Soil Environment and Land Contamination

Chapter 9: Environmental Statement for application 2007/0823/P

9.0 SOIL ENVIRONMENT AND LAND CONTAMINATION

9.1 INTRODUCTION

This section of the ES considers the implications of ground conditions at the site, including the potential for the occurrence of ground contamination at the site, soil movement and construction effects. Measures are proposed to mitigate any potential impacts identified. Furthermore, the potential effects of any contamination which may be present on sensitive receptors both during the construction and operational stages are considered.

9.2 PLANNING AND CONTAMINATION AND UNSTABLE LAND

9.2.1 Legislation

Current legislation on contaminated land is principally contained within Part IIA of the Environmental Protection Act 1990, which was retrospectively inserted by Section 57 of the Environment Act 1995. This legislation came into effect on 1 April 2000 when the government issued its Circular 02/2000, dated 20th March 2000. Under this 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 that:*

a) significant harm is being caused or there is a significant possibility of such harm being caused; or

b) pollution of controlled waters is being, or is likely to be, caused.'

'Significant harm' is defined in the guidance on risk-based criteria and must be the result of 'pollutant linkage', which can be assessed using a qualitative risk assessment that addresses the identification of:

- *potential sources of contamination;*
- *sensitive receptors; and*
- *migration pathways linking the source to the receptor.*

All three aspects must be present for a significant pollutant linkage to exist. The presence of contamination in itself does not necessarily indicate a need for remedial action.

9.2.2 National Planning Policy

PPS 23 deals with planning and pollution control, with Section 4 dealing specifically with contaminated land. Annex 2 of PPS 23 provides guidance on the need to take into account the environmental consequences of contaminated land in drawing up development plans and in determining planning applications.

9.2.3 Regional Planning Policy

The Mayor's London Plan includes policy 4A.16 on *"Bringing contaminated land into beneficial use."* Although the Site has not been identified as contaminated, the London Plan has been considered in this section of the ES.

9.2.4 Local Policy

<u>LBC's Adopted Unitary Development Plan (2006)</u>
In order to bring land back into beneficial use, it is important that hazards are removed or minimised. Land is an important resource in a densely built up borough and hazards that potentially make development unsafe or unhealthy have to be identified and dealt with. Relevant policy includes:

POLICY SD10 - Hazards

A - Hazardous substances

The Council will not grant planning permission for the siting of hazardous substances, or for developments in close proximity to sites used to store hazardous substances, unless it considers that there will be no harm to the environment, or to the health, safety and well-being of local residents, workers and visitors to the Borough.

B - Contaminated land and uses

The Council will only grant permission for development on sites that it knows or suspects to be contaminated if the applicant has investigated the hazards and proposed remedial measures to the Council's satisfaction. Where a development includes any potentially contaminating uses, the Council will expect proposals to be submitted for preventing future contamination and may impose conditions to that effect.

C - Unstable land

The Council will only grant planning permission for development in locations where it considers there is geological instability if it can be satisfied that any actual or potential instability can be overcome and that there is no risk to adjoining land and local amenities.

9.3 APPROACH AND METHODOLOGY

9.3.1 Baseline Data

The baseline information used for this section of the ES has been drawn from the following sources:

- a review of historical maps to identify former potentially contaminating land uses;
- London Borough of Camden (LBC) Adopted UDP;
- Arup, '*Osnaburgh Street Preliminary Geotechnical desk Study*", October 2000 (Appendix G);
- Yolles Partnerships Ltd, "*Regents Place Geotechnical Desk Study Report: Version 1*", June 2005 (Appendix H); and
- Yolles Partnerships Ltd, "*Regents Place Basement Loading Bay, Site Investigation Trial Pits*", May 2004 (Appendix H).

9.3.2 Identification of Impacts

The main effects on soil resources resulting from both the construction and operational phase of the development are:

- the impact of the construction of the development on contaminated land, such as opening up new linkages. This may include exposing contaminated soil, contaminated dust, contaminated run off and creating pathways to ground water resources / receptors.
- the impact of contamination on the development, including the risks to users, building materials, landscaping etc.
- the effects of the construction of the development on the foundations of buildings adjacent to the site.

The impacts of construction on contaminated land are usually mitigated by the approach to and precautions taken during construction. Appropriate design measures incorporated in the development (slab, gas venting, clean foundations etc) can mitigate the impact of contamination on the development.

Usually, the fact of the development is a major element in mitigating the environmental effects of contaminated land, which would usually continue were it not for the development. However, there may always be residual impacts post remediation. These have been addressed below.

9.4 BASELINE CONDITIONS

9.4.1 Introduction

The previous uses of the site and surrounding areas, and the nature of soil conditions have an important bearing on the potential for contamination. Details of the history of the site and surrounding area have been drawn from historical maps and records and a detailed desk based appraisal of the archaeological potential of the site (see Section 9.4.2 for a brief overview). Section 9.4.3 gives a summary of the observations made from the site geological and hydrological conditions that may be relevant to contamination risk in terms of the presence of sensitive groundwater resources, which may also act as pathways for contamination migration. Potentially sensitive receptors to any contamination present have also been identified.

9.4.2 The Potential Contamination from Historical Uses

The previous uses of the site have an important bearing on the potential for contamination. Details of the history of the site and surrounding area have been drawn from a review of historical maps dating from 1591 to the present day, carried out as part the archaeological assessment undertaken by MoLAS (refer to Section 11.5 for further detail on the historical use of the site).

Historical maps indicate the site was mainly undeveloped and was used largely for farming land, with some quarrying until the mid 18th century (see Rocque's Map, Section 11.5, Figure 11.1).

Early 1800s residential buildings were developed across the site, with the possibility of the site being exploited for brickearth and London Clay. In the late 1800s, the Holy Trinity Church was constructed on the corner of Osnaburgh Street and Euston Road, with Portland Road Station constructed on the opposite corner. The site and surrounds consisted of mainly mixed residential and commercial uses throughout the 1800's and early 1900's.

The earliest map examined, by Horwood in 1813 (see Section 4.5, Figure 4.3), shows the site to be built-up, but it is not possible to infer the nature of the area and the specific land uses from the map. In 1870 a number of light industries were located in the area, including a cotton mill in the centre of the site, and a brewery and foundry within 500m north and south east of the site respectively.

By 1953, the Ordnance Survey Plan (Figure 9.1) indicates that a few small businesses had been established within the area of the site, including a garage (at the location of the Cotton Mill) and an upholstery and joinery works. The surrounding area appears to be largely residential. Some of the small residential buildings had been aggregated to form larger buildings for a furniture works, printing works and timber yard to the north of the site. It is not possible to infer the use of all larger buildings at this time.

The Ordnance Survey Plan of 1969 (Figure 9.2) showed the area of the site to have been completely transformed. All the existing buildings had been demolished and to the south, Euston Tower had been constructed.

By 1977 the OS map (Figure 9.3) showed that additional buildings had been constructed in the northern part of the site, including Beatty House and the Polytechnic of Central London Language School, which later became known as the University of Westminster. No changes have occurred on site since this time.

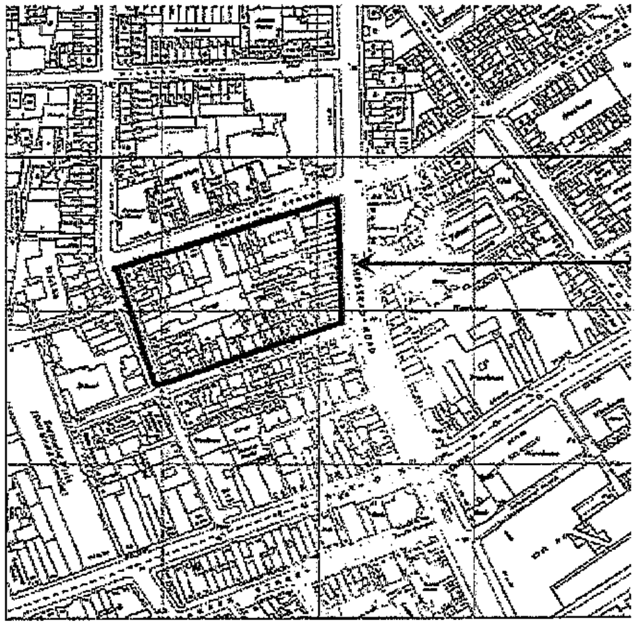

Figure 9.1: OS Map 1953

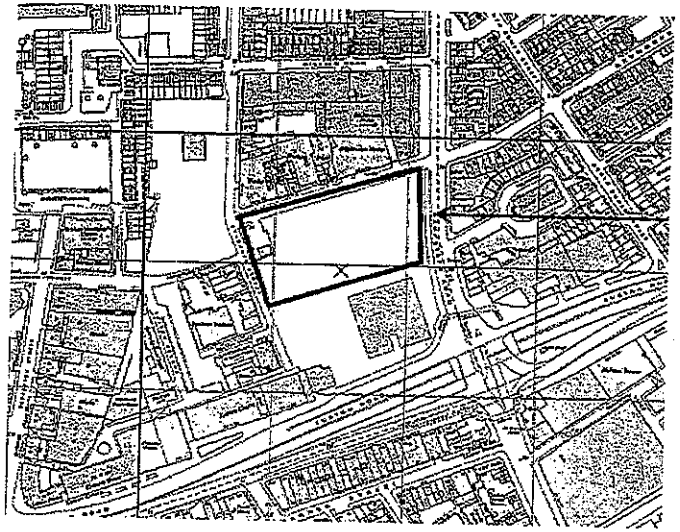

Figure 9.2: OS Map 1969

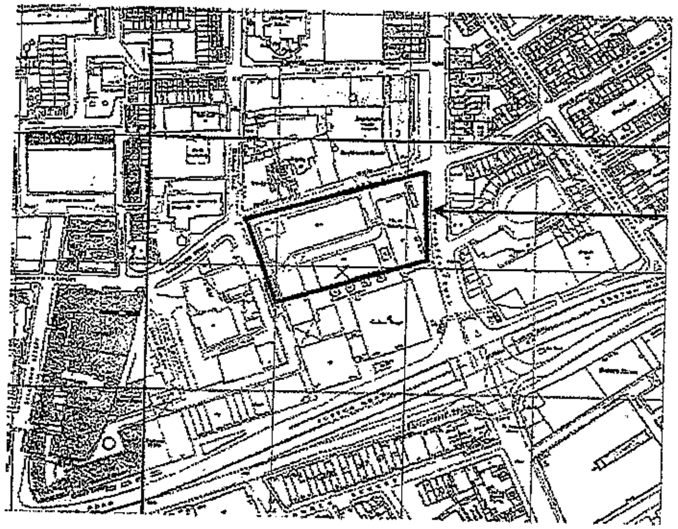

Figure 9.3: OS Map 1977

9.4.3 Geology, Hydrology and Hydrogeology of the Site

The geology of this part of London is well understood. London occupies part of the Thames Basin, a broad syncline of chalk filled in the centre with Tertiary sands and clays. In most of London, this Tertiary series of bedrock consists of London Clay. Above the bedrock lies the Quaternary fluvial deposits of the River Thames, arranged in gravel terraces. These terraces represent the remains of former floodplains of the river.

Geological Map Sheet 256, North London, (Solid & Drift) scale 1:50,000, shows the geological sequence underlying the site to be Lynch Hill Gravels (Terrace Gravels), underlain by London Clay, Lambeth Group deposits (Woolwich and Reading Beds), Thanet Sand and Chalk.

A site investigation has been undertaken by Arup (2000) on adjacent land; this included a 12 borehole investigation prior to the Regent's Place / Triton Square development, adjacent to the western site boundary of the site. Furthermore, Geotechnical and Environmental Associates (GEA) excavated two trial pits within the area of the proposed loading bay in May 2004. The location of the boreholes and trial pits is indicated in Figure 9.4. Table 9.1 below illustrates the geological sequence of strata at the Regent's Place / Triton Square site.

The two trial pits within the area of the proposed loading basement at the NEQ site (TP1 and TP2, see Figure 9.4) and located in the current basement car park, encountered clay at 22.4 mOD (absent depth below ground level), a shallower depth than anticipated from records of boreholes elsewhere at Regent's Place. The clay exposed was firm and stiff and underlain by sand and gravel.

Water was encountered at the top surface of the clay at TP1 and ingress to the excavations was minimal; therefore it was determined that it was probable that the water recorded in previous boreholes (see Figure 9.1) was a result of pools held in depressions in the clay. The findings of the May 2004 site investigation concluded that there are no significant water flows across the site.

The underlying gravels are designated as a minor aquifer by the EA and may potentially be in hydraulic continuity with surface water courses in the surrounding area. The London Clay is a non aquifer and effectively isolates shallow groundwater within the gravels from the deeper major aquifer. There is only one water abstraction within 1km of the site, located approximately 1000m south of the site (TQ 29100 81400). The water is used for industrial, commercial and public services and is extracted from the Thames groundwater.

The site does not lie within a groundwater Source Protection Zone (SPZ) and the nearest natural body of surface water to the site is Regent's Canal, which is located approximately 1.5km north of the site, and the Thames Estuary, which is located approximately 2.7km to the south.

The generated waste and surface water flows would be discharged into the adjacent existing Thames Water Authority (TWA) sewerage infrastructure

TABLE 9.1 ARUPS GEOTECHNIC ANTICIPATED GEOLOGY SUMMARY

Stratum	Description	Top of Stratum (mOD)	Thickness (m)
Fill/Made Ground	Demolition and buildings waste.	Approx. +28	0.5 to 4.3
Lynch Hill Gravels	Medium to coarse orange-brown sand and fine to medium gravel.	+26.2 to +22.4	0.9 to 5.5
London Clay	Firm, becoming stiff to very stiff, dark greyish brown clay; partings of sand on fissures: basal beds becoming very sandy or a clayey sand.	+22.8 to +20.7	20.5 to 30.4
Lambeth Group (formerly known as Woolwich and Reading Beds)	Very Stiff mottled Clay (Woolwich and Reading Clays) becoming hard and very sandy clay (Woolwich and Reading Sands). Basal layer of rounded sandy gravel.	+.02 to -7.6	8.5 to 17.4
Thanet Sands	Very dense light greyish brown sand with a thin basal layer of very dense gravel.	13.5 to 18.5	4.4 to 5.1
Chalk	Recovered as gravel sized fragments of very weak to very strong Chalk.	-19.9 to -23.6	0.5m Proven

9.4.4 Underground Constraints

London Underground

London Underground Ltd (LUL)'s Northern Line tunnels run along Hampstead Road, approximately 25 metres below the current ground level, before veering east towards Euston Station, with the result that they could be within around 10m from the extent of the site. LUL's tunnel locations are indicated in Figure 9.5.

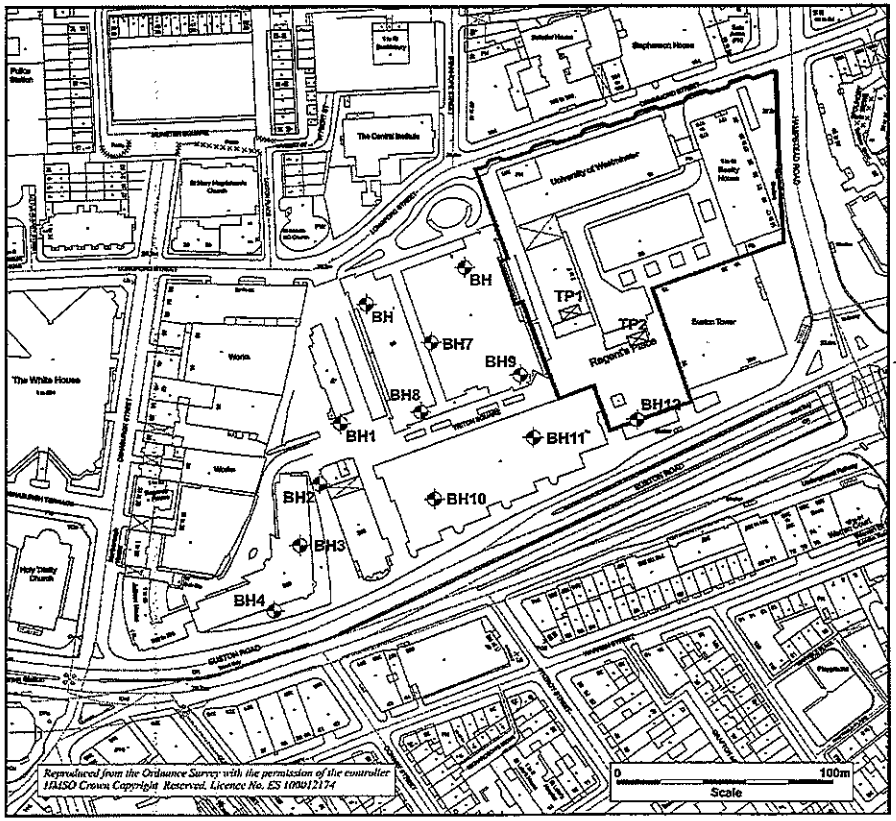

Figure 9.4: Location of Boreholes and Trial Pitts at the Regent's

Before any work starts on site LUL engineers will need full details of the proposals, including the proposed foundations and loadings, so that the safety of the railway can be assured. The construction programme would take into consideration the special requirements of LUL approvals.

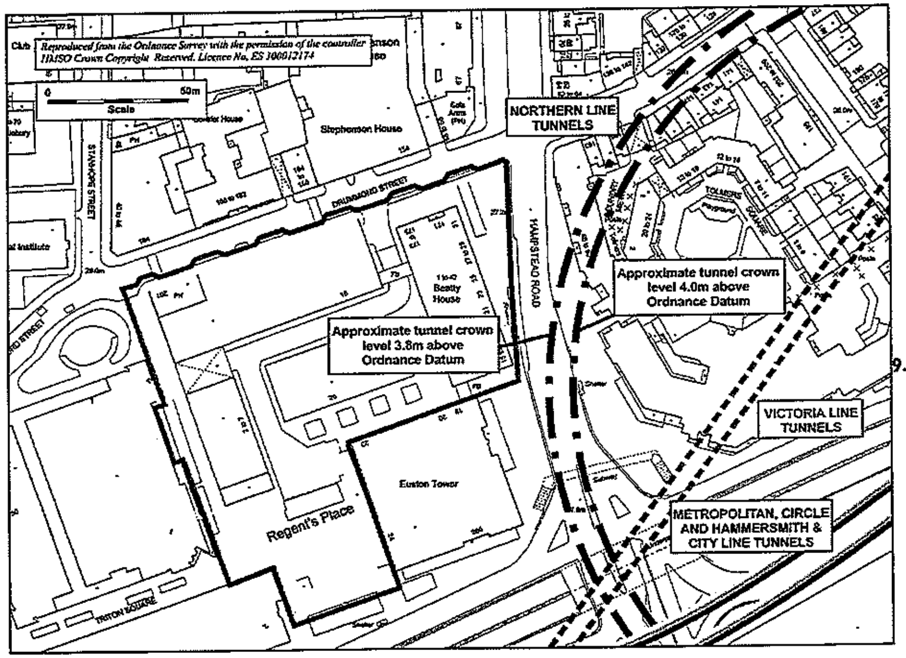

Figure 9.5: LUL Tunnel Locations

<u>Unexploded Ordnance (UXO)</u>

There is a risk in London of UXO occurring on sites being redeveloped, due to the city being bombed during World War 2, and to a lesser degree World War 1. However, the construction of the basements for the buildings currently occupying the site is likely to have removed the zone of soil with potential for containing unexploded ordnance. It can therefore be concluded that the risk of unexploded ordnance being present at the site is low.

9.4.5 Potential Sensitive Receptors

Sensitive receptors identified as potentially at risk from any ground contamination present onsite include:

- Site workers, in particualr contractors undertaking work that may bring them into contact with soil (see Section 9.5.2);
- Future site occupants;
- Groundwater resources;
- Adjacent Property and Occupants;
- Services and Infrastructure; and
- Ecological Receptors

9.5 RISK ASSESSMENT OF SOIL AND GROUNDWATER CONTAMINATION

With respect to contaminated land, the guidance classifies contaminated land as land where there is a 'significant pollutant linkage' (as discussed earlier in Section 9.2.3). Environmental risk assessment provides a framework for evaluating the hazards or harm that might arise from these linkages. At a reconnaissance level it comprises two steps: hazard identification and initial risk estimation. Tables 9.2 and 9.3 identify the potential sources of contamination have been identified in the desk based assessment both on and off-site.

TABLE 9.2 HISTORICAL INDUSTRIAL LAND WITHIN THE REDLINE

Land Use	Date of Mapping	Potential Contaminants
Cotton Mil	1870	Metals, Hydrocarbons, solvents, asbestos
Garage	1953	Hydrocarbons, solvents, metals, asbestos
Upholstery and Joinery works	1953	VOCs and SVOCs (associated with paints, varnished, thinners and solvents), asbestos, hydrocarbons

TABLE 9.3 HISTORICAL INDUSTRIAL LAND USE IN CLOSE PROXIMITY TO THE SITE (Within 400 m)

Distance : Direction From Site*	Date of Mapping	Land Use
20m N	1953	Furniture works, printing works and timber yard
170 m SE	1894	Railways
190 m SE	1940	Electricity Railway Station
220 m SW	1894	Railways
290 m S	1985-2001	Tanks
300 m S	1985-2001	Tanks
300 m E	1894	Station
330 m SW	1873-1894	Station

The excavation of the basements of the existing buildings constructed in the 1960's, 1970's and early 1980's would have removed any potentially contaminated material within the basement areas on site. Although there still remain areas of relatively undisturbed land on the development site below basement level, which could potentially be contaminated, the external perimeter of the existing basement defines the extent of the development footprint.

The construction of the proposed basements would involve further excavation 3.5m below the level of the existing basements in some areas. This would remove a significant volume of potentially contaminated material that may still be present below the level of the existing basement. Limited information available from trial pits excavated on-site indicates the presence of sand and gravel overlying clay beneath the site.

If contaminated material is found to be present on the site, appropriate safe handling practices, including the disposal of contaminated materials will be implemented. The disposal of contaminated materials would be in accordance with Duty of Care Regulations, the Landfill Regulations (2004) and the new Hazardous Waste Regulations (2005).

Based on the above, the risks to sensitive receptors identified in section 9.4.5 have been assessed and appropriate mitigation identified where necessary, as follows:

Site workers:

Contamination (if present) could represent a potential hazard to ground workers through contact, inhalation or the ingestion of contaminated material. Appropriate safe systems of works and personal protective equipment should be adopted when contractors undertake work that may bring them into contact with soil (see Section 9.5.2).

Future site occupants:

The end use of the of the proposed site will be predominantly office accommodation and residential units, with a small proportion of retail. Office and retail are not end uses that are considered to be particularly sensitive to contamination given that opportunities for occupants to come into contact with contaminated materials on the site (which will be entirely hard surfaced) will be negligible.

The proposed residential accommodation would be much more sensitive to potential contamination, as residents on the site are likely to have longer exposure to any contaminants and the risk would therefore be slightly higher. However, the residential properties would not have private gardens at ground level and the site will be entirely hard surfaced with no potential exposure pathways between residents and contaminants present, therefore the risk of potential contamination is significantly reduced.

Groundwater resources:

The site is located in a moderate-to-low sensitivity setting with respect to groundwater resources. The London Clay will act as an impermeable barrier to any potential contamination, protecting the sensitive major aquifer within the underlying chalk. There remains a possibility that contamination may reach the minor aquifer within the river terrace gravels in the shallower strata, however the information reviewed in the course of this assessment indicates that the potential for presence of significant contamination is low.

Adjacent Property and Occupants:

All adjacent properties are in similar commercial and residential uses, with no significant areas of unsurfaced ground. Although potential pathways to off-site occupants have been identified in the permeable shallow river gravels strata, there is limited potential for contamination at the site and the associated risks are therefore considered negligible.

Services and Infrastructure

Some contaminants have potential to damage building materials (i.e. hydrocarbons may cause britalisation of plastic pipes, phenols may penetrate plastic pipes and taint water supplies and sulphates compounds may damage concrete). Limited potential for contamination has been identified on the proposed site. No significant potential risks associated with contaminants with potential to impact on services and infrastructure has been identified.

Ecological Receptors:

There are no significant ecological receptors on or surrounding the site (see Section 8.0)

Prior to the commencement of construction, the possible risks arising during construction would be established, by means of a site specific (qualitative) risk assessment to ensure that the construction of the development is undertaken without risk to site users, water resources, or to the environment in general. Construction activities will be managed in accordance with the guidance provided in a Construction Environmental Management Plan (see Section 15.0 for more detail).

9.6 CONSTRUCTION IMPACTS AND MITIGATION

9.6.1 Construction Impacts

The potential impacts during construction are as follows;

- Impacts of the development on contaminated land; and
- Impacts of contaminated land on the development.

In the event that contamination is present onsite, there is potential for construction activities to create new pathways between the sources of contamination and sensitive receptors, thereby creating complete pollutant linkages which do not currently exist. A key example of how this may occur is in the event of piling through contaminated material and the pile creating a pathway through which any contamination present in shallow strata may migrate to deeper strata.

Any contamination present may also have direct impacts on the development proposed, in particular on services, building materials and infrastructure as noted in section 9.5. It is considered unlikely that such contaminates are present onsite, based on past uses and the observed nature of soils onsite in previous geotechnical site investigations. In addition the potential for exposure of site workers to contaminants during construction workers must be considered and appropriate management measures put in place to mitigate any associated risks to worker health and safety, as discussed in section 9.6.2.

In addition, the extent of the proposed development is defined by the existing basements, which have been previously excavated, which are likely to have removed the majority of any potentially contaminative material present. Impacts associated with any contaminated material encountered during the redevelopment work proposed would relate principally to:

- identification of appropriate disposal methods for excavated soils to be removed from the site;
- the potential effects of deep piles on groundwater (see Section 10.0, Water Resources);
- the safety of the LUL tunnels;
- health and safety requirements of the site workforce; and
- requirements for any special construction methods to deal with any contaminated soil conditions should they be identified (e.g. use of sulphate resistant concrete, piling or grouting of ground).

Construction activities will be managed in accordance with the guidance provided in the Construction Environmental Management Plan (CEMP) which will be prepared for the site (see Section 14.0).

The findings of the May 2004 site investigation concluded that there are no significant water flows across the site and that the volume of water likely to be encountered during the proposed basement excavation could be handled by local sump pumps.

The development, as defined in the guidance and stated elsewhere, is a 'moderately sensitive use' in terms of ground contamination, as part of the development would be for residential dwellings. However, there would be no private gardens at ground level, and any contamination resulting from historical uses will have already been excavated and removed from the site during the construction of the existing basements. Thus, the likelihood of a significant pathway linking contamination and potential receptors has previously been reduced.

Provisions would be made for the appropriate disposal of any contaminated material found on the site. Disposal of contaminated materials will be in accordance with the requirements of the Landfill Directive (2004) and the new Hazardous Waste Regulations (2005).

9.6.2 Construction and Environmental Management

The conditions of the site would be made appropriate for the development. The measures taken to achieve this would be agreed with the relevant authorities. During construction, any effluent from de-watering would be subject to testing prior to disposal to the public sewer in accordance with the requisite consents. Mitigation measures to protect groundwater and soil quality are set out in Section 10.5, and these would protect soil quality during the construction phase.

The development would include substantial floor slabs for both proposed buildings on the site, basement walls and hardcover over the whole site. As a result, potential contaminant pathways between the remaining sources and receptors would be removed. It is possible that liquid contaminants could migrate through the basement wall at a very low rate of ingress. However, water and liquids penetrating the outer wall would be removed *via* drainage systems.

The most significant source of risk to human health would be to construction workers. These potential risks could be controlled and mitigated by health and safety precautions during the works. These precautions should be established on the basis of a full Control of Substances Hazardous to Health (CoSHH) assessment but are likely to include:

- the use of protective clothing and equipment;
- careful control of dust generation during the works;
- careful control of waste arising to prevent uncontrolled release of contaminants; and,
- provision of health and safety training, guidance notes and signs.

Appropriate personal protective equipment (PPE) and careful control of dust generation would restrict pathways such that exposure would be reduced. Consequently, the health risks to construction workers, site visitors and the public would be low.

There may be a pollutant linkage between the potentially contaminated ground and the materials used in the construction of the basement walls and services. Building materials normally identified as being at risk on contaminated sites are concrete, plastic and metals. The risk can be controlled by the specification of suitably resistant materials or adequate protective measures. All services coming into the site should be laid in clean backfill or completely isolated from the surrounding ground.

9.7 SETTLEMENT PREVENTION AND MONITORING

9.7.1 Foundation Options

Given the size of the proposed buildings, it is likely that pile foundations would be required to limit total settlement of the taller buildings. The commercial building would be founded on 2000mm thick pile caps sitting on 250mm diameter bored piles, ranging from 15m to 25m with the longest pile reaching 25m, reaching into the London Clay. The pile caps would be connected with 350mm concrete slab that is capable of resisting any potential underground water pressure, as well as the potential live loads.

The residential buildings foundations would be a continuous raft, 2000mm deep under the high rise building and 1800mm thick elsewhere. The raft would sit on 1500mm bored piles, which have an average length of 20m.

It would appear that the existing buildings on the site are on spread foundations; therefore new piling would not be obstructed by existing piles. The foundations of both buildings would be separated from the existing remaining foundations by an expansion joint that would run east-west of the south end of the new development and the north end of the existing remaining building.

Towards the base of the London Clay, the basal beds tend to be a sandy clay or clayey sand. Depending on the groundwater regime, it may be advisable to avoid terminating the piles in this material or close to the London Clay / Lambeth Group interface. As discussed above, there is the possibility of significant variation in the level of this interface; it may therefore be necessary to extend the piles into the Lambeth Group or Thanet Sand.

The new basement would be approximately 1.5m deeper than the existing. As a result, the depth of new pile caps and piled raft require approximately 3.5m of excavation to occur. With the excavation and demolition of the existing buildings, there is a potential that due to the unloading the clay would heave.

To compensate this, the basement slab would either be designed to withstand the heave pressure (the current design) or have cell core void formers below to accommodate the earth movements.

9.7.2 Piling Options

A significant amount of foundation works would be required to support the structural loads of the proposed buildings, particularly the tall residential structure to the north of the site, which would reach a height of 25 storeys.

The depth of the boreholes would be dictated by the foundation loading and proposed foundation solution. Cable percussive, or possibly rotary, boreholes to a depth of up to around 50m may be required. U100[1] samples should be obtained to assess the strength and compressibility properties of the London Clay and Lambeth Group; this should be backed up by in-situ SPT tests[2]. Similarly, SPT tests in, and laboratory tests on samples obtained from, the granular strata should provide information for retaining wall design.

The nature of the ground investigation can be better decided when the likely foundation solution is known. However, given the extent of the site, it is suggested that five boreholes spread over the footprint of the site should be considered. Standpipes installed in these boreholes would provide information on groundwater levels within the upper granular strata. Piezometers should be installed where water strikes are noted in granular facies within the Lambeth Group or within the Thanet Sand. This assumes that factual ground investigation information from the adjoining sites that form part of the Regent's Place developments are made available.

A combination of sheet and secant piling with internal propping would be used. The final selection would depend on the construction and condition of the existing surrounding basement walls, which are to be retained. An internal reinforced concrete lining wall would be constructed where sheet piling is installed. This sheet and secant piling would act as a mitigation measure to prevent ground movements. The settlement of the 450 to 750 mm diameter piles is anticipated to be in the order of 10mm.

Where sheet piling is installed adjacent to properties that are ground bearing, some vibration is likely to be experienced. To mitigate this, appropriate damping of the hammer would need to be provided, particularly where residential accommodation is located adjacent to the site. The hours of working would be restricted.

Further detailed site investigations would determine the relevant design parameters. The design and construction methods would be developed to also ensure that the ground movements for the adjacent buildings located within a 25 m zone around the development (the anticipated zone of influence, based on experience of other similar developments) are kept within acceptable limits. These limits would be established for each circumstance having due regard to the nature of construction and current condition, and taking into account guidelines and definitions given in the Building Research Establishment Digest 251. It is not expected that the construction work on the site would cause any detectable movement outside this zone.

During design, the monitoring criteria would be established so that in a timely manner the condition of the existing structures could be established prior to construction. During the works, a monitoring regime would be established, and the results would be reported to the project engineers. Following construction over a pre-determined period, of up to say 12 months following completion of the project, a further monitoring regime would be established. These procedures would be established through the structural engineers during design, and would be implemented during construction in conjunction with the Principal Contractor.

By implementing this level of control, any ground movements can be kept within acceptable limits, thereby minimising any potential effects on adjacent buildings.

9.8 OPERATIONAL EFFECTS AND POST DEVELOPMENT

The development would be used for a mix of residential, office and retail purposes with some hard standing and soft landscaping areas as public space. Therefore, as there would be no private open space at ground level (e.g. gardens associated with residential accommodation), no contamination impacts are anticipated and no mitigation is proposed, as there is considered to be a relatively low risk to users during the operational phase of the development.

[1] *U100:* This is a 450mm long, 100mm diameter undisturbed sample. The tube has a cutter at one end and the driving equipment at the other. Behind the cutter is a core catcher, incorporating 3 arms that go into the sample as it is withdrawn, to prevent the sample from falling out. Care should be taken to ensure that the cutting shoe is as clean and sharp as possible.

[2] *SPT test:* This is a dynamic test as described in BS1377 (Part 9) and is a measure of the density of the soil.

9.9 OVERALL SUMMARY AND CONCLUSIONS

Existing excavations will have removed a significant quantity of soil on site, including any contaminated soils which may be present. A detailed assessment of the potential for residual contamination would be undertaken prior to the finalisation of construction design to ensure the potential to create new pollutant linkages and to affect underground structures has been properly controlled.

Appropriate safe handling practices and disposal of contaminated materials would be in accordance with Duty of Care Regulations, the provisions which enact the Landfill Directive (2004) in the UK and in particular the Hazardous Waste Regulations (2005).

The development would be used for a mix of for residential, office and retail purposes, with some hard standing and soft landscaping areas as public space. As there would be no private open space at ground level (e.g. gardens associated with residential accommodation), no contamination impacts are anticipated.