Defence Estates

Additional Sites at Sites D&E, DSDC Bicester

Land Quality Assessment

Phase One: Desk Study
DE Project No.: 13014

Final LQA Report

25 March 2011

Prepared by Entec UK Limited for the Ministry of Defence under commission FTS3/PTSELM/091

DEFENCE ESTATES
Delivering Estate Solutions to Defence Needs

Report for

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1	Draft Report	11 February 2011
2	Final Report	25 March 2011

Land Quality Statement for Additional Sites at Sites D&E, DSDC Bicester

Introduction and Terms of Reference

Entec UK Ltd (Entec) was commissioned by Defence Estates (DE) to undertake a Phase One Land Quality Assessment (LQA) of the Ministry of Defence (MOD) of two additional sites (hereafter referred to as Area 1 and Area 2 or 'the site') adjacent to Sites D&E, DSDC Bicester. This commission was carried out under the interim contracting arrangement and the FATS/3 framework between Entec and Defence Estates.

Site Location, Description and History

The site is located approximately 1.5 km south-east of Bicester town centre, Oxfordshire. Area 2 is located to the immediate north and east of the summit of Graven Hill, which is located at National Grid Reference (NGR) 458800 220500, and Area 1 is immediately north and east of Area 2. Area 1 is bounded on the north and east by DSDC Bicester D&E sites.

The site forms a semi circle of land surrounding the wooded summit of Graven Hill and covers a total area of approximately 49.1 ha. The majority of the site is fields used for agricultural grazing. The far south of the site adjacent to the St David's Barracks is used for sports fields. During the site walkover, the hard standing area in the north of Area 1 was being used as an overflow car park for the nearby Bicester Village retail outlet. In the wooded areas there were industrial bird feeders suggesting that these areas are used for rearing game birds.

Historic mapping and aerial photographs indicate that the entire DSDC Bicester site was built on agricultural land and woodland during the period 1941-1943 and was subsequently stocked with tanks, armoured cars, other vehicles and guns in preparation for the invasion of Europe in 1944. A 500 yard rifle range is marked on historic maps from 1898 and 1920 to the west of E2, with the rifle targets and butts marked at the northern boundary of Area 2. A plan of the depot dated June 1943 shows that the vast majority of the existing site infrastructure was in place by that time. A series of three workers camps (Camp Nos. 5, 6 and 7) are marked on the 1943 plan. Camp Nos. 5 and 6 are located on the Area 1 and Area 2 sites (Camp No. 5 in the west and Camp No. 6 in the east) and Camp No. 7 is the location of the present day St David's Barracks.

The 1950s maps and aerial photos show the presence of the Garrison Theatre, with the general field layout and wooded areas very similar to that of the present day. The 1966 and 1970 historical maps show that Camp No. 5 has been demolished and land use has reverted to agricultural fields, and the current overflow car park is marked on the maps. Camp No. 6 appears to still to be operational and a roadway loop has appeared to the east of Area 1. Camp No. 7 has been replaced with St David's Barracks. Aerial photos from 1975 show what appears to be the demolition of the Camp No. 6 area and by the 1980s the maps and aerial photographs show the site in the current layout.

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Environmental Setting and Sensitivity

Geology/ Hydrogeology

According to the GeoInsight report, the solid geology consists of the Peterborough, Stewartby and Weymouth members (all mudstones) of the Oxford Clay Formation. Drift deposits are generally absent beneath the site. Beneath the Oxford Clay Formation, the Kellaways Sand and Kellaways Clay members of the Kellaways Formation both outcrop to the north of the Site. According to the Aquifer and Abstraction License Map provided in the EnviroInsight Report, the site is underlain by a Non-Aquifer (Negligibly Permeable), which appears to relate to the Oxford Clay Formation. The site does not fall within a groundwater Source Protection Zones (SPZ) and there are no SPZ marked within 1 km of the site.

Groundwater Sensitivity: Low

Hydrology

The closest surface water feature to the site is the Langford Brook, which is located approximately 600 m north of Area 1. The Langford Brook discharges into the River Ray approximately 3 km south-west of the site. During the site walkover, a number of dry surface water drainage ditches were noted, principally adjacent to the circular road between areas 1 and 2, although another ditch was noted running northwards within agricultural land in the north of Area 1. It is likely that these ditches would ultimately discharge to the Langford Brook. There are no records of surface water abstraction licenses within 1 km of the site.

Surface Water Sensitivity: Moderate/ Low

Ecology

The EnviroInsight Report provides details of three Environmentally Sensitive Areas (ESAs) within the vicinity of the site. These three areas are all part of the same ESA, the Upper Thames Tributaries. The closest of these areas is 450 m south-west of the site boundary. In addition, the site falls within a Nitrate Vulnerable Zone (NVZ).

Ecological Sensitivity: Moderate/ Low

Sources of Information

General mapping sources and public body records were consulted for this study, including topographical, geological and groundwater vulnerability maps of the area, the British Geological Survey (BGS), the local authority, emapsite™ GroundSure reports and aerial photographs from the National Monuments Record. Specialist radiological and explosive ordnance desk studies were commissioned. MOD sources of information include plans, previous reports as well as anecdotal information from site personnel.

Potential Site Contamination

Following the assessment of historical and current activities, there are several potentially contaminative activities which have been identified both on and off site. On site sources relate to the former firing range and Nissen hut camps, as well as areas of demolition and disturbed ground and asbestos within structures. Off site sources include the adjacent St David's Barracks. Most of the above identified sources are generally likely to be limited in their extent, with the possible exception of the former Nissen hut camps.

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Environmental Risks

The risks to most human receptors, including current site users/ visitors, construction and maintenance workers, future residential/commercial/industrial users and neighbouring site users have been assessed in the range of **moderate** to **low**, with the **moderate** risks generally associated with future residential users and construction/ maintenance works from source areas including the former firing range and historical Nissen hut camps.

There is a generally **negligible** risk for contaminant migration to groundwater due to the generally negligible permeability strata beneath the site. It is likely that the on-site ditches will ultimately discharge to the Langford Brook, some 600 m north of Area 1. The risks to surface water have therefore been assessed as generally **moderate/low**.

Although a number of ecologically sensitive receptors have been identified in the vicinity of the site, given the limited potential contamination identified on site and the dilution and attenuation of contaminants given the distance of the identified sources to potential receptors, the risk to ecological receptors and vegetation is assessed as generally **negligible** to **low**. Similarly, the risks to agricultural receptors have been assessed as **negligible** to **low**, although a **moderate/low** risk is assessed for unexploded ordnance within the former rifle range.

The potential presence of localised contamination at the site generally gives rise to **low** to **negligible** risks to buildings and buried services.

Overall Land Quality and Suitability for Redevelopment

In general, it is considered that the land quality at the majority of the site is likely to be generally good, with isolated areas of potentially poor land quality associated with the principal areas used for the former firing range, historical Nissen hut camps and infilling along with demolition and disturbed ground. Therefore, the site is considered to be suitable for its present (predominantly agricultural) use given the current site configuration.

Due to the uncertainty regarding the nature of the some of the areas, including the former firing range, historical Nissen hut camps and infilling along with demolition and disturbed ground, these potential land quality issues have carried forward into the risk assessment. In areas associated with these current and former potentially contaminative uses it is likely that land quality will have been impacted and redevelopment proposals, especially those related to a residential with gardens end use, will need to be tailored to the potential contamination present in these areas.

It is considered likely that construction/ redevelopment workers will come into direct contact with areas of potential contamination and all workers should be made aware of potential risks that exist at the site and take suitable measure to avoid or mitigate potential risk. Appropriate personal protective equipment (PPE) should be used and good working practices adhered to during any future investigation or redevelopment work at the site.

Development may involve the removal of the subsurface infrastructure and obstructions. Remediation may be required if following the removal of infrastructure the soils and waters are found to have been impacted by any contamination. Development may also require the removal or alteration of building foundations, building fabric, underground pipework/services and underground voids.

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Development of the land is also likely to involve the removal of buildings present on site, some of which are known to contain asbestos within the building fabric. Disposal of all asbestos containing material would need to be carried out by a specialist contractor.

Finally, it should be noted that the high sulphate concentrations present within the Oxford Clay present beneath the site are likely to be detrimental to concrete foundations. Therefore, any new foundations will likely require construction with a Sulphate Resistant Portland Cement.

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Glossary of Terms

Site Specific

BFI	Bulk Fuel Installation
DE	Defence Estates
DSTL	Defence Science and Technology Laboratory
DSTL RPS	DSTL Radiation Protection Service
MOD	Ministry of Defence
MT	Motor Transport
OSU	Operational Service Unit
OWI	Oil Water Interceptor
POL	Petrol, Oil and Lubricants
RPC	Regional Prime Contractor
UXO	Unexploded Ordnance
WWII	World War 2
QM	Quarter Master

Environmental

ACM	Asbestos Containing Material
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
bgl	below ground level
BGS	British Geological Survey
CLEA	Contaminated Land Exposure Assessment
DEFRA	Department for Food and Rural Affairs
EA	Environment Agency
EPA	Environmental Protection Act 1990
GAC	Generic Assessment Criteria
GQA	General Quality Assessment (Surface Water)
GQRA	Generic Quantitative Risk Assessment
HPA	Health Protection Survey

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LQA	Land Quality Assessment
ESA	Environmentally Sensitive Areas
NGR	National Grid Reference
NNR	National Nature Reserves
NRPB	National Radiological Protection Board
NGR	National Grid Reference
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbons
Part 2A	Part 2A of the Environmental Protection Act (1990)
PCB	Polychlorinated Biphenyls
PPE	Personal Protective Equipment
QRA	Quantitative Risk Assessment
SAC	Special Area of Conservation
SPA	Special Protection Areas
SPZ	Source Protection Zone (groundwater)
SSSI	Site of Special Scientific Interest
TPH	Total Petroleum Hydrocarbons

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1. Introduction

1.1 Terms of Reference

Entec UK Ltd (Entec) was commissioned by Defence Estates (DE) to undertake a Phase One Land Quality Assessment of two additional sites (hereafter referred to as Area 1 and Area 2 or 'the site') adjacent to Sites D&E, DSDC Bicester. This commission was carried out under the interim contracting arrangement and the FATS/3 framework between Entec and Defence Estates.

The purpose of the assessment is to provide information on the site as well as any health and environmental risks that any potential contamination may present to existing site users and in changing the use of the land.

1.1.1 Aims and Methodology

The aim and purpose of the Phase One Land Quality Assessment (LQA) report is to collate and review desk study information on the likely ground and contamination conditions at the site to enable a health and environmental risk assessment to be undertaken. The assessment also addresses the potential for ground contamination to arise from the demolition of buildings and structures presently on the site. The objective of the risk assessment is to identify any potential health or environmental risks and liabilities posed by the site which may affect its valuation or future use and to describe the scale of any identified risks.

The following methodology was adopted:

- A site reconnaissance visit was carried out to record potentially contaminative features and operations on site and to gather any evidence of past contaminative uses;
- During the site reconnaissance, potential pathways and environmental receptors were identified, both on the site and within the immediate surrounding area;
- Historical maps, aerial photographs and site layout plans indicating areas where potentially contaminative activities may have been undertaken were inspected;
- Environmentally pertinent information was gathered regarding the site and the surrounding locality from a variety of sources including the Environment Agency (EA), the Local Authority (LA), British Geological Survey (BGS) and Dstl Radiological Protection Service (DRPS); and
- Present day maps, geological records, and groundwater information were inspected.

The findings of the study are based on the information made available to Entec by the MOD and personnel, together with information obtained from public domain and other sources.

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1.1.2 Site Management and Future Use

It is understood from Defence Estates that the site is being considered for disposal to a currently unconfirmed end use. Consequently, this report considers the risks applicable to various potential end uses, including commercial/ industrial, public open space and residential with gardens.

1.2 Site Location

The site is located approximately 1.5 km south-east of Bicester town centre, Oxfordshire. Area 2 is located to the immediate north and east of the summit of Graven Hill, which is located at National Grid Reference (NGR) 458800 220500, and Area 1 is immediately north and east of Area 2. Area 1 is bounded on the north and east by DSDC Bicester D&E sites.

Access to the site is made via a dedicated access road off a roundabout on the A41 to the immediate south of Bicester.

The location of the site is shown in Figure 1.

1.3 Site Description

1.3.1 General

The site forms a semi circle of land surrounding the wooded summit of Graven Hill. The site covers a total area of approximately 49.1 ha (Area 1, 25.5 ha and Area 2, 23.6 ha) with buildings, roads and other hardstanding covering less than 5 % of the site area and the balance as soft landscaping, fields and woodland.

A site layout plan is included as Figure 2.

1.3.2 Site Visit

An Entec representative conducted a site walkover on 29 December 2010. The site was closed for the Christmas break so on site interviews with site staff were not possible. However, hardcopy and electronic data was obtained from site staff and LQA Sponsor during the previous 2010 Entec Phase One and Two LQA of the adjacent D&E sites.

The Entec representative was able to access the vast majority of the site, with the exception of the inside of some of the buildings, which were locked or otherwise inaccessible at the time for health and safety reasons.

Selected photographs taken during the site walkover are presented as Annex A to this report.

General Land Use

The majority of the site is fields used for agricultural grazing. The far south of the site adjacent to the St David's Barracks is used for sports fields. During the site walkover, the hardstanding area in the north of Area 1 was being used as an overflow car park for the nearby Bicester Village retail outlet, the surface of which appeared to be broken in places (see Plate 9 in Annex A). In the wooded areas there were industrial bird feeders suggesting that these areas are used for rearing game birds.

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Site Buildings and Activities

With reference to Figure 2, Table 1.1 summarises the buildings/activities within each area of the site.

Table 1.1 Site Buildings and Activities

Building No.	Description and Activities
Area 1	
Garrison Theatre	Two storey brick building with asbestos roof. Currently unused and boarded up.
Small brick building north of Garrison Theatre	Small brick building. Currently unused and boarded up.
Sports field changing rooms	Small temporary building used as changing facilities.
Area 2	
There are no buildings on Area 2.	

Evidence of Former Structures, Fill Material and/or Disturbed Ground

The predominant surface cover at the site is a mixture of soft landscaping and woodland. Although some snow still remained on the ground, evidence of several former structures, fill material and/or disturbed ground was noted during the site walkover, and, with reference to historic maps and plans is summarised in the following table and on Figure 2.

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Table 1.2 Site Former Structures, Fill Material and/or Disturbed Ground

Building No.	Description
Area 1	
Eastern part of Area 1	Historical maps and photos show this area as camp between 1943 and 1975. The majority of the camp structures have been removed. However, there is a 10 x 10 m concrete plinth with a brick surround (representing a probable former building) and a overgrown 10 x 20 m concrete plinth, (representing a probable area of hardstanding).
Western part of Area 1	Historical maps and photos show this area as camp between 1943 and 1966. The majority of the camp structures have been removed. However, there are two areas of building rubble just off the circular road and in a wooded area near the very west of Area 1.
Area 2	
Eastern part of Area 2	Historical maps and photos show this area as camp between 1943 and 1975, with no evidence of any remaining structures during the site walkover.
Western part of Area 2	Historical maps and photos show this area as camp between 1943 and 1966, with no evidence of any remaining structures during the site walkover.
Range Target	There earliest available maps (1898) show a 500 yard range across the site with the target at the north of Area 2. The Target area is now scrubland with slightly raised banks.

Waste

There is evidence of ad-hoc waste disposal at the rear of the changing rooms on the sports field in the southern part of Area 1, which appear to consist of building materials including plasterboard, timber and paint containers (see Plate 4 in Annex A). Scrap timber, barbed wire and apparently empty small calibre ammunition containers were noted at the rear of a container on the car park in the north of Area 1 (see Plate 8 in Annex A). Scrap metal and vehicle wheels were also noted in woodland directly to the south of the roadway loop in Area 1.

Water Mains and Waste Water Drainage

Plans of buried water and waste water services were made available to Entec by Kelda Water Services, the Project Aquatrine Contractor for the DSDC Bicester site, during the 2010 Phase Two LQA. The plans show a water main adjacent to the circular road separating Area 1 and Area 2, along with other water mains radiating from the water main adjacent to the road.

Foul sewerage and storm drainage from the vicinity of the Garrison Theatre drains to the north towards DSDC Bicester E Site. Foul sewage and storm drainage are also shown in the agricultural field in the east of Area 2, which may have been related to the former camps situated in this area.

Topography

Area 1 is located on the generally flat surroundings of Graven Hill, with Area 2 located on the lower slopes of Graven Hill. The summit of Graven Hill is at 115 m AOD with most of the site between approximately 75 and 95 m AOD.

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1.3.3 Site Boundaries

Land uses surrounding the site are summarised in Tables 1.3 and 1.4 below.

Table 1.3 Area 1 Boundaries and Adjacent Land Uses

Boundary	Adjacent Land Use	Nearby Land Use
North	Military (DSDC Bicester E Site), railway	A41 road, agricultural and residential
East	Military (DSDC Bicester D&E Sites)	Predominantly agricultural with some residential
South	Area 2, DSDC Bicester E Site and woodland	Military (DSDC Bicester D Site)
West	Military (St David's Barracks and DSDC Bicester E Site)	Agricultural

Table 1.4 Area 2 Boundaries and Adjacent Land Uses

Boundary	Adjacent Land Use	Nearby Land Use
North	Area 1, Military (DSDC Bicester E Site), railway	A41 road, agricultural and residential
East	Area 1, Military (DSDC Bicester D Site)	Predominantly agricultural with some residential
South	Woodland	Military (DSDC Bicester D Site)
West	Area 1, Military (St David's Barracks and DSDC Bicester E Site), railway	Agricultural

1.3.4 Tenants, Lodgers and Enclaves

According to mapping provided by DE, the entire site appears to be owned by the Land Command Top Level Budget holder (TLB) of MOD. However, it would appear that from additional June 2010 mapping made available by DE that approximately two-thirds of Areas 1 and 2 are 'Full Agricultural Tenancy' land, which appears to equate to all of the open agricultural land that makes up the majority of the site.

1.4 Site-Sourced Information

Additional environmentally pertinent information relating to the site was requested from the site contact. This information is summarised in the following sections.

1.4.1 COSHH Register and Material Safety Data Sheets

According to site staff, each building at the DSDC Bicester site has an individual hardcopy COSHH Register. It has not been possible to view the COSHH register(s) for the buildings on

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site, although it is understood from a conversation with the Site Manager that the COSHH records are generally for minor quantities of substances kept in each building.

1.4.2 Asbestos Surveys

There are very few buildings on site, with the exception of the Garrison Theatre (see Plate 1 in Annex A) and a limited number of small brick buildings in the vicinity of the theatre and the changing rooms in the south of the site (see Plate 4 in Annex A).

From the site walkover, it appears that signage has been placed around the Garrison Theatre warning of asbestos within the building, and access to the building has been prevented.

Conversations with PriDE, (the site Regional Prime Contractor) who hold asbestos surveys and registers for the DSDC Bicester site, revealed that the only buildings within areas 1 and 2 for which asbestos surveys are available are the Garrison Theatre (also referred to as Building 1 Garrison Briefing Facility) and the adjacent portakabin WC (referred to as building SDBB02GHT002). PriDE is not aware of asbestos within the other buildings in areas 1 and 2.

Entec were provided with copies of the above asbestos surveys by PriDE, which are reproduced as Annex H to this report.

In summary:

- Asbestos containing materials (ACMs) were detected in many locations within the Garrison Theatre, as asbestos cement, insulating board, gaskets and liners, fire blanket, pipes, panels, cowls, rope, fascia and cisterns. Most of the asbestos identified was chrysotile (white asbestos), although amosite (brown asbestos) was identified in a sample of a cistern. It was recommended that much of the ACMs identified could be 'marked and managed', although it was recommended that the asbestos insulating board, fire blanket, cement debris, pipe lagging and rope are removed. It was recommended that the 'durasteel panels' in the roof void are to be encapsulated/ enclosed; and

- No asbestos containing materials (ACMs) were detected in the portakabin building.

1.4.3 Ordnance

As part of this Phase One LQA, an updated Explosive Ordnance Threat Assessment (EOTA) was commissioned. The EOTA was undertaken by BACTEC International Ltd (BACTEC), a specialist consultancy. The EOTA concluded as follows:

- DSDC Bicester has been a military depot for over 65 years. No evidence could be found to indicate that the purpose of the depot was ever for the storage of explosive ordnance. Nevertheless, as with all historic military facilities, there is always a residual risk of explosive ordnance contamination;

- During the war years, the facility would have been defended, and weaponry in the form of small arms and land service ammunition (LSA and SAA) would have been stored and available for use. Furthermore, as a result of the military association with the area, it is likely that the land on and around the depot would have been utilised for ground training exercises historically;

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- The ‘house-keeping’ of WWII facilities is known to have often been poor with unwanted and unused items of explosive ordnance frequently buried, burnt, lost or otherwise discarded within a facility perimeter. Given the available history of the site, the likelihood of this having occurred within the perimeter of DSDC Bicester itself is not considered high, but cannot be entirely discounted. BACTEC consider that the risk of encountering LSA and SAA in Proposed Additional Areas 1 and 2 [the subject site of this LQA Report] is somewhat higher than the background level due to the areas use for US ‘Bolero’ Army Camps during WWII – it is very unlikely that explosive ordnance would have been stored in large quantities within these camps, but it is likely to have been present and available for use, and potentially therefore buried and/or discarded within these areas;

- It should be noted that several search and clear operations have been undertaken at several locations on the site by 33 Engineer Regiment (EOD) in the post-war period. Although nothing was found, the requirement for and completion of such operations at the cost of the MoD indicates that there was a credible perceived threat/possibility of explosive ordnance contamination being present. It should also be noted that only small sections of DSDC Bicester have been subject to such searches, those searches only providing 12.5% clearance;

- Research indicates that bombing density over the Bicester area was low. Very few references could be found to raids over the region despite there being a number of high profile RAF targets present. ARP records for COD Bicester could not be located (reports of bombing on military land were generally made by military personnel and kept separate from civilian records). It has therefore not been possible to confirm that the facility was not attacked. However, work on the construction of the depot did not commence until after the main period of bombing in this part of the UK;

- The depot employed thousands of people and for the latter part of WWII at least, would have been manned twenty-four hours a day. It is considered very unlikely that evidence of unexploded ordnance would have been overlooked across the site subsequent to construction work beginning in June 1941. Prior to this date, the site comprised open, agricultural land on which it is conceivable that unexploded bombs could have been overlooked had they been dropped. However, given the low bombing density in this part of the county and lack of viable targets within the site area in 1940/early 1941, the likelihood of unexploded bombs having been dropped is considered minimal.

Entec is content with BACTEC’s EOTA for the site. The potential risks to the identified sensitive receptors from ordnance are further discussed in Section 4 and Annex G of this report.

The full EOTA is included as Annex B to this report.

1.4.4 Ionising Radiation Sources and DSTL Radiological Desk Study

As part of the Phase One LQA for the adjacent DSDC Bicester Sites D&E, undertaken in early 2010, a desk study was commissioned through the Dstl Environmental Services Department (Dstl ESD). As part of this study, Dstl ESD conducted a search of records relating to any radiological contamination issues at the whole DSDC Bicester site, which includes the subject sites of this Phase One LQA.

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Dstl ESD records show that a very large number of items of standard military equipment containing radioactive material have been stored at the DSDC Bicester site from at least 1994 to the present day; the site being a major distribution centre for the main storage facility at DSDC Donnington. These include various pieces of instrumentation and check sources containing the following radionuclides: tritium (H-3), nickel-63 (Ni-63), thorium-232 (Th-232), strontium-90 (Sr-90) chlorine-36 (Cl-36) and cobalt-57 (Co-57). In addition, an instrumentation dial from a Canberra (jet aircraft) cockpit containing radium-226 (Ra-226) has been stored on site since at least 1999.

The desk study concluded that the likelihood of contamination being present on other parts DSDC Bicester is deemed to be moderate. In particular, if any additional burning grounds, disposal areas or workshops are identified on the site, these should be subject to a radiological survey.

Entec is content with DSTL's radiological desk study for the site. The potential risks to the identified sensitive receptors from radiological artefacts are further discussed in Section 4 and Annex G of this report.

The full Dstl ESD desk study is included as Annex C to this report.

1.5 Site History

1.5.1 Historical Landuse Summary

Historic mapping and aerial photographs indicate that the entire DSDC Bicester site was built on agricultural land and woodland during the period 1941-1943 and was subsequently stocked with tanks, armoured cars, other vehicles and guns in preparation for the invasion of Europe in 1944. A 500 yard rifle range is marked on historic maps from 1898 and 1920 to the west of E2, with the rifle targets and butts marked at the northern boundary of Area 2. A plan of the depot dated June 1943, included in the 1998 Aspinwall Phase One LQA factual report, shows that the vast majority of the existing site infrastructure was in place by that time. The June 1943 plan shows that, at the time, D Site was the site armaments depot, whereas E Site was the small arms sub-depot. A series of three workers camps (Camp Nos. 5, 6 and 7) are marked on the 1943 plan. Camp Nos. 5 and 6 are located on the Area 1 and Area 2 sites (Camp No. 5 in the west and Camp No. 6 in the east) and Camp No. 7 is the location of the present day St David's Barracks. The Aspinwall Phase One LQA factual report indicates that these camps consisted of Nissen huts and were used to accommodate troops and depot workers.

Historic aerial photographs and mapping from 1947 and 1950 show the majority of Areas 1 and 2 is used for the worker camps consisting of a large number of small buildings linked by roadways. The 1950s maps and aerial photos show the presence of the Garrison Theatre, with the general field layout and wooded areas very similar to that of the present day.

The 1966 and 1970 historical maps show that Camp No. 5 has been demolished and land use has reverted to agricultural fields, and the current overflow car park is marked on the maps. Camp No. 6 appears to still to be operational and a roadway loop has appeared to the east of Area 1. Camp No. 7 has been replaced with St David's Barracks.

Aerial photos from 1975 show what appears to be the demolition of the Camp No. 6 area and by the 1980s the maps and aerial photographs show the site in the current layout.

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Selected historic aerial photographs are included as Annex D.

1.6 Environmental Setting and Sensitivity

1.6.1 Geology

Geological information on the site is provided within the emapsite™ GroundSure GeoInsight Report obtained as part of the site data acquisition exercise, a copy of which is included in Annex E. The geological information provided in the GeoInsight report is derived from the British Geological Survey (BGS) Digital Geological map of Great Britain and 1:50 000 scale, Sheet 219.

According to the GeoInsight report, the solid geology consists of the Peterborough, Stewartby and Weymouth members (all mudstones) of the Oxford Clay Formation. Drift deposits are generally absent beneath the site. Beneath the Oxford Clay Formation, the Kellaways Sand and Kellaways Clay members of the Kellaways Formation both outcrop to the north of the Site.

Beneath the Oxford Clay and Kellaways Formation is the Cornbrash Formation (predominantly calcareous shelly mudstones and fossiliferous limestones) which outcrops to the north-west and south-east of the site.

No faults are marked within the site boundary. The closest fault to the site is marked within 200 m of the south-eastern boundary of the adjacent DSDC Bicester D Site, with a strike trending north-west to south-east.

The natural ground subsidence section of the GeoInsight Report presents the following assessment of risks by the BGS for potential geological hazards that may be present in the general area of the site:

- Potential for shrink-swell clay ground stability hazards: Moderate (source: BGS);
- Potential for landslide ground stability hazards: Very Low to Moderate (source: BGS);
- Potential for ground dissolution of soluble rocks stability hazards: Very Low (source: BGS);
- Potential for compressible deposits stability hazards: Negligible to Very Low (source: BGS);
- Potential for collapsible deposits stability hazards: No Hazard to Negligible (source: BGS);
- Potential for running sand stability hazards: Negligible (source: BGS);
- Radon: The site is not within a radon Affected Area, as less than 1 % of properties are above the Action Level. No radon protection measures are necessary (sources: Health Protection Agency and Building Research Establishment); and
- Mining: There are no historical mining and/or coal mining areas within 1 km of the site boundary. The maximum hazard rating of subsidence relating to shallow mining within the site is Negligible. There are no non-coal mining cavities, natural

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cavities, brine extraction areas, gypsum extraction areas, tin mining areas or clay mining areas within 1 km of the site boundary (sources: GroundSure, Coal Authority, BGS, Peter Brett Associates mining cavities and natural cavities databases, British Gypsum and relevant tin and clay mining records).

Ground Workings

According to the GroundSure GeoInsight Report, included within Annex E of this report, there are no records of any historic surface ground workings within the site boundary.

In addition to the above, the site Estate Development Plan (v1.1, dated 15 August 2008) states in Section 16.38 that: *'High sulphate concentrations in clay which are detrimental to concrete foundations, require construction with a Sulphate Resistant Portland Cement'.*

1.6.2 BGS Borehole Records

The GroundSure GeoInsight report provides details of six exploratory holes within the site boundary. Of these exploratory holes, four appear to be trial pits. Of the remaining two boreholes, both are recorded in the south-eastern part of the site.

As the adjacent DSDC Bicester D&E sites have already been subject to several stages of intrusive site investigation, borehole logs were not ordered from the BGS. The ground conditions encountered during the June 2001 and September 2010 Phase Two LQAs generally concur with the BGS geological mapping, indicating Made Ground in places over Oxford Clay. The thickness of the clay has not been fully established, although the Aspinwalls 2001 Phase Two LQA report states that: *'The Oxford Clay is an estimated 15m minimum thickness below DSDC Bicester and there is no hydraulic continuity with the underlying Great Oolite Aquifer'.*

1.6.3 Groundwater

Hydrogeological information on the site is provided within the emapsite™ GroundSure EnviroInsight Report obtained as part of the site data acquisition exercise, a copy of which is included in Annex E.

According to the Aquifer and Abstraction License Map provided in the EnviroInsight Report, the site is underlain by negligibly permeable strata, which appears to relate to the Oxford Clay Formation.

Beneath the Oxford Clay and Kellaways formations, the Cornbrash Formation (part of the Great Oolite Group) that outcrops to the north-east and south-west of the site, is also classified as a Secondary 'A' Aquifer of Low Leaching Potential.

According to the site Estate Development Plan (EDP) (v1.1, 15 August 2008) groundwater levels, although recorded at 70m Above Ordnance Datum (AOD) are within the aquifer of the Great Oolite Group (approximately 30 m below ground level), comprising limestone and sands. The EDP states that this confined aquifer is under high pressure conditions, which if penetrated by a borehole will produce artesian conditions with a head of approximately 20 m. The September 2010 Entec Phase Two LQA recorded groundwater levels in the monitoring boreholes installed across DSDC Bicester D&E sites at between 63 and 71mAOD, which equates to a minimum of 4 metres below ground level in the lowest areas of the site.

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The site does not fall within a groundwater Source Protection Zones (SPZ) and there are no SPZ marked within 1 km of the site.

Groundwater Abstraction Licenses

The EnviroInsight Report provides details of seven groundwater abstraction licenses within the vicinity of the site. The closest is 700 m to the north-east of the site and relates to a general farming and domestic supply from a borehole at Wretchwick Farm, Bicester.

Potable Water Abstraction Licenses

The EnviroInsight Report provides details of three potable water abstraction licenses within the vicinity of the study site, of which none are within 1 km of the site.

Groundwater Sensitivity: Low

1.6.4 Surface Water

The closest surface water feature to the site is the Langford Brook, which is located approximately 600 m north of Area 1. The Langford Brook discharges into the River Ray approximately 3 km south-west of the site.

During the site walkover, a number of dry surface water drainage ditches were noted, principally adjacent to the circular road between areas 1 and 2, although another ditch was noted running northwards within agricultural land in the north of Area 1. It is likely that these ditches would ultimately discharge to the Langford Brook.

The EA record the quality of the Langford Brook in two reaches within approximately 1 km of the site. The first (Stratton Audley - Bicester STW) is rated by the EA as chemical grade 'D' (fair) and biological grade B (good). The second reach (Bicester STW - Ray) is rated as chemical grade 'C' (fairly good) and biological grade B (good).

Surface Water Abstractions

There are no records of surface water abstraction licenses within 1 km of the site.

Discharges

There are records of thirty-three Licensed Discharge Consents within the vicinity of the site, nineteen of which relate to permits that are now revoked. Details of the extant permits are as follows:

- Four relate to the discharge of sewage effluent by the adjacent DSDC Bicester D&E sites to the Langford Brook;
- Three relate to the discharge of sewage effluent by the adjacent DSDC Bicester D&E sites to the River Ray;
- Three relate to storm water or final/treated sewage discharge by Bicester STW to the Langford Brook;
- One relates to discharge of final/treated sewage by Wretchwick Farm to a tributary of the Langford Brook;

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- One relates to miscellaneous discharges by Bicester Retail Park to a tributary of the Langford Brook;
- Two relate to discharge of final/treated sewage by Alchester House to a tributary of the Gagle Brook.

During a conversation with a representative of Kelda Water Services, the Aquatrine Contractor for the wider DSDC Bicester site, it was indicated that no discharge consents related to the adjacent DSDC Bicester D&E sites site are still extant.

Flooding

The Surface Water Flood Map provided with the EnviroInsight Report shows that none of the site is within Zone 2 and Zone 3 floodplains.

There are BGS groundwater flooding susceptibility flood areas within the vicinity of the site, and a high groundwater flooding susceptibility is indicated. This means that due to the underlying geology, the area groundwater flooding hazard should be considered in all land use planning decisions. The BGS confidence rating for the groundwater flooding susceptibility areas is moderately high; meaning the groundwater flooding susceptibility areas can be used with confidence.

Surface Water Sensitivity: Moderate/ Low

1.6.5 Ecology

The EnviroInsight Report provides details of three Environmentally Sensitive Areas (ESAs) within the vicinity of the site. These three areas are all part of the same ESA, the Upper Thames Tributaries. The closest of these areas is 450 m south-west of the site boundary.

In addition, the site falls within a Nitrate Vulnerable Zone (NVZ).

Ecological Sensitivity: Moderate/ Low

1.7 Additional Information

1.7.1 IPPC Authorisations

According to the EnviroInsight report, there are records of a single Integrated Pollution Prevention and Control (IPPC) Authorisation within 500 m of the site. This authorisation appears to be related to a poultry farm (Ambrosden Farm) located 300 m south-east of Area 1.

1.7.2 List 2 Dangerous Substance Inventory Sites

According to the EnviroInsight report, there are records of a List 2 Dangerous Substance Inventory Site within 500 m of the site. This relates to the Bicester STW 460 m north-west of the site and the 'authorised substance' is iron.

1.7.3 Environment Agency Recorded Pollution Incidents

According to the EnviroInsight report, there are records of two recorded pollution incidents within 500 m of the site. The first relates to a diesel spill on site on 21 April 2003 at the

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adjacent DSDC Bicester Site D (approximately 300 m from Area 1) and was a Category 2 (Significant) incident with regard to the impacts to land and water. The second incident relates to spillage/ discharge of 'other sewage material' on 17 April 2002 at a location 500 m north-east of Area 1. This incident was a Category 3 (Minor) and Category 4 (No Impact) incident with respect to the impacts to water and land respectively.

1.7.4 Waste Sites

According to the EnviroInsight report, there are records of a historic landfill 1 km north of Area 1 at NGR 458800 221900. The operator was Ploughley Rural District Council and the waste types included inert, industrial, commercial and household.

In addition, there are records of four 'other waste sites' within approximately 1.5 km of the site, all of which are metal recycling sites. The closest site is 1 km north of Area 1 and is operated by McGregor Railway Services Ltd for a metal recycling site with an annual throughput of between 25 000 and 75 000 tonnes. The Waste Management License number for this site is 86100.

1.7.5 Petrol and Fuel Sites

According to the EnviroInsight report, there are records of an 'obsolete' petrol station 1.5 km south-east of the site boundary, which is known as Three Corners Garage. From publicly available street-level imagery, Three Corner Garage now appears to be a MOT Test Centre and car/van sales centre with no obvious signs of being a petrol station.

1.7.6 Archaeological Issues

According to the Multi-Agency Geographic Information for the Countryside (MAGIC) website (www.defra.magic.gov.uk, accessed 25 January 2011) there are records of two Scheduled Ancient Monuments (SAMs) within 1 km of the site, details of which are as follows:

- Alchester Roman Site (460 m south-west of the site); and
- Wretchwick Deserted Medieval Settlement (two areas 530 m and 810 m north-east of the site).

In addition, historic mapping shows St David's Barracks to be the site of a battle between Danes and Saxons, and a roman road crossing the site in an approximate south-west to north-east orientation in the far west of Area 1.

1.7.7 Local Authority Environmental Services Department

A response for an information request for Sites D&E at DSDC Bicester was received by Entec from Cherwell District Council Environmental Service Department (ESD) on 19 January 2010. This search includes a 500 m search buffer around Sites D&E, which appears to overlap the entire area of the site.

The response is extensive, amounting to a 52 page report using information gathered from the Landmark Group and the BGS, as well as records held within Cherwell ESD. The response includes detailed information on the site geology (including information on borehole records), hydrogeology and hydrology, naturally occurring arsenic (no naturally occurring arsenic at the

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site), historical mapping, infilled sites, landfill sites, licensed waste management facilities, environmentally sensitive data, sites of environmental importance and heritage sites.

The data from Landmark and BGS is noted by Cherwell ESD to be current up to 01/04/07. Therefore, it has been assumed that the majority of information provided is superseded by the emapsite™ reports, which was commissioned by Entec in January 2010. However, information on historical land use, infilled ground, site of environmental importance and pollution incidents from the Cherwell ESD has been included in this section for the sake of completeness.

On the historical land use maps covering the periods 1899-1905 and 1913-1926, an 'MOD firing range' is shown in the centre-north of Area 2. The firing range is not explicitly shown on the earlier or later historical land use maps, although the 1891-1912, 1904-1939 and 1914-1943 maps also appears to show 'Military Land' in the same area, which is assumed to also relate to the firing range. The 1940-1970 and 1970-1996 show the entire site as 'Military Land'.

'Unknown Infilled Ground' is marked on an infilled sites plan (c.1840-1997) included with the Cherwell ESD report in three locations within the site boundary: two locations in the north of Area 1 and one location in the far south of Area 1.

The woodland to the immediate south of Area 2 is shown on the 'Sites of Environmental Importance' map as ancient woodland (County Wildlife site).

No pollution incidents are recorded on site, with the closest pollution incident marked approximately 360 m south-west of Area 1, adjacent to Building D4 at DSDC Bicester D Site. This incident is classed as a 'minor current pollution incidents (2001-)' with no further details provided. There are also records of nineteen historical and one current pollution incidents within the 500 m search buffer, which generally relate to spillages of sewage, oils, fuels and poultry manure, the closest of which is almost immediately off site to the north-east of Building D9 at DSDC Bicester D site.

The full Cherwell ESD response is included as Annex F to this report.

1.8 Previous Assessments

1.8.1 BOD Bicester Land Quality Assessment Phase One: Desk Study, Aspinwall & Company Ltd, August 1998

This desk study, presented in three volumes (Factual Report, Interpretive Report and Land Quality Statement) covers the entire DSDC Bicester site, which is referred to in the reports as the Base Ordnance Depot (BOD) Bicester.

A number of current and historical activities/issues are identified that may give rise to contamination. Those specific to the site include the old firing range in the centre-north of Area 2, for which there are no clearance records. The report suggests that potential small calibre explosive ordnance could be present in near surface soils at this former range.

The reports also states that the roof of the Garrison Theatre consists of asbestos sheets and gutters, which are noted as being in 'poor' condition in need of replacement according to the September 1996 inspection. There are also records of asbestos in many of the buildings and the underground water main at the St David's Barracks. The report states that the asbestos register

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for the site recommends replacement in approximately 50% of the locations where asbestos has been identified, which was taking place as an ongoing programme at the time of writing.

A hand tracing of site plan dating from 1943 included with the report indicates that the vicinity of the site as 'Camp No. 5' and 'Camp No. 6'. The report states that these camps were used to accommodate troops and depot workers, presumably during WWII and the post war period.

It is understood from the reports that large quantities of explosive ordnance have never been stored or used at the site, although small calibre explosive ordnance could be present in near surface soils at the former firing range. The report goes on to state that targets from a pre 1950's rifle range were located in the same area.

In addition, the reports state that the only radioactive sources kept on site are night sights and related equipment at the barracks sites at DSDC Bicester.

The environmental risk assessment carried out as part of the reports concludes that the risk to current site users/workers is low, unless ground conditions are disturbed. Contractors undertaking intrusive works at the site who come into contact with contaminated materials may be at risk, and appropriate health and safety precautions should be adopted.

The risk to soils from metals and explosives in the former rifle range was assessed as moderate, and the risk to humans from asbestos was assessed as moderate/low, but negligible for current users providing it remains undisturbed. The risk to soils, surface waters and humans from PCB containing oils from transformers was assessed as low. The greatest risks identified were to surface waters, which provide a preferential route for the migration of any pollutants present in surface run-off. Groundwater pollution risks were not considered significant at the site.

In summary, Aspinwalls state that the 'vast majority' of the DSDC Bicester site is unlikely to have been contaminated by historical activities, but that current activities, generally associated with fuel storage, may give rise to localised contamination of soils and surface water. A number of sources of potential contamination were identified, few of which are located within Areas 1 or 2, which include the former range, structure(s) with asbestos in their fabric and electrical transformers. Aspinwalls state that it is unlikely that there would be any major constraints to further developments at the site proposed as part of ongoing operations, although there may be a requirement to remove localised sources of ground contamination prior to building construction. If the site was to be sold for redevelopment for commercial/industrial use, some limited remedial works would likely be necessary. In addition, although 'large tracts' of the site would potentially be suitable for housing with gardens, some areas of the site (which particularly relate to the depot areas at the adjacent D&E sites) would not be suitable for housing without some form of remedial work.

1.8.2 DSDC Bicester Land Quality Assessment Phase Two: Intrusive Survey, Enviros Aspinwall Ltd, June 2001

This report, presented in two volumes (LQA Report and Technical Note) covers the potentially contaminated areas of the site prioritised for investigation from the previous Phase One LQA reports. None of the potentially contaminated areas prioritised for investigation are within Areas 1 or 2.

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1.9 Historical MOD Practices

1.9.1 On Site

During the development and function of the site, historical MOD practices and activities may have led to contamination issues. The site has had a generally consistent land use since development in the 1940s. Potential activities that may have led to contamination include the following:

- Unrecorded disposal of waste materials in the ground. The MOD historically tended to opt for local waste disposal practices;
- Burning grounds and disposal of ash/ clinker waste, often to ground, as an aggregate material;
- Demolition of former buildings which may have contained ACMs and subsequent retention of some demolition rubble as fill or founding aggregate;
- Use and storage of fuels, oils and other chemicals;
- Use and storage of limited quantities of explosive ordnance probably relating to small arms (for guard/ defence personnel and training purposes); and
- Electrical distribution substation transformers that are likely to have contained oils and polychlorinated biphenyls (PCBs).

1.9.2 Off Site

Historically, land at and surrounding the site has been used for agricultural, transport (road and rail) and various MOD activities (St David's Barracks and the other component sites of the wider DSDC Bicester site).

The above various MOD activities are assessed in the 1998 Aspinwall Phase One LQA and 2010 Entec Phase One LQA, which mention that limited quantities of small arms ammunition and radioactive sources (night sights and related equipment) are stored at the St David's Barracks site and that small arms ammunition is likely to have been used at the former firing range. The rest of the DSDC Bicester site is discussed in detail in the Phase One LQAs, which describes a number of potential issues related to use and storage of fuels and oils, infilled areas and burning grounds, potential radiological contamination and possible small arms ordnance. However, the Phase One LQAs conclude that the majority of the DSDC Bicester site is unlikely to have been contaminated by historical activities.

Historical construction and demolition activities of MOD buildings in the vicinity may have resulted in the presence of some demolition rubble. This could potentially include ACMs.

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2. Sources of Information

2.1 Sources of Information

The following sources of information have been used to inform the Land Quality Assessment and have been selected based on the requirements contained in the following MOD documents and from Entec experience of undertaking LQAs:

- Land Quality Assessment (LQA) Management Guide, Defence Estates, April 2007; and
- Detailed Statement of Requirement (LQA Directive), Ref: 13014 dated 3/11/2010.

Public Domain and Non-MOD Sourced Information:

- General mapping/ plans: recent and historical;
- BGS Digital Geological mapping;
- Hydrogeology mapping and Groundwater Vulnerability mapping;
- emapsite™ GroundSure data search (GeoInsight and EnviroInsight reports);
- Local Authority (Cherwell District Council) environmental data search;
- English Heritage (National Monuments Record) Aerial Photographs; and
- Multi-Agency Geographic Information for the Countryside (MAGIC) website www.magic.gov.uk.

Specialist Data Searches:

- A search of records relating to any radiological contamination issues was requested from Dstl ESD. The letter response was received on 5 February 2010, reference ESD/AS/490158 /ENTEC/SH and is included as Annex C; and
- An updated Explosive Ordnance Threat Assessment (EOTA) was commissioned through BACTEC. The report was received on 19 January 2011, reference 3063TA REV_1 and is included as Annex B.

Site and MOD Sourced Information:

- Plans provided by Defence Estates;
- Estate Development Plan (v1.1, 15 August 2008) provided by Defence Estates;
- Phase One and Phase Two LQA Reports undertaken by Aspinwall & Company (1998 and 2001);
- Anecdotal information from Estates Management Personnel; and

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- OS Tiles provided by DE Geographical Information Unit.

Site Visit Information:

- Observations and notes from the site walkover; and
- Photographs and visual assessment of the site and surrounding area.

2.2 Presentation of Data within Report

Information is contained in the following annexes:

- Annex A Site Photographs;
- Annex B Explosive Ordnance Threat Assessment;
- Annex C Dstl Radiological Information Letter Response;
- Annex D Selected Historic Aerial Photographs;
- Annex E emapsite™ GroundSure reports;
- Annex F Local Authority Correspondence;
- Annex G Environmental Risk Assessment Table; and
- Annex H Site Asbestos Surveys.

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3. Sources of Contamination

3.1 Historical On-site Issues

The following areas of concern from a contaminated land perspective, relating to historical uses of the site, are described below and shown on Figure 3.

3.1.1 Former Rifle Range

A 500 yard rifle range is marked on historic maps from the 1890s to the 1940s to the west of building E2 on the adjacent DSDC Bicester E Site, with the rifle targets and butts marked within Area 2. Small arms ammunition is likely to have been used at the former firing range.

Given that this potential source is present within the site boundary, the former rifle range has been carried forward into the risk assessment.

3.1.2 Historical Nissen Hut Camps

A hand tracing of a 1943 site plan is presented within the Aspinwalls Phase One LQA report indicates the vicinity of the site was 'Camp No. 5' and 'Camp No. 6' at the time. The report states that these camps consisted of Nissen huts used to accommodate troops and depot workers, presumably during WWII and the post war period.

Although Nissen huts were often primarily constructed of corrugated steel, some variants were constructed of ACMs. It is possible that the Nissen huts were demolished in-situ when they were no longer required. In addition, activities in the camps are likely to have involved the disposal of ash from the burning of fuels for heating as well as potentially minor quantities of hydrocarbons (oils, solvents, etc.) from ad-hoc servicing of vehicles and equipment.

Given the above and the evidence of former structures in the vicinity of these historical camps, the camps have been carried forward into the risk assessment.

3.1.3 Historical Infilled Ground

'Unknown Infilled Ground' is marked on an infilled sites plan (c.1840-1997) included with the Cherwell ESD report in three locations within the site boundary: two locations in the north of Area 1 and one location in the far south of Area 1.

The report states that the 'Unknown Infilled Ground' relates to infilled ponds, marshes, rivers, or streams. There is no other information provided in the Cherwell ESD Report, although the GroundSure GeoInsight report shows no records of any surface ground workings, mining, extraction, natural cavities or areas of landfilling in the vicinity of these areas. However, land marked as 'landscaped ground (undivided)' is shown in the vicinity of all of these areas, appearing to represent the shallow ground conditions across the adjacent DSDC Bicester D&E sites.

On the basis of the above, the areas of unknown infilled ground have been carried forward into the risk assessment.

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3.2 Historical Off-site Issues

From the recent Entec Phase One LQA for the adjacent DSDC Bicester D&E Sites, there are several historical off-site issues related to D&E Sites, including:

- Former vehicle fuelling areas at E11 and D18 (particularly related to any former/ current underground storage tanks within these areas);
- Former railway workshops within current buildings D6 and D9;
- Former fire training building E20 (particularly related to fuel storage and usage, along with the ad-hoc storage of containers of potential contaminants); and
- Former waste tip near building E15.

The subsequent Entec Phase Two LQA revealed little evidence of significant ground contamination in any of these areas, with the possible exception of the former waste tip adjacent to building E15, some 200 m west of Area 1. Given the results of the Entec assessment, the distance to the former waste tip, the low permeability of the geological strata and the elevation of the site relative to all of the above off-site issues, the historical issues at the D&E Site have not been carried forward into the risk assessment.

According to the EnviroInsight report, there are records of a historic landfill 1 km north of the site boundary. In addition the report provides records of an 'obsolete' petrol station 1.5 km south-east of the site boundary. Given the distance of the historic landfill and obsolete petrol station to the site, and the low permeability of the geological strata beneath the site limiting the potential for dissolved or gaseous contaminant migration, these potential sources have not been carried through into the risk assessment.

3.3 Current and Recent On-site Operations

3.3.1 Areas of Demolition and Disturbed Ground

The following areas of demolition and disturbed ground were observed during the site visit:

- Field forming far western part of Area 1: A small brick building appears to have been demolished in-situ at a location immediately north of the circular road separating Areas 1 and 2 (see Plate 10 in Annex A). A further pile of building rubble was also noted further to the west within this field;
- South-east of Area 1, to immediate south-east of circular road: There is a 10x10 m concrete plinth with a brick surround (representing a probable former building) and a overgrown 10x20 m concrete plinth, representing a probable area of hardstanding (see Plates 5 and 6 in Annex A).

These areas of demolition and disturbed ground have been carried forward into the risk assessment.

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3.3.2 Distribution Substations and Transformers

There are two distribution substations (DSS) within Area 1; one adjacent to the Garrison Theatre (see Plate 3 in Annex A) and one adjacent to the roadway loop in the far east of the site (see Plate 7 in Annex A). They both appear to be in good order with no obvious signs of leaks. However, the ground within the DSS compounds has recently been covered with gravel, making it difficult to check for signs of previous leaks. During the site walkover at the adjacent D&E Sites, contractors were noted on site replacing some of the transformers and laying down gravel. They do not recollect there being any obvious signs of major leakage at any of the DSS. According to the contractors, transformers within the DSS compounds are replaced as soon as there is the slightest indication of any leakage onto their respective concrete plinths.

PCBs are known to have been used historically within electrical equipment and smaller units would have held minor quantities. PCBs have generally been withdrawn from use in external transformers. The 1998 Aspinwalls Phase One LQA factual report states that *'information supplied by the Works Services Manager (WSM) indicates that the substations and transformers have all undergone coolant change in the past five years, and that there are therefore no polychlorinated biphenyl (PCB) containing coolants on site. The WSM is not aware of any historic spills or leaks of coolants at substation or transformer sites.'*

Owing to the above, the limited quantities of oils contained within the transformers, the low mobility of PCBs and the negligible permeability of the underlying strata, the DSS are not considered further into the risk assessment.

3.3.3 Modern Containerised Boiler and Fuel Tank

Adjacent to the Garrison Theatre is a modern containerised boiler (see Plate 2 in Annex A) and associated '3/50 FFO' 5000 litre capacity heating oil tank, that appears to be self-bunded (see Plate 1 in Annex A). These units are identical to the others seen across DSDC Bicester D&E sites. The fuel from the tank is transferred via a small diameter underground pipe to the containerised boiler and there was no evidence of any leaks during the site walkover.

Due to the modern nature of the equipment and the absence of any evidence of contamination, the containerised boiler and fuel tank have not been carried forward into the risk assessment.

3.3.4 Asbestos within Structures

Buildings constructed pre 1990 are generally expected to have been built with some asbestos containing material prior to the UK Asbestos Regulations (1985) which prohibited the use of all forms of asbestos.

The Garrison Theatre (see Plate 1 in Annex A) still appears to contain substantial amounts of ACMs, as documented in the asbestos survey included within Annex H and discussed further in Section 1.4.2. PriDE is not aware of asbestos within the other buildings in areas 1 and 2.

3.4 Current and Recent Off-site Operations

From the recent Entec Phase One LQA for the adjacent DSDC Bicester D&E Sites, there are several current off-site issues related to D&E Sites, including:

- Railway lines (site-wide);

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- POL stores and POL points (fuel tanks) (site-wide);
- Oil/water interceptors (site-wide);
- Made Ground at BIFT and between D6/D9; and
- Made Ground: stockpile(s) of ash ballast materials.

The site-wide railway lines, oil/water interceptors and stockpiles of ash ballast were not prioritised for further investigation due to the relatively low risks to the sensitive receptors identified. The subsequent Entec Phase Two LQA revealed little evidence of significant ground contamination in the above areas that were investigated, with the possible exception of the vicinity of the fuel tanks near buildings E14/E16, some 200 m south-west of Area 1. Given the results of the Entec assessment, the distance to the E14/E16 fuel tanks, the low permeability of the geological strata and the elevation of the site relative to all of the above off-site issues, the current issues at the D&E Site have not been carried forward into the risk assessment.

According to the EnviroInsight report, there are records of a single Integrated Pollution Prevention and Control (IPPC) Authorisation within 500 m of the site. This authorisation appears to be related to a poultry farm (Ambrosden Farm) located 300 m south-east of Area 1. Given the distance of the poultry farm to the site and the low permeability of the geological strata beneath the site limiting the potential for dissolved or gaseous contaminant migration, these potential sources have not been carried through into the risk assessment.

In addition, and again according to the EnviroInsight report, there are records of a List 2 Dangerous Substance Inventory Site within 500 m of the site. This relates to the Bicester STW 460 m north-west of the site and the 'authorised substance' is iron. Due to the distance of this potential contamination source and the site, this source has not been carried through to the risk assessment.

The EnviroInsight Report also notes four 'other waste sites' within approximately 1.5 km of the site, all of which are metal recycling sites. The closest site is 1 km north of Area 1 and is operated by McGregor Railway Services Ltd for a metal recycling site. Given the distance of these waste sites to the site, and the low permeability of the geological strata beneath the site limiting the potential for dissolved or gaseous contaminant migration, these potential sources have not been carried through into the risk assessment.

No pollution incidents are recorded on site, with the closest pollution incident marked approximately 360 m south-west of Area 1, adjacent to Building D4 at DSDC Bicester D Site. This incident is classed as a 'minor current pollution incidents (2001-)' with no further details are provided. There are also records of nineteen historical and one current pollution incidents within the 500 m search buffer, which generally relate to spillages of sewage, oils, fuels and poultry manure, the closest of which is almost immediately off site to the north-east of Building D9 at DSDC Bicester D site.

Land at, and surrounding, the site continues to be used for various MOD activities including barracks (St David's Barracks). These MOD activities are assessed in the 1998 Aspinwall Phase One LQA, which mentions that limited quantities of small arms ammunition and radioactive sources (night sights and related equipment) are stored at the St David's Barracks. Given the proximity of the St David's Barracks to the site, it has been carried forward into the risk assessment.

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4. Preliminary Qualitative Risk Assessment

4.1 Approach

4.1.1 Legislative Framework

The potential risks and liabilities associated with contaminants identified at the site have been assessed using a risk based framework established to support the implementation of the contaminated land regime in the UK.

The regulatory regime for defining, identifying and remediating contaminated land is Part 2A of the Environmental Protection Act (EPA) 1990. It was introduced in England in April 2000 by the Contaminated Land (England) Regulations 2000, which were later updated in 2006. The regulations are in turn supported by Statutory Guidance issued by the Department for the Environment Food and Rural Affairs (DEFRA) in September 2006, DEFRA Circular 01/2006.

Part 2A provides a statutory definition of 'Contaminated Land' and sets out the nature of liabilities that can be incurred by owners of contaminated land and groundwater. According to the Act, 'contaminated land' is defined as:

> *"any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substance in, on, or under the land that:*
>
> - *Significant harm is being caused, or there is significant possibility of such harm being caused; or*
> - *Pollution of controlled waters is being, or is likely to be caused."*

Where harm is attributable to radioactivity, the definition of contaminated land has been modified 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 following situations are defined where harm is to be regarded as significant:

i) Death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions of humans;

ii) Irreversible or other substantial adverse change to an ecological system, or harm which affects any special interest and which endangers the long term maintenance of the population of that species;

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iii) Structural failure, substantial damage, or interference with the right of occupation of buildings;

iv) Death, serious disease or other physical damage to livestock or crops;

v) The pollution of controlled waters.

Central to the Part 2A regulatory approach is a rigorous procedure of risk assessment which is used to determine whether land meets the definition of 'contaminated land' in accordance with the Statutory Guidance. Under the risk assessment procedure for such harm to humans, the environment or pollution of controlled waters to be possible, there must be a 'pollutant linkage', as follows:

- A **Source** of pollution (Hazard);
- A **Pathway** for the pollutant to move from source to receptor;
- A **Receptor** (Target) which is affected by the pollutant. This includes human beings, other living organisms, controlled waters, physical systems and built structures which could be affected by the hazard.

In February 2010, Defra announced its decision to review the Statutory Guidance which underpins the contaminated land regime under Part 2A of the Environmental Protection Act 1990 and consider where it could be amended to reflect experience in delivering the regime and developments in scientific understanding.

A proposed new Contaminated Land Statutory Guidance document had been issued by DEFRA for formal consultation, which closes on 15 March 2011. DEFRA has stated that while this work proceeds, Local Authorities should continue to fulfill their legal duty to identify and deal with contaminated land.

For the purpose of assessment within this report the legislation as it currently stands has been considered. However this appraisal may need to be re-assessed should there be changes in the Statutory Guidance.

4.1.2 Assessment Framework

The tiered approach to assessing risks from land contamination is set out in the DEFRA and Environment Agency publication "Model Procedures for the Management of Land Contamination" CLR11.

Entec's approach to undertaking risk assessments is based on a tiered framework in accordance with CLR11, as outlined below:

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Table 4.1 Tiered Framework

Tier 1: Preliminary Risk Assessment	• Development of a conceptual model; • Preliminary Risk Assessment examining potential contaminants, pathways and receptors to identify the potential 'pollutant linkages'; • Identification of further risk assessment requirements.
Tier 2: Generic Quantitative Risk Assessment (GQRA)	• Screening of analytical results against generic assessment criteria (GAC) for soils and groundwater including Soil Guideline Values, Environmental Quality Standards, etc., to identify issues that require more detailed consideration; • Identification of further risk assessment or risk management requirements.
Tier 3: Detailed Quantitative Risk Assessment (DQRA)	• Refinement of site conceptual model which may require the collection of additional data; • Application of detailed quantitative risk assessment procedures in accordance with CLR Guidance to further assess potential pollutant linkages: - With respect to human receptors this may involve assessment of site specific exposure scenarios taking into account toxicological properties of substances to derive site specific assessment criteria (SSAC); - With respect to controlled water receptors this may involve simple analytical calculations of groundwater and/or surface water flow and contaminant attenuation to derive remedial target concentrations. • To undertake the assessment proprietary software such as RISC4, RBCA or RAM may be used; • Identification of further risk assessment or risk management requirements.

In general the application of increased tiers of analysis will result in less conservative remediation targets resulting in less costly remedial action. Therefore the cost for increased tiers of assessment is justified where remediation liabilities are potentially high and less costly solutions can be established as acceptable by detailed risk assessment.

This report is based upon a Tier 1 assessment. No quantitative data is available for this site and therefore only the qualitative contaminant→pathway→receptor assessment has been undertaken.

The contaminant→pathway→receptor relationship allows an assessment of potential environmental risk to be determined based on the nature of the source, the degree of exposure of a receptor to a source and the sensitivity of the receptor. On this basis an assessment is made of the environmental liabilities associated with the risk. These can be expressed, for example, in terms of: additional costs associated with site redevelopment or remedial measures; the potential for costs, fines or penalties imposed for breaches of environmental legislation or third party claims; and loss of land value.

The identified potential environmental liabilities have been evaluated with respect to the potential for:

- Impacts on current and future site users;
- Impacts on construction and maintenance workforce;
- Impacts on neighbouring site users;
- Impacts on site buildings and buried services;

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- Impacts on groundwater;
- Impacts on surface water bodies;
- Impacts on agricultural receptors; and
- Impacts on ecological receptors.

4.2 Summary of Potential Contamination

4.2.1 On-site Sources

Following the assessment of historical and current activities, there are several potentially contaminative activities which have been identified on the site, namely:

- Former rifle range;
- Historical Nissen hut camps;
- Historical infilled ground; and
- Areas of demolition/ disturbed ground.

4.2.2 Off-site Sources

Following the assessment of historical and current activities, the following potentially contaminative activities which have been identified off site which may have an impact on the site:

- Military use (St David's Barracks).

4.3 Receptors and Pathways

Potential receptors and pathways from identified sources to receptors are as follows:

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Table 4.2 Potential Receptors and Pathways

Receptor	Pathway
Site Visitors/Users (Commercial/Industrial)	Dermal contact, direct contact, ingestion, inhalation
Construction and Maintenance Workers	Dermal contact, direct contact, ingestion, inhalation
Future Site Users (Commercial/Industrial)	Dermal contact, direct contact, ingestion, inhalation
Future Site Users (Residential with Gardens/Public Open Space)*	Dermal contact, direct contact, ingestion, inhalation
Neighbouring Site Users	Dermal contact, direct contact, ingestion, inhalation
Groundwater (unproductive strata)	Leaching from soils, transport in groundwater, groundwater contamination
Surface Water (site drainage ditches, Langford Brook)	Leaching from soils, transport in groundwater, groundwater contamination, run-off
Ecological Receptors	Uptake, direct contact
Agricultural Receptors	Uptake, direct contact
Buildings and Buried Services (current and future)	Degradation (chemical attack), direct contact, vapour migration

* The risk assessment has considered a residential with gardens end use as being reasonably protective of public open space end use.

4.4 Environmental Risk Assessment

The preliminary risk assessment and conceptual model have identified a number of potential pollutant linkages (contaminant-pathway-receptor linkages) on the site. These are tabulated in Annex G. Each pollutant linkage has been qualitatively assessed using the following criteria:

i) Potential consequence of pollutant linkage;

ii) Likelihood of pollutant linkage; and

iii) Risk classification.

The 'Potential Consequence of Pollutant Linkage' gives an indication of the sensitivity of a given receptor to a particular source or contaminant of concern under consideration. It is a worst case classification and is based on full exposure via the particular linkage being examined.

'Likelihood of Pollutant Linkage' is an assessment of the probability of the selected source and receptor being linked by the identified pathway. This assessment is ranked based on site-specific conditions.

The 'Risk Classification' column is an overall assessment of the actual risk, which considers the likely effect on a given receptor, taking account of both of the previous rankings.

The criteria are set-out in Table 4.3.

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Table 4.3 Risk Assessment Criteria

Potential Consequence of Contaminant (Source)-Receptor Linkage	
Severe	Acute risks to human health. Short-term risk of pollution of sensitive water resource (e.g. major spillage into controlled waters). Impact on controlled waters e.g. large scale pollution or very high levels of contamination. Catastrophic damage to buildings or property (e.g. explosion causing building collapse). Ecological system effects – irreversible adverse changes to a protected location. Immediate risks.
Medium	Chronic risks to human health. Pollution of sensitive water resources (e.g. leaching of contaminants into controlled waters). Ecological system effects - substantial adverse changes to a protected location. Significant damage to buildings, structures and services (e.g. damage rendering a building unsafe to occupy, such as foundation damage).
Mild	Non-permanent health effects to human health. Pollution of non-sensitive water resources (e.g. pollution of non-classified groundwater). Damage to buildings, structures and services (e.g. damage rendering a building unsafe to occupy, such as foundation damage). Substantial damage to non-sensitive environments (unprotected ecosystems e.g. crops).
Negligible	Non-permanent health effects to human health (easily prevented by appropriate use of PPE). Minor pollution to non-sensitive water resources. Minor damage to non-sensitive environments (unprotected ecosystems e.g. crops). Easily repairable effects of damage to buildings, structures, services or the environment (e.g. discoloration of concrete, loss of plants in a landscaping scheme).
Likelihood of Contaminant (Source)-Receptor Linkage	
High likelihood	An event is very likely to occur in the short term, and is almost inevitable over the long term OR there is evidence at the receptor of harm or pollution.
Likely	It is probable than an event will occur. It is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	Circumstances are possible under which an event could occur. It is by no means certain that even over a longer period such an event would take place, and less likely in the short term.
Unlikely	It is improbable that an event would occur even in the very long term.
Potential Significance	
Very High Risk	Severe harm to a receptor may already be occurring OR a high likelihood that severe harm will arise to a receptor, unless immediate remedial works/mitigation measures are undertaken.
High Risk	Harm is likely to arise to a receptor, and is likely to be severe, unless appropriate remedial actions/mitigation measures are undertaken. Remedial works may be required in the short term, but likely to be required over the long term.
Moderate Risk	Possible that harm could arise to a receptor, but low likelihood that such harm would be severe. Harm is likely to be medium. Some remedial works may be required in the long term.
Low Risk	Possible that harm could arise to a receptor. Such harm would at worse normally be mild.
Negligible	Low likelihood that harm could arise to a receptor. Such harm unlikely to be any worse than mild.

The potential significance for each Contaminant-Receptor Linkage is calculated from the following matrix (Table 4.4):

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Table 4.4 Potential Significance of Contaminant-Receptor Linkage Matrix

Matrix		Likelihood			
		High Likelihood	**Likely**	**Low Likelihood**	**Unlikely**
Potential consequence	**Severe**	Very High	High	Moderate	Moderate/Low
	Medium	High	Moderate	Moderate/Low	Low
	Mild	Moderate	Moderate/Low	Low	Negligible
	Negligible	Moderate/Low	Low	Negligible	Negligible

Figure 3 shows the areas of potential contamination and Figure 4 shows the accompanying Conceptual Model for the site.

An environmental risk assessment for the site is included in Annex G, which comprises an analysis of potential pollutant linkages (source-pathway-receptor) on the site.

4.4.1 Current Site Users

The site currently consists primarily of open agricultural land and woodland with a car park, sports pitches and a limited number of buildings. The majority of the site is suitable for use by the current users. However, due to the long history and the type of activities undertaken at the site, there are some potential but generally localised sources have been identified and the risks identified for these sources are assessed as **low** to **moderate/low**. A **moderate/low** risk was generally assessed to be associated with the severe but generally unlikely consequence of exposure to unexploded ordnance in the former firing range.

4.4.2 Construction and Maintenance Workers

A pollutant linkage is created during redevelopment activities, as extensive ground disturbance or entry into confined spaces may take place. However, exposures may be controlled by working methods and suitable personal protective equipment (PPE). The exposure pathways include dermal contact, ingestion and inhalation.

It is assumed that ground work would be the subject of a site specific health and safety assessment and appropriate measures would be taken for any redevelopment work at the site. The risks to ground workers during redevelopment cover the range of **low** to **moderate**. The incorporation of appropriate Health and Safety protocols will likely reduce these risks.

The risks during demolition or intrusive work could be greater than this, depending on the potential extent and condition of localised asbestos and work close to any fuel leaks or unexploded ordnance.

4.4.3 Future Site Users (Residential, Commercial and Industrial)

The risk to future site users depends on the type of redevelopment. The future site use is currently not known. For the most sensitive potential end uses, namely residential with gardens the risk to site users in the areas of identified potential contamination is generally **moderate/low**

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but are covered by a breadth of risks in the range of **low** to **moderate,** with the **moderate** risks being assessed for source areas including unexploded ordnance at the former firing range.

For potential commercial/industrial end users, the risk is slightly lower, due to the probable placement of hard surfaces and consequent reduced contact with soil, which would reduce/ negate potential pathways for contaminant migration to identified, less sensitive receptors. The exposure frequency and duration to contaminants from outdoor air is also reduced for commercial/ industrial workers. The risks presented to future commercial/ industrial end users have generally been assessed in the range of **low** to **moderate/low**.

4.4.4 Neighbouring Site Users

The site is bounded in the main by DSDC Bicester D&E sites and St David's Barracks. Whilst there is some potential for contaminants to be present on site, the localised nature of much of the identified potential contamination and negligible permeability of the underlying strata means that it is less likely to migrate from the site, especially given the distances in most cases. Consequently, generally **moderate/ low** and **low** risks are considered to be posed to this receptor.

4.4.5 Groundwater

According to the Aquifer and Abstraction License Map provided in the EnviroInsight Report, the entire site is underlain by a Non-Aquifer (Negligibly Permeable), which appears to relate to the Oxford Clay Formation. Consequently, there is a generally **negligible** risk of contaminant migration to groundwater.

4.4.6 Surface Water (Site Drainage Ditches, Langford Brook)

The closest surface water feature to the site is the Langford Brook, which is located approximately 600 m north of Area 1. The Langford Brook discharges into the River Ray approximately 3 km south-west of the site. During the site walkover, a number of dry surface water drainage ditches were noted, principally adjacent to the circular road between areas 1 and 2, although another ditch was noted running northwards within agricultural land in the north of Area 1. It is likely that these ditches would ultimately discharge to the Langford Brook. The risks to surface water have therefore been assessed as generally **moderate/low**.

4.4.7 Ecological Systems

The EnviroInsight Report provides details of three Environmentally Sensitive Areas (ESAs) within the vicinity of the site. These three areas are all part of the same ESA, the Upper Thames Tributaries. The closest of these areas is 450 m south-west of the site boundary. In addition, the site falls within a Nitrate Vulnerable Zone (NVZ). Given the limited potential contamination identified on site and the dilution and attenuation of contaminants given the distance of most of the identified sources to potential receptors, the risk to ecological receptors and is assessed as generally **negligible** to **low**.

4.4.8 Agriculture (Arable and Livestock)

Much of the site is leased by DE to tenant farmers for use as agricultural land. These areas appear to be used for the grazing of livestock at the time of the site visit. However, given the negligible permeability of the underlying strata, risks to agricultural receptors have been

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assessed as **negligible** to **low**, although a **moderate/low** risk is assessed for unexploded ordnance within the former rifle range.

4.4.9 Buildings and Buried Services

Risks to buildings and buried services may occur via direct contact, or vapour migration from contaminants in soils accumulating and potentially exploding. The potential presence of localised contamination at the site generally gives rise to **low** to **negligible** risks.

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5. Conclusions

5.1 Potential Site Contamination

Following the assessment of historical and current activities, there are several potentially contaminative activities which have been identified both on and off site.

On site sources relate to the former firing range, historical Nissen hut camps and infilling along with demolition and disturbed ground. Off site sources include the adjacent St David's Barracks.

Most of the above identified sources are generally likely to be limited in their extent, with the possible exception of the former Nissen hut camps.

5.2 Environmental Risks

The risks to most human receptors, including current site users/ visitors, construction and maintenance workers, future residential/commercial/industrial users and neighbouring site users have been assessed in the range of **moderate** to **low**, with the **moderate** risks generally associated with future residential users and construction/ maintenance works from source areas including the former firing range and historical Nissen hut camps.

There is a generally **negligible** risk for contaminant migration to groundwater due to the generally negligible permeability strata beneath the site. It is likely that the on-site ditches will ultimately discharge to the Langford Brook, some 600 m north of Area 1. The risks to surface water have therefore been assessed as generally **moderate/low**.

Although a number of ecologically sensitive receptors have been identified in the vicinity of the site, given the limited potential contamination identified on site and the dilution and attenuation of contaminants given the distance of the identified sources to potential receptors, the risk to ecological receptors and vegetation is assessed as generally **negligible** to **low**. Similarly, the risks to agricultural receptors have been assessed as **negligible** to **low**, although a **moderate/low** risk is assessed for unexploded ordnance within the former rifle range.

The potential presence of localised contamination at the site generally gives rise to **low** to **negligible** risks to buildings and buried services.

5.3 Overall Land Quality and Suitability for Redevelopment

In general, it is considered that the land quality at the majority of the site is likely to be generally good, with isolated areas of potentially poor land quality associated with the principal areas used for the former firing range, historical Nissen hut camps and infilling along with demolition and disturbed ground. Therefore, the site is considered to be suitable for its present (predominantly agricultural) use given the current site configuration.

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Due to the uncertainty regarding the nature of the some of the areas, including the former firing range, historical Nissen hut camps and infilling along with demolition and disturbed ground, these potential land quality issues have carried forward into the risk assessment. In areas associated with these current and former potentially contaminative uses it is likely that land quality will have been impacted and redevelopment proposals, especially those related to a residential with gardens end use, will need to be tailored to the potential contamination present in these areas.

It is considered likely that construction/ redevelopment workers will come into direct contact with areas of potential contamination and all workers should be made aware of potential risks that exist at the site and take suitable measure to avoid or mitigate potential risk. Appropriate personal protective equipment (PPE) should be used and good working practices adhered to during any future investigation or redevelopment work at the site.

Development may involve the removal of the subsurface infrastructure and obstructions. Remediation may be required if following the removal of infrastructure the soils and waters are found to have been impacted by any contamination. Development may also require the removal or alteration of building foundations, building fabric, underground pipework/services and underground voids.

Development of the land is also likely to involve the removal of buildings present on site, some of which are known to contain asbestos within the building fabric. Disposal of all asbestos containing material would need to be carried out by a specialist contractor.

Finally, it should be noted that the high sulphate concentrations present within the Oxford Clay present beneath the site are likely to be detrimental to concrete foundations. Therefore, any new foundations will likely require construction with a Sulphate Resistant Portland Cement.

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Figures

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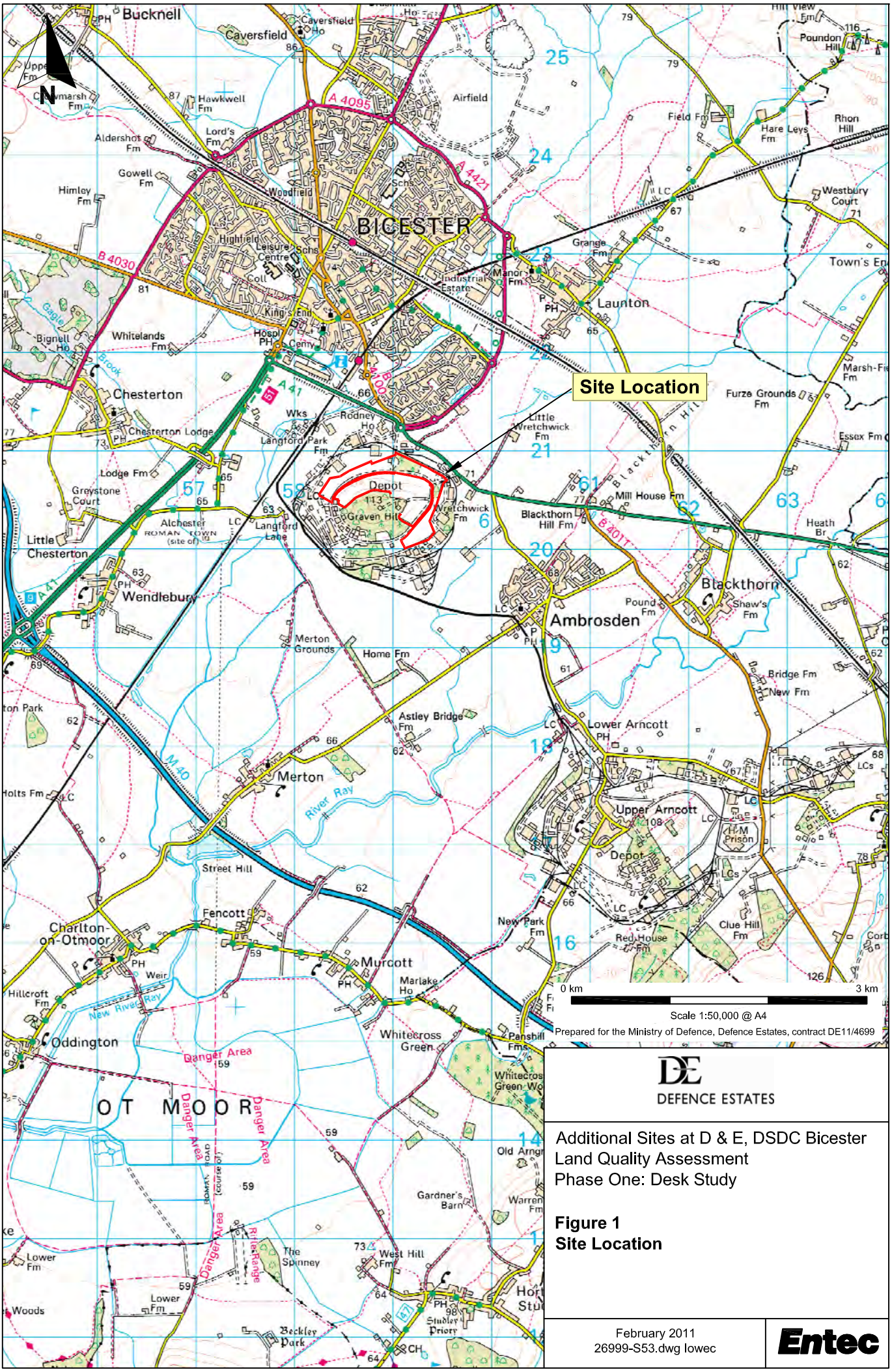

DEFENCE ESTATES

Additional Sites at D & E, DSDC Bicester
Land Quality Assessment
Phase One: Desk Study

Figure 1
Site Location

February 2011
26999-S53.dwg Iowec

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Key

- Additional Area 1 (25.5 ha)
- Additional Area 2 (23.6 ha)
- D and E site boundary
- D14 — Building numbers
- EWS — Emergency water supply

0 m — 400 m

Scale 1:8000 @ A3

Prepared for the Ministry of Defence, Defence Estates, commission FTS3/PTSELM/03

DEFENCE ESTATES

Additional Sites at D & E, DSDC Bicester
Land Quality Assessment
Phase One: Desk Study

Figure 2
Site Layout

March 2011
26999-S54a.dwg lowec

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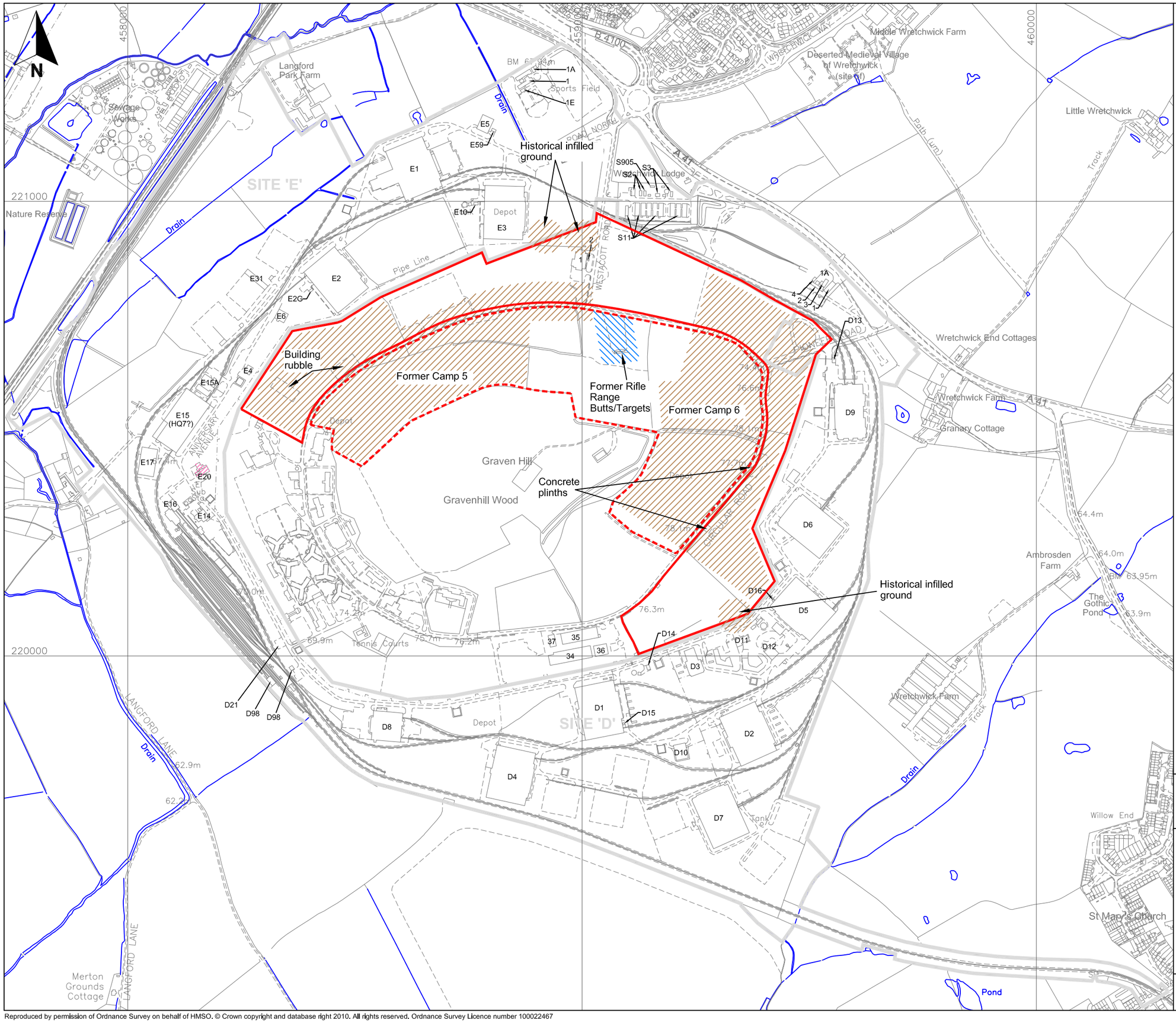

Key

- Additional Area 1 (25.5 ha)
- Additional Area 2 (23.6 ha)
- D and E site boundary
- Waste disposal/disturbed ground
- Explosive Ordnance/residues and Ordnance metals

Note:
Solid colour denotes potential source.
Coloured hatching or shading is used for areas of uncertainty over contaminant dispersal.

Site wide oil water interceptors not shown.

0 m — 400 m

Scale 1:8000 @ A3

Prepared for the Ministry of Defence, Defence Estates, commission FTS3/PTSELM/03

DEFENCE ESTATES

Additional Sites at D & E, DSDC Bicester
Land Quality Assessment
Phase One: Desk Study

Figure 3
Areas of Potential Contamination

February 2011
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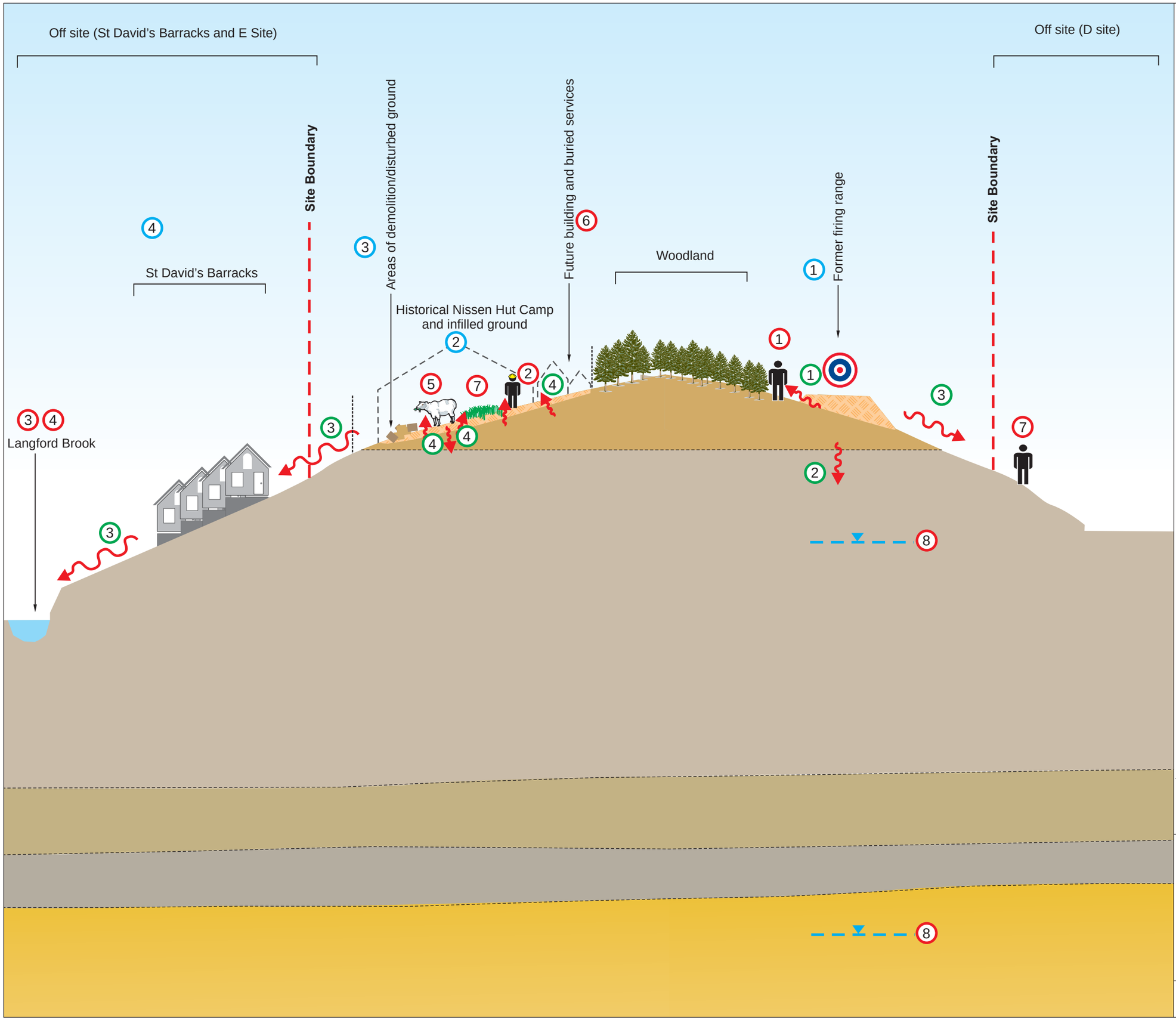

Key

- Made Ground
- Stewartby Member
- Peterborough Member (Oxford Clay Formation)
- Kellaways Sand (Interbedded Sandstone and Siltstone)
- Kellaways Clay (Mudstone)
- Cornbrash (Limestone)

Sources

1. Former Firing Range
2. Historical Nissen hut camps and infilled ground
3. Areas of demolition/disturbed ground
4. St Davids Barracks (off-site)

Pathways

1. Dermal contact, direct, contact, ingestion, inhalation
2. Leaching, transport, groundwater contamination
3. Leching, transport, groundwater contamination, run-off
4. Uptake direct contact

Receptors

1. Current/future site users
2. Construction/maintenence worker
3. Surface water
4. Ecological receptors
5. Agricultural receptors
6. Building and buried services
7. Neighbouring site users
8. Groundwater

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DEFENCE ESTATES

Additional Sites at D & E, DSDC Bicester
Land Quality Assessment
Phase One: Desk Study

Figure 4
Conceptual Model

March 2011
26999-S56a.cdr lowec

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