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Crossrail Route Wide Generic Activities Land Contamination Report

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Crossrail route wide

Generic activities land contamination report

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Crossrail route wide

Generic activities land contamination report

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1 Introduction

1.1 Project summary

Crossrail is a major new cross-London rail link project that is being developed to serve London and the southeast of England. The project includes the construction of a twin-bore tunnel on an east-west alignment under central London and the upgrading of existing National Rail lines to the east and west of central London.

A Hybrid Bill for the Crossrail scheme was submitted to Parliament in February 2005 accompanied by an Environmental Statement. A Contaminated Land Specialist Technical Report was produced at the same time to provide more detail about the land contamination assessment.

It is anticipated that the scheme will be constructed by one or more 'nominated undertakers' to be appointed by the Secretary of State for Transport. These nominated undertakers will be required to comply with a Construction Code currently in draft form which will become binding by the Secretary of State.

1.2 Purpose of the report

The purpose of this report is to build on the draft Construction Code by:

- Identifying, in land contamination terms, generic activities and the locations at which they are relevant; and
- Setting out a draft framework for the nominated undertaker to consider land contamination issues when carrying out these generic activities.

This report therefore builds on existing available information about the Crossrail scheme, notably the Environmental Statement, Contaminated Land Specialist Technical Report and the Draft Construction Code. It follows discussions with Local Authority Environmental Health Officers and the Environment Agency over July to October 2005, including the submission of the proposed approach to the Crossrail Planning Forum in September 2005.

This version is a draft of the report for consultation with Local Authority Environmental Health Officers and the Environment Agency. Once the Construction Code has been finalised (expected before Royal Assent) this report will need to be reviewed and finalised accordingly. In the interim, it is proposed to use this document as a guide for any advanced contamination sampling.

1.3 Contaminated land regulations and guidance

Under the regime for contaminated land set out in Part IIA of the Environmental Protection Act 1990 (EPA 1990), which came into effect on 1 April 2000, "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) significant 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 a significant "pollutant linkage". The presence of a pollutant linkage relies on the Source-Pathway-Receptor concept, where all three factors must be present and potentially or actually linked for a potential risk to exist. An initial assessment of pollutant linkage can be made qualitatively.

The contaminated land regime in Part IIA was introduced specifically to address the historical legacy of land contamination. It focuses on the identification and remediation of land which is in such a condition by reason of contamination that it gives rise to significant harm or the significant possibility of significant harm to certain named receptors, or gives rise to pollution of controlled waters or the likelihood of such pollution. It applies where there is unacceptable risk, assessed on the basis of the current use (including any use that already has the benefit of planning permission but might not yet be implemented, including development permitted under the General Permitted Development Order 1995) and the relevant circumstances of the land.

It is not directed to assessing risks in relation to a future use of the land that would require a specific grant of planning permission or other consent, such as an Act of Parliament and supporting provisions. This is primarily a task for the consent system, which aims to control development and land use in the future. Consequently, for planning purposes, the assessment of risks arising from contamination and remediation requirements should be considered on the basis of both the current use and circumstances and its proposed new use. Planning Policy Statement 23 (PPS23), Planning and Pollution Control, has been introduced to address risks relating to 'land affected by contamination' based upon the new or intended use of the land. It states that the developer is responsible for ensuring that the development is safe and suitable for the purpose for which it is intended.

In most other respects, however, the underlying approach to identifying and dealing with risk, and the overall policy objective of safeguarding human health and the environment, are similar. A wider range of contamination and receptors is relevant to planning because of its wider spatial perspective but the degree of harm or pollution relevant to planning and the approach to remediation are essentially the same, i.e. unacceptable risk in planning terms includes the risks addressed by Part IIA of the EPA 1990.

The Environment Agency and Defra have published the document 'Model Procedures for the Management of Land Contamination (CLR 11)' to provide the technical framework for applying a risk management process when dealing with land affected by contamination. The process involves identifying, making decisions on, and taking appropriate action to deal with land contamination in a way that is consistent with government policies and legislation within the UK.

1.4 Summary of land contamination assessment

The Crossrail land contamination assessment found that 635 sites were identified within 250m of the Crossrail route alignment as being a potential source of contamination. The potential risk associated with each site in relation to the Crossrail scheme was evaluated using the pollution linkage approach in accordance with Part IIA of EPA 1990. Details of the methodology used to decide the risk categorisation and predicted pollution linkages (where found) for all 635 sites identified as potential sources of contamination are set out in the Contaminated Land Specialist Technical Report (Volume 1). Volume 2 of the Contaminated Land Specialist Technical Report contains mapping of all 635 sites.

For 491 sites, no potential pollution linkage was identified. These were classified as 'low' risk sites in the Contaminated Land Specialist Technical Report. The term 'low' risk in this context relates to the fact that the nominated undertaker should be aware of the existence of these sites, even though no significant potential pollution linkage has been identified between such sites and the Crossrail scheme. It is anticipated that no further assessment will be carried out at these locations. This approach is more cautious than CLR 11 which states that without a pollutant linkage, there is not a risk, even if a contaminant is present.

The remaining 144 individual sites were identified as 'medium' or 'high' risk sites, by virtue of being located on or in close proximity to areas of ground break required for the Crossrail scheme and are considered to have potential for significant impacts to either human health (mainly construction workers and site visitors during the construction period), groundwater or surface water resources prior to the implementation of suitable mitigation measures.

The 144 sites are located on or adjacent to 50 locations within the Crossrail scheme where groundworks (e.g. stations, portals, shafts or platform extensions) will be undertaken.

1.5 Structure of the report

Provisions within the Construction Code, for example relating to health and safety plans, risk assessments, site security, will apply to all sites, be there potential links to high, medium or low risk sites. They also apply to other forms of ground disturbance, such as track realignment. Relevant extracts of the current draft of the Construction Code are attached at Annex A.

In some locations there is an evident need to carry out more complex land contamination assessments and/or investigations. These are based on the high and medium risk classifications. Following discussions with Local Authorities during 2005 (a list of consultations carried out is attached at Annex B), a two-tier approach is proposed:

i) Category One Sites

For sites which have been classified as high risk or medium risk sites with more complex issues CLRL will produce individual desk study (Phase 1) reports by Spring 2006 and site specific intrusive investigations will be completed as part of the construction planning process. The locations within 'Category One' are listed in Annex C and are not further detailed within this report.

ii) Category Two Sites

By contrast, the majority of sites which have been classified as medium risk comprise either small areas of railway land (e.g. areas which will be disturbed during minor works such as platform extensions) or areas which may have experienced modest contaminative uses. For these sites the generic provisions in this report will apply. These are identified as 'Category Two' sites, and are explained in further detail in Section 2. The preliminary risk assessment measures to be applied are explained in Section 3 and the conceptual model for Category Two sites is presented in Annex D.

Through meetings with Local Authorities, concerns have also been raised about contamination effects from other forms of ground disturbance, such as track realignment, hoardings, footings etc. The approach with regard to such activities is set out in Section 4.

2 Category Two Sites

2.1 Introduction

The 'Category Two' medium risk sites covered by this report come under four categories. These are:

- Platform extensions or alterations
- Railway depots, stabling or sidings
- Central stations and shafts
- Railway infrastructure

At this stage of design the exact method of construction is still to be decided, however the following sections provide generic information about the groundbreak related to each activity, followed by a discussion on the land contamination implications.

Annex D contains a preliminary risk assessment with a matrix summarising the works being undertaken, the potential source of contamination, pathways and receptors for each Category Two site.

2.2 Platform extensions

As set out individually in Annex D**,** there are 26 locations where platform extensions are proposed as part of the Crossrail Scheme. Although the form of construction for each platform extension has not yet been decided, it is likely that these will be chosen from the following three options:

- The traditional Block and Infill system - The system consists of a concrete strip footing on which a brickwork wall is constructed. Behind the wall fill material is placed and compacted in layers to form a firm solid base. The base course and surfacing can be then placed to form the platform surfacing.
- A pre-fabricated steel proprietary platform extension system - The platform is constructed of structural hollow steel sections connected together to form frame units. The front edge of the platform is a large cantilever system and is assembled by one structural hollow section fitting inside larger sections. The base unit can be extended and the platform deck is then fixed to the structure.
- A pre-cast concrete proprietary platform extension system - The system is formed from concrete or brick pillars positioned perpendicular to the railway. These act as the platform supports. These supports are founded onto strip footings. Between these pillars span precast concrete beams which form the base onto which the base course and tarmac surfacing can be applied to form the platform surface.

For each system approximately 0.5-1m of ground disturbance beneath the platform base is required to provide suitable foundations.

2.3 Platform extensions - Potentially associated land contamination

The vast majority of platform extensions will take place on railway land which will continue to be railway land[1] Discussions with Network Rail indicate their records show that there is little to no contamination to be found along the permanent way or at small or intermediate size stations (see Section 1.4 above and Annex E). Leakages from trains etc. will probably be the main source of infrequent, low levels of contamination. Works of this nature are often carried out by Network Rail (e.g. their recent Power Supply Upgrade Project) with no substantial land contamination issues identified. Network Rail has procedures in place for the removal and treatment of ballast which are included in Annex F.

Network Rail also maintains two internal environmental databases that contain information relating to land contamination:

- Marlin, a web-based Geographical Information System which includes contaminated land, sensitive ecosystems, heritage sites, hydrology, groundwater, source protection zone information; and

- Railway Asset Register (RAR) which contains hazard information, including environmental hazards such as site contamination, asbestos, buried oil pipes etc.

As set out in Section 3, the nominated undertaker will take account of the current information within these databases when carrying out individual risk assessments at each site.

2.4 Construction of stablings and sidings

The construction of sidings requires the re-grading of land areas which will be used as stabling and siding locations and the introduction of appropriate track. Track construction comprises the installation of ballast on the ground foundation which is compacted and consolidated to support the weight of the track and the loading of passing trains. The track is secured on sleepers to keep the rails at the correct distance apart and capable of supporting the weight of trains. Sleepers will typically be concrete structures. The rail rests on a cast steel plate which is screwed or bolted to the sleeper. Disturbance of ground beneath the ballast is typically 0.5-1m bgl.

2.5 Construction of stablings and sidings – Potentially associated land contamination

Sidings and stablings will be constructed either adjacent to the permanent way (e.g. Gidea Park) or within existing or historic maintenance depots (e.g. Ilford and Clacton) which serve the rail network. Discussions with Network Rail indicate that their records show that there is little contamination found at locations within the permanent way as described in Section 2.3. However, a review of landholdings by Network Rail has indicated that there is potential for greater levels of contamination to be found within maintenance depots locations where the maintenance of diesel locomotives required the storage and handling of large quantities of fuel and where historic materials handling procedures may not have been of the current standard. Network Rail is undertaking a programme of investigations and remedial actions at a number of locations. Further information regarding the Network Rail assessments and its relationship with Crossrail is presented in Annex E.

[1] At West Drayton, proposed platform alterations extend into neighbouring property. At Hanwell, proposed platform extensions extend into rail land that has been leased as private gardens.

As described in Section 2.4 above Network Rail maintain two internal environmental databases which contain information relating to land contamination, which can be used to inform individual risk assessments at each site.

2.6 Maintenance depot

The main maintenance depot for Crossrail will be located at Old Oak Common. Discussions are continuing with EWS, a freight company which currently operates from Old Oak Common, to try and find a way of retaining as much as possible of EWS' activities at Old Oak Common. Alternatives include relocation of EWS' activities to North Pole depot. The North Pole depot is located on the southern side of the Great Western Main Line (GWML) and is the current UK depot for maintaining and stabling Eurostar trains who will vacate the depot in 2007. With some alterations to North Pole depot, it would be suitable for use by EWS. The existing store building could be demolished and extensive trackwork constructed, along with the walls and, if required, a base for a turntable relocated from Old Oak Common.

The proposed Crossrail depot building, ancillary buildings, and twenty-six sidings would be placed in the northern section of the existing Old Oak Common depot. Buildings currently located on the site of the proposed new sidings would need to be demolished.

2.7 Maintenance depot – Potentially associated land contamination

As described above, a review of landholdings by Network Rail has indicated that there is potential for greater levels of contamination to be found within maintenance depots locations where the maintenance of diesel locomotives required the storage and handling of large quantities of fuel and where historic materials handling procedures may not have been of the current standard. Network Rail is undertaking a programme of investigations and remedial actions at a number of locations. Further information regarding the Network Rail assessments and its relationship with Crossrail is presented in Annex E.

As described in Section 2.4 above Network Rail maintain two internal environmental databases which contain information relating to land contamination, which can be used to inform individual risk assessments at each site.

2.8 Central stations and shafts

The construction of the stations and shafts through the central areas will vary from site to site in accordance with the design requirements for each station or shaft.

The stations which fall into Category Two will be tunnelled with surface structures above and links to associated London Underground or mainline rail facilities. There is some potential for rail associated contamination to be contained within these locations due to their historical and current use. The land uses at street level are typical of an urban environment (commercial and residential) and no significant sources of contamination have been identified.

Crossrail shafts are constructed where distances between stations exceed 1km. They will have a minimum diameter of 9m and will form a permanent vertical link to the Crossrail tunnels below. The land uses at street level are again typical of an urban environment (commercial and residential) with open space/car parking often being a particularly immediate land use. The shafts which fall into Category Two are where there are or have been above ground potentially contaminative activities in the vicinity.

2.9 Central Stations and shafts – Potentially associated land contamination

Crossrail has undertaken a number of ground investigations in and around the central stations and shaft locations. These investigations have been primarily for geotechnical purposes and limited contamination testing has been undertaken. Review of field logs and accompanying information did not identify any significant visual or olfactory observations of contamination. There is potential for some contaminated material to be present due to adjoining uses but the nature and extent is expected to be limited. There is a need for this to be systematically checked across the Category Two sites.

2.10 Rail infrastructure

New rail infrastructure will be required to facilitate the movement of services within the rail corridor.

A new rail underpass will be constructed to make train paths available for freight trains going to and from Acton yard without disrupting Crossrail and other services. This will take the eastbound line beneath the tracks that connect with Acton yard. The ramp for the underpass will commence to the west of Noel Road bridge. Beyond the underpass, a further ramp will take the relief line back to ground level immediately to the west of Acton Mainline station. The maximum depth of an underpass is typically is 8-10m bgl.

There will also a new flyover to accommodate the eastbound Crossrail/Heathrow Express line. The structure will require retaining walls and piled foundations to support the flyover structure as it crosses the Great Western Mainline towards Heathrow. The depths of the foundations are currently unknown and will be confirmed during the detailed design phase.

Portals will be constructed at Victoria Dock and Plumstead to facilitate the movement of trains from tunnels at depth to surface rail. At Victoria Dock a 21m by 20m by 14m deep chamber will be constructed which will be fitted out with an emergency escape and invention facilities from the twin-bore tunnels. The portal will comprise a 43m by 11.5m surface structure which will permit the trains to move from the tunnels to surface level. At Plumstead a 21m by 30m chamber will be constructed which will house the emergency escape and intervention facilities from the twin-bore tunnels. From the tunnel eye to the portal an approximate 100 m long cut and cover box with associated surface structures will be constructed.

2.11 Rail Infrastructure – Potentially associated land contamination

There is potential for disturbance of contaminated material within shallow ground during the construction of these features. Again information from Network Rail (described in Section 2.3) suggests that the degree of contamination associated with these areas will be modest.

As described above Network Rail maintain two internal environmental databases which contain information relating to land contamination. The nominated undertaker will take account of the updated information within these databases when carrying out individual risk assessments at each site.

2.12 Conclusions

The Category Two sites referred to in this section are sites which are currently and have historically been used as rail, underground or small scale industrial activities whose legacy is unlikely to have cause widespread or significant levels of contamination. These sites will be used as railway platforms, depots, sidings and stabling, as station or shaft locations or as rail infrastructure to support the operations of Crossrail (e.g. flyovers, dive-unders or portals) in the future. The overall sensitivity of these locations in relation to land contamination following the development of the Crossrail scheme is considered to be low, and the potential for long term chronic exposure of human receptors at these sites is therefore considered to be minimal. Impacts, if they do arise, will do so during the construction phase, with the main considerations being construction workers and, in specific locations, groundwater and surface water protection.

Construction workers are not normally considered within quantitative human health risk assessments. However, given the scale of the proposed scheme and the length of the construction (currently estimated to be six years route-wide) it is necessary to assess ground conditions to ensure that appropriate protection measures are in place, especially for any construction workers who may be present during the entire duration of the construction scheme (potentially working at different sites along the route).

3 Sampling and Mitigation strategies

3.1 Introduction

The Category Two sites referred to in this report are currently and have historically been used as rail or underground station associated or small scale industrial activities. The overall sensitivity of these locations in relation to land contamination following the development of the Crossrail scheme is considered to be low.

Nevertheless, it is important that appropriate measures are put into place to ensure that any contaminated material is appropriately dealt with.

The mitigation strategy for dealing with Category Two sites contains three stages:

- Sampling strategy
- Protection of receptors during construction works
- Recording any remedial works

3.2 Sampling Strategy

The preliminary risk assessment will comprise a targeted sampling programme to retrieve soil samples for analysis. At the current time this approach is considered suitable due to the low potential for long term chronic exposure to humans or significant impact to controlled water resources. The contamination sampling strategy across the Category Two sites will focus on the key receptors which could potentially be impacted during the construction of Crossrail in addition to the characterisation of soils for waste disposal purposes. At each sampling location samples shall be obtained across the soil profile by appropriately qualified staff (e.g. 0.5-1.0m bgl to assess for human health of construction workers). Additional samples will be obtained wherever an unusual coloration, odour or soil texture is encountered.

Soil samples will be stored and transported in an appropriate manner to a MCERTS accredited laboratory for a range of analysis appropriate to the historical uses of the site. This will include parameters such as metals, petroleum hydrocarbons, volatile and semi-volatile hydrocarbons, phenols, polychlorinated biphenyls, asbestos as well as the physical condition of the soil (e.g. total organic content) as required.

Leachability analysis will be conducted on selected soil samples to determine the mobility of contaminants.

Waste acceptance criteria testing will be undertaken on soil samples which have been classified as ‘hazardous’ under the definitions provided in the European Waste Catalogue and supporting documents and are intended for disposal to landfill.

It is proposed that samples obtained for Category Two sites will be targeted on the footprint of the proposed activity and will be carried out as follows:

Activity	Benchmark No. of lateral sampling locations sought
Platform Extensions	1 every 30-40m
Stabling and Sidings	1 every 30-40m
Central Stations and Shafts	3 per site identified
Railway Infrastructure	1 every 30-40m
Depots	1 every 25-30m

The frequency of sampling suggested is in line with current guidance provided by Network Rail, CIRIA, the British Standards Institute and the Department of the Environment[2].

The methodology and ability to meet these benchmarks will be determined following a review of access arrangements, health and safety arrangements and ability to find suitable locations to undertake sampling. Where practicable, the programme will be developed in liaison with Crossrail Geotechnical Ground Investigations. In some locations (predominantly central stations), sampling may not be possible until land is within Crossrail control and/or site clearance has been carried out. Additional sampling will be necessary across the route for waste classification purposes and further land contamination information may come from this exercise.

If there are sites which Local Authorities consider there may be a requirement for a more extensive sampling strategy for purposes of complying with contaminated land legislation and guidance (as set out in Section 1.3), then these should be raised on an individual basis with CLRL or the nominated undertaker.

The nominated undertaker will share the results of the sampling with the relevant Local Authority and, in cases where groundwater is an identified receptor (as set out in Annex D), the Environment Agency. Where the regulatory bodies have a concern about compliance with contaminated land legislation and guidance (as set out in Section 1.3) then remedial works or design alterations can be investigated.

If, as a result of detailed design, the works referred in this report are no longer necessary for the Crossrail project (and therefore no groundwork is proposed), the relevant local authority will be informed that no sampling is required.

3.3 Mitigation Measures

3.3.1 Protection of Construction Workers

Site workers employed in the Crossrail Scheme are potentially at risk from land contamination due to the likelihood of exposure to contaminants in excavations and during materials handling. As set out in the Construction Code (see Annex A), in order to mitigate any potential impacts the nominated undertaker will establish appropriate industry standards for health and safety and will seek continuous improvement in safety performance, in accordance with the principles of HSG65 “Successful health and safety management”, published by the Health and Safety Executive.

[2] Track maintenance, renewal or alteration – used ballast handling, Network Rail, 2004
Remedial Treatment for Contaminated Land, Publication 103, Volume 3, CIRIA 1995
BS 10175:Investigation of potentially contaminated sites: a code of practice, British Standards Institute, 2000
CLR 4, Sampling Strategies for Contaminated Land, Department of the Environment, 1994

For example, with respect to contaminated land, the nominated undertaker will follow the guidelines given the HSE publication, "Protection of workers and the general public during development of contaminated land" (HSG66), or any similar guidance published by the time of construction works.

Risk assessments will be carried out at each specific location, as appropriate to evaluate mitigating measures and use of Personal Protection Equipment (PPE) where necessary. Within surface railway locations, these risk assessments will take account of information (for example on spillages) within the two Network Rail databases, Marlin and RER. Any contamination issues identified will be recorded in the project Health and Safety Plan in accordance with the Construction (Design and Management) Regulations 1994 to protect affected parties.

All these works will be carried out by the nominated undertaker within the context of an Environmental Management System consistent with BS EN ISO14001 principles.

3.3.2 Protection of Groundwater or Surface Water Resources

As outlined in Annex D, in certain locations, Crossrail construction works have the potential to impact groundwater or surface water resources due to the disturbance of contaminated materials. The soil sampling and leachability testing which will be undertaken prior to construction works will indicate if significant contaminants are present and could potentially impact controlled waters.

Where necessary, in developing individual mitigation proposals, the nominated undertaker will then have regard to PPS23, the Environment Agency's Pollution Prevention Guidance Notes (PPGs) in respect of water pollution (PPG01, PPG02, PPG05, PPG06, PPG21 and PPG23) and Defra/Environment Agency's Model Procedures for the Management of Contaminated Land.

3.4 Recording any Remedial Works

The nominated undertaker will record any remedial works and provide a copy of all relevant documentation to the appropriate regulatory body.

4 Other ground disturbances

4.1 Introduction

In addition to the Category Two sites, there will be other ground disturbances across the route due to construction activities. These are described in general terms below. It should be noted that at this stage of design, the list below is indicative rather than exhaustive[3]. In general, activities described here fall into two categories:

- They will be short term, site specific and very localised and potential impacts can be mitigated through general site procedures as set out in the Construction Code (see Annex A)
- They are of a longer duration but take place in an area where no significant contamination issues are expected.

Prior to such works being undertaken, preliminary risk assessments will be carried out by the nominated undertaker with reference information collated by Crossrail, and from the Network Rail databases if relevant. If these reveal land contamination concerns, specific sampling and/or mitigation measures may be required.

If there are particular sites which local authorities have concerns about then these will be registered through the consultation process of this document and consulted on an individual basis by the nominated undertaker.

4.2 Track realignment

Track realignment comprises the installation of ballast on the ground foundation which is compacted and consolidated to support the weight of the track and the loading of passing trains. The track is secured on sleepers to keep the rails at the correct distance apart and capable of supporting the weight of trains. Sleepers will typically be concrete structures. The rail rests on a cast steel plate which is screwed or bolted to the sleeper. Disturbance of ground beneath the ballast is typically less than 0.5m bgl.

4.3 Drainage

Existing drainage network information is not available at the current time. However in order to discharge the additional run off produced by new Crossrail structures the general proposal is likely to involve extending the existing drainage system where necessary by providing the same or equivalent outlet features.

[3] The list excludes the disturbance of river and dock sediment which requires a separate approval process with the Port of London Authority, Environment Agency and British Waterways as necessary. For further details regarding disturbance of river sediment, refer to the Isle of Dogs Phase 1 Contaminated Land Assessment Report, or the Limmo Peninsula and Manor Wharf 2005 Intertidal Studies Report (January 2006).

The drainage provided for the Crossrail scheme will need to be compatible with the existing drainage in the area. This will require the falls on the new layout to be in a similar plane as the existing and the flows to be in the same direction.

A full survey of the drainage system will need to be carried out, before detailed design takes place. At this stage, the degree of ground disturbance is unknown and will vary from site to site.

4.4 Signalling

The foundations for signalling equipment will vary with the size of signals and equipment being installed and individual ground conditions but will be confirmed during the detailed design stage. Ground disturbance will occur where the footings of signals will be placed.

4.5 Overhead Electrification

Much of the Great Western Mainline (GWML) is not electrified: only the section between Paddington and the Stockley Road bridge in Hillingdon is electrified at present. Overhead Electrification (OHLE) will take place along the western route, west of the Stockley Flyover (route window W11) and along the south-east route east of Victoria Dock Portal (route window SE2).

OHLE will generally comprise 6m high gantries from which catenary wires and contact wires will be suspended. Ground disturbance will occur where the footings of the gantries will be placed and will be dependent on individual ground conditions.

4.6 Utility Works

Crossrail will require a number of utility works which require ground disturbance in a number of ways, such as excavation of trenches, duct/pipe laying, chamber construction, pulling and jointing cables, connections commissioning and reinstatement. A fuller description of proposed utility works can be found in the Supplementary Environmental Statement 2 (January 2006**)**

4.7 Demolitions and building foundations

As part of the Crossrail scheme the demolition of a number of buildings and structures (e.g. bridges) will be required. Replacement structures may require new footings and foundations. Some ground disturbance will occur as a result of these activities although the exact nature is unknown at the current time and will vary from site to site.

4.8 Shafts

Some shafts within the Central Section, such as Hyde Park shaft, are located in areas where no land contamination risks were identified within the Contaminated Land Specialist Technical Report (February 2005), and consequently have not been included as Category Two sites. As set out in Section 2.6, these will include a permanent vertical link of a minimum of 9m diameter to the Crossrail tunnels.

In addition, a number of temporary compensation grout shafts are proposed in the Central Section. These will typically be 4.5-5m in diameter, 8-15m deep and in the majority of cases will be in position for about 18 months.

4.9 Worksites and Equipment Footings

Some ground disturbance is also likely at construction sites. The majority of disturbances will be fairly shallow activities, such as the laying down of hardstanding. However, some construction equipment may require footings deeper than 0.5m. The main equipment sources requiring deeper footings likely to be used are listed below.

Equipment	Indicative Footing Depth	
	From	**To**
Gantry cranes	0.6m	1.0m
Tower cranes	1.5m	2.0m
Offices and portacabins	0.4m	0.8m
Temporary services	0.2m	1.2m
Hoarding support posts	0.8m	1.5m
Substations	0.5m	0.9m
Conveyor supports, and associated hoppers, transfer points, etc	0.5m	0.9m
Bentonite plant for diaphragm walling	0.5m	0.9m
Batch plants – concrete, grout	0.5m	1.0m
Lighting columns	1.0m	1.5m
Gateposts etc	0.8m	1.5m

5 Storage, Transportation and Treatment of Contaminated Material

As set out in the Construction Code, the nominated undertaker will ensure that there are designated areas on sites where contaminated materials can be separated from clean ones and stored in an appropriate environment. Storage of contaminated materials may require specific facilities to prevent contaminants from leaching into the ground, nearby watercourses or neighbouring properties.

Where contaminated material is to be transported, this will be separated from other material, with appropriate protection (e.g. covered lorries) and transported to appropriate treatment facilities or appropriately licensed landfill sites.

An Excavated Material and Waste Management Strategy is set out in Annex 4 of the Environmental Minimum Requirements. This sets out a materials management hierarchy to identify the most appropriate destination for excavated materials and construction and demolition waste. The hierarchy also applies to contaminated waste. The nominated undertaker will:

- Minimise generation of excavated material and waste;
- Reuse and recycle excavated material and waste within the Crossrail project;
- Reuse and recycle excavated material and waste through environmentally beneficial use (for example at registered exempt sites or as landfill restoration cover); and
- Dispose of excavated material and waste at licensed landfill sites.

There are a wide range of remedial techniques which can be used to reduce or contain and/or reduce the effects of contamination in soils and waters, including bioremediation techniques, soil washing or soil stabilisation or commercial off-site treatments. However, the extent to which remediation techniques can be carried out within the construction sites will be determined by the nature of the contamination, the available space and the amount of time available within the construction programme. Given the minor levels of contamination material expected at Category Two sites and other areas of ground disturbance, in situ remedial options are not expected to be practicable due to site size and the restrictions associated with working many of the locations identified. This assumption will be reviewed by the nominated undertaker in accordance with the waste hierarchy referred to above.

Appendix A Construction Code

Note: At present the Construction Code is in draft form (Revision 3.0, Ref CR/QMS/P/0302) and is available to view on the Crossrail website (www.crossrail.co.uk) by selecting the link to *Crossrail Bill Supporting Documents*, then selecting to the link to the *Draft Environmental Minimum Requirements (Including Draft Construction Code)*. As such, relevant paragraphs are referred to in this Appendix. When the Construction Code is finalised, it is intended that relevant extracts will be included in this Appendix.

A.1 Environmental Principles

Paragraph 2.2.1

Paragraph 2.2.2

A.2 Health and Safety Principles

Paragraph 2.3.1

Paragraph 2.3.2

Paragraph 2.3.3

Paragraph 2.3.4

Paragraph 2.3.5

Paragraph 2.3.6

Paragraph 2.3.7

A.3 Asbestos

Paragraph 6.4.1

Paragraph 6.4.2

Paragraph 6.4.3

A.4 Water Resources

A.4.1 General

Paragraph 7.1.1

Paragraph 7.1.2.

Paragraph 7.1.3

Paragraph 7.1.4

A.4.2 Site Drainage

Paragraph 7.2.1

Paragraph 7.2.2

Paragraph 7.2.3

A.4.3 Protection of Watercourses

Paragraph 7.3.1

Paragraph 7.3.2

Paragraph 7.3.3

Paragraph 7.3.4

Paragraph 7.3.5

A.4.4 Control of Pollution of Surface Water

Paragraph 7.4.1

A.4.5 Control of Pollution of Groundwater

Paragraph 7.5.1

Paragraph 7.5.2

A.4.6 Hygiene Requirements to Protect Groundwater

Paragraph 7.5.3

A.4.7 Mitigation of Impacts at Abstraction Boreholes

Paragraph 7.6.1

A.5 Contaminated Land

A.5.1 Introduction

Paragraph 8.1.1

Paragraph 8.1.2

A.5.2 Site Assessment and Remedial Practice

Paragraph 8.2.1

Paragraph 8.2.2

A.6 Dust

Paragraph 6.3.3

Paragraph 6.3.4

Paragraph 6.3.5

Paragraph 6.3.6

Paragraph 6.3.7

Paragraph 6.3.8

Appendix B Consultations with Local Authorities

Date	Name of Local Authority	Personnel
26 July 2005	LB Tower Hamlets	[redacted]
17 August 2005	Westminster CC	[redacted]
18 August 2005	LB Newham	[redacted]
18 August 2005	LB Redbridge	[redacted]
19 August 2005	LB Havering	[redacted]
23 August 2005	RB Kensington & Chelsea	[redacted]
5 September 2005	Slough BC	[redacted]
3 October 2005	LB Greenwich	[redacted]
21 October 2005	LB Islington	[redacted]
31 October 2005	South Bucks BC	[redacted]
7 November 2005	Brentwood BC	[redacted]

Appendix C Category One Sites

This Annex lists the High Risk Sites and Medium Risk Sites for which Phase 1 Reports are being produced and are therefore not covered by this report.

As set out in the Contaminated Land Specialist Technical Report, high risk sites are limited to the following six areas:

- The tunnel portal at Royal Oak, Paddington [LB Westminster]
- Isle of Dogs Station [LB Tower Hamlets]
- Pudding Mill Lane portal [LB Newham]
- Romford Depot [LB Havering][4]
- North Woolwich Portal [LB Newham]
- Arsenal Way Shaft, Woolwich [LB Greenwich]

Following consultations with Local Authorities (as set out in Annex B above), medium risk sites included in Category One are as follows:

- Limmo [LB Newham]
- Chequers Bridge [Slough BC/South Bucks BC]*
- Thorney Lane Bridge [South Bucks BC]*
- Whitechapel [LB Tower Hamlets]

(* To be confirmed with the relevant local authority following design updates).

It was agreed with LB Greenwich that the Phase 1 Report for Arsenal Way Shaft should cover Warren Lane shaft too.

If following the production of Phase 1 Reports, it is agreed with the Local Authority that no further phases of investigation are required then the provisions of Section two and three of this report will apply.

[4] The Crossrail Bill submitted to Parliament proposed that the main Crossrail depot would be constructed near Romford on derelict railway land and a former gas works. Since deposit of the Bill increased capacity has become available at Old Oak Common to the west of London and there is no longer a requirement to construct a depot in Romford.

Appendix D Risk Assessment of Category Two sites

D.1 Category 2 Sites Conceptual Model

Current environmental legislation in respect of contaminated land includes the Environment Act 1995, Water Resources Act 1994, Environmental Protection Act (EPA) 1990, Health and Safety at Work Act 1994, Town and Country Planning Act 1990 and Building Regulations 1985. Part IIA of the EPA 1990 was implemented by Section 57 of the Environment Act 1995. The Department of Environment, Transport and Regions (DETR) circular 02/2000 includes a statement of government policy, a description of this new regime, the statutory guidance and a guide to the supporting regulations.

The statutory definition of contaminated land is based on the risk of significant harm to human health and the environment, or pollution of controlled waters. By adopting the principles of risk assessment and risk management the intention is to ensure that contaminated land is managed effectively based on its current use, proposed end use and environmental setting.

Land is only defined as Contaminated under the above Regulations if there is a significant 'pollutant linkage'. This requires evidence of the presence of a contaminant (the source), a pathway (or pathways) through which contaminants could travel and a receptor that could be harmed by the contaminant. In addition the type of receptor and any harm must meet the descriptions of significant harm given in the statutory guidance. A site where a contaminant is causing or is likely to cause significant pollution of surface water or groundwater (controlled waters) also constitutes Contaminated Land.

This risk assessment is iterative and will be developed as more information is available.

D.1.1 Potential Sources of Contamination

The main identified potential hazard sources are as follows.

Rail Associated Contamination

Currently and historically the majority of these sites have been used as railway land. In most cases the land use has comprised small or intermediate size railway stations or the associated permanent way. Contaminants associated with these type of land uses are ash, clinker, coal, fuel oils, lubricants, general hydrocarbons and solvents, contents of underground and above ground fuel storage tanks, heavy metals, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), phenols, herbicides and pesticides, creosote and timber treatment products and asbestos. Information received from Network Rail indicates that the level of contamination present is generally low and is routinely managed within their standard procedures (as detailed in Annex E).

Three Crossrail stabling sites will be positioned within existing or historic railway depots or maintenance areas (Acton Yard, Old Oak Common and Aldersbrook). As part of the Network Programme of land assessments site investigations were carried out at Old Oak Common and revealed that petroleum hydrocarbons, originating from a spillage or leak of diesel, were present in the soil and groundwater around Old Oak Common Depot. There was no evidence of contamination migrating across the site to the south (i.e. Wormwood Scrubs Park). It concluded that there is no significant health risk to on site employees or recreational users of Wormwood Scrubs Park in its current use.

Further investigations reported high concentration of soil gases (methane and carbon dioxide) in the Old Oak Common area due to the degradation of petroleum hydrocarbons present within the groundwater. However, it was concluded that the soil gases were not a risk to employee health with the site in its current use. A remedial programme is currently underway to remove the source of contamination at Old Oak Common as a precautionary measure.

No detailed information is currently available at other locations relevant to the Crossrail scheme.

The stations and shafts which will be constructed throughout the central (tunnelled) section of the route (e.g. Bond Street, Tottenham Court Road, Farringdon and Liverpool Street) will be linked to the associated London Underground facilities. Again there is some potential for rail associated contamination to be contained within these locations due to their historical and current use.

Other sites

Two Category 2 Sites have had non-rail associated historical uses and are detailed below:

- Blackwall Way Intervention shaft will be constructed within an area which was extensively used as dockland and associated features from the late 1700s to the 1950s. During the 1950s/1960s the site was occupied by a scrap yard but has been vacant since this period. There is potential for contamination from products such as metals, ash and clinker and general hydrocarbons.

- Stepney Green Intervention Shaft is located in an area which was extensively bombed during the Second World War. There is potential for unexploded ordnance to be encountered at this location.

D.1.2 Potential Migratory Pathways

The following migratory pathways for contaminants potentially exist:

- Dermal contact with contaminated soil;
- Inhalation of vapours or dusts;
- Ingestion and uptake of contaminated soil or groundwaters;
- Horizontal migration of contaminants through surrounding surface waters;
- Vertical migration of contaminants via groundwater; and
- Migration via drainage channels and existing boreholes which may form preferential pathways for mobile contaminants.

D.1.3 Potential Receptors at Risk

The potential receptors at risk are identified as follows and further details are provided in the adjoining table:

- **Construction workers and site visitors during general groundworks;**

- **Groundwater in the underlying aquifers which are used for abstraction; and**

- **Surface waters which cross the route or lie in close proximity.**

Residential receptors which are present along the route are not considered to be a significant receptor of contamination for the following reasons:

- The likely concentrations of contamination are not expected to be significant based on information provided by Network Rail;

- If unacceptable levels of contamination are identified following the proposed sampling exercise it will be necessary to dispose of or treat such material prior to construction being undertaken and undertake measures to prevent lateral migration of contaminants on to adjacent properties;

- The nominated undertaker will carry out the works within the context of an Environmental Management System which will include a requirement to protect air quality and minimise dust generation.

The risk of degradation of building structures is considered to be low. Environmental and geotechnical sampling which will be undertaken prior to construction will inform the design features.

The likelihood of ecological receptors being significant receptors to the impacts rising from land contamination is considered to be low. Provisions for the management of ecologically sensitive areas are included in the Crossrail Environmental Minimum Requirements (Annex 3).

D.2 Qualitative Risk Assessment

Based on the information obtained a qualitative assessment of the potential risks to potential receptors is provided below.

D.2.1 Soil contamination

Information provided by Network Rail indicates that the levels of contamination generally encountered in and around the permanent way are considered to low and generally are managed within the standard network rail procedures. Operations carried out within depots and maintenance areas can lead to greater levels of contamination due to the nature of the activities carried out in these locations. However the targeted sampling programme to retrieve samples prior to construction will assist with the identification of areas where alternative remediation or design considerations will need to be incorporated.

Following the construction of Crossrail, all of these areas will continue to be used as operational railway and the overall sensitivity of this land use was considered to be low.

D.2.2 Construction workers/Groundworkers

During the groundworks construction workers and site visitors may inhale, ingest or have dermal contact with material which is contaminated and has the potential to cause impacts to human health.

These impacts can be mitigated by ensuring that all appropriate Health & safety requirements are implemented. This will be ensured through the Construction Code providing the sampling exercise does not show significant levels of contamination.

D.2.3 Groundwater contamination

The risk of contamination to groundwater varies along the route alignment.

- A major aquifer lies with the gravel deposits which are present along the western section of the route, between Maidenhead (W25) and Ealing (W5). There are a number of licensed groundwater abstractions along this stretch of the route as well as source protection zones. This water body would be a sensitive receptor to any site derived contamination.

- The area between Ealing (W5) and Paddington (C2) is underlain by London Clay and the potential for contamination of groundwater is considered to be low due to the absence of any significant groundwater resources.

- The superficial deposits which are present beneath Central London (C2 to C9) are classified as a minor aquifer by the Environment Agency. There are no licensed groundwater abstractions from these deposits and it is generally agreed that the groundwater quality in the shallow aquifer is non-potable. The potential for significant impacts to the shallow aquifer from contamination is considered to be low. The potential for contamination of the deeper Chalk aquifer is also considered to be low due to the presence of low permeability London Clay.

- On the north eastern section of the route, superficial deposits of gravels are present overlying London Clay between Stratford (NE1) and Harold Wood (NE12). Claygate Beds are present beneath the route at the eastern end between Brentwood (NE15) and Shenfield (NE17). There are no licensed groundwater abstractions from the shallow aquifer across the north eastern section of the scheme and the potential for significant impacts to the shallow aquifer from contamination is considered to be low. Where there are licensed groundwater abstractions from the underlying Chalk aquifer, the presence of London Clay or the Bagshot Beds will restrict the migration of contaminants if present.

- Between Blackwall Way (SE1) and Woolwich (SE4) on the south eastern section of the route, the groundwater quality is generally considered to be poor due to saline intrusion from the River Thames. As the alignment moves further south east the geology is more permeable and is classified as a minor aquifer which could be impacted from site derived contamination.

These impacts can be mitigated by ensuring that all appropriate measures are implemented. This will be ensured through the Construction Code, providing the sampling exercise does not show significant levels of contamination.

D.2.4 Surface waters

The risk to surface waters varies along the route alignment. The following surface water courses are considered to be potential receptors of contamination due to their proximity to areas of groundbreak. However the measures presented in the Construction Code would be expected to prevent any significant impacts.

Route Window	Work site	Surface water course	Proximity to area of groundbreak
W13	West Drayton Station	Frays River Grand Union Canal	On-site Adjacent to northern boundary of site
W11	Stockley Flyover	Stockley Road Pond	Adjacent to east of site
W10	Hayes and Harlington Station	Grand Union Canal	Adjacent to northern boundary of site
W3	Old Oak Common	Grand Union Canal	Adjacent to northern boundary of site
NE1	Stratford Station	Channelsea River	On-site in culvert
NE4	Ilford Station	River Roding	50m east
NE4	Aldersbrook Sidings	Alders Brook	On western boundary of site
NE9	Romford Station	River Rom	40m west
NE11	Gidea Park Sidings	Ravensbourne River	On-site in culvert

There are other surface water courses along the route alignment but these are located at significant distances from groundbreak locations and the potential for these surface water courses to be receptors of site derived contamination is considered to be low.

These impacts can be mitigated by ensuring that all appropriate measures are implemented. This will be ensured through the Construction Code, providing the sampling exercise does not show significant levels of contamination.

D.2.5 Risk Assessment Summary

Overall the plausible potential receptors which may be impacted as a result of ground disturbance at Category Two sites are construction workers, groundwater and surface waters in sensitive environmental settings.

Route window	Local Authority	Worksite	Proposed Works	Geology	Ground-water (aquifer status)	Surface Water	Potential Source of Contamination	Potential Pollution Linkage						Significant Receptors				
								Ingestion /Inhalation	Dermal contact	Ingress into buildings	Vertical migration into aquifer	Horizontal migration to surface water course	Migration to adjacent sites	Construction Workers	Residential	Surface waters	Significant groundwaters	Building Structures
W25	RB Windsor and Maidenhead	Maidenhead Station	• Stabling and turnback facility • New ticket hall • New bay platform and platform extension • Extension to existing subway	Chalk	Major	Maidenhead Ditch 350m E	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W23	South Bucks DC	Taplow Station	• Platform extensions • Footbridge works	Taplow and Floodplain Terrace Gravels - 8m Chalk	Major	Jubilee River 800m W	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W21	Slough BC	Burnham Station	• Platform extensions	Brickearth Taplow and Floodplain Terrace Gravels - 8m Reading Beds Chalk	Major	Chalvey Ditch 200m E	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W19	Slough BC		• Track lowering and bridge upgrading at William Street Bridge, Stoke Poges Lane footbridge and Farnham Road Bridge	Brickearth, Taplow Terrace Gravels - 4-8m Reading Beds Chalk	Major	Salt Hill Stream 150m S	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W18	Slough BC	Slough Station	• Changes to the ticket hall, a new footbridge and provision of lift access • Platform extensions and a new bay platform • Works to three road bridges	Brickearth, Taplow Terrace Gravels - 4-8m Reading Beds London Clay	Major	Grand union Canal 550m N	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W17	Slough BC		• Replacement of Middlegreen Road bridge, St. Mary's Road (Church Lane) bridge, and Trenches footbridge	Brickearth, Taplow Terrace Gravels 6-8m London Clay	Major	Grand Union Canal 150m N	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W16	South Bucks DC	Langley Station	• Platform extension • Reinstatement and	Boyn Hill Gravel Brick earth	Major	Grand Union Canal	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X

Route window	Local Authority	Worksite	Proposed Works	Geology	Ground-water (aquifer status)	Surface Water	Potential Source of Contamination	Potential Pollution Linkage						Significant Receptors				
								Ingestion /Inhalation	Dermal contact	Ingress into buildings	Vertical migration into aquifer	Horizontal migration to surface water course	Migration to adjacent sites	Construction Workers	Residential	Surface waters	Significant groundwaters	Building Structures
			extension of track at Langley East Junction	1- 5m London Clay		200m N Horton Brook 400m E	Langley Oil Storage Depot											
W14	South Bucks DC	Iver Station	• Replacement of ticket office • Platform extension and provision of new platform face	Boyn Hill Gravel Brick earth 1- 5m London Clay	Major	Grand Union Canal 450m N Colne Brook 900m E	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W13	LB of Hillingdon	West Drayton Station	• New stabling facility on the site of former West Drayton coal depot	Alluvium, Taplow Gravels, Boyn Hill Gravel, Brickearth 1- 5m London Clay	Major	Frays River On-site Grand Union Canal Adjacent to north of site	Railway land since 1800s	✓	✓	X	✓	✓	X	✓	X	✓	✓	X
W11	LB of Hillingdon	Stockley Flyover	• New viaduct along the north side of the railway and new transfer structures at either end, with associated works	Brick earth London Clay	Major	Stockley Road Pond/ Broads Dock Grand Union Canal 250m N	Present since the construction of chemical works between 1914 and 1935 Railway land since 1800s	✓	✓	X	✓	✓	X	✓	X	✓	✓	X
W10	LB of Hillingdon	Hayes & Harlington Station	• track on north side of rail corridor and extension of Station Road bridge • New ticket hall, footbridge and lifts • New platform and platform extensions	Brick earth London Clay	Major	Grand Union Canal Adjacent to north of site	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W8	LB of Ealing	Southall Station	• Reconstruction of Southall station • Extended platforms and new lifts • Track works including new track	Brickearth and River Terrace Deposits London Clay	Major	Grand Union Canal 350m S	Railway land since 1800s	✓	✓	X	✓	✓	X	✓	X	✓	✓	X
W7	LB of Ealing	Hanwell Station	• Platform extensions	Brickearth and River Terrace Deposits London Clay	Major	River Brent 250m E	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X

Route window	Local Authority	Worksite	Proposed Works	Geology	Ground-water (aquifer status)	Surface Water	Potential Source of Contamination	Potential Pollution Linkage						Significant Receptors				
								Ingestion /Inhalation	Dermal contact	Ingress into buildings	Vertical migration into aquifer	Horizontal migration to surface water course	Migration to adjacent sites	Construction Workers	Residential	Surface waters	Significant groundwaters	Building Structures
W6	LB of Ealing	West Ealing Station	• Replacement of the ticket hall new overbridge and lifts • New bay platform • Platform extensions	Lynch Hill Gravels London Clay	Major	N/A	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W5	LB of Ealing	Ealing Broadway Station	• Replacement of the ticket hall • Platform extensions	Lynch Hill Gravels London Clay	Major	N/A	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
W4	LB of Ealing	Acton Station	• New ticket hall • New footbridge • Platform extensions and new lifts	London Clay	Non – aquifer	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
W4	LB of Ealing	Acton Yard	• New rail underpass west of Acton Yard • Realignment of Sidings	London Clay	Non – aquifer	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
W3	LB of Hammersmith & Fulham	Old Oak Common	• New maintenance depot with trackworks	London Clay	Non – aquifer	Grand Union Canal Adjacent to north	Railway land since 1800s	✓	✓	X	X	✓	X	✓	X	✓	X	X
W2	LB of Hammersmith & Fulham	North Pole	• Re-located depot with trackworks	London Clay	Non – aquifer	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	✓	X	X
W2	R.B. Kensington & Chelsea		• Track reconfiguration	London Clay	Non – aquifer	Grand Union Canal 200m N	Kensal Green Gasworks to the Gasworks since 1870	✓	✓	X	X	X	X	✓	X	X	X	X
W1	R.B. Kensington & Chelsea		• Track reconfiguration	London Clay	Non – aquifer	Grand Union Canal 200-300m N	Railway station since 1870	✓	✓	X	X	X	X	✓	X	X	X	X
C4	City of Westminster	Bond Street station	• Western and Eastern ticket halls • Twin-bore tunnels	Taplow Gravel, Alluvium and Brickearth London Clay	Minor	N/A	Used as underground station since early 1900s	✓	✓	X	X	X	X	✓	X	X	X	X
C5	City of Westminster LB of Camden	Tottenham Court Road station	• Western and Eastern ticket halls • Twin-bore tunnels	Taplow Gravel and Alluvium London Clay	Minor	N/A	Used as underground station since early 1900s	✓	✓	X	X	X	X	✓	X	X	X	X
C6	LB of Camden LB of Islington City of London	Farringdon station	• Western and Eastern ticket halls • Twin-bore tunnels	London Clay	Minor	N/A	Railway /London underground land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X

Route window	Local Authority	Worksite	Proposed Works	Geology	Ground-water (aquifer status)	Surface Water	Potential Source of Contamination	Potential Pollution Linkage						Significant Receptors				
								Ingestion /Inhalation	Dermal contact	Ingress into buildings	Vertical migration into aquifer	Horizontal migration to surface water course	Migration to adjacent sites	Construction Workers	Residential	Surface waters	Significant groundwaters	Building Structures
C7	City of London LB of Tower Hamlets	Liverpool Street station	• Moorgate ticket hall • Blomfield Street shaft • Finsbury Circus • Twin-bore tunnels	Taplow Gravel and Alluvium London Clay	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
C9	LB of Tower Hamlets	Stepney Green Shaft	• Intervention shaft	Floodplain Gravel and Alluvium London Clay	Minor	Regents Canal 650m W	Area Bomb damaged during WWII	✓	✓	X	X	X	X	✓	X	X	X	✓
NE1	LB of Newham	Stratford Station	• Platform alterations	Alluvium London Clay	Minor	Channelsea River On-site culvert	Railway land since 1800s	✓	✓	X	X	✓	X	✓	X	✓	X	X
NE2	LB of Newham	Forest Gate Station	• Platform extensions	Floodplain Gravel and Alluvium Lambeth Group	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
NE3	LB of Newham	Manor Park Station	• Platform extensions • Removal of freight loop	Floodplain and Taplow Gravel London Clay	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
NE4	LB of Redbridge	Ilford Station	• Extension of platforms and removal of the bay platform • Construction of a new ticket hall	Alluvium London Clay	Minor	River Roding 50m E	Railway land since 1800s	✓	✓	X	X	✓	X	✓	X	✓	X	X
NE4	LB of Redbridge	Aldersbrook	• New sidings for construction/fitout of the central area tunnels	Alluvium London Clay	Minor	Alders Brook On western boundary	Railway land since 1800s	✓	✓	X	X	✓	X	✓	X	✓	X	X
NE5	LB of Redbridge	Ilford Depot	• Replace two depot buildings with stabling sidings	Taplow Gravel and Brickearth London Clay	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
NE5	LB of Redbridge	Seven Kings Station	• Platform extensions	Taplow Gravel and Brickearth London Clay	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
NE6	LB of Redbridge	Goodmayes Station	• Platform Extensions	Taplow Gravel and	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X

Route window	Local Authority	Worksite	Proposed Works	Geology	Ground-water (aquifer status)	Surface Water	Potential Source of Contamination	Potential Pollution Linkage						Significant Receptors				
								Ingestion /Inhalation	Dermal contact	Ingress into buildings	Vertical migration into aquifer	Horizontal migration to surface water course	Migration to adjacent sites	Construction Workers	Residential	Surface waters	Significant groundwaters	Building Structures
			• Introduction of new freight loop (Chadwell Heath Loop)	Brickearth London Clay														
NE7	LB of Redbridge LB of Barking and Dagenham	Chadwell Heath Station	• Platform extensions	Taplow Gravel Brickearth	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
NE9	LB of Havering	Romford Station	• Extension of platforms • Reconstruction of the ticket hall and extension of the ticket hall	Alluvium London Clay	Minor	River Rom 40m W	Railway land since 1800s	✓	✓	X	X	✓	X	✓	X	✓	X	X
NE10	LB of Havering	Gidea Park Station	• Platform extensions	Boyn Hill Gravel London Clay	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
NE11	LB of Havering	Gidea Park	• Stabling Sidings	Boyn Hill Gravel London Clay	Minor	Ravensbourne River On-site in culvert	Railway land since 1800s	✓	✓	X	X	✓	X	✓	X	✓	X	X
NE12	LB of Havering	Harold Wood Station	• Platform extensions	Boyn Hill Gravel London Clay	Minor	Ingrebourne River 500m E	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
NE15	Brentwood DC	Brentwood Station	• Platform extensions	Bagshoot Beds and Claygate Beds	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
NE17	Brentwood DC	Shenfield Station	• New stabling sidings • A new platform face	Claygate Beds	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X
SE1	LB of Tower Hamlets LB of Newham	Blackwall Way	• Blackwall Way intervention shaft	Made Ground Floodplain deposits London Clay	Minor	River Thames	Coal yard associated with dockyards	✓	✓	X	X	X	X	✓	X	X	✓	X
SE2	LB of Newham	Victoria Dock Portal	• Victoria Dock Portal • Railway track	Alluvium London Clay	Minor	Royal Docks	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
SE6	LB Greenwich	Plumstead	• Plumstead Portal		Minor	Alluvium, River Terrace Gravels and Chalk	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X
SE8	LB of Greenwich	Abbey Wood	• Alterations to Abbey Wood Station	Superficial deposits Thanet Sands	Minor	N/A	Railway land since 1800s	✓	✓	X	✓	X	X	✓	X	X	✓	X

Route window	Local Authority	Worksite	Proposed Works	Geology	Ground-water (aquifer status)	Surface Water	Potential Source of Contamination	Potential Pollution Linkage						Significant Receptors				
								Ingestion /Inhalation	Dermal contact	Ingress into buildings	Vertical migration into aquifer	Horizontal migration to surface water course	Migration to adjacent sites	Construction Workers	Residential	Surface waters	Significant groundwaters	Building Structures
R2	Tendring DC	Clacton	• Alterations to depot building	Superficial deposits London Clay	Minor	N/A	Railway land since 1800s	✓	✓	X	X	X	X	✓	X	X	X	X

Appendix E Railway Land

i) Statutory Land Contamination Review

In 2000, Railtrack wrote to all Local Authorities in the UK with the results of a systematic investigation of their landholdings to identify areas which might be contaminated according the Statutory definition taken from Section 57 of the Environment Act 1995 (inserting Part IIA into the Environmental Protection Act 1990). It is assumed that Local Authorities have taken account of this information in developing their Contaminated Land strategies.

This Railtrack project involved an assessment by independent environmental consultants of all types of Railtrack property landholdings. It commenced with a review of land ownership plans, followed by desk studies and site inspections of around 500 sites. Intrusive site investigations of soil and groundwater conditions were then undertaken at more than 140 sites considered most as risk. The remaining 360 sites were considered unlikely to be contaminated.

Of the sites subject to intrusive investigation, approximately one third were identified as potentially contaminated and further detailed. The remaining sites investigated were found not to be contaminated under the statutory definition.

The project generally found that contaminated land is confined to depots where the maintenance of diesel locomotives required the storage and handling of large quantities of fuel.

At the time of writing to Local Authorities, Railtrack reported that 54 sites were currently undergoing detailed investigations and risk assessments to determine if remedial actions were required at the sites, and that in all cases, the investigations and subsequent risk assessments were being undertaken in consultation with the Environment Agency/Scottish Environmental Protection Agency, and the relevant Local Authority.

As part of the preparations for the Crossrail Environmental Statement and Contaminated Land Specialist Technical report, Mott MacDonald carried out a review of available Network Rail/Railtrack Site Investigation and Interpretative Reports. The sites within the Crossrail route alignment were:

- W3 Old Oak Common
- C13 Bow Midland Yard East

Bow Midland Yard East is part of the Category One Site at Pudding Mill Lane (to be covered in a Phased Report). The results of the reports at Old Oak Common have been incorporated within the risk assessment presented in Annex D of this report.

ii) Guide to Railway Investment Projects (GRIP)

Ongoing investment project work by Network Rail is controlled by the Guide to Railway Investment Projects (GRIP). Network Rail has developed this approach to managing investment projects in order to minimise and mitigate the risks associated with delivering such projects on an operational railway. The approach defines the investment project lifecycle, key products and controls for network investment schemes. Land contamination issues and risks are one of the environmental aspects which are routinely covered within the GRIP system.

Appendix F Network Rail Ballast Handling Procedures