A13.2 – Water Resources Baseline Report (Mott MacDonald)

Baseline Report – Water Resources

N133-BCR-MMD-00-Z-DC-N-0007-S0-0.1

August 2011

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Issue and revision record

Version	Date	Originator	Checker	Approver	Description
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0.1	August 2011				

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Content

1. Introduction

1.1 Background

Bank Station is a major underground hub with interconnecting tube lines (Northern, District & Circle, Central and Waterloo & City) and Docklands Light Rail services (DLR). The northern line platform capacity is severely restricted. With such high levels of underground interchange and demand for the northern line set to increase, Bank station capacity threshold is predicted to be reached in near future years.

London Underground (LU) has commissioned Mott MacDonald to design and construct improvements to the Northern Line platforms at Bank Station with the prime purpose of improving congestion relief and delivering step free access.

A new 10 metre diameter southbound platform tunnel will be constructed some 40m to the west of the existing platform tunnels in virgin ground. With the Southbound platform moved, there will also be a necessary realignment of the track to enable train entry into the platform. A new section of running tunnel must be constructed to accommodate the new realignment which will ultimately junction with the existing Southbound running tunnel to the north and south of the platform tunnel.

The newly constructed platform tunnel will greatly increase capacity by creating an adequately wide platform, a new central circulation area, new access to the triplication area and new access to the DLR. Step free access will be provided by lifts within a shaft located at 10 King William Street.

Work will be carried out under a Transport and Works Act Order (TWAO) with completion planned for 2021. It is intended that this initial study will highlight constraints and opportunities with regards to ecological resources, with a purpose of informing the feasibility, design and Environmental Impact Assessment (EIA) of the project.

1.2 Transport and Works Act process

As with any major transport scheme of this nature powers to construct and operate the scheme are being sought through an Order made under the Transport and Works Act (TWA), 1992.

An Order application is being prepared and, amongst other things, this requires the preparation of a draft Order, planning application documents and associated plans and drawings, a Book of Reference and (unless otherwise directed by the Secretary of State for Transport) an ES.

The TWA Order application will be submitted to the TWA Unit within the DfT in due course. The Secretary of State for Transport will normally determine the need for a Public Inquiry and put in place the arrangements for one to be held.

The Public Inquiry will examine the TWA Order application including its associated documentation following which the Planning Inspector leading the Inquiry will make recommendations to the Secretary of State.

1.3 The EIA process

At an early stage, it was recognised that an EIA should be conducted for the scheme in order to both comply with the requirements of the TWA Procedure Rules and also to demonstrate that environmental considerations have been fully taken into account in the scheme design.

EIA is a structured process to identify the potential impacts of a development proposal after mitigation and the likely residual effects that are predicted to be significant. These are then reported in the ES that is submitted with the TWA Order application.

A Scope and Methodology Report has been developed for scheme. As the name suggests, this sets out the technical scope of the EIA and the spatial and temporal scope of each environmental topic area. It also describes the overall approach to the EIA and the individual methodologies for each environmental discipline.

As part of the EIA process it is necessary to compile information on baseline environmental conditions in order that possible changes that can be attributable to the construction and operation of the proposed scheme can be predicted and assessed.

The purpose of the baseline reports for Bank Station Capacity Upgrade is to describe the current baseline conditions for each environmental discipline, given the information which is available at the current time. This is the baseline report for water resources.

The baseline reports will form part of the supporting documentation for the ES.

2. Legislative framework & policy guidance

2.1 General

This section provides an overview of the legislation relevant to water resources and flood risk. This is addressed from the perspective firstly of national requirements and Government guidance and policy, then in terms of the regional policies and guidance and the relevant requirements of the London Plan, and finally in terms of local polices and guidance promulgated by the City of London.

2.2 International Legislation/guidance

2.2.1 Water Framework Directive 2000/60/EC

The Water Framework Directive (WFD) sets out to protect and improve all European Union aquatic ecosystems and associated wetlands through safeguarding them against future deterioration and enhancing water quality. The WFD also aims to promote sustainable use of water resources and ensure progressive reduction of groundwater pollution. Member States must reach 'good' ecological and chemical status for all inland and coastal waters by 2015.

In the UK the WFD is implemented through a river basin scale approach; River Basin Districts have been set up, and each one of the districts will have a River Basin Management Plan. Water quality and flow standards are being devised by the UK's Technical Advisory Group (UKTAG) and meeting these standards is intended to ensure that surface waters and associated ecosystems meet the WFD requirement to achieve or maintain good ecological and chemical status. The WFD considers mitigation measures to reduce flood risk, but does not give any specific flood risk objectives. The WFD is transposed into national law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003.

2.2.2 Groundwater Daughter Directive 2006/118/EC

The Groundwater Daughter Directive set out the basis for groundwater protection from pollution in Europe. The Directive supersedes the Groundwater Directive (80/68/EEC) and will be repealed and superseded by the Water Framework Directive in 2013. The Directive restricts the discharge of hazardous substances to groundwater in order to protect aquifers. The classification of hazardous and non-hazardous substances replaces the previous definition of List I and List II substances, as defined by the Groundwater Directive. The Groundwater Daughter Directive sets out requirements for countries to establish boundaries around groundwater bodies, to identify trends of chemical substances in these groundwater bodies, and to establish criteria on which to assess good groundwater chemical status. The Groundwater Daughter Directive is implemented though the Environmental Permitting Regulations (EPR) 2010 in the UK.

2.2.3 Birds Directive 79/09/EEC

The Birds Directive describes obligations under the Bern Convention and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). One of the main provisions is the classification of Special Protection Areas (SPAs) for rare and vulnerable bird species listed in Annex I of the Directive.

2.2.4 Habitats Directive 92/43/EEC

The Habitats Directive describes the obligations of Member States under the Convention of European Wildlife and Natural Habitats (Bern Convention). Its measures include protecting and surveillance of habitats and species. The Directive requires the designation of Special Areas of Conservation (SAC), which together with SPAs form the Natura 2000 sites.

2.2.5 Floods Directive 2007/60/EC

The Floods Directive requires all European Union Member States to assess if all watercourses are at risk of flooding, to map the flood extent and assess the risk to assets and humans. The Member States will also have to provide adequate and coordinated measures to reduce this flood risk. The Floods Directive should be carried out in coordination with the WFD. Flood risk maps should be prepared by 2013 and a flood risk management plan focused on prevention, protection and preparedness

2.3 National planning guidance

2.3.1 Land Drainage Act, 1991

The Land Drainage Act 1991 provides the responsibilities given to Internal Drainage Boards (IDB), the Environment Agency and Local Authorities in relation to land drainage. The Local Authority is the operating authority for ordinary watercourses in locations where there is no IDB.

2.3.2 Water Resources Act, 1991

The Water Resources Act 1991 (WRA 1991) states the responsibilities and the powers of the Environment Agency with respect to river flood defences, fisheries, water abstractions, water quality and other duties.

The WRA 1991 Section 85 makes it an offence to knowingly pollute controlled waters, which comprise all groundwater and surface waters including ponds, streams and rivers. An agreement of the outfall design is required from the Environment Agency before the construction of drainage outfalls which discharge to infiltration ponds commences.

The WRA 1991 and the WRA 1991 (Amendment) (England and Wales) Regulations 2009 Section 93 provides for the establishment of water protection zones. This is implemented under the Environment Agency's Policy and Practice for the Protection of Groundwater through the definition of Source Protection Zones (SPZs). Within the SPZs the Environment Agency seeks to restrict certain potentially polluting activities, with the most onerous restrictions applied to the SPZ I.

In addition to SPZ, Water Protect Zones have been trialled by the Environment Agency, to further address the issues of diffuse water pollution and hydro-morphological damage. Within these areas the Environment Agency will have additional powers to ensure the protection of water.

2.3.3 Water Industry Act, 1991

The Water Industry Act 1991 controls the activities of the water company operating in each area. In the study area, the relevant water company is Thames Water. In undertaking these activities water companies

must conserve and enhance flora, fauna, geological and physiographical features of special interest, as well as protect buildings, sites or objects of archaeological, architectural or historic interest.

2.3.4 Environment Act, 1995

The Environment Act 1995 established the Environment Agency as an agency responsible for making provisions for the control of pollution, the conservation of natural resources and the conservation or enhancement of the natural environment. The Environment Agency is, as such, the regulatory authority for water resources. From a water resources perspective the Agency's duties include the conservation of the visual amenity, ecology and recreational value of inland and coastal waters. The Agency also has a duty for licensing discharges to watercourses. The Agency will achieve these duties through a variety of measures including the control of pollution to waters. The Environment Agency will be the main consultee for this project.

2.3.5 Water Act, 2003

The Water Act 2003 amends the Water Resources Act 1991 and the Water Industry Act 1991. The four broad aims of the Act are:

- the sustainable use of water resources;
- strengthening the voice of consumers;
- a measured increase in competition; and
- the promotion of water conservation.

The Act sets out the objectives of the regulation of the water industry and the function of the Consumer Council.

The Water Act also sets out new regulations on water abstractions and impounding, as well as providing connections between land drainage and flood defence. These measures aim to improve sustainability and conservation of water resources through changes to the licensing regime. The new regulations require that consent is obtained for any abstraction greater than 20 m^3/s per day. Abstractions for any purpose below this threshold do not need license. Secondly, the Act also requires that consent is sought for dewatering activities, which was previously not required. The Act also makes a distinction between permanent and temporary consents to abstract water. A temporary consent is valid for 40 days only. These regulations are currently in an intermediate stage of implementation.

2.3.6 Environmental Permitting (England and Wales) Regulations, 2010

The Environmental Permitting Regulations 2010 provide a standardised environmental permitting system to protect human health and the environment. The regulations replace the 2007 regulations, the system of consenting of water discharges of the Water Resources Act 1991, the groundwater permitting system in the Groundwater Regulations 2009 and the system of radioactive substances in the Radioactive Substances Act 1993. As a result, the regulations integrate waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations and radioactive substances regulation. The regulations are due to be amended in 2011.

2.3.7 Flood and Water Management Act, 2010

The Flood and Water Management Act 2010 aims to create a simpler and more effective means of managing the risk of flood and coastal erosion, sustainability of water resources and protection against potential droughts. The Act gives the local authorities a lead role in the management of local flood risk, including surface water, groundwater and ordinary watercourses. The Environment Agency is given a strategic overview role for all flood risk.

Schedule 3 of the regulations encourages the use of sustainable drainage, in particular sustainable drainage systems (SuDS) as a part of developments and re-developments. The drainage systems will need to be approved against National Standards before construction commences and connections to sewers is allowed, if required. According to the Act, the local authorities are responsible for adopting and maintaining SuDS.

2.3.8 The Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order, 2006

This Order amends the Town and Country Planning Act to ensure that statutory consultation with the Environment Agency on flood risk is carried out prior to the granting of planning permission.

2.3.9 Planning Policy Statement 23: Planning and Pollution Control (PPS23), 2004

Planning Policy Statement 23: Planning and Pollution Control and its Annexes, set out recommendations for the assessment of developments, focusing on existing and potential pollution.

Appendix A of PPS 23 sets out the main planning and pollution control considerations during the planning application process. The issues that are relevant to this study are set out below:

- The potential sensitivity of groundwater and surface waters to the effects of pollution;
- The possible impact of potentially polluting developments (both direct and indirect) on land use, including effects on health, the natural environment or general amenity;
- The potential benefits that the development may bring, for example enhancement, restoration or creation of habitats;
- The need for compliance with statutory environmental quality standards, such as the Urban Waste Water Directive, 1991;
- The possible adverse effects on water quality and the impact of any discharge of effluent or leaches which may impact groundwater or surface water;
- The need to make suitable provision for the drainage of surface water; and
- The provision of sewage and sewage treatment and the provision of any existing sewage infrastructure.

2.3.10 Planning Policy Statement 25: Development and Flood Risk (PPS25), 2006

Planning Policy Statement 25: Development and Flood Risk sets out recommendations for assessing developments with regard to existing and potential flood risk. The policy aims to ensure that flood risk is taken into account at all stages in the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk.

An assessment of flood risk needs to be carried out to identify land at risk and the degree of risk of flooding from all major sources, including land and sea flooding. The risk is then managed through development

policies to avoid flood risk to people and property where possible, and manage any residual risk, taking into account the impacts of climate change. The benefits of the development must outweigh the risk from flooding and must be considered safe. The flood risk should also be reduced where possible, including the incorporation of SuDS, flood storage and defence measures.

2.3.11 Other guidance

Other non-statutory guidance is set out in the Environment Agency's "Policy and Practice for the Protection of Groundwater" and Pollution Prevention Guidelines (PPG).

2.4 Regional requirements

2.4.1 The London Plan 2011

Policy 5.12 Flood Risk Management: The Mayor will work with all relevant agencies including the Environment Agency to address current and future flood issues and minimise risks in a sustainable and cost effective way.

Development proposals must comply with the flood risk assessment and management requirements set out in PPS25 over the lifetime of the development and have regard to measures proposed in TE2100 and Catchment Flood Management Plans.

Policy 5.13 Sustainable Drainage: Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so and should aim to achieve greenfield run-off rates and ensure that surface water runoff is managed as close to its source as possible in line with the following drainage hierarchy.

The Mayor will work in partnership with appropriate agencies within London and adjoining Local Planning Authorities to protect and improve water quality and ensure that London has adequate and appropriate sewerage infrastructure.

Policy 5.15 Water use and supplies: The Mayor will work in partnership with appropriate agencies within London and adjoining regional and local planning authorities to protect and conserve water supplies and resources in order to secure London's needs in a sustainable manner

2.4.2 Water Matters: The Mayor's Draft Water Strategy, March 2007

A Draft Water Strategy for London was sent out for consultation in March 2007. The strategy aims to secure a fair share of water for Londoners and London's water-related environment, and to minimise the release of wastewater into the clean water environment. It further aims to reduce the threat to people and their property from flooding and to mitigate against its effects. In respect of flooding, the Mayor proposes a hierarchy. Firstly, types of development that are vulnerable to flooding should be avoided. Secondly,

vulnerability should be reduced through design and construction techniques by providing space for rivers. Finally, flood risk should be alleviated through flood defences.

2.5 Local requirements

2.5.1 The City of London Local Development Framework, 2011

Policy CS15 Sustainable development and climate change: The Policy requires developments to positively address water quality and flood risk, in particular in areas at risk of sewer flooding, as identified in the Strategic Flood Risk Assessment (SFRA).

Policy CS18 Flood Risk: The Policy aims to ensure that the City remains at low risk of flooding by:

- Minimising risk of flooding from rivers;
- Reducing risk of surface water flooding;
- Reducing surface water run-off;
- Ensure that flood defences offer the highest level of protection; and
- Reviewing and updating the SFRA every 5 years.

3. Methodology

3.1 Overview

These studies have been prepared to assist with planning requirements and/or to provide a review of baseline conditions for any future Environmental Impact Assessment (EIA) process, as may or may not be required.

3.1.1 Spatial scope

The baseline study focuses on the area within one kilometre of the site boundary of the existing site. Additionally, the study considers areas outside this study area, where these are of particular importance, such as designated sites which are hydraulically connected to water resources within the study area.

3.1.2 Temporal scope

The baseline study attempts to define the current state of the baseline. The study uses the most recent data that is available. Historic data is only used where it is considered that it represents the current conditions.

A brief assessment of how the baseline is expected to change up to the commencement of construction and operation is also provided.

3.1.3 Methodology guidance

The method for determining and appraising baseline conditions is based on that proposed in the Department for Transport's Transport Analysis Guidance (WebTAG), Unit 3.3.11 'The Water Environment Sub-Objective', considered as best practice guidance for EIAs.

The baseline for flood risk issues has been established in accordance with Planning Policy Statement 25: Development and Flood Risk. It aims to describe the potential risk of flooding to the site and the possible effect of the development on flood risk elsewhere.

3.1.4 Sources of data

The following data sources are used in the baseline study:

- topographic maps;
- aerial photos;
- solid geology and drift maps (BGS);
- Environment Agency website;
- Natural England Nature on the Map;
- Thames River Basin Management Plan (RBMP);
- Thames Corridor Catchment Abstraction Management Strategy (CAMS);
- City of London Strategic Flood Risk Assessment (SFRA);
- Geo-technical Desk Study;
- EC directives;
- Office of Public Sector Information (OPSI) website;

- Local Government Association website;
- Department of Environment, Food and Rural Affairs (DEFRA) website;
- government website on environmental legislation (NetRegs website);
- The London Plan; and
- City of London Local Development Framework.

3.1.5 Resources and Receptors

The water management and flood risk study focuses on the presence of the resources/receptors given in Table 3.1.

Table 3.1: Resources and receptors of the water environment

Resource/Receptor	Description
Surface water	Any controlled waters or other surface water features that may be affected by the proposed development. This includes licensed and protected rights to abstract or discharge to surface water.
Groundwater	The presence and quality of any aquifers, including any associated licensed and protected rights to abstract, or discharge to groundwater, as well as the contribution of groundwater to 'baseflow' to surface waters.
Floodplains	Land with pre-existing flooding potential. Key receptors are the development footprint itself, settlements downstream of the development and surface watercourses.
Landform and drainage patterns	Key receptors include any areas that may be affected by changes in the surface water flow regime on the site. This includes surrounding areas which may be subject to increased flooding due to an increase in overland flows from the site or from changes to flow patterns through the site.

3.2 Specialist consultation

Pre application consultation has been held with the Environment Agency in relation to potential impacts to water resources. A copy of their response is located in Appendix B.

The Environment Agency reviewed the information provided and did not consider the development problematic for either groundwater resources or hydrology as the shaft will case out the gravels and will not be extending into the underlying principle (chalk) aquifer and that there were no obvious surface water issues.

4. Baseline Conditions

The site is located on the northern side of the River Thames at approximately 14 m to 14.5 mAOD. The ground in the area slopes gently southwards towards the Thames, which is situated at approximately 5 mAOD [Ref 17].

The average annual rainfall is 583.6 mm at the closest weather station at Greenwich, approximately 6 km south east of the development site [Ref 5].

The site is currently occupied by a six storey office building which includes a two storey basement. To the south is an adjacent building with a basement. The other two sides of the triangular area are bordered by the public highways King William Street and Abchurch Lane. The site is therefore completely covered by hard surfacing.

4.1 Hydrology

4.1.1 Overview

The proposed development site is located approximately 300 m north of the River Thames, in the Thames River Basin District. As the name of the basin district suggests, the drainage network is dominated by the River Thames and its tributaries. The river meanders through London and discharges into the North Sea 58 km east of the proposed development site in via the Thames estuary.

The River Thames is a tidally influenced river, with tidal influence reaching as far upstream as far as Teddington [Ref 13].

The development site is located east of the buried River Walbrook, one of the so called Lost Rivers of London. The Lost Rivers of London is a term used for historic rivers, which have now been turned into subsurface sewers and form part of Thames Water's combined sewer system . The River Walbrook runs along the road 'Walbrook' towards the River Thames [Ref 9]. The river was completely covered by the late 1400s. Its role as a combined sewer is further described in Section 5.3.4.

No other surface water features have been identified within the study area.

4.2 Hydrogeology

4.2.1 Aquifers

An overview of the stratigraphy and the presence of aquifers at the site, with indicative thicknesses, at and around the development site is given in Table 4.1. The geology is described further in the geo-technical desk study [Ref 17].

Table 4.1: Site geology and hydrogeology

Time	Group	Formation	Aquifer type	Average Thickness (m)
Quaternary		Made Ground	Non-aquifer	2.5
		Alluvium	Secondary aquifer	1.2
		River Terrace Deposits (also known as Taplow Gravel Formation)	Secondary aquifer	6.0
Eocene		London Clay Formation	Non-aquifer	40.0
Palaeocene	Lambeth Group	Reading Formation	Non-aquifer	17.0
		Woolwich Formation	Non-aquifer	
		Upnor Formation	Secondary aquifer	
		Thanet Sand	Principal aquifer	9.0
Cretaceous	Chalk Group	Chalk	Principal aquifer	>

Source: BGS Lexicon of Rock Units [Ref 1], Geo-technical Desk Study [Ref 17]

The Chalk is the principal aquifer in the London and Thames Valley region [Ref 3]. The Chalk is usually hydraulically connected to the overlying sands of the Thanet Sands and sandier facies of the Upnor Formation and other lower Lambeth Group strata together these constitute the deep aquifer. The Chalk is confined by the London Clay and the clay beds of the Upper Lambeth Group.

The Chalk forms a synclinal basin underneath London. Groundwater collects at the higher ground in the north and south and flows through the Chalk towards the centre of the basin below London.

The River Terrace Deposits are a defined as a secondary aquifer in the region [Ref 3]. This shallow aquifer is unconfined; it is saturated at depth, and generally unsaturated near the surface, above the water table.

This shallow aquifer contains a perched water table, which is separated from the deep aquifer by the London Clay and upper Lambeth Group. These formations generally have low permeability and are therefore classed as non-aquifer or ‘aquitard’ [Ref 11]. Although there may be small amounts of groundwater present in occasional sandier layers or sand lenses, this groundwater can be considered isolated from the aquifers above and below the clay formation.

The groundwater vulnerability map of the site shows the shallow aquifer to be of high vulnerability [Ref 11]. Due to the less reliable soil information in urban areas, a worst case scenario is assumed and the soils are classed as having high leaching potential until proven otherwise.

4.2.2 Groundwater levels

4.2.2.1 Upper (secondary) aquifer

Groundwater has been encountered at approximately 10 metres below ground level (mbgl) at a borehole located at Swan Lane [Ref 17]. This suggests a water table at around 102 to 105 mATD

Water levels within the shallow aquifer are generally controlled by the balance between urban recharge from rainfall, soakaways, and pipeline leakage and outflows to natural and artificial drains. It is also likely that the water levels and local groundwater flow within the upper aquifer is locally related to the tidal fluctuations in the Thames. However the magnitude of tidal fluctuations is attenuated with distance from the river bank and the type of flood defences in place. A study of the shallow aquifer in the nearby Tyburn catchment, including review of watertable fluctuations was undertaken by CIRIA [Ref 18] and the general principles apply to the Walbrook catchment.

There may also be some lowering of groundwater levels along preferential flow paths in the backfill along the culverted River Walbrook, or sediments along the original course of the river.

4.2.2.2 Deep (principal) aquifer

The Environment Agency publishes an annual report with groundwater levels in the London Basin. Monitoring boreholes near the development area show groundwater levels at between 60 to 65 mATD in Jan 2010 [Ref 14]. The two closest boreholes are at Leith Ho in Gresham Street and St Agnes Well.

At present, the groundwater levels in the Chalk are controlled by the GARDIT (General Aquifer Research, Development and Investigation Team) strategy. GARDIT was developed to address the issue of rising groundwater levels. The objective of the strategy is “to control groundwater level in the Chalk aquifer under central London in order to maintain the integrity of underground structures and foundations in the London Clay”.

Historically, the Chalk groundwater levels in London were lowered by over abstraction. Following a reduction in abstractions in the mid 1960’s, groundwater levels recovered at a rate of up to a few metres per year. However, the 2010 Environment Agency report [Ref 14] shows levels fell by up to 5 m between January 2000 and January 2010.

4.2.3 Groundwater quality

No groundwater quality data for the shallow aquifer has been acquired for the baseline study. However, it has been reported in the Environmental Statement for Crossrail [Ref 19] that ‘The water of is very rarely of a quality suitable for potable supply and is therefore seldom abstracted. CIRIA (1993) reports on seven sample sites with high lead concentrations being common, electrical conductivities over 2000 µS/cm at two sites but less than 1000 µS/cm at only two sites”. The status of the shallow aquifer at Bank is expected to be similarly affected and non-potable as a result of urbanisation.

The Environment Agency has reported [Ref 19] on the qualitative status of groundwater in London , where the principal (Chalk) aquifer is confined. Their site ref PGWU1416 is close to Bank Station and is reported as being of type Na-SO_4-HCO_3. This suggests a degree of sodium and sulphate enrichment compared to most potable water wells iun the Chalk aquifer. The accompanying maps suggest the fluoride concentration is between 1.4 and 2 mg/l which is possibly too high for a potable water (MAC 1.5 mg/l).

4.2.4 Pathways between the shallow and deep aquifers

Although the water quality and water level data suggests there is insignificant hydraulic connection between the shallow and deep aquifers, there is potential for pathways to develop and thus allow indirect impacts on water quality in the deep aquifer.

The potential for a natural pathway arises because the London Clay formation is associated with local, deep drift filled hollows. These are thought to be glacial features which can be seen as depressions in the surface of the London Clay.

Hutchinson (1991) [Ref 20] agreed with Berry (1979) [Ref 21] that scour hollows would have been created in channels formed by river erosion at times when rivers exhibited higher energies due to glacial melt-water. However, he argues that this does not account for the depth of some of the depressions. Hutchinson suggests that the deep depressions encountered in Central London are actually groundwater discharge features formed in areas where the covering of London Clay is thinner (less than 35 metres thick) and unable to withstand artesian pressures emanating from groundwater present in the underlying strata. The forces required for the hydraulic uplift to have occurred may have resulted from a build-up of artesian water pressures generated by melt-water run-off into the aquifer during interstadial/interglacial warm periods. Springs formed, forcing themselves up from the aquifer through the frozen ground above in areas where resistance was lower and where the ground above had been removed by scouring. Hutchinson suggests that under the appropriate climatic and hydrogeological conditions, some of the depressions may have formed open-system pingos, generated from the water-bearing strata below the London Clay.

The geo-technical desk study has identified the presence of a depression in the area of the site, which may be a drift filled hollow. However, the presence of a fully penetrating pingo, even if unlikely, remains a possibility to be resolved by further site investigation or construction monitoring.

There are also breaks in the continuity of the London Clay and Lambeth Group strata where Chalk water supply boreholes have been constructed. There is an attendant generic risk that a pathway between the two aquifers could develop if the works result in collapse of such water wells. Boreholes constructed in the last 50 years or those now in use as licensed abstractions (see below) tend to have grouted steel casing as a liner and reasonable inforrnation as to their location. The location, construction and status of older boreholes, especially those associated with the 17th and 18th century in the area, are less well documented.

The preparation of the groundwater baseline study has identified 68 recorded water supply boreholes within 250 m of the development site using the “water well” filter within the BGS GeoIndex [Ref 1]. Details of these boreholes are given in Appendix 1. There is a remaining risk of unrecorded water supply boreholes or dug wells.

4.2.5 Abstractions

Seven water abstraction points have been identified within 250 m of the site [Ref 11]. These are shown in Table 4.2.

Table 4.2: Water abstractions within 250 m of the development site

Reference	1	2	3	4	5	6	7
Operator	The London Assurance	J.P.I.T. (Pte) Limited	City Of London Real Property	Asgard Estates Ltd	Lloyds Tsb Bank Plc	National Westminster Bank Plc	Bank Of China
Licence number	28/39/39/0127	28/39/39/0056	28/39/39/0050	28/39/39/0094	28/39/39/0166	28/39/39/0072	28/39/39/0170
Location	1 King William Street, LONDON, Ec4	Three Boreholes At 9 Gracechurch Street, London Ec3	52 Gracechurch Street, LONDON, Ec3	Borehole At 98/106 Cannon Street, London Ec4	71 Lombard Street, London - Borehole	1 Princes Street, LONDON, Ec2	90-96 Cannon Street, LONDON
Abstraction	Office	Commercial/ Industrial/Public Services: Drinking; Cooking; Sanitary; Washing; (Small Garden)	Commercial Use (pubs etc)	Commercial/ Industrial/Public Services: Drinking; Cooking; Sanitary; Washing; (Small Garden)	Commercial/ Industrial/Public Services: Drinking; Cooking; Sanitary; Washing; (Small Garden)	Commercial Use (pubs etc)	Drinking, Cooking, Sanitary, Washing or Swimming Pools
Abstraction type	Not Supplied	Water may be abstracted from a single point	Not Supplied	Water may be abstracted from a single point	Water may be abstracted from a single point	Not Supplied	Not Supplied
Source	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Authorised start	Not Supplied	01-Jan-10	Not Supplied	31-Dec-10	01-Jan-10	Not Supplied	Not Supplied
Authorised end	Not Supplied	31-Dec-10	Not Supplied	20th February 1990	31-Dec-10	Not Supplied	Not Supplied
Permit start date	Not Supplied	1st January 1997	Not Supplied	Not Supplied	6th April 2000	Not Supplied	Not Supplied

Source: Envirocheck report [Ref 11]

Although drinking is stated to be included within the permitted use, it is likely that none of the users are in fact treating the water to potable standards and supplying this as drinking water. The current regulatory requirements and attendant costs of treatment tend to result in drinking water being supplied by Thames Water.

The licensed abstractions from the Chalk aquifer are included within the water resources baseline since it is possible that the owners would prefer to see their assets included within the EIA process rather than being scoped out.

The Environment Agency has defined Source Protection Zones (SPZs) for groundwater sources that are used for public drinking water supply. These zones indicate the risk of contamination of the drinking water supply from any pollution sources and activities in the area.

There are no source protection zones within 1km of the proposed development site [Ref 3].

4.3 Flood Risk

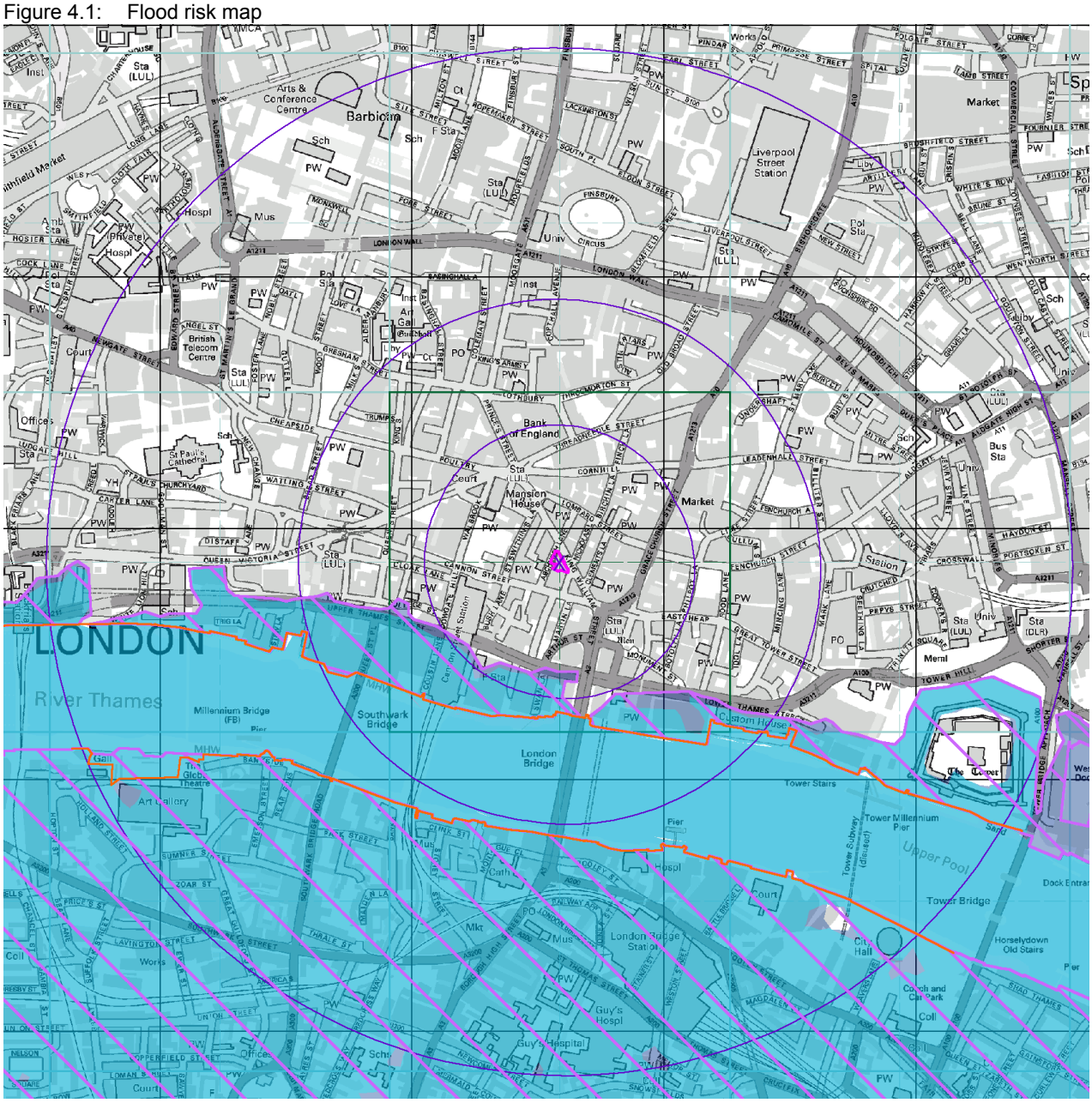
4.3.1 Fluvial and tidal flood risk

The proposed development is located outside flood zone 2 and 3 and is therefore considered at low risk from fluvial or tidal flooding (probability of flooding in any year is less than 1 in 1000).

The nearest surface water feature is the tidal River Thames. The river benefits from flood defences along the river and from the Thames Barrier (Environment Agency website). The river is located at approximately 5 mAOD, whilst site is located at approximately 14 mAOD [Ref 17].

A flood risk map of the area is provided in Figure 4.1. The proposed development site is marked in pink in the Figure. The flood risk area is marked in blue, whilst the area benefiting from flood defences is the hatched area.

Figure 4.1: Flood risk map



Source: Envirocheck report [Ref 11]

4.3.2 *Surface water runoff*

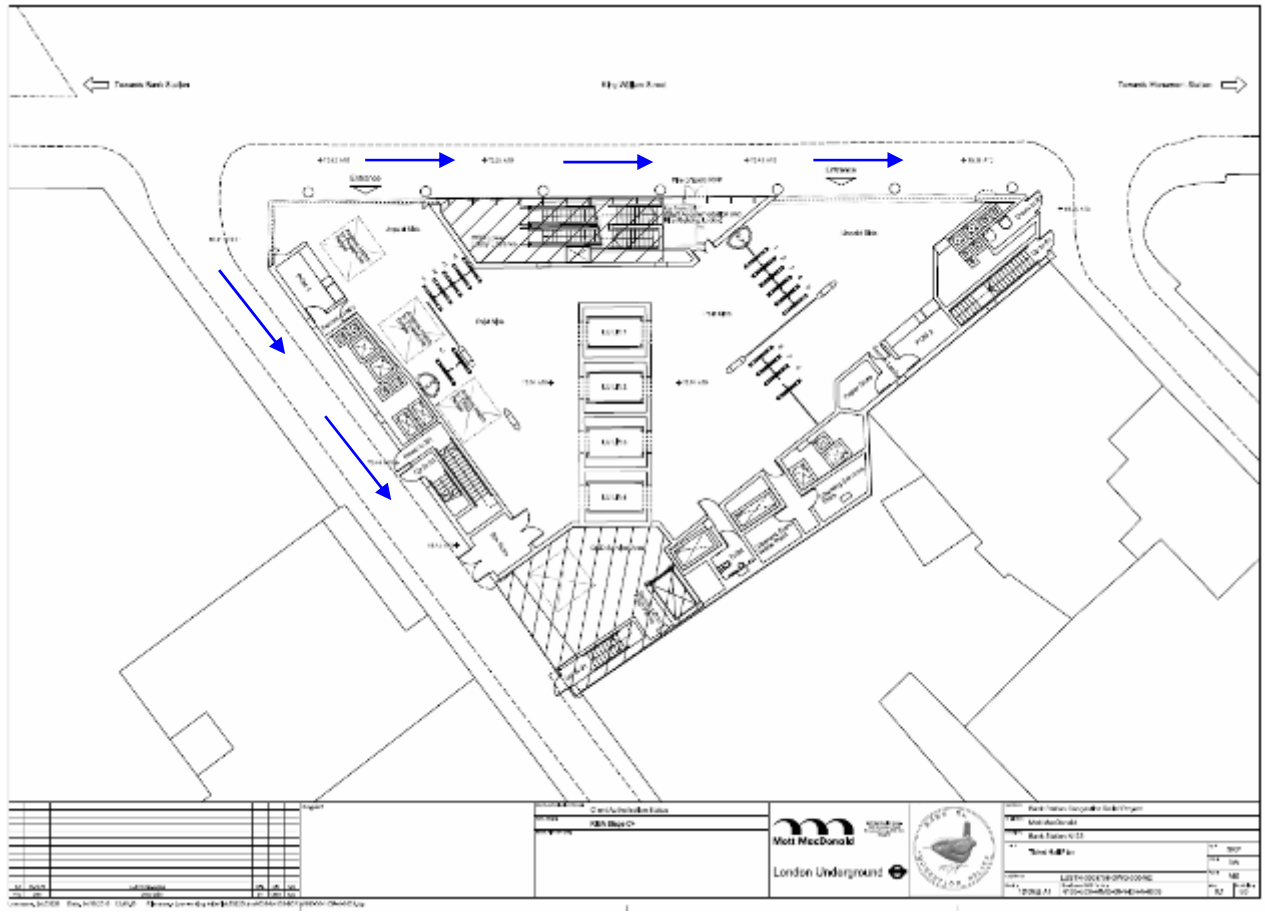
Intense rainfall, often of short duration, unable to soak into the ground or enter the drainage system can cause local flooding. In heavily developed sites such as the area around the Bank Station there is no open ground allowing for easy infiltration into the ground. Furthermore the drainage system can be overwhelmed

by heavy rainfall blockage or inadequate capacity contributing being contributing factors. The direction and depth of resulting surface flows along the road network depends on the local topography.

Due to its location on a slope, surface flood water is likely to enter the site area from the north and flow southwards towards the River Thames. Ground levels in the immediate vicinity of the development together with potential surface water flow paths are shown in Figure 4.2: Potential Flow Routes of Surface Water .

A number of drainage points exist along the road. It is assumed that these drainage points connect to the underlying combined sewer (Section 4.3.4).

Figure 4.2: Potential Flow Routes of Surface Water



Source: MM

4.3.3 Groundwater flood risk

The site is underlain by a superficial minor aquifer. The groundwater levels have been indicated to be approximately 10 mbgl [Ref 17]. The area has been identified to be of moderate to moderately high susceptibility to groundwater flooding [Ref 11] although it is not known how this conclusion was arrived at.

The groundwater levels within the Chalk are both deep and controlled as a result of the abstraction regime in place, as described in Section 4.2.2.2. The Chalk aquifer is therefore unlikely to result in flooding at the site.

The SFRA considers City of London to be at low risk of groundwater flooding due to the tight control of water levels within the Chalk [Ref 15].

4.3.4 Sewage and water mains

4.3.4.1 Thames Water Sewers

The sewer records from Thames Water show that there are one trunk sewer and two low level sewers in the vicinity of the development site. The trunk sewer serves as a combined sewer, draining foul water and surface water flows. It is thought that the sewer is up to 8.5 mbgl [Ref 17].The sewer is located beneath King William Street.

The two low level sewers are run approximately west to east, under Canon Street and just north of the development site. The depths of these are unknown.

As previously mentioned, the former River Walbrook was located near the development site. The river is now culverted and forms part of London's combined sewer system.. The river does not discharge freely into the River Thames, except during high rainfall events when overflows occur. Normal flows in the combined sewer are intercepted and ultimately piped to the Beckton sewage treatment plant.

The proposed development site is not located within the so called Critical drainage area. This is an area which is at risk of sewer flooding in extreme circumstances. The outline of the critical drainage areas is defined in the City of London Strategic Flood Risk Assessment (SFRA) [Ref 14].

It is currently unclear where the inlet gullies and manholes are located around the site. Any individual overflows from gullies or manholes are likely to flow towards the south, and the River Thames along the roads over the impermeable surfaces.

4.3.4.2 Thames Water Mains

Bursts in water mains cause local flooding of the highway. The risk or history of bursts has not been investigated since the resultant flooding is expected to discharge to the combined sewer system via the gullies in the road.

Water mains are located within the roads around the development site, including King William Street, Nicholas Lane, Cannon Street and Abchurch Lane [Ref 17].

Two water trunk mains and water distribution mains have been identified near the site.

The water distribution mains range in diameter from 100 mm to 250 mm, and serve the Crouch Hill Water Pressure Zone. Specific depths of mains are unknown at this stage, but are likely to be less than 2 m below ground level.

The two water trunk mains are 600 mm diameter. The depths of the trunk mains are unknown at the time of writing.

4.3.5 Flood Defences

The Thames flood defences are located within 350 m of the site and a lesser distance to the underground tunnel works. Settlement modelling undertaken to date has not identified impacts to the flood defences as a result of the proposed tunnelling works.

4.4 Environmental Impact Assessment

Given the limited impact the scheme will have on the water environment, it is proposed to scope out any further assessment of water resources out of the EIA assessment for the scheme.

Measures for ensuring the protection of the water environment will be incorporated into the Code of Construction and implemented through contract documents.

5. Assumptions & Limitations

5.1 Generic assumptions

The baseline study relies on the following generic assumptions:

- Data received from third party is accurate; and
- No major design change will occur.

5.2 Topic specific assumptions

The baseline study relies on the following topic specific assumptions:

- no other abstractions than those that have been identified are located within the study area;
- monitoring data is accurate and consistently measured;
- historic data is reliable and conditions have not changed since measurements were taken;
- map data (e.g. geological maps, flood risk maps) are accurate and reliable;
- topographic survey of the historic water supply boreholes and Thames flood defences and the assessment of the risk of settlement damage will be undertaken as part of the station design; and
- Thames Water maps show correct underground utilities.

In addition, the following technical tasks have not been considered necessary for the baseline study:

- hydraulic modelling of the watercourses;
- further monitoring of groundwater or surface water features; and
- topographic survey of the watercourses.

5.3 Topic specific limitations

The following topic specific limitations are relevant to the baseline study of water management and flood risk:

- data on private water supplies have not been acquired;
- groundwater monitoring data is limited to a few locations; and
- not all elements of the existing surface drainage have been identified.

6. Summary

The proposed development site is located in central London, within the lower Thames Valley. The site currently comprises an office building. The sides of the development are outlined by King William Street and Abchurch Lane.

The baseline study has been carried out in accordance with best practice guidance for EIA (WebTAG) and flood risk (PPS25).

The site is located approximately 300 m north of the tidal River Thames which flows towards the east where it discharges into the North Sea. The River Thames is considered to be of moderate ecological quality but fails the Environment Agency criteria for chemical quality.

No protected sites have been identified within the study area; however, a number of protected sites exist upstream and downstream of the site, which are though to be hydraulically connected to the River Thames.

The principal Chalk aquifer underlies London. This deep aquifer is hydraulically connected to the permeable beds of the Thanet Sands. The Chalk is confined by the Lambeth Group and the London Clay in the area of the development site. Groundwater flow within the Chalk is from the high ground in the north and the south towards the centre of the basin.

A perched water table is present in the shallow River Terrace Deposits and the Alluvium, which overlie the London Clay. Due to the impermeable nature of the London Clay, the shallow and deep aquifers are considered to not be hydraulically connected.

Groundwater levels within the London Basin are strictly controlled to ensure protection of the existing structures. Groundwater levels near the development site have been reported to be approximately -35 to -40 metres above ordnance Datum (mAOD).

Groundwater has been encountered at approximately 10 mbgl within the River Terrace Gravels. Water levels within the shallow aquifer are controlled by the balance between urban recharge and outflows. Groundwater levels and flow may also be related to the tidal fluctuations of the River Thames.

The study has identified seven water abstraction points within 250 m of the site. One of these is used for human consumption. No Source Protection Zones exist within 1 km of the site.

The proposed development is located outside flood zone 2 and 3 and is therefore considered at low risk from fluvial or tidal flooding (probability of flooding in any year is less than 1 in 1000). The nearest surface water feature is the River Thames, which benefits from flood defences along the river and from the Thames Barrier.

Any surface water runoff is likely to enter the site from the north, and exit the site in the site, flowing across the site towards the River Thames. Due to the low permeability of the surfaces at the site, surface water runoff is likely to be routed along the roads, towards the river. Drainage points in the road are assumed to connect to the combined sewer.

Due to the tight control of groundwater levels within the Chalk, the site is not considered to be at risk of flooding from the deep aquifer. The area has, however, been identified to be of moderate to moderately high susceptibility to groundwater flooding.

Thames Water sewers and mains are located within the roads surrounding the development site. A Trunk sewer and the buried River Walbrook, located west of the site, act as combined sewers. These sewers discharge overflow into the Thames during heavy rainfall events. Any sewer flooding through manholes is likely to be routed along the roads towards the River Thames.

Given the limited impact the scheme will have on the water environment, it is proposed to scope out any further assessment of water resources out of the EIA assessment. This is consistent with the response received from the Environment Agency.

7. References

7.1 Website sources

[Ref 01] – BGS website www.bgs.ac.uk

[Ref 02] – Department for Environment, Food, Rural Affairs www.defra.gov.uk

[Ref 03] – Environment Agency www.environment-agency.gov.uk

[Ref 04] – Local Government Association www.lga.gov.uk

[Ref 05] – Met Office, www.metoffice.gov.uk

[Ref 06] – Natural England Nature on the Map www.natureonthemap.naturalengland.org.uk

[Ref 07] – NetRegs, *www.netregs.gov.uk*

[Ref 08] – Office of Public Sector Information (OPSI), *www.opsi.gov.uk*

[Ref 09] – Walbrook River, *http://walbrookriver.org/*

7.2 Report sources

[Ref 10] – Regional Development Strategy

[Ref 11] – Envirocheck Report, Landmark Information Group Service, 2009

[Ref 12] – Environment Agency, Thames River Basin Management Plan (RBMP) (Bristol, Environment Agency, 2009)

[Ref 13] – Environment Agency, Thames Corridor Catchment Abstraction Management Strategy (CAMS) (Reading, Environment Agency, 2004)

[Ref 14] – Environment Agency, Management of London Basin Chalk Aquifer (Bristol, Environment Agency, 2010)

[Ref 15] – Mouchel Parkman, City of London Strategic Flood Risk Assessment (SFRA) (Sutton Coldfield, Mouchel Parkman, 2007)

[Ref 16] – Wynne Rees, City of London Local Development Framework Core Strategy (London, Department of Planning and Transportation, 2010)

[Ref 17] – Mott MacDonald, Geo-technical Desk Study (London, Mott MacDonald, 2011)

[Ref 18] – CIRIA Report 139, A study of the impact of urbanisation on the Thames Gravels aquifer (CIRIA, 1993)
[Ref 19] Hutchinson, J.N. (1991). Theme lecture: Periglacial and slope processes. From Forster, A. , Culshaw, M.G., Cripps, J.C., Little, J.A. & Moon, C.F. (eds), 1991. Quaternary Engineering Geology, Geological Society Engineering Group Special Publication Nr. 7, pp 283-331

[Ref 20] Berry, F.G. (1979). Late Quaternary scour-hollows and related features in central London. Quarterly Journal of Engineering Geology, 1979 Vol. 12 pp. 9-29,

Appendices

Appendix A. Water wells

Water wells located within 250 m of the proposed development site have been identified using the BGS GeoIndex. The identified water wells are given in Table A.1.

Table A.1: Water wells located within 250 m of the development

REFERENCE	REGNO	LOCATION	EASTING	NORTHING	DEPTH	YEAR	DATUM	AQUIFER
TQ38/486	TQ38SW2834/BJ	54 LOMBARD STREET	532950	180970	213.4	1932	13.11	CHALK GROUP
TQ38/424	TQ38SW3347/BJ	81 KING WILLIAM STREET	532810	180970	147.5	1926		CHALK GROUP
TQ38/425A	TQ38SW3348/BJ	KING WILLIAM STREET	532790	180930	137.2	1916		CHALK GROUP
TQ38/425B	TQ38SW3349/BJ	KING WILLIAM STREET	532790	180930	137.2	1925		CHALK GROUP
TQ38/426	TQ38SW3350/BJ	KING WILLIAM STREET	532800	180700	137.5	1921		CHALK GROUP
TQ38/427	TQ38SW2822/BJ	ARTHUR STREET WEST, KING WILLIAM STREET	532840	180760	152.4	1934		CHALK GROUP
TQ38/430	TQ38SW3353/BJ	39-40 LOMBARD STREET	532900	180900	129.8	1909	5.64	CHALK GROUP
TQ38/352A	TQ38SW3261/BJ	41 LOTHBURY	532700	181200	152.5	1929		CHALK GROUP
TQ38/352B	TQ38SW3262/BJ	41 LOTHBURY	532700	181200	152.5	1929		CHALK GROUP
TQ38/352C	TQ38SW3263/BJ	41 LOTHBURY	532700	181200	213.4	1929		CHALK GROUP
TQ38/352D	TQ38SW3264/BJ	41 LOTHBURY	532700	181200	211.1	1930		CHALK GROUP
TQ38/352E	TQ38SW3265/BJ	41 LOTHBURY	532700	181200	214	1930		CHALK GROUP
TQ38/353A	TQ38SW3266/BJ	27-32 POULTRY	532610	181160	135.3	1911		CHALK GROUP
TQ38/353B	TQ38SW3267/BJ	27-32 POULTRY	532610	181160	167.9	1925		CHALK GROUP
TQ38/353C	TQ38SW3268/BJ	27-32 POULTRY	532610	181160	174.4	1927	13.41	CHALK GROUP
TQ38/353D	TQ38SW3269/BJ	27-32 POULTRY	532610	181160	182.9	1937	15.24	CHALK GROUP
TQ38/354A	TQ38SW3270/BJ	PRINCES STREET	532680	181140	182.9	1933		CHALK GROUP
TQ38/354B	TQ38SW3271/BJ	PRINCES STREET	532680	181140	152.4	1930		CHALK GROUP
TQ38/354C	TQ38SW3272/BJ	PRINCES STREET	532680	181140	182.9	1936	11.43	CHALK GROUP
TQ38/359	TQ38SW3284/BJ	1-2 THREADNEEDLE STREET	532890	181170	140.2	1924	7.92	CHALK GROUP

REFERENCE	REGNO	LOCATION	EASTING	NORTHING	DEPTH	YEAR	DATUM	AQUIFER
TQ38/360A	TQ38SW3285/BJ	5 THREADNEEDLE STREET	532950	181180	161.5	1926	11.28	CHALK GROUP
TQ38/360B	TQ38SW3286/BJ	5 THREADNEEDLE STREET	532940	181170	182.9	1930	11.28	CHALK GROUP
TQ38/361A	TQ38SW3287/BJ	ROYAL EXCHANGE, CORNHILL	532860	181130	152.9	1928		CHALK GROUP
TQ38/361B	TQ38SW3288/BJ	ROYAL EXCHANGE, CORNHILL	532790	181120	198.1	1929		CHALK GROUP
TQ38/361C	TQ38SW3289/BJ	ROYAL EXCHANGE, CORNHILL	532810	181120	161.7	1929		CHALK GROUP
TQ38/362	TQ38SW3290/BJ	78-80 CORN HILL	532920	181140	121.9	1923		CHALK GROUP
TQ38/363	TQ38SW3291/BJ	75/77 CORNHILL	532940	181130	137.2	1924		CHALK GROUP
TQ38/364C	TQ38SW3073/BJ	4 BISHOPSGATE	533000	181100	182.9	1931		CHALK GROUP
TQ38/380A	TQ38SW3313/BJ	17-20 FENCHURCH STREET	533000	180950	152.4	1927	10.36	CHALK GROUP
TQ38/380B	TQ38SW3314/BJ	17-20 FENCHURCH STREET	533000	180950	153	1928		CHALK GROUP
TQ38/383	TQ38SW3446/BJ	85 GRACECHURCH STREET	533030	181040	213.4	1934	13.72	CHALK GROUP
TQ38/384A	TQ38SW3317/BJ	7-12 GRACECHURCH STREET	532970	181030	137.2	1913		UNKNOWN
TQ38/384B	TQ38SW3318/BJ	7-12 GRACECHURCH STREET	532970	181030	137.2	1913		UNKNOWN
TQ38/385	TQ38SW3319/BJ	170 FENCHURCH STREET	533000	180960	137.2	1911	14.33	CHALK GROUP
TQ38/386A	TQ38SW3320/BJ	24 LOMBARD STREET	532860	180980	137.2	1911	9.14	CHALK GROUP
TQ38/386B	TQ38SW3321/BJ	24 LOMBARD STREET	532860	180970	137.2	1929	9.14	UNKNOWN
TQ38/387A	TQ38SW3322/BJ	67 LOMBARD STREET	532840	181040	64.2	1931	3.66	CHALK GROUP
TQ38/387B	TQ38SW3447/BJ	67 LOMBARD STREET	532860	181050	214.3	1932	15.85	CHALK GROUP
TQ38/388	TQ38SW2791/BJ	68 LOMBARD STREET	532820	181070	152.4	1929	3.66	CHALK GROUP
TQ38/389	TQ38SW2792/BJ	24-26 CORNHILL	532830	181080	213.4	1934	2.44	CHALK GROUP

REFERENCE	REGNO	LOCATION	EASTING	NORTHING	DEPTH	YEAR	DATUM	AQUIFER
TQ38/390A	TQ38SW3448/BJ	71 LOMBARD STREET	532790	181090	152.4	1927	3.66	CHALK GROUP
TQ38/390B	TQ38SW3449/BJ	71 LOMBARD STREET	532800	181090	243.8	1934	3.66	CHALK GROUP
TQ38/391	TQ38SW3074/BJ	ST MARY WOOLNOTH, LOMBARD STREET	532740	181090	86	1839	14.63	UNKNOWN
TQ38/392	TQ38SW3323/BJ	1-2 KING WILLIAM STREET	532700	181000	137.8	1921		CHALK GROUP
TQ38/393A	TQ38SW3075/BJ	5-6 LOMBARD STREET	532710	181070	121.9	1910	12.19	CHALK GROUP
TQ38/393B	TQ38SW3070/BJ	5-6 LOMBARD STREET	532710	181070	121.9	1915	12.19	CHALK GROUP
TQ38/395	TQ38SW3324/BJ	SALTERS HALL, ST SWITHIN'S LANE	532700	181000	137.2	1908	12.5	CHALK GROUP
TQ38/396A	TQ38SW3325/BJ	KING WILLIAM STREET	532740	180960	137.2	1915		CHALK GROUP
TQ38/396B	TQ38SW3326/BJ	KING WILLIAM STREET	532740	180960	182.9	1915		CHALK GROUP
TQ38/396C	TQ38SW3327/BJ	KING WILLIAM STREET	532760	180950	189.6	1932		CHALK GROUP
TQ38/397A	TQ38SW2800/BJ	77 KING WILLIAM STREET	532840	180940	137.2	1923	7.62	CHALK GROUP
TQ38/397B	TQ38SW2801/BJ	77 KING WILLIAM STREET	532840	180940	137.8	1923	7.62	CHALK GROUP
TQ38/398	TQ38SW3328/BJ	3 LOMBARD COURT	532890	180910	152.4	1927	10.67	CHALK GROUP
TQ38/399A	TQ38SW3450/BJ	PLOUGH COURT, 31 LOMBARD STREET	532890	180940	137.2	1912	1341	CHALK GROUP
TQ38/399B	TQ38SW3329/BJ	PLOUGH COURT, 31 LOMBARD STREET	532880	180930	152.4	1913	13.41	CHALK GROUP
TQ38/400	TQ38SW3330/BJ	42 GRACECHURCH STREET	532890	180850	198.1	1935	6.1	CHALK GROUP
TQ38/401	TQ38SW3331/BJ	52-54 GRACECHURCH STREET	532960	180860	167.6	1930		UNKNOWN
TQ38/402	TQ38SW3332/BJ	KING WILLIAM STREET	532860	180870	137.5	1921	7.62	CHALK GROUP
TQ38/403	TQ38SW3333/BJ	STAFFORD HOUSE, KING WILLIAM STREET	532800	180870	152.4	1928		CHALK GROUP

REFERENCE	REGNO	LOCATION	EASTING	NORTHING	DEPTH	YEAR	DATUM	AQUIFER
TQ38/404	TQ38SW3334/BJ	90-96 CANNON STREET	532680	180860	167.6	1935		CHALK GROUP
TQ38/405	TQ38SW3335/BJ	110 CANNON STREET	532780	180850	146.5	1909	9.6	CHALK GROUP
TQ38/406	TQ38SW2810/BJ	98-106 CANNON STREET	532730	180850	198.1	1936		CHALK GROUP
TQ38/407	TQ38SW440/BJ	UPPER THAMES STREET	532610	180860	133.7	1847		UNKNOWN
TQ38/408	TQ38SW3336/BJ	NORFOLK HOUSE, CANNON STREET	532720	180760	152.4	1928	6.83	CHALK GROUP
TQ38/409A	TQ38SW3337/BJ	KING WILLIAM STREET HOUSE	532790	180750	152.4	1926	8.53	CHALK GROUP
TQ38/409B	TQ38SW3338/BJ	KING WILLIAM STREET HOUSE	532790	180750	152.4	1952		CHALK GROUP
TQ38/411A	TQ38SW1233/E/ BJ	REGIS HOUSE, 45 KING WILLIAM STREET	532860	180720	169.2	1930		CHALK GROUP
TQ38/411B	TQ38SW3340/BJ	REGIS HOUSE, 45 KING WILLIAM STREET	532880	180710	182.9	1937	8.84	CHALK GROUP

Source: BGS GeoIndex [Ref 1]

Appendix B. Environment Agency correspondence

creating a better place

Environment Agency

Frances A. Storey
Mott Macdonald
8 Sydenham Road
Croydon
Surrey
CR0 2EE

Our ref: NE/2011/112418/01-L01
Your ref: N/A

Date: 13 July 2011

Dear Frances,

Pre-application enquiry for extension of Bank Underground Station.
LAND BORDERING KING WILLIAM STREET AND NICHOLAS LANE, EC4N 7BG

Thank you for consulting us by way of pre-application for the above development.

Having reviewed the information provided we do not consider the development problematic for either groundwater resources or hydrology as the shaft will case out the gravels and will not be extending into the underlying principle (chalk) aquifer and there are no obvious surface water issues.

However, we would like to see further information on construction methods, particularly those relating to any boreholes or foundations that extend to a greater depth as part of the works.

I trust this response is satisfactory but if you have any questions please don't hesitate to contact me.

Yours faithfully,

Marc Deeley
Major Project Officer

Direct dial 02070914000
Direct fax 02070914090
Direct e-mail marc.deeley@environment-agency.gov.uk