 1999, administered by the Health and Safety Executive, are concerned with the protection of workers and members of the public from hazards arising from exposure to radiation in the workplace.

Liability for radioactivity at the site is covered in a separate radioactivity investigation report and Technical Note prepared by Entec.

3.4.5 PCBs

The Environmental Protection (Disposal of Polychlorinated Biphenyls and other Dangerous substances) (England and Wales) Regulations 2000 place a responsibility on all holders of PCBs, but contain particular requirements for holders of contaminated equipment. Contaminated equipment means any equipment (including any transformer, capacitor or receptacle containing residual stocks) which contains PCBs or, having contained PCBs has not been decontaminated and has a volume more than 5 dm³. Should the site transformers remain in place, and have been cooled in the past with PCB-containing oils, then there potentially will be a liability under this legislation.

3.4.6 Oil Storage Regulations

The guidance note which accompanies the Control of Pollution (Oil Storage) (England) Regulations 2001 contains a number of recommendations that are pertinent to the Daedalus site. Regulation 3 (2) sets out the requirements for secondary containment of the primary container or ancillary pipework and equipment. Where fuel is stored on site, the storage should be in accordance with these regulations. The guidance also notes that underground pipes, the use of which is not recommended unless absolutely necessary, must have adequate facilities for detecting leaks, and be inspected annually. Remote fill points are similarly not recommended.

3.5 Summary of Liabilities

The findings of the Phase Two LQA indicate that the majority of the site is free from significant contamination with only localised areas of the site (approximately 2%) affected by hydrocarbons, solvents, metals and asbestos contamination. Areas of localised contamination have been identified which comprise:

- Hangars/Workshops in Technical Area: Chlorinated Solvent Contamination in groundwater;
- MT Section and Storage Tanks: Hydrocarbon/Fuel contamination;
- East of Technical Area and areas of demolished buildings: Shallow localised asbestos contamination;
- Waste Disposal Area (Former Victorian Tip), North of airfield.

The site may incur liabilities under several areas of legislation. The most significant potential statutory liability is the known presence of solvent and hydrocarbon contamination in groundwater at the site. Other liabilities would be realised as the site is redeveloped.

4. Assessment of Management Options

It is understood that imminent disposal of the site is planned for 2006. The Maritime and Coastguard Agency (MCA) proposes to purchase the existing main operational runway, along with land to the north west of the runway and a buffer zone around the runway. The remainder of the site is to be purchased by the South East England Development Agency (SEEDA) for onward transfer and development. Redevelopment is most likely to comprise mixed residential, commercial or industrial use. This assessment assesses risks to current users and all future site users, including a residential end use and commercial/ industrial end uses.

For those parts of the site to be sold, under the Part IIA legislation, MOD as the Class A person can transfer the liability for contaminated land by disclosing to the purchaser all known information on ground conditions, i.e. the Land Quality Assessment. The purchaser can then take this into account in their offer for the site. This may be a suitable option for some of the identified contamination.

The risk based site investigation has identified three areas of contamination that require management. Table 4.1 identifies the key pollutant linkages in these areas:

Table 4.1 Key Pollutant Linkages

Pollutant Linkage	Area/ Building	Contaminant (Source)	Potential Receptor	Potential Pathway to Receptor	Potential for Significant Pollutant Linkage	Liability
1	Hangars, Workshops & BFI	Chlorinated solvents	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Unlikely	D
2			Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Possible	D, A1
3			Groundwater (Minor Aquifer)	Leaching Migration	Almost Certain	C

Table 4.1 (continued) Key Pollutant Linkages

Pollutant Linkage	Area/ Building	Contaminant (Source)	Potential Receptor	Potential Pathway to Receptor	Potential for Significant Pollutant Linkage	Liability
4	Fuel Storage Areas, MT Section	Hydrocarbons	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Unlikely	D
5			Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Possible	D, A1
6			Groundwater (Minor Aquifer)	Leaching Migration	Almost Certain	D
7	Burning Grounds/Tips	Ash containing metals,	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Unlikely	D
8			Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Possible	D, A1
9	Burning Grounds/Tips	Ash containing PAHs	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Unlikely	D
10			Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Possible	D, A1
11	Former Firing Range	Metals	Humans (Site Users)	Dermal Contact Ingestion Inhalation	Unlikely	D
12			Humans (Redevelopment Workers)	Dermal Contact Ingestion Inhalation	Possible	D, A1
13	Asbestos in Soils nr demolished buildings	Asbestos fibres	Humans (Redevelopment Workers)	Inhalation	Possible	D, A1

These significant risks are now assessed to determine the possible management options for HMS Daedalus given that disposal of the site is anticipated in the near future.

The following management options are considered for HMS Daedalus:

Option 1: Do Minimum;

Option 2: MOD Divest Site Unremediated;

Option 3: MOD Remediate for a Given End-Use;

4.1 Option 1: Do Minimum - Continued MOD Usage

The contamination identified at HMS Daedalus is not currently impacting human receptors but has impacted shallow groundwater. The activity which gave rise to the groundwater contamination has ceased, although contamination migration from shallow soil to groundwater may be on-going.

Under the new contaminated land regulations discussed in Section 6 of the main report the Regulatory Authorities could require further investigation of the groundwater contamination and investigation of potential source areas of this contamination. The investigation would comprise drilling of boreholes installation of groundwater monitoring standpipes, soil and groundwater sampling, laboratory analysis and interpretation.

If the Environment Agency consider the shallow groundwater at the site as a receptor, and source-pathway-receptor linkage is demonstrated by further investigations, then action could be required by the regulator to manage/mitigate the risks. This is likely to entail undertaking in the first instance a quantitative risk assessment (QRA) to ascertain if remedial action is necessary. In our opinion this is likely to conclude that impacts on environmental receptors such as the Solent and River Alver are acceptable and that ongoing monitoring only will be required to demonstrate that the contamination plume is not spreading or threatening sensitive receptors.

Impacts on human receptors could also be demonstrated by QRA as acceptable unless, in the case of redevelopment workers, excavations are to take place within identified areas of contamination.

It should also be noted that statistical tests under the CLEA assessment methodology have identified that further investigation is necessary to fully define site contamination of shallow soils.

Due to uncertainties over soil contamination caution must be exercised for any excavations in areas of Made Ground not identified in the LQA investigation. The potential for contaminated Made Ground should be notified to contractors before any major groundworks or developments on the site. Staff should use appropriate working methods and PPE to reduce risks.

4.2 Option 2: MOD Divest Site Unremediated

As a defence site, the site will be classified as a 'Special Site' under Part IIA of Section 57 of the Environment Act, Regulation 2(1)(f). MOD will be defined as a Class A 'Appropriate Person' and will be liable for any required clean up. Should the MOD choose to divest the site to a potential developer, together with the findings of the Risk Based Site Investigation, MOD may qualify for exclusion from clean up liability under Test 3 ("Sold with Information"). This would, however, require confidence on the part of the developer that the information supplied was sufficient to quantify the potential liability. MOD should seek specialist legal advice to clarify what residual liability may remain with MOD, if, for example, the developer passes into liquidation before any required remedial works take place or if new contamination liabilities are found post sale. In these circumstances whether MOD then become liable for costs or what may constitute contamination not reasonably foreseen is open to debate.

If MOD aims to divest the site with full knowledge, the potential developer(s) would negotiate either to discount the land value for the site to take account of estimated remedial costs or set up an insurance policy to cover the costs. In this instance, MOD may also qualify for exclusion from clean up liability under Test 2 (Payments Made for Remediation). The liability for

remediating any contamination not identified as part of the information supplied with the land transaction would be dependent upon the contract conditions and whether it could reasonably have been foreseen. Again it is recommended that specialist legal advice is sought to clarify MOD's liability in these circumstances.

This option would allow the risks associated with identified contamination to be addressed by a future site owner within the context of future site development.

4.3 Option 3: MOD Remediate for a Given End-use

Under this option, the MOD would carry out remediation works to provide a site which was suitable for a given end-use, such as industrial/commercial or domestic housing. This option has the advantage to the MOD that they retain control of the site remediation, although as a consequence of this, they also accept the risks associated with remedial costs and volumes, and also unforeseen contamination not identified to date.

This approach is unlikely to be appropriate for rapid divestment of the site. An additional site investigation would be required to confirm the condition of the areas of the site not covered in the Risk Based Site Investigation and to allow reassessment of any necessary remedial strategy. In addition, any remedial actions will need to be reviewed and agreed by the local authority and Environment Agency.

There is a possibility that following this strategy will result in MOD undertaking remedial actions which could be managed in a more economic manner as part of a redevelopment plan. For example, this could include development layout or landscaping options, such as the use of hard landscaping instead of conventional garden areas to disrupt the pathway between the source and the receptor, or strategic location of landscaped areas and infrastructure and avoid excavation and disposal costs.

5. Remedial Measures

5.1 Introduction

This section presents our opinion of the remedial measures required for the above options and associated volumes of contamination present on site which require to be dealt with as a statutory liability or as part of any site redevelopment. Estimated costs for dealing with the contamination are presented in Section 5.

Redevelopment options are considered for continued MOD usage, commercial/industrial redevelopment and residential redevelopment. The requirements for residential end use are in addition to the requirements for commercial/industrial use. However, given that the principal contaminants of concern are chlorinated solvents and hydrocarbons and the receptor at risk is controlled waters, the differing redevelopment options have limited impact upon the remedial measures required.

5.2 Continued MOD Usage

For continued MOD usage the statutory liability arising from groundwater contamination will need to be managed. The following measures represent the simplest approach to managing this issue with the objective of achieving regulator acceptance at minimum cost:

- i. Further investigation of the source area of soil contamination that may require remedial action for the following:
 - solvent contamination in the southwest of the site (25 window samples);
 - MT refuelling area (6 window samples);
- ii. Preliminary negotiations with the regulatory authorities to agree the minimum action to manage risks posed by groundwater contamination. It is likely that a quantitative risk assessment will be required (in accordance with Remedial Targets Methodology, Hydrogeological Risk Assessment for Land Contamination (Environment Agency, 2006) for the solvent contaminated groundwater with the objective of demonstrating that action to treat groundwater is unnecessary and to define soil clean-up criteria;
- iii. If areas of soil contamination are identified that exceed cleanup criteria, then excavation and disposal of source areas of soil contamination will be necessary;
- iv. Monitoring of groundwater on a quarterly basis for approximately 12-24 months following removal of contaminated soils to demonstrate that the plume is not spreading and no longer presents a risk to receptors of concern.

At this stage, the measures outlined above are considered likely to be sufficient to manage risks and additional measures for remediation of groundwater (for example by groundwater pump and treatment) are unlikely to be required. Any structures and hardstanding present at locations of contaminated soils would require removal prior to removal of contaminated soils.

The summary of costs for recommended further site investigations to delineate contaminated source areas under continued MOD usage is summarised in Table 5.1 below.

Table 5.1 Summary of Costs for Recommended Further Site Investigations for Continued MOD Usage

Item	Cost £
<i>Third Party Costs</i>	
Drilling window sampling holes	5 000
Laboratory Analysis of Soils and Groundwater	2 000
Equipment Hire and Consumables	500
<i>Consultants Fees</i>	
Project Management and Contractor Procurement	2 250
Supervision of Site Investigation (including subsistence)	5 200
Site Investigation Interpretation and Reporting	7 800
Quantitative Risk Assessment and Regulatory Negotiations	8 000
Total	30 750

The anticipated volumes of contaminated soil requiring off-site disposal are summarised in Table 5.2 below. There are currently large uncertainties regarding the remedial works required

and this will be subject to the findings of the further site investigations, quantitative risk assessment and regulatory negotiations.

Table 5.2 Excavation Volumes for Continued MOD Usage

Action Item	Area (m ²)	Thickness (m bgl)	Volume (m ³)
Area of solvent contamination of soil	1000	1	1000
Area of hydrocarbon contamination, MT Section	25	3	75
Area of hydrocarbon contamination, Grounds Maintenance section	25	2	50
Total	1050		1125

Following removal of the contamination sources identified above, it is likely that groundwater monitoring will also be required for 12-24 months following source removal. The nature of on-going monitoring would be subject to regulatory negotiations.

5.3 Commercial/ Industrial Redevelopment

It is anticipated that a commercial/ industrial development would comprise a combination of built structures, hard standing and landscaped areas. It is considered through careful end use planning in the location of hard cover and landscaped areas, the extent of remediation involving the removal of contaminated soil would be minimal subject to the following:

- Removal of shallow soil contaminated by chlorinated solvent;
- Removal of soil contaminated by hydrocarbons in former MT refuelling section and former grounds maintenance area. The structures and hardstanding present at these locations would require removal prior to removal of contaminated soils;
- Importation of replacement fill in areas of contaminated soil removal;
- Redevelopment must also consider existing buried foundations and the potential presence of heating ducts with potential asbestos lagging;
- Monitoring of groundwater for approximately 12-24 months following removal of contaminated soils;
- Excavation and removal of shallow Made Ground contaminated by metals in Former Victorian tip, former firing range and localised parts of the technical area.

The volumes derived from the above remedial measures are summarised in Table 5.3.

Table 5.3 Excavation Volumes for Commercial/Industrial Redevelopment

Action Item	Area (m ²)	Thickness (m bgl)	Volume (m ³)
Area of solvent contamination of soil	1000	1	1000
Area of hydrocarbon contamination, MT Section	25	3	75
Area of metals contamination above industrial/commercial screening criteria, Victorian Tip (100m x 100m)	10000	1	10000
Area of metals contamination above industrial/commercial screening criteria, Former Firing Range (25m x 25m)	625	1	625
Area of metals contamination above industrial/commercial screening criteria, Technical Area (25m x 25m)	625	1	625
Area of Asbestos Contamination in areas of demolished buildings (2m x 2m)	4	0.5	2
Total	1050		12327

The volumes detailed in Table 5.3 apply only to redevelopment of the site for a typical industrial/commercial end use layout. These volumes are approximate and further investigation could result in the numbers being reduced.

5.4 Residential Development

A more comprehensive remediation would be required for residential development which is a more sensitive end use. The extent of remediation would depend on the proposed design and style of development. Prior to such proposals a more comprehensive site investigation would be required focusing on sensitive areas of the planned development such as gardens. Such works are likely to identify further areas requiring remediation.

The contamination associated with solvent contamination and localised hydrocarbon contamination are considered an unacceptable development risk. Also, there may be areas of local shallow metal contamination which further investigation could prove to be unacceptable. Notable unacceptable risks could occur where gardens are planned or where children could come into contact with these materials. Excavation and removal is thus recommended and estimated volumes are summarised in Table 5.4.

If flats or town houses development with no vegetable gardens are proposed, then there will be less requirement to remediate the areas outlined in Table 5.4.

Table 5.4 Excavation Volumes for Residential Redevelopment

Action Item	Area (m ²)	Thickness (m bgl)	Volume (m ³)
Area of solvent contamination of soil	1000	1	1000
Area of hydrocarbon contamination, MT Section	25	3	75
Area of metals contamination above residential housing with gardens criteria, Victorian Tip (150 m x 150 m)	22500	1	22500
Area of metals contamination above residential housing with gardens criteria, Former Firing Range (50 m x 50 m)	2500	1	2500
Area of metals contamination above residential housing with gardens criteria, Technical Area (50 m x 50 m)	2500	1	2500
Area of Asbestos Contamination in areas of demolished buildings (2 m x 2 m)	4	0.5	2
Total	28525		28577

5.5 Redevelopment Considerations (All Site Areas)

The recommendations discussed above will remove or reduce the risks for the identified area of contamination. Some residual risks will, however, remain that may be realised during redevelopment works and other areas of contamination may be present. Further development specific site investigation will be required for any future development.

During site redevelopment and prior to this continued site maintenance, care will need to be exercised to control the handling and removal of any asbestos products encountered.

All soil excavated from the areas identified as contaminated must be treated as such unless proven otherwise prior to the appropriate disposal route being identified.

All buried concrete should be specified in accordance with BRE363 to avoid any deleterious effects from sulphate.

6. Financial Risk Estimates for Remediation Costs

6.1 Financial Risk Estimate Calculations

Financial Risk Estimate calculations have been carried out for each of the potential end uses of the site in line with the recommendations in Section 5. The costs are summarised in Table 6.1 for each of the redevelopment options.

Detailed calculations for the above costings are included in Annex B as follows:

- Table B1 - Continued MOD use;
- Table B2 - Industrial/ commercial redevelopment;

- Table B3 - Residential redevelopment.

The costs have been calculated on the basis of carrying out each of the remedial options as an individual contract and the following costs are excluded from the above:

- Landfill tax;
- VAT;
- Provision of topsoil for landscaping and domestic gardens;
- Landscaping;
- Removal of site buildings, infrastructure, foundations etc.

6.2 Financial Risk Estimates

The background to risk estimates for continued MOD use and redevelopment are summarised below.

The key redevelopment risk is the actual extent of contaminated soil requiring removal and the cost of its disposal. Due to the low density of investigation locations, in completing excavation and removal remediation works it is possible that the extent of contamination could be substantially larger than anticipated. An increase of 50% contaminated soil is assessed for the average risk estimate and 200% for the maximum likely risk estimate. More detailed intrusive investigations would enable these risk allowances to be reduced. However, there remains a low possibility that in areas of the site not investigated, there may be a significant volume of contaminated materials and therefore due to the low density of investigation the prices can only be considered indicative.

The largest area of contamination which results in the high cost of remediation for both commercial/industrial and residential development is the Victorian tip. With careful attention to the development design, it should be possible to minimise remediation costs for this area by, for example, using it as hardstanding.

Increased UK and European waste regulation proposals will result in higher charges to dispose of contaminated land to landfill. An increase of 10% disposal charge is assessed for the average risk estimate and 25% for the maximum likely risk estimate.

The Risk Registers for the remediation works are given in Annex C.

6.3 Estimated Costs

Table 6.1 shows the estimated costs for redevelopment options.

Table 6.1 Estimated Costs for Redevelopment

Option	Risk Free Base Cost (£)	Average Risk Estimate (£)	Maximum Likely Risk Estimate (£)
Continued MOD use	180 000	234 000	369 000
Commercial/Industrial Redevelopment	1 162 000	1 707 000	3 107 000
Residential with Gardens Redevelopment	2 795 000	4 163 000	7 684 000

7. Conclusions and Recommendations

7.1 Overall Land Quality

The majority of the site is expected to be free of significant contamination. The current working practices at the site are largely good therefore the land quality is unlikely to be impacted by recent contamination in most areas. The most substantial contamination is likely to be derived from historical activities such as degreasing using solvents in workshops/hangars, fuel storage and on-site waste burning and disposal.

The investigation has shown that the majority of the site is uncontaminated with only localised areas of the site (approximately 2%) affected by hydrocarbons, solvents, metals and asbestos contamination. Areas of localised contamination have been identified which comprise:

- Hangars/Workshops in Technical Area: Chlorinated Solvent Contamination;
- MT Section & Storage Tanks: Hydrocarbon/Fuel contamination;
- East of Technical Area and areas of demolished buildings: Shallow localised asbestos contamination;
- Waste Disposal Area (Former Victorian Tip), North of airfield;
- Former Firing Range, west of airfield.

The site investigation was designed on a risk based approach that identified areas more likely to have contamination present given their historical use. As such, it is possible that further contamination sources may be present on site that have not been identified during the current Entec site investigation.

7.2 Environmental Risks

The risks to human receptors under current and industrial/commercial use posed by the identified contamination sources are generally assessed as low across the majority of the site rising to moderate in areas of identified contamination.

A moderate to high risk is assessed in the areas of known contamination for future residential site use with garden areas.

In areas of known contamination, risks rise to moderate to high for redevelopment workers by contact, ingestion or inhalation of any contamination encountered during redevelopment works.

The site is underlain by a Minor Aquifer and has been impacted by chlorinated solvents and hydrocarbons in the Technical Area. Subsequently a very high risk is assessed for groundwater, given that contamination of groundwater has been identified. Across the remainder of the site, the Minor Aquifer does not appear to have been impacted and the risk has therefore been assessed as moderate to low.

The risks to surface waters are assessed as generally low to moderate. This reflects the distance to the River Alver (at least 1 km) and the likelihood of dilution and attenuation of contaminants during transport via tributaries or baseflow. Any contamination entering the Solent would undergo significant dilution given the volume and tidal nature of this water body. The risks to this Environmentally Sensitive Area (SSSI, Ramsar designation) are therefore generally assessed as low.

Risk to services and building materials are generally low to moderate in contaminated areas, associated with degradation of services and contaminant penetration.

7.3 Suitability of the Site for Development

Based on the information available it is likely that the site is suitable for commercial and industrial use subject to localised remediation. Notably the solvent and hydrocarbon contamination in the technical area groundwater require remediation or mitigation measures.

The majority of the site, particularly the areas within the taxiways, are suitable for residential use, as are most of the non-industrial parts of the Technical Area. Localised areas of the site require remediation where gardens are planned. Further site investigation is required for residential development dependent upon the form and development plan to confirm the absence of contamination in sensitive areas such as gardens.

During any site redevelopment, risks to construction workers are expected to be mainly low, except for the higher risk areas where risks from limited contamination would be mitigated by personal protective equipment (PPE).

7.4 Recommended Option

The investigation has identified that solvent and hydrocarbon contamination of groundwater is present in a localised area of the site that represents a potential statutory liability. It is therefore recommended that MOD manage this potential liability as outlined in the continued MOD use option.

In the first instance it is recommended that the additional investigations are implemented, the appraisal of source treatment options completed and the assessment of natural attenuation undertaken. This work can be integrated into the Remedial Action Plan (RAP) for the site which can form the basis of negotiations of the proposed scheme with the regulatory authorities (Environment Agency, Local Authority). At this point MOD has the option of continuing into remediation or passing on the obligations as part of the sale of the site.

Following this work remediation costs can be confirmed and can form a sound basis for negotiating a price for the site. It will also be possible to ensure that liability is clearly transferred to the purchaser (with the obligation to manage the statutory issues) such that future risks of claims as a result of being a 'Class A person' are minimised.

With respect to the other contamination identified it is recommended that no remedial action is taken, MOD selling the site with information available in the Land Quality Assessment and agreeing a price based on the new owner accepting the contamination liability.

6. Figure

7. Annexes

Annex A DE LQA Directive

19 Pages

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MINISTRY OF DEFENCE

DEFENCE ESTATES

SITE – HMS DAEDALUS

LAND QUALITY ASSESSMENT

**PHASE TWO: Site Investigation
and Radiological Survey**

Project No. 05002

DE LQA DIRECTIVE

Client's Representative:

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Date: 1 November 2005

DE Project Ref: 05002

Clients Ref:

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SITE-SPECIFIC INFORMATION

<u>Site Name</u>	HMS DAEDALUS	
<u>Site Address</u>	HMS Daedalus Lee-on-the Solent Hampshire PO13 9NX	
<u>Background</u>		
<u>Anticipated Future Use</u>	Industrial, Commercial and Residential	
<u>Other Considerations</u>		
<u>Target Delivery Date (Draft)</u>	May 07	
<u>Deliverables</u>	Type	Number Required
	Draft LQA Report and Technical Note	4
	Final LQA Report and Technical Note	7
	Electronic Copy	1

References to the 'Site' in the following directive relate to the site or sites listed above under 'site name' and the area or areas indicated on the attached plan/s.

LAND QUALITY ASSESSMENT: PHASE TWO – INTRUSIVE SURVEY

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LAND QUALITY ASSESSMENT: PHASE TWO - INTRUSIVE SURVEY

Background

1. The MOD needs to know more details of the land quality on the site and the health & environmental risk that any contamination may present currently or in association with changing the use of the land.
2. MOD propose to achieve this by undertaking a phased investigation of the site as described in DE Technical Bulletin 95/28 entitled Land Quality Assessment Management Guide. A Desk Study (Phase One LQA) has already been undertaken. The report of the Phase One LQA assessed the potential for contaminated land to exist on the site. It also recommended the further action necessary to confirm the conclusions presented within the report. The next phase of the Land Quality Assessment aims to address the recommendations made in the Desk Study and to identify the actual extent and implications of any contamination on the site. This Directive initiates the Phase Two LQA.
3. The outputs which results from this study (Land Quality Assessment Report and Technical Note) may be used by MOD Property Managers and Selling Agents and as such may be relied upon by third parties such as Purchasers and PFI Partners.

Additional Information

4. MOD held information pertinent to the study is available through the Site Liaison Officer and may include:
 - Phase One Land Quality Assessment for the Site
 - Plans, maps and technical/process drawings (all available dates).
 - Deeds and other estate records.
 - Existing aerial and other photographs.
 - Records/files detailing former and current uses/activities on the site.
 - Anecdotal evidence from former and present employees.

Project Objective

5. The objective of the study is to provide information, in the form of an LQA Report and Technical Note, relating to the environmental quality of the ground and groundwater conditions present on the establishment. Existing information should be appraised and further work undertaken as necessary, to produce a reliable assessment of the Land Quality and Environmental Risk at the site and how different types of future use may affect this. Information should also be gathered relating to the potential for future ground contamination occurring as a result of demolition of the existing buildings. An assessment is to be made of the potential health and environmental risks at the site and the degree of confidence stated. If this assessment shows that there may be a significant risk to health and safety or the environment, then options for remediation of the contamination should be provided.

Scope of the Works

6. The assessment comprises a Phase Two Land Quality Assessment relating to the whole of the establishment as shown on the Site Plan and also its interaction with the neighbouring land and environment.
7. The scope of work includes an assessment of the management options relating to the current and future management of the land and buildings, including financial risk assessment, an environmental risk assessment and other consequences of following each option. A recommended option should be identified. An assessment of potential remediation requirements should also be given together with cost and timescale implications of the remediation work.
8. The scope of work also includes provision of a Collateral Warranty, refer to paragraph 13 for further details.

Requirements of the Study

Hazard Assessment

9. All intrusive investigations have the potential to reveal hazardous substances. The Consultant must make an assessment to ensure that adequate Health and Safety safeguards are employed by his personnel at all times.
10. The site is likely to operate a Permit to Dig system. The programme, locations and character of all intrusive works must be discussed and agreed in advance with the Property Manager.

Explosive Ordnance

11. There may be a potential risk from buried explosive ordnance on military establishments. The Consultant must ensure that the intrusive investigation only takes place on areas assessed as clear of ordnance. Even after clearance of explosive ordnance is completed, a residual risk remains and hence utmost vigilance should be employed at all times. If anything suspicious is found, work should cease immediately, the area should be evacuated and the assistance of the Explosive Ordnance Disposal (EOD) team enlisted through the Property Manager.

Management Requirements

12. The Term Consultant for the LQA is to act in the role of Lead Consultant and is required to employ and supervise all specialist sub-contractors required for the study. The Lead Consultant is ultimately responsible for all technical aspects of the investigation, including design, supervision, interpretation and recommendations arising from the study.

Collateral Warranty

13. The LQA Report and Technical Note produced under this Directive may be used by MOD's property managers and selling agents. Consequently they may be relied upon by purchasers, property managers, tenants and PFI Partners alike. The Consultant shall therefore, provide, if requested, Collateral Warranties regarding their professional work in the standard agreed form to the PFI Partner (where appropriate), first purchaser and/or tenant of the whole site or part thereof to a limit of two parts, and to the first funder of those parties. The Consultant shall also, at the reasonable request of MOD, provide Collateral Warranties in the standard agreed form to second purchasers and/or tenants and their funders ("Secondary Warranties") for a reasonable fee per warranty as agreed under the Term Contract. Should any party eligible to benefit from the Secondary Warranty require variations from the agreed standard form, the Consultant shall be entitled to levy additional fees and/or expenses to reflect the reasonable costs in negotiating such variations. The limit of liability/level of PI cover and form of the Collateral Warranty required (6 to 12 year deed or agreement) shall be agreed between the Consultant and the party eligible for the warranty and will not exceed £5M in aggregate unless agreed otherwise.

Specialist Sub-Consultants

14. A radiological contamination assessment should be undertaken in close co-operation with the Dstl Radiation Protection Service (DRPS). The Consultant should approach DRPS to consult and arrange this liaison. Any work undertaken by DRPS should be incorporated into the LQA and completed to the satisfaction of the Consultant with the intention of it being covered by the Consultant's Collateral Warranty.

Ground Investigation Contractor

15. At least three competitive tenders are to be obtained for sub-contracted aspects of the Intrusive Survey. Sub-contractors must be experienced in the appropriate field of environmental site investigation and should work to accredited quality assurance standards. The Lead Consultant should produce a short report to the Task Officer to summarise the tender exercise and to recommend the Best Value Tender. Task Officer acceptance must be obtained before the Specialist Sub-Contractor is engaged.

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Laboratory Analysis

16. At least three competitive tenders should be obtained for the laboratory analysis aspects of the assessment. Laboratories must work to quality assured standards. Laboratories asked to quote rates must have extensive UKAS accreditation for relevant analytical procedures. Laboratories must also participate in the CONTEST and/or AQUACHECK schemes. The Lead Consultant is to ensure that tendering laboratories have performed satisfactorily under these schemes. The Lead Consultant should produce a short report to the Task Officer to summarise the tender exercise and to recommend the Best Value Tender. This report should include information on the CONTEST performance of the laboratories. Task Officer acceptance must be obtained before the specialist laboratory is engaged.

Reconnaissance

17. An initial walk over reconnaissance of the site should be undertaken by the consultant in order to gain an understanding of the establishment and all matters pertaining to the Land Quality Assessment. This is likely to include an appraisal of the site infrastructure, drainage, services and site operating procedures past and present. Information should also be gathered relating to the potential for future ground contamination occurring as a result of any demolition or refurbishment of the existing buildings. Any environmental issues requiring urgent attention should be reported immediately.

Document Review

18. The Consultant should review the existing Phase One Desk Study together with any further information that has become available. The Consultant should undertake any further desk investigation considered necessary and if required shall identify (via the Site Liaison Officer) and interview persons with long standing knowledge of the site. Consideration should be given to the recommendation of the Phase One Desk Study.

Intrusive Investigation

19. The Consultant should propose his preferred excavation, sampling and analysis regime for the site, which should employ the industry's current best practice for investigation, sample extraction, preservation and analysis.
20. At all times the objective is to undertake any investigation on a logical and rational basis in order to achieve both economy in the expenditure of resources and confidence in the end result.
21. Information collected should include geotechnical soil properties relevant to contaminant transport and remediation effectiveness.
22. During the course of the investigation the Consultant should make reactive adjustments to the investigation process in the light of information obtained during the investigation. The Task Officer must give written approval to either expand or reduce the scope of the investigation prior to any changes to the overall scope of works.
23. The Consultant (with his Specialist sub-Consultants where appropriate) should supervise and administer all the work of his Contractors and should provide a competent Environmental Engineer on site at all times during the physical investigation to supervise the works.
24. The Consultant shall ensure that all disturbances to the ground caused by himself or a sub-contractor are made good at the earliest opportunity. If there are any locations that cannot be made good by the consultant this must be drawn to the attention of the Property Manager prior to commencement of works.

Presentation of Information

25. Information from the Land Quality Assessment should be provided by way of a single report, the Land Quality Assessment Report and separate Technical Note.
26. The Land Quality Assessment Report is a combined factual and interpretative report which should comprise the factual information and other evidence gathered relating to the environmental quality of the site and a technical qualitative Environmental Risk Assessment. The Land Quality Assessment Report

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should be prefaced with a short summary of the environmental condition of the site. This summary is to be entitled 'Land Quality Statement for [SITE TITLE]'. This is a non-technical summary of the environmental condition of the site, its suitability for re-use and the effects of any contamination on development potential. The Land Quality Statement must not include reference to recommendations for further work. For the Final Report, the Task Officer may request that the Land Quality Statement be also issued in unbound form to allow subsequent copying.

27. The Land Quality Assessment Report should include the following minimum information:

- A summary of the factual elements of the Desk Study (Phase One LQA).
- A description of the work carried out during the intrusive site investigation.
- A coloured Site Plan identifying the site boundary, locations of all exploratory work and any other pertinent information.
- The Environmental Engineer's signed logs of exploratory excavations and boreholes etc. with accompanying level information and photographs where appropriate. Detail and presentation of logs should conform to BS 5930:1999.
- Details of the samples taken and the techniques used.
- In-situ test results.
- Presentation of laboratory results including information on preservation methods, analytical procedures used, qualitative and quantitative results.
- Full details of the quality assurance procedures employed.
- **A contamination model of the site.** This should identify and, quantify where possible, the contaminated and uncontaminated areas of the site. Information should be shown on plans and sections etc. and, where applicable, should include contamination concentration isolines.
- An estimate of the percentage area of the site that may be affected by contamination should be included.

28. The Potential Significance category of the Environmental Risk Assessment Summary Table comprises two elements: classification of risk and classification of liability. The Environmental Risk Assessment table in the Land Quality Assessment Report should include the risk classification but exclude the liability classification, which is to be confined to the Technical Note. Hazard – receptor linkage, risk and liability classifications are included in Annex B. Please note that if more than one liability classification is applicable, more than one letter may be quoted.

29. The Technical Note should comprise interpretation and opinions on liability, the complete risk assessment table, costs for any further work, remediation, disposal options and an Option Study into future handling of the site. **In particular it should include a comment on how likely the site is to fall under the statutory definition of contaminated land, and if likely, on what basis. An estimate of the percentage of the site area which could potentially be affected by contamination should also be included.** A copy of the DE LQA DIRECTIVE should be incorporated in an Annex of the Technical Note. In addition, a completed LQA Summary sheet (ANNEX D) should be incorporated into the report. The Technical Note is classified RESTRICTED – COMMERCIAL (see Security).

30. Where the Health or Environmental Risk is considered to be high, then recommendations should be made within the Technical Note regarding any remediation required to meet different types of future land use. This should include outline costs and timescales of any remediation for each scenario. Remediation options should include consideration of source removal, pathway disruption or receptor protection. The Consultant should take into consideration the most likely future use of the site.

31. Costs should be estimated in sufficient detail to provide a reliable basis for identifying a recommended option. This should include a financial risk assessment and whole life costing and presented only in the Technical Note.

Environmental Risk Assessment

32. The Consultant should incorporate a Tier 1 qualitative Environmental Risk Assessment into the study unless instructed otherwise. This should consider individual potential pollutants and their potential hazards, pathways and receptors under current conditions for different types of after use to include, but not be limited to, agricultural, residential, industrial and commercial. The key objective is to identify issues that may lead to significant harm or a significant possibility of such harm or pollution or likely pollution of controlled waters. Hence all areas of potential contamination should be prioritised in terms of health and environmental risk. This information should be shown on a clear plan and related to the

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Summary Table as outlined in Annex B. There may be occasions where a Tier 2 quantitative risk assessment is more appropriate.

33. The classifications for Likelihood of Hazard-Receptor Linkage and Potential Significance are given in Annex B. Potential Significance comprises two elements: classification of risk and classification of resulting liability. **The Land Quality Assessment Report should include the risk classification but exclude the liability classification, which is only to be included in the Technical Note.**
34. The Consultant should include an Explosive Ordnance Risk Assessment and Radiological Risks into the risk assessment.

Environmental Impact of Remediation

35. The Environmental Impact of remediation options should be addressed and a firm indication of the Best Practicable Environmental Option given in the Technical Note.

Financial Appraisal

36. A reliable Order of Cost Estimate (OCE) is required for each option, and shall be carried out in accordance with DE Technical Bulletin 99/19, entitled Order of Cost Estimates, dated July 1999. Costs are to be current quarter price levels without inflation and the relevant cost index and its source should be quoted. VAT and fees should be itemised clearly. The OCE should include a Financial Risk Analysis, carried out and presented in accordance with DE Technical Bulletin 99/214, entitled Estimating using Risk Analysis, dated July 1999. Costs for both "Average Risk Estimate" and "Maximum Likely Risk Estimate" cases are required and full details of the risks and their individual contribution to the risk element shall be identified in the Technical Note only.

Conclusions

37. The Technical Note should conclude with discussion and recommendations relating to the land quality issues identified and the most appropriate way to manage the identified environmental health and liability risks and if necessary release the site from MOD ownership. This must take full account of the current regulatory regime, particularly Part IIA of the Environmental Protection Act.

Limitations and Standards

Constraints

38. The following constraints must be taken into consideration:
 - The site may operate a Permit to Dig system, which must be adhered to at all times.
 - A photographic pass may be needed before site work commences.
 - Prior to any work commencing on site, a Method Statement is to be provided for approval by the Client, in consultation with the DE Task Officer. Health and Safety risk assessments are to be completed in advance of all stages of the work.
 - Any investigations must be undertaken at such times and in such a manner as to avoid disruption to routine operation and maintenance of the Site.
 - Although the survey will take place mainly within the establishment's boundary, it shall be undertaken in such a manner as to avoid concern to the general public. In the event of any approach by the Press or broadcasting media, they are to be referred immediately to the Client's Representative and no comment whatsoever shall be made.
39. The Technical Note should conclude with discussion and recommendations relating to the contaminated land issues including the significance of any contamination for present and other land use. If the site is to be sold, the conclusions should include discussion on most appropriate way to release the site from MOD ownership.

Contact with Regulatory Bodies and Public Information Sources

40. Any contact with the Environment Agency, the Scottish Environment Protection Agency, Local Authorities and other regulatory bodies or public information sources must be specific to this commission. Any enquiries of public information sources should reflect the sensitivity of LQA work.

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Environmental Impact of Intrusive Investigations

41. It is MOD policy to minimise the adverse environmental effects of its projects and operations. Recycled or recyclable products are to be used whenever feasible.
42. All work undertaken in relation to this project shall employ the Best Available Techniques Not Entailing Excessive Cost (BATNEEC) to minimise the environmental impact of the project.
43. In particular, the Consultant shall ensure that:
 - Industry best practice is followed
 - Intrusive investigations are only undertaken using methods that do not create pollution transfer pathways.
 - The excavation of trial holes, boreholes or other excavations do not risk contamination of the groundwater regime.
 - Polluted soil arisings and water emanating from boreholes or trial pits is disposed of without causing environmental damage and in accordance with the waste management Duty of Care.
 - Noise and other potential nuisance from plant is kept within acceptable limits.
 - The emission of pollutants, harmful radiation or ozone depleting chemicals is minimised.
 - The use of energy is minimised.
 - Products that contribute to the destruction of rain forests or endangered wildlife are not used.
 - The use of noxious substances, especially DOE "Red List" and EU List 1 substances is minimised.
44. The specific written authorisation of the Project Sponsor is required before use or emission of any product, pollutant, or substance that affects any of the above Clauses. If there is any doubt then the DE Task Officer must be consulted.

Health and Safety

45. All members of the study team are to be suitably briefed. A written Method Statement and Risk Assessment shall be required before any site work is undertaken. All MOD regulations and instructions concerning safe working procedures shall be rigorously adhered to.
46. The Intrusive Survey is to be undertaken in accordance with all relevant Health and Safety Legislation.
47. In cases where the Construction (Design and Management) Regulations 1994 are applicable, the Lead Consultant shall undertake the roles of both Planning Supervisor and Principal Contractor.
48. Recommendations made for remediation shall comply fully with all relevant Health and Safety Legislation.
49. The Study shall identify any special health and safety hazards that should be considered by Site Management for operations on the Site.

Deliverables

Timescale and Distribution

50. The Site Specific Information Sheet supplied with this directive indicates the target delivery date and the number of copies of the Draft Land Quality Assessment Report and Technical Note which are to be delivered to the Task Officer. The Draft Report may be discussed at a meeting to be arranged. The target date for issue of the final Desk Study Reports is 10 working days following the above meeting or receipt of written comments from the Task Officer.
51. The Site Specific Information Sheet supplied with this directive also indicates the number and type (e.g. electronic) of copies of the Final Land Quality Assessment Report and Technical Note which are to be delivered to the DE Task Officer.

Format of Report and Technical Note

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52. The format of the LQA Report and Technical Note for this Land Quality Assessment is to conform to the "Standard Framework", attached at Annex C. When the Task Officer is satisfied that this commission has been completed, the Report is to be signed by both the Consultant and the Task Officer.

Paper

53. It is DE policy to reduce paper use and as a result both draft and final deliverables should be produced using double sided printing and copying where possible. In addition best use should be made of alternative technologies such as electronic media and where possible, chlorine free recycled paper comprising at least 80% genuine post consumer waste should be used. Where specialist non-recycled paper has to be used it should comprise virgin pulp sourced from sustainably managed woodlands. Also wherever possible material should be sealed, if necessary, using a water based varnish as opposed to a plasticised finish and be bound as far as possible using materials that do not make it harder to recycle. We appreciate that for final deliverables the latter will not necessarily be possible.

Administration of the Study

Security

54. This assessment is classified as RESTRICTED - COMMERCIAL. The Land Quality Assessment Report is Unrestricted but should only be discussed with staff nominated by the Client's Representative. The Technical Note is classified as RESTRICTED - COMMERCIAL and as such RESTRICTED - COMMERCIAL should be marked on the header and footer of each page, including the cover and each figure.
55. The names of individual MOD staff connected with this project should not appear within the body of the LQA Report but should instead be provided in a letter to accompany the Report. It is acceptable for post titles to be mentioned within the main text of the Report.

Access

56. Entry to the Site is strictly controlled, and all personnel requiring repeated access must be in possession of MOD Security Clearance. When the Consultant wishes to visit the Site all study team members are required to obtain visitor's passes for each visit, notwithstanding any security clearances already held, and to give prior notice of intended visits to the Site Liaison Officer.

Points of Contact

57. The Task Officer is the principal contact for this project and is to be promptly informed of all developments. Instructions may only be issued by the Task Officer or a nominated alternative. Details of the MOD staff connected with this project, their duties and their responsibilities will be provided in an accompanying letter from the Task Officer.

Note: The LQA is a decision making tool and as such it is essential that it is robust, auditable and defensible.

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ANNEX A

LOCATION PLAN

ANNEX B

LAND QUALITY ASSESSMENT: ENVIRONMENTAL RISK ASSESSMENT SUMMARY TABLE

Area / Building	Potential Pollutant (Hazard)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of Hazard-Receptor Link	Likelihood of Hazard-Receptor Linkage	Potential Significance
		(specific to pollutant)	(specific to pollutant)	(specific to pollutant)	e.g. Severe Moderate Mild Negligible	e.g. Certain Almost Certain Likely Possible Unlikely Nil Chance	e.g. Risk: Very High Risk High Risk Moderate Risk Low Risk Negligible Risk Liability: A B C D E F

Classifications are defined on the accompanying Table

Classifications to be Used in Environmental Risk Assessment Summary Table

	Potential Consequence of Hazard-Receptor Linkage
Severe	Inrepairable damage to buildings, structures or the environment A significant change to the number of one or more species or particular ecosystem(s). Damage to human health. Substantial pollution of sensitive water resources
Moderate	Damage to sensitive buildings, structures or the environment. A change to population densities of non-sensitive species. Non-permanent health effects to humans. Pollution of non-sensitive water resources or small-scale pollution of sensitive water.
Mild	Easily repairable effects of damage to buildings or structures. Some change to population densities but with no negative effects on the function of the ecosystem. Slight short-term health effects to humans. Slight pollution to non-sensitive water resources.
Negligible	Very slight non-structural damage or cosmetic harm to buildings or structures. No significant changes to population densities in the environment or in any ecosystem. No measurable effect on humans. Insubstantial pollution to non-sensitive water resources.

	Likelihood of Hazard-Receptor Linkage
Certain	100%
Almost Certain	95 – 99%
Likely or probable	55 – 94%
Possible or As likely as not	45 – 54%
Unlikely or improbable	5 – 44%
Nil Chance	0 - 4%

	Potential Significance: Risk Classification
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without appropriate remedial action
High Risk	Harm is likely to arise to a designated receptor from an identified hazard at the site without remedial action
Moderate Risk	It is possible that without appropriate remedial action, harm could arise to a designated receptor but it is relatively unlikely that any such harm would be severe and if any harm were to occur it is more likely that such harm would be relatively mild.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard but it is likely that at worst, that this harm, if realised, would normally be mild.
Negligible Risk	The presence of an identified hazard does not give rise to the potential to cause significant harm

	Potential Significance: Liability Classification
A	Immediate significant risk of health hazard occurring
B	Immediate significant risk of unacceptable damage to the environment
C	Large remediation liability
D	Minor remediation liability
E	Minor significance, no remediation required
F	No effect on re-use options or site value

These tables do not indicate direct correlation between the classification systems shown. More than one liability classification letter may be used if appropriate, e.g. A,D.

ANNEX C

REPORT AND TECHNICAL NOTE - STANDARD FRAMEWORK

1. LQA Report

Content

- a. Land Quality Statement: This is a non-technical summary of the environmental condition of the site, its suitability for re-use and the effects of any contamination on development potential. The Land Quality Statement must not include reference to recommendations for further work.
- b. Background: Brief details of the site, or sites, giving location(s), MOD unit, any environmental constraints, including details of any historical listings, any anticipated geotechnical problems and any operational, time or security needs stipulated by the Client. Where the aspects can be more clearly shown in the drawn form then drawings and/or diagrams should be included.
- c. Factual Information and Interpretation: Details of present and historical use of the site, investigation methodology and findings Interpretation of this information using appropriate criteria with reference to the potential for contamination of land, surface water or groundwater. Reference to the suitability of the site for re-use.

2. Technical Note

Content

- a. Background: Brief details of the objectives, methodology, constraints including any anticipated geotechnical problems, any operational, time or security needs stipulated by the Client.
- b. Interpretative information must include not necessarily be limited to environmental risk assessment, regulatory context, management options, recommended option or options and conclusions.
- c. Options: Each option dealt with in depth, including the costs and the contractual approach (if any) inherent in each option. Drawings sufficient to explain the option(s) to those unfamiliar with the site should be included. A very brief comparison of advantages and disadvantages of each option considered, including the cost, should be included.
- d. Conclusion and Recommendation: Giving clear-cut recommendations, the option preferred and the operational and economic advantages (including timescales) that justify the recommendation(s).
- e. Summary of LQA (See ANNEX D) also to be completed electronically.

3. Face Sheet

This should contain:

- a. DE title "DEFENCE ESTATES" centred at the top of the sheet.
- b. Title as shown on the Directive in the centre of the sheet, with the Project No. immediately below.
- c. Name and address of the relevant DE office in the bottom left hand corner of the sheet.
- d. The legend "Prepared by (the Consultant's name) for the Ministry of Defence, Defence Estates, under commission (number)" in the bottom right hand corner of the sheet along with the month and year in which the Study was produced.
- e. Marked areas for signing by the Task Officer and the Project Sponsor to indicate acceptance of the report.

4. Size

This should always be A4 vertical format, but may contain folded A3 or larger sized sheets in clear A4 pocket inserts.

5. Maps and Plans

Maps should indicate the site location and where scale permits should also show the site boundary. Site Plans should include a scale bar and a north arrow.

ANNEX C1 - Guide to Structure of Report

Land Quality Statement

- 1 Introduction
 - 1.1 Terms of Reference
 - 1.2 Site Location
- 2 Site Description
 - 2.1 Site Layout
 - 2.2 Site Operations
 - 2.3 Summary of Phase One Land Quality Assessment
 - Site History
 - Environmental Setting
 - Site Sensitivity
 - Environmental condition of the Site
 - Sources of Potential Contamination
- 2 Site Investigation
 - 2.1 Summary
 - 2.2 Methodology
 - 2.3 Investigation of Findings
- 3 Assessment of Risks
- 4 Overall Land Quality
- 5 Suitability for Redevelopment

Figures

ANNEX D

Summary of LQA Findings

1. Site DPR #	2. Site Name	3. Area (ha)	4. Grid Ref	5. LQA Priority	6. Current LQA Phase	7. Start Date	8. Finish Date	9. Total spend to date	10. Overall Land Quality	11. Pollutant Source	12. Pollutant	13. Receptor	14. Approx Area of Site Affected	15. Liability Class
										1.				
										2.				
										3.				
										4.				
Comments:														

Guidance Notes for the Completion of LQA Returns

1. Site DPR Ref. #: This is only to be filled out if known
2. Site Name: Please provide current name and aliases
3. Area: Please provide area in hectares
4. Grid Reference: Please provide 8 figure grid ref. for the centre of the site
5. LQA Priority: Please insert the priority number as follows:
 - Priority 1: Land identified for disposal or subject to rationalisation or where significant change in land use is envisaged.
 - Priority 2a: Land in sensitive area and with known or suspected contamination
 - Priority 2b: Known threat; site in sensitive area such as major aquifer
 - Priority 2c: Strongly suspected threat or possible threat from e.g. radioactive substances, dioxins, CW materials
 - Priority 2d: No known evidence of threat, i.e. all other sites
6. Current LQA Phase: State whether it is:
 - 0 Prioritisation
 - 1 Desk Study
 - 2 Site Investigation
 - 3 Assessing need to remediate
 - 4 Remediation
10. Overall Land Quality: Please insert appropriate number:
 - 1 No known or potential sources of contamination
 - 2 Majority of the site is unlikely to be contaminated. A number of localised sources of contamination are or may be evident.
 - 3 Majority of the site is or is likely to be contaminated.
14. Approximate area of contamination: Please estimate area likely to be affected in m²
15. Liability Class: This should be presented as the risk assessment table within the technical note.

Annex B Remediation Cost Estimate

3 Pages

Table B1

HMS Daedalus - Continued MOD Use: Investigation and Removal of Contamination

RISK FREE BASE COST ESTIMATES

Volume of contaminated material	1125 m ³			
Item	Amount	Unit	Unit rate, £	Cost, £
Confirmatory Site Investigation		sum		£7,500
Excavation of Contamination Source	1125	m ³	1.50	£1,688
Disposal to licensed landfill	1125	m ³	63.00	£70,875
Backfill void with imported clean fill	1125	m ³	10.00	£11,250
Dealing with groundwater		Allow		£500
Attenuation Monitoring of Groundwater		Allow		£10,500
Mobilisation, prelims, temp facilities				£3,000
Contractor's overheads & insurance		Percentage	15	£15,797
Risk Free Base Construction Cost				£121,109
ORA, Consultations and negotiations with Regulators		sum		£8,000
Confirmation SI Design, Site Supervision and Reporting		sum		£15,000
Detail Remediation Design and Project Management		Sum		£5,000
Contract Documents and Tendering		Sum		£4,000
Site supervision of Remedial Works	3000	week		£6,000
Attenuation Monitoring of Groundwater	8000	year		£16,000
Completion reporting		sum		£5,000
Risk Free Base Resource Cost				£59,000
Total Risk Free Base Cost				£180,109

RISK ELEMENT CALCULATION

From Procedures outlined in DWS Technical Bulletin 99/21, Table C1 in appendix C presents the Risk Register for the above works. Risk allowances are based on assumptions discussed in section 4.2

Risk Element	Average Risk Value (percentage for variable risk)	Maximum Likely Risk Value (percentage for variable risk)	Type (variable or fixed)	Average Risk			Maximum Likely Risk		Spread	Square the Spreads	
				Base Value of Risk Element	Probability Factor (Fixed) or Confidence Limit (Variable)	Value	Base Value of Risk Element	Probability Factor (F) or Confidence Limit (V)		Value	Deviation from the Average (h)
CONSTRUCTION RISKS											
Increased excavation, disposal, backfill	50	200	V	83,813	50%	41,906	83,813	90%	167,625	125,719	1.58E+10
Increased disposal cost to landfill	10	25	V	70,875	50%	7,088	70,875	90%	17,719	10,631	1.13E+08
RESOURCE RISKS											
Increased resource costs (site supervision)	50	200	V	6,000	50%	3,000	6,000	90%	12,000	9,000	8.10E+07
Regulatory Approvals	20	50	V	8,000	50%	1,600	8,000	90%	4,000	2,400	5.76E+06

Construction Average Risk Allowance:	48,994	Sum of (h) ² :	1.59E+10
Resource Average Risk Allowance:	4,600	Square root of sum of (h) ² :	126,167
		Add Average Risk Allowance:	126,167
		Construction Maximum Risk Allowance:	175,161

F= Fixed (expressed as a ratio for Average and Maximum Likely Risk)

V= Variable (expressed as a percentage for Average and Maximum Likely Risk)

	Sum of (h) ² :	8.68E+07
	Square root of sum of (h) ² :	9,315
	Add Average Risk Allowance:	4,600
	Resource Maximum Risk Allowance:	13,915

NOTE

- Quantities and rates based on designers estimate of available data.
- EOD risk assessment and specialist EOD supervision of development excavations are not included.
- Remediation costs do not include for the removal of buildings, structures, foundations, tanks infrastructure etc.
- Disposal costs include for Landfill Tax.

RISK ADDITION

	RISK FREE BASE COSTS			RISK ALLOWANCES		SUM OF BASE + RISK		
	Construction	Resource	TOTAL BASE COST	Construction	Resource	Construction	Resource	TOTAL RISK ESTIMATES
Average Risk Estimate	121,109	59,000	180,109	48,994	4,600	170,103	63,600	233,703
Maximum Likely Risk Estimate	121,109	50,000	180,109	175,161	13,915	296,271	72,915	369,185

Table B2

HMS Daedalus: Commercial / Industrial Development

RISK FREE BASE COST ESTIMATES

Volume of contaminated material 12327 m³

Item	Amount	Unit	Unit rate, £	Cost, £
Confirmatory Site Investigation		sum		£19,000
Excavation (Remove solvent/ hydrocarbon/metals source)	12325	m ³	1.50	£18,488
Disposal to licensed landfill	12325	m ³	63.00	£776,475
Backfill void with imported clean fill	12325	m ³	10.00	£123,250
Dealing with groundwater		Allow		£1,000
Attenuation Monitoring of Groundwater				£10,500
Mobilisation, prelims, temp facilities				£5,000
Contractor's overheads & insurance		Percentage	15	£142,007
Risk Free Base Construction Cost				£1,088,719

GRA, Consultations and negotiations with Regulators		sum		£8,000
Confirmation SI Design and Site Supervision		sum		£20,000
Detail Remediation Design and Project Management		Sum		£7,000
Contract Documents and Tendering		Sum		£5,000
Site supervision of Remedial Works	3000	week		£12,000
Attenuation Monitoring of Groundwater	8000	year		£16,000
Completion reporting		sum		£5,000
Risk Free Base Resource Cost				£74,000

Total Risk Free Base Cost £1,162,719

RISK ELEMENT CALCULATION

From Procedures outlined in DWS Technical Bulletin 99/21, Table C1 in appendix C presents the Risk Register for the above works. Risk allowances are based on assumptions discussed in section 4.2

Risk Element	Average Risk Value (percentage for variable risk)	Maximum Likely Risk Value (percentage for variable risk)	Type (variable or fixed)	Average Risk			Maximum Likely Risk			Spread	Square the Spreads
				Base Value of Risk Element (Variable)	Probability Factor (Fixed) or Confidence Limit (Variable)	Value	Base Value of Risk Element	Probability Factor (F) or Confidence Limit (V)	Value		
CONSTRUCTION RISKS											
Increased excavation, disposal, backfill	50	200	V	918,213	50%	459,106	918,213	90%	1,836,425	1,377,319	1.90E+12
Increased disposal cost to landfill	10	25	V	776,475	50%	77,648	776,475	90%	194,119	116,471	1.36E+10
RESOURCE RISKS											
Increased resource costs (site supervision)	50	200	V	12,000	50%	6,000	12,000	90%	24,000	18,000	3.24E+08
Regulatory Approvals	20	50	V	8,000	50%	1,600	8,000	90%	4,000	2,400	5.76E+06

Construction Average Risk Allowance: 536,754
Resource Average Risk Allowance: 7,600

Sum of (h)²: 1.91E+12
Square root of sum of (h)²: 1,382,236
Add Average Risk Allowance: 536,754
Construction Maximum Risk Allowance: 1,918,988

F= Fixed (expressed as a ratio for Average and Maximum Likely Risk)
V= Variable (expressed as a percentage for Average and Maximum Likely Risk)

Sum of (h)²: 3.30E+08
Square root of sum of (h)²: 18,159
Add Average Risk Allowance: 7,600
Resource Maximum Risk Allowance: 25,759

NOTE

- Quantities and rates based on designers estimate of available data.
- EOD risk assessment and specialist EOD supervision of development excavations are not included.
- Remediation costs do not include for the removal of buildings, structures, foundations, tanks infrastructure etc.
- Disposal costs include for Landfill Tax

RISK ADDITION

	RISK FREE BASE COSTS			RISK ALLOWANCES		SUM OF BASE + RISK			
	Construction	Resource	TOTAL BASE COST	Construction	Resource	Construction	Resource	TOTAL RISK ESTIMATES	
Average Risk Estimate	1,088,719	74,000	1,162,719	536,754	7,600	1,625,473	81,600	1,707,073	
Maximum Likely Risk Estimate	1,088,719	74,000	1,162,719	1,918,988	25,759	3,007,708	98,759	3,107,467	

Table B3

HMS Daedalus: Residential Development

RISK FREE BASE COST ESTIMATES

Volume of contaminated material

31077 m³

Item	Amount	Unit	Unit rate, £	Cost £
Confirmatory Site Investigation		sum		£17,000
Excavation of Contamination source	31075	m ³	1.50	£46,613
Disposal to licensed landfill	31075	m ³	63.00	£1,957,725
Backfill void with imported clean fill	31075	m ³	10.00	£310,750
Dealing with groundwater		Allow		£1,000
Attenuation Monitoring of Groundwater				£10,500
Mobilisation, prelims, temp facilities				£5,000
Contractor's overheads & insurance		Percentage	15	£352,288
Risk Free Base Construction Cost				£2,700,876

QRA, Consultations and negotiations with Regulators		sum		£8,000
Confirmation SI Design and Site Supervision and reporting		sum		£25,000
Detail Remediation Design and Project Management		Sum		£9,000
Contract Documents and Tending		Sum		£6,000
Site supervision of Remedial Works	3000	week		£24,000
Attenuation Monitoring of Groundwater	8000	year		£16,000
Completion reporting		sum		£7,000
Risk Free Base Resource Cost				£95,000

Total Risk Free Base Cost £2,795,876

RISK ELEMENT CALCULATION

From Procedures outlined in DWS Technical Bulletin 99/21, Table C1 in appendix C presents the Risk Register for the above works. Risk allowances are based on assumptions discussed in section 4.2

Risk Element	Average Risk Value (percentage for variable risk)	Maximum Likely Risk Value (percentage for variable risk)	Type (variable or fixed)	Average Risk		Maximum Likely Risk		Spread	Square the Spreads		
				Base Value of Risk Element	Probability Factor (Fixed) or Confidence Limit (Variable) Value	Base Value of Risk Element	Probability Factor (F) or Confidence Limit (V) Value		Deviation from the Average (h)	Square of the Deviation (h ²)	
CONSTRUCTION RISKS											
Increased excavation, disposal, backfill	50	200	V	2,315,088	50%	1,157,544	2,315,088	90%	4,630,175	3,472,631	1.21E+13
Increased disposal cost to landfill	10	25	V	1,957,725	50%	978,863	1,957,725	90%	489,431	263,658	8.62E+10
RESOURCE RISKS											
Increased resource costs (site supervision)	50	200	V	24,000	50%	12,000	24,000	90%	48,000	36,000	1.30E+09
Regulatory Approvals	20	50	V	8,000	50%	1,500	8,000	90%	4,000	2,400	5.76E+06

Construction Average Risk Allowance: 1,353,316
Resource Average Risk Allowance: 13,600

Sum of (h)²: 1.21E+13
Square root of sum of (h)²: 3,485,025
Add Average Risk Allowance: 1,353,316
Construction Maximum Risk Allowance: 4,838,342

F= Fixed (expressed as a ratio for Average and Maximum Likely Risk)
V= Variable (expressed as a percentage for Average and Maximum Likely Risk)

Sum of (h)²: 1.30E+09
Square root of sum of (h)²: 36,080
Add Average Risk Allowance: 13,600
Resource Maximum Risk Allowance: 49,680

NOTE

- Quantities and rates based on designers estimate of available data.
- EOD risk assessment and specialist EOD supervision of development excavations are not included.
- Remediation costs do not include for the removal of buildings, structures, foundations, tanks infrastructure etc.
- Disposal costs include for Landfill Tax

RISK ADDITION

	RISK FREE BASE COSTS			RISK ALLOWANCES		SUM OF BASE + RISK		TOTAL RISK ESTIMATES
	Construction	Resource	TOTAL BASE COST	Construction	Resource	Construction	Resource	
Average Risk Estimate	2,700,876	95,000	2,795,876	1,353,316	13,600	4,054,192	108,600	4,162,792
Maximum Likely Risk Estimate	2,700,876	95,000	2,795,876	4,838,342	49,680	7,539,217	144,680	7,683,897

Annex C Risk Register

3 Pages

Table C1 Risk Register for Excavation Works – Continued MOD Use

Ref	Description	Dependencies (Ref to)	Effect Time/Cost	Allowance		Status		Comments
				Average	Maximum	Current	Previous	
S1	Increased Excavation, Disposal and backfill	D1	T/C	£42 000	£168 000	A	N/A	
S2	Increased Landfill Disposal Cost	S1, D1	T/C	£7 068	£17 719	A	N/A	
D1	Increased Base Resource Cost (Remediation Supervision)	S1 and S2	C	£3 000	£12 000	A	N/A	
D2	Increased Regulatory Approval costs	N/A	T/C	£1600	£4 000	A	N/A	

Note:

- T = Third Party Risks
- S = Site Risks
- CI = Client Risks
- D = Design Team Risks
- CO = Contractors Risks
- O = Other Risks

Ref is the reference to the dependant risks

For use with Quantitative Assessment

T = Time
C = Cost

A = Assessed and allowed
M = Managed out
D = Designed out
S = Shared
I = Ignored

Hold
Current
Urgent
Critical

Table C2 Risk Register for Excavation Works – Commercial/Industrial Redevelopment

Ref	Description	Dependencies (Ref to)	Effect Time/Cost	Allowance		Status		Comments
				Average	Maximum	Current	Previous	
S1	Increased Excavation, Disposal and backfill	D1	T/C	£459 000	£1 836 000	A	N/A	
S2	Increased Landfill Disposal Cost	S1, D1	T/C	£77 648	£194 119	A	N/A	
D1	Increased Base Resource Cost (Remediation Supervision)	S1 and S2	C	£6000	£24000	A	N/A	
D2	Increased Regulatory Approval costs	N/A	T/C	£1600	£4 000	A	N/A	

Note:

T = Third Party Risks
 S = Site Risks
 CI = Client Risks
 D = Design Team Risks
 CO = Contractors Risks
 O = Other Risks

Ref to is the reference to the dependant risks

For use with Quantitative Assessment

A = Assessed and allowed
 M = Managed out
 D = Designed out
 S = Shared
 I = Ignored

Hold
 Current
 Urgent
 Critical

Table C3 Risk Register for Excavation Works – Residential Redevelopment with Gardens

Ref	Description	Dependencies (Ref to)	Effect Time/Cost	Allowance		Status		Comments
				Average	Maximum	Current	Previous	
S1	Increased Excavation, Disposal and backfill	D1	T/C	£1 157 000	£4 630 000	A	N/A	
S2	Increased Landfill Disposal Cost	S1, D1	T/C	£196 000	£489 000	A	N/A	
D1	Increased Base Resource Cost (Remediation Supervision)	S1 and S2	C	£12 000	£48 000	A	N/A	
D2	Increased Regulatory Approval costs	N/A	T/C	£1600	£4 000	A	N/A	

Note:

- T = Third Party Risks
- S = Site Risks
- Cl = Client Risks
- D = Design Team Risks
- CO = Contractors Risks
- O = Other Risks

Ref to is the reference to the dependant risks

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A = Assessed and allowed
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Hold
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