

PRUPIM

Green Park Phase 3 - Green Park Station

Synopsis Geoenvironmental Report on Ground Conditions

Project Ref: 11321/4004

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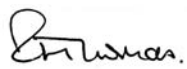
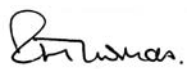
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1 Introduction

1.1 Background

Peter Brett Associates LLP (PBA) has been retained by Prudential Property Investment Managers (PRUPIM), the Client, to provide consultancy services in relation to a development proposed as part of the wider Green Park Village scheme, referred to as Reading Green Park Railway Station (RGPRS).

Planning consent for the permanent RGPRS development (Approved Scheme) was achieved in 2007, (Reading Borough Council reference 07/01108/FUL, and West Berkshire Council Reference 07/02570/COMIND). Planning permission ref: 07/01108/FUL (now superseded by planning permission ref: 019/01494/VARAT) expires in December 2010 and included conditions in respect of the management of potential land contamination at the site. Significant progress has been made towards the discharge of these conditions under Consent 09/01494/VARIAT.

This report has been prepared to summarise ground contamination matters in support of a new planning application for RGPRS. The new application is required because the existing consent expires in December 2010 and also because the Client proposes amendments to the layout of the car parking areas.

The access road and its corridor from Longwater Avenue to the station site is now also included in the Application. Previously this was covered by a temporary consent under a separate planning application (09/00347/FUL). Proposals to upgrade the temporary station access route to a permanent access route also form part of the 2010 planning application for Green Park Village.

1.1.1 Report Purpose and Scope

PBA have prepared a number of ground condition reports (refer to Section 1.5 for details) in relation to the main station area of this development and those on adjacent land (Green Park Village and Temporary Access Works).

The ground condition characterisation has progressed to the point where a detailed remedial strategy has been prepared (PBA 2009D) and agreed with the regulators. Documentation relating to these agreements in principle is presented in Appendix 1.

Given the considerable work undertaken and progress achieved in the discharge of conditions for the Approved Scheme, PBA undertook a pre planning application consultation seeking agreement in principle to the new scheme being granted subject to amended conditions that reflect the actual progress that has been made in discharging the conditions for the approved scheme. The letter setting out our proposed approach is presented in Appendix 2 together with the reply from Reading Borough Council Environmental Health Officer. At the time of preparing this report a response had not been received from the Environment Agency (EA).

In the absence of a response from the EA it was considered beneficial to support the new application with a synopsis report on ground conditions at the main station site that would allow the current situation regarding ground characterisation and risk management to be formally presented in a single report summarising the work carried out in the various separate reports. This report is a synopsis of the findings presented in these reports and therefore should not be considered in isolation.

Ground conditions along the access road corridor are covered in detail in a single report specifically for that area (PBA 2009A) and that information is not duplicated herein.

Attention is drawn to Section 7 which provides guidance to assist the reader in using this report.

1.2 Site Location and General Description

The centre of the application land is located at approximate National Grid reference SU 703 705 approximately 1.5km south of Reading Town Centre and 0.5km north of the M4 Motorway.

The application land is approximately 1.7ha in area and predominantly flat and low lying. At the time of writing, the application land was unoccupied, further information on land use is presented in Chapter 2.

1.3 Proposed Development

The main elements of the proposed development covered in this report comprise a station building (on less than 10% of the application land) with platforms on either side of the existing railway line linked by a footbridge, a bus interchange and Multi-Storey Park and Ride Car Park with landscaping together with a corridor for the access road. The RGPRS application will be identical to the current, extant Planning Permission in all respects with the exception of the re-configured car park. The revised proposals will provide a car park that has a reduced footprint, but which will be consequently higher in density in order to continue to accommodate 200 spaces.

Appendix 3 contains a drawing showing the layout of the 2010 application. The blue line shown is for that element of the proposed development that is located within the jurisdiction of Reading Borough Council. The remaining element is located on land in the jurisdiction of West Berkshire District Council. Figure 2 shows the development boundary in more detail.

The ground level across the proposed development will be raised by approximately 1m for flood alleviation purposes.

The changes are not considered to alter the sources, pathways or receptors previously identified for the Approved Scheme.

1.4 Methodology Adopted for Ground Condition Assessment

The methodology adopted by PBA and used in this assessment is presented in Appendix 4. This methodology has been prepared by PBA with reference to technical guidance including CLR11 (DEFRA 2002).

In line with the guidance a staged approach has been adopted with several phases of intrusive investigation.

A plan showing the exploratory hole locations from the various phases is presented as Figure 1.

1.5 Information Sources

PBA have prepared and utilised data from the following previous ground condition reports (all of which have been submitted as part of previous planning applications):

- **PBA 1998:** This scoping study comprised a desk based investigation which gathered geoenvironmental and geotechnical information on the site and other land owned by Bucknell Holdings nearby. An intrusive investigation was not undertaken as part of this study.
- **PBA 2001:** This report presents the findings of ground investigation along the route of a proposed electric cable on land adjacent to the railway line. The investigation involved the excavation of nine trial pits, two boreholes and five window sample boreholes. Soil and groundwater testing was carried out on a number of samples.
- **PBA 2002:** This investigation involved the excavation of 18 trial pits and the drilling of 19 boreholes and seven window sample locations. The investigation targeted the wider Phase III area of Green

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Park and included soil and groundwater chemical testing along with ground gas monitoring. A geoenvironmental risk assessment and geotechnical assessment was also carried out.

- **PBA 2007A:** This report presents the findings of a gas and groundwater/surface water quality monitoring programme to assess whether lateral migration of potential pollutants is taking place from the landfill present to the north of Green Park Phase III land.
- **PBA 2007B:** This investigation involved the excavation of twelve trial pits and the drilling of six boreholes and eight window sample locations within the area used by Clembins as Waste Transfer Station and included soil and groundwater chemical testing along with ground gas monitoring.
- **PBA 2008A:** This report presents a hydrogeological risk assessment associated with the proposed dewatering of the Trout Lakes (to the east of the proposed RGPRS).
- **PBA 2009A:** This investigation involved the excavation of twelve trial pits along the course of a proposed temporary access road and car park to be developed as part of the RGPRS but the subject of a separate planning application.
- **PBA 2009B:** This supplementary investigation comprised the excavation of fourteen trial pits and the drilling of seven boreholes in conjunction with groundwater and ground gas monitoring. This investigation targeted potential data gaps around the proposed RGPRS.
- **PBA 2009C:** This investigation comprised the excavation of 11 trial pits and groundwater monitoring undertaken to assess two potential hot-spots (WS8 and BHC) in order to finalise the outline remedial strategy for the proposed RGPRS.
- **PBA 2009D:** Report presenting a detailed remedial strategy for the RGPRS.
- **PBA 2010:** Synopsis Report on Ground Conditions for Green Park Village

2 Land Use

2.1 Introduction

The information on land use is based on historical maps presented in PBA 2002 and 2009B a selection of which are reproduced in Appendix 5. An annotated aerial photograph is presented as Figure 3.

2.2 On Site

A summary of the on site land use information is presented below.

- The site is not currently occupied. A railway line (Reading to Basingstoke) runs north south approximately 7m from the western boundary of the development. The land to the west of the railway is open ground (grass/shrub).
- The earliest available OS map (1883) indicates that the site is part of undeveloped common land and marshland.
- Small areas of ground workings, possibly representing gravel extraction pits, are located adjacent to the western boundary. The pits are no longer marked on the 1900 map, possibly indicating infilling.
- A waste management licence for a waste transfer and treatment facility (54/12/4/361) was issued to Mr A L Clements on the 12th June 1995. Figure 2 shows the footprint of the land under licence. The facility is believed to have been operated by Clembins Ltd and the site vacated and operations ceased in 2007. The licence was surrendered in 2010.
- The land to the west of the railway track is shown on the Environment Agency web site as previously being two historic landfills known as Cottage Lane No1 and No2 (refer to Off Site West below).

2.3 Off Site

- East - The Trout Lakes are marked on the 1972 map and are shown as four lakes. Further mineral extraction within the Trout Lakes took place in 1996/1997, when material from the Lambeth Group was locally won for use as engineered fill over the Phase 1 Green Park development area. The 2008 map indicates that the Trout Lakes have been re-profiled, and are shown to be of similar layout to present day (two open water bodies (a large and a small lake)). The northeastern, southeastern and southwestern most lakes are shown to have been merged, and now form one continuous water body. The northwestern lake is shown to have been infilled over the northern half. Beyond the Trout Lakes is Pingemead Industrial Estate and land referred to as Eastern Triangle, all of which are proposed for redevelopment as Green Park Village.
- Northeast - A large sewage works (digesters) and Reading Stadium is located on Longwater Avenue. The stadium and sewage works were constructed in the 1990's. The Environment Agency web site shows the land to be landfills referred to as Island Road Tip, Sludge Beds and Smallmead Stadium. Remedial measures carried out as part of the sewage works construction included the removal of sludge and the construction of a bentonite cut off wall into the Lambeth Group. As such, it is considered that the new Sewage Treatment Works are unlikely to represent a source that will impact the proposed development.
- North – The land is part of the proposed Green Park Village development and whilst the majority is outside of the WML footprint for the waste transfer station there is evidence of the operations extending onto this land. A surface water ditch forms the northern boundary. The Environment Agency web site shows the land beyond the ditch to have been a landfill. From the west (adjacent to the railway) is Burghfield landfill which is operated by Biffa/RMC, and believed to be in the

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process of restoration, under licence (86028) which received Hazardous waste. Adjacent to this there is Smallmead Farm, another Hazardous waste landfill, which is a closed site which was operated by RMC under licence (86029). The land is also shown as a historic landfill referred to as Burghfield Area D under licence reference 86253.

- West - This land is shown on the Environment Agency web site as previously being two historic landfills known as Cottage Lane No1 and No2. Cottage Lane No1 was unlicensed and filled with inert and industrial wastes between 1977 and 1981. Cottage Lane No2 (approximately 5Ha) was filled with inert waste between 1977 and 1989 under licence 54/12/4/17 which is recorded as "returned". Three exploratory holes are located in this area and the logs are presented in Appendix 5, together with a print out of the EA web page.
- Northwest - A large electricity substation is present approximately 150m from the north western corner of the application land.
- Southwest - The open water bodies of Kirtons Farm Hotel are adjacent to the railway to the south west. The lakes were formed following gravel extraction in the 1970's.
- South - The southern boundary is formed by Smallmead Road beyond which there is open ground used for agriculture. The southern boundary to the eastern half is formed by Longwater Avenue beyond which is the recently constructed Green Park development that predominately comprises offices. The former Courage Brewery is located approximately 1km to the south east.

2.4 Tier 1 Hazard Identification

2.4.1 Introduction

UK policy and legislation promote the use of a staged risk based approach to the assessment of ground quality/conditions. The underlying principle is the evaluation of *pollutant linkages* in order to assess whether the presence of a source of contamination could potentially lead to harmful consequences.

2.4.2 Potential to Generate Contamination Based on Land Use

A Tier 1 hazard identification identifies the potential to generate contamination based on a consideration of the previous or ongoing activities on and near to the site in general accordance with the criteria presented in PBA Methodology. In addition, consideration is given to the potential for 'point source' pollutants to be present, such as local spillages of hydrocarbons.

The classification based on landuse are identified as follows:-

- On Site East of Railway track – Waste Transfer Station / Made Ground – Moderate
- On Site West of Railway tracks – Historic Landfill - Moderate
- Offsite North - Smallmead Landfill – Very High
- Offsite East - Trout Lakes and Pingemead Industrial Estate – Low and Moderate
- Offsite South – Agricultural Land - Low and Very Low
- Offsite West - Cottage Lane 1 and 2 historic landfill– Moderate

An aerial photograph of the application land and vicinity is presented as Figure 3.

3 Geoenvironmental Setting

3.1 Geology

3.1.1 Published Geology

The 1:50 000 scale geological map sheet of the area (BGS, 2000) indicates the natural geology in the vicinity of the site comprises the following sequence:

Superficial Deposits (Pleistocene and Recent)	Alluvium Second River Terrace Deposits (sand and gravel)
Solid Geology	Lambeth Group (stiff clay overlaying silty fine to medium sands) - Palaeocene Age. Upper Chalk Formation – Cretaceous Age.

The geological map indicates that the application land lies within a zone designated as 'worked ground'.

3.1.2 Geology – Previous Ground Investigations

The results of the previous intrusive investigations generally confirmed the sequence of strata given in Section 3.1.1 with the addition that Made Ground is present locally and generally underlain by Alluvium or River Terrace Deposits.

The ground conditions are summarised below:

Table 3.1 Summary of Strata Profile

Strata	Depth to Top (m bgl)	Elevation to Top (m AOD)	Thickness (m)
Made Ground (locally absent)	Ground Level	Ground Level	0.20 to 4.7
Alluvium (locally absent)	0.1 to 1.1	37.55 to 38.85	0.2 to 1.5
River Terrace Deposits	0.2 to 2.1	36.3 to 38.9	1.1 to 3.55
Lambeth Group	2.7 to 4.5	34.0 to 35.9	13.45 to 15.55
Chalk Formation	17.7 to 19.0	19.4 to 20.55	Not Proven

3.2 Hydrogeology and Aquifer Classification

3.2.1 Aquifer Classification

The Upper Chalk is classed as a Primary Aquifer, (previously classified as a Major Aquifer), and such aquifers are described as layers of rock or drift deposits that have high intergranular and/or fracture permeability and may support water supply and/or river base flow on a strategic scale.

The Superficial Deposits and Lambeth Group are designated as Secondary A Aquifers described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These were formerly classified as minor aquifers.

3.2.2 Flow Direction

The regional hydrogeological map (Sheet 7) indicates that the groundwater flow within the Upper Chalk Aquifer is likely to flow towards the southeast and the potentiometric groundwater surface within the Chalk at the site was around 35m AOD in 1976.

From intrusive investigation data the groundwater flow in the superficial deposits is to the north.

From intrusive investigation data the groundwater flow in the Lambeth Group is to the south/southeast.

3.2.3 Source Protection Zones

According to the Environment Agency (EA) web site the development area is located within an Outer Groundwater Source Protection Zone (SPZ). An Inner SPZ is located adjacent to the southeast of which relates to the abstraction located at the Scottish and Newcastle (Courage) Brewery approximately 1200m to the southeast. The brewery is not operational.

Two groundwater abstraction licences have been identified within a 1km radius and are summarised in Table 3.2.

Table 3.2 Summary of Groundwater Abstraction Licenses

Licence Holder	Approximate Distance and Direction From Site (m)	Purpose of Abstraction	Licensed volume (m ³ /yr)
Kennet Valley Park Ltd	70m North	Agriculture and private water supply	6819
Reading Football Club Plc	600m Southeast	Environmental Treatment	119734

3.3 Hydrology and Surface Water

Foudry Brook is located approximately 400m from the eastern boundary, flowing in a north easterly direction.

An un-named drainage ditch flows in an easterly direction adjacent to the northern boundary, to join the Foudry Brook.

A further un-named drainage ditch is located adjacent to the eastern boundary of the Pingemead Estate, believed to be flowing in a southerly direction.

A number of water bodies representing flooded former gravel pits are present in the vicinity of the development boundary.

The River Kennet is approximately 1.3km to the north, orientated in an east - west direction and flowing towards the east.

A Flood Relief Channel is present adjoining the extreme north eastern boundary of the Green Park Village development boundary, flowing in a northerly direction. The channel was lined with clay along the reach to the north of the site due to the presence of the landfill and sludge beds associated with a former sewage works located to the north east off the present day A33.

The historic maps show the land to have been marsh and the natural/original hydrological regime has been altered to facilitate managed drainage.

4 Review of Gas Data

4.1 Introduction

The gas data assessment has been undertaken using the methodology presented in CIRIA C665 (CIRIA, 2007) and is presented below.

4.2 Gas Generation Sources

Gas generating sources have been identified as

- (1) degradable materials including hydrocarbons in the Made Ground (localised/unforeseen) both within the development land and adjacent (wider area of waste transfer station operations)
- (2) organic content of natural Alluvium (site wide)
- (3) off site north - Smallmead Landfill (landfill receiving domestic waste)
- (4) historic landfill to west of rail tracks Cottage Lane 1 and 2 both within the development land and adjacent (wider area of historic landfill)

Using the guidance the gas generation potential for the three sources are assessed as Low for the Made Ground associated with the waste transfer station operations (within and adjacent to the development), historic landfill (within and adjacent to the development) and natural Alluvium (within and adjacent to the development) and Very High for the off site landfill to the north.

The recommended number of gas monitoring rounds and frequency depends on the type of development and gas generation potential. In this instance, where the development is for Commercial/Industrial end use and the gas generation potential on site is Low the guidance recommends six rounds over two months.

4.3 Gas Generation from On Site Sources

This review is based on data from eight gas monitoring wells installed within the application land and a four in the land to the north. Whilst the land to the north is not part of the subject development it is considered that gas generation potential of the Made Ground and Alluvium is the same throughout the former Clembins area, and the off-site data may be used to assist in the site characterisation.

- The locations have been monitored on up to nine occasions over a two year period.
- Monitoring rounds were conducted during rising and falling atmospheric pressure conditions, with pressures at the time of monitoring between 998mb and 1027mb.
- The highest recorded methane concentration is 54.0%v/v in WS7 recorded on the 18/07/07 (the reason for this particularly high concentration in this location is not certain but the borehole log records the presence of wood and tarmacadam). Nine of the facilities monitored recorded a concentration of 1% or more on at least one occasion and six of these recorded a concentration of 10% or more.
- The maximum carbon dioxide concentration recorded was 27.0%v/v in WS5 recorded on the 18/07/07. Seven of the facilities monitored recorded a concentration of 1.5% or more on at least one occasion and six of these recorded a concentration of 5% or more.
- The maximum flow was recorded as 6.8l/hr in BHC on the 13/01/09. It should be noted that on this occasion the slotted section was below the water level and that subsequently the well could not be monitored as the area was flooded. During the earlier rounds there was one occasion when the

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well was not flooded and the steady state reading was 2.1l/hr. The maximum reading from other wells was 1.0l/hr in BHE, WS3 and WS4.

The worst case flow reading of 6.8l/hr would give a maximum Gas Screening Value (GSV) of 3.6l/hr for methane. Using the flow reading from when this location was not flooded (2.1l/hr) gives a GSV of 1.13l/hr and using the more typical and widespread flow of 1.0l/hr gives a GSV of 0.54l/hr.

It is considered that assigning a classification of Characteristic Situation CS4 is inappropriate as the calculated worst case GSV is only marginally above the CS3 threshold of 3.5l/hr and well below the CS4 upper threshold of 15l/hr.

CS3 is typical for old landfills (pre 1960's) and is considered appropriate for the known ground conditions at this site.

The proposal to design the subject development to Characteristic Situation CS3 is presented in the remedial strategy report PBA 2009D which has been agreed in principle with the Environmental Health Officers at both Local Authorities.

4.4 Off Site Source to the North

A total of 13 monitoring wells have been installed (G2 to G8 inclusive in 2002 and G9 to G14 inclusive in 2005) at off-site locations between the subject site and the Smallmead Landfill to allow identification of any gas migration southwards from the Landfill.

- PBA have undertaken up to six rounds of monitoring in 2002 and 14 rounds in the period May 2005 to May 2006.
- At least three of the visits were during low atmospheric pressure (less than 1000mbar). Information on atmospheric pressure in the 48hours before and after each round was not recorded.
- Methane concentrations (as flammable gas) were all below the instrument limit of detection (less than 0.1%v/v).
- The maximum carbon dioxide concentration recorded was 12%v/v in G2. Elevated concentrations (of 9% and above) were recorded at this location on four of the six rounds undertaken in 2002. In the later monitoring period the maximum was 6.1%v/v. Concentrations of 1.5%v/v and above were recorded in G2, G4, G5, G9 and G10. It should be noted that Made Ground was recorded during drilling of G2, G9 and G10 peat was recorded during drilling of G4 and G5.
- The maximum flow rate was 1.2l/hr recorded in G3 on the 7th June 2002 when atmospheric pressure was 996mBar.
- Exposed slot length was good (more than 0.5m) in G2 and G8, poor (less than 0.5m) in G3, G4, G7, G9, G10, G13 and G14 and insufficient (flooded) in G5, G6, G11 and G12.

Additional gas protection measures over those proposed to manage the risk from the on site ground conditions are not considered necessary to manage the risk from the off site source.

5 Tier 2 Hazard Identification

5.1 Intrusive Investigation

There are 40 exploratory holes within the application land boundary for Green Park Station. A further 29 are located in the land to the north and three to the west of the railway track. Data from the off site exploratory holes to the north have been utilised where appropriate to assist in characterisation of the subject site because it is considered that the historical industrial operations that created the near surface ground conditions are no different to those on site. A plan showing exploratory hole locations is presented as Figure 1.

The PBA intrusive investigations were designed to provide sufficient information to allow a characterisation of the ground conditions across the application land. The design and procedures adopted for the various intrusive investigations were in general accordance with technical guidance including BSI 1999 and BS 2001. The locations of the initial exploratory holes were selected on a predominately non targeted or randomly sited basis with subsequent targeted investigation where ground conditions were more contaminated.

The analytical testing was based on the potential contaminants identified in technical guidance (CRL 2 and DOE 1995).

5.2 Selection of Assessment Criteria

The PBA rationale for selection of generic assessment criteria is presented in Appendix 6. The following text describes the report specific generic criteria adopted for the Tier 2 screening.

5.2.1 For assessing the potential to impact human health

- The soil results have been compared to the Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGVs), where available. For contaminants where a CLEA SGV is not available the concentrations have been compared to the criteria published by Land Quality Management (LQM). A highlighted table is presented in Appendix 7.
- The groundwater, surface water and leachability results have been compared to drinking water standards and surface water abstraction standards

5.2.2 To assess the potential to impact Controlled Waters

- The groundwater, surface water and leachability results have been compared to the Environmental Quality Standards (EQS- DOE circular 7/89) as the primary receptor of concern is the environment (groundwater is not currently abstracted for human consumption). A highlighted table is presented in Appendix 8.
- For parameters where the criterion is hardness dependant the upper value has been used as the groundwater in this area is classed as "Very Hard" which is confirmed by the alkalinity results which gives averages of 2,771mg/l, 300mg/l and 300mg/l for the superficial, Lambeth Group and Chalk respectively.
- There are no published assessment criteria for assessing the degree of risk to controlled waters from soil contaminant concentrations.

5.3 Soil Data

None of the results exceed the published screening criteria for the protection of human health with a commercial/industrial end use.

The leachability testing on seven samples of Made Ground in the former Clembins operations indicate that zinc, copper, vanadium, sulphate and EPH are present in a form(s) that can be mobilised (leached) and potentially generate liquids with concentrations of potential contaminants above the assessment criteria for controlled waters.

5.4 Groundwater Data

5.4.1 Surface Water

The results from surface water bodies show that only ammoniacal nitrogen exceeds the EQS.

5.4.2 Chalk

The results from the Chalk show that only ammoniacal nitrogen exceeds the EQS and is recorded at similar concentrations to those recorded in the surface water bodies.

5.4.3 Lambeth Group

The results from the Lambeth Group show that ammoniacal nitrogen exceeds the EQS and is recorded at similar concentrations to those recorded in the surface water bodies.

Three out of six results exceed the EQS for iron.

5.4.4 River Terrace Deposits

The results from the River Terrace Deposits show that ammoniacal nitrogen exceeds the EQS and that higher concentrations are recorded in the hydraulically up gradient well.

5.4.5 Made Ground

The water present within the Made Ground shows generally higher concentrations of a number of parameters as summarised below:-

- One sample out of 12 exceeds the EQSs for Chromium and Lead.
- Iron and Sulphate are also recorded above the EQSs (5 out of 10 and 4 out of 12 respectively).
- Petroleum Hydrocarbons were recorded at concentrations above the selected assessment criterion of 10ppb on occasion in some of the wells. Only WS8 consistently records elevated concentrations.

5.5 Discussion

5.5.1 Ammoniacal Nitrogen

All the results (from surface water and all strata) exceed the selected screening criterion for ammoniacal nitrogen. The assessment presented in PBA 2009C was that: (1) the contaminant is probably natural in origin, (2) that the ground conditions only seem to be adversely impacting the quality of a shallow perched water body and (3) the wider groundwater quality on site is similar to that regionally. Therefore ammoniacal nitrogen has not been taken forward as a potential contaminant of concern and this is documented in the remedial strategy for the Approved Scheme PBA 2009D which has been agreed with in principle with the Environment Agency.

5.5.2 Petroleum Hydrocarbons

Targeted investigation was undertaken of the ground conditions in the vicinity of WS8 (reported in PBA 2009C). Petroleum Hydrocarbons have not been taken forward as a site wide potential contaminant of concern, however, the remediation of a "hot spot" around WS8 is proposed and this is documented in

the remedial strategy for the Approved Scheme PBA 2009D which has been agreed with in principle with the Environment Agency.

6 Risk Assessment

6.1 Hazards Identified for the Protection of Human Health

6.1.1 Ground gases

Ground gases have been identified as potential hazards and gas protection measure for commercial/industrial development on land assessed as having a characteristic situation of CS3 are proposed.

6.1.2 Soil Hazards

The soil chemistry has not been identified as a potential human health hazard for the end user.

6.1.3 Water Hazards

Controlled waters have been eliminated as potential sources of human health hazards on the basis that neither groundwater nor surface water is abstracted for public use within a 1km radius of the site.

The potential for organic hazards to permeate through plastic water supply pipes into drinking water has been retained subject to discussions with the water utility provider. The risks associated with this pathway are estimated as very low and low. The risk can be eliminated through adoption of protected pipework if discussions indicate a need.

6.2 Hazards Identified for the Protection of Controlled Waters

The composition of the Made Ground has the potential to impact water quality and there is evidence of localised poor water quality in wells screened in the Made Ground (considered to be at least partially perched based on recharge rates during purging). However, the Made Ground is part of a wider area considered to have the same origins and composition and is located in an area with a number of current and historic landfills.

It is considered that the nature of the development itself reduces the risk of controlled water quality being impacted because the scheme includes the placement of imported soil and/or hardstanding across the majority of the site which will reduce infiltration and therefore the risk of leaching from the Made Ground.

It is considered that site wide remediation is not required but that “hot spot” removal around WS8 would be appropriate and mitigation measures will also be incorporated into the site wide design. The mitigation measures comprise a lined drainage system, a protocol detailing management of unforeseen ground conditions and measures to ensure no uncontrolled discharges including run off, adoption of an appropriate piling technique to minimise creation of preferential pathways. The measures are considered viable both technically and commercially.

7 Conclusions

7.1 Protection of Human Health

Soil remediation for the protection of end user human health is not considered necessary. In addition, the raising of ground levels by 1m for flood alleviation using clean inert fill will remove direct contact pathways.

Gas mitigation measures are considered necessary. The design of the development will adopt measures commensurate with Characteristic Situation CS3.

The design of protected water supply pipes will be considered subject to discussions with the water utility provider.

7.2 Protection of Controlled Waters

It is considered that site wide remediation is not required but that “hot spot” remediation of ground in the vicinity of WS8 and site wide mitigation measures should be incorporated in to the development design.

The mitigation measures comprise lined drainage systems, a protocol detailing management of unforeseen ground conditions and measures to ensure no uncontrolled discharges including run off, adoption of an appropriate piling technique to minimise creation of preferential pathways.

7.3 Confidence and Uncertainty

CLR 11 requires appropriate range and level of information to be collected. The information quality criteria given in CLR 11 are:-

- Relevant – to the context of the assessment
- Sufficient – for the required level of confidence
- Reliable – reflect the true or likely conditions
- Transparent – in meaning and origin

The investigation techniques adopted, sample locations and suite of potential contaminants selected provide *indicative* information on ground conditions. Whilst the data used in this assessment is considered robust, there will always be some degree of uncertainty regarding ground and gas conditions due to the potential for unforeseen ground conditions, however, these are not anticipated to result in making the development unviable as the density of investigation points indicates that the extent of any unforeseen ground will be small relative to whole site.

7.4 Planning Application

A comprehensive programme of contamination investigation has been carried out and a detailed remedial strategy has been prepared (PBA 2009D). The relevant regulatory bodies have given their agreements in principle to the strategy (refer to Appendix 4).

The measures in the strategy are considered viable both technically and commercially and therefore it is concluded that the planning application should be granted because the ground contamination risks that remain can be managed through the application of the agreed remedial strategy, and the use of appropriately worded planning conditions to manage its implementation and deal with any unexpected ground contamination. The conditions proposed are given in Appendix 2.

8 Essential Guidance for Report Readers

This report has been prepared within an agreed timeframe and to an agreed budget that will necessarily apply some constraints on its content and usage. The remarks below are presented to assist the reader in understanding the context of this report and any general limitations or constraints. If there are any specific limitations and constraints they are described in the report text.

The opinions and recommendations expressed in this report are based on statute, guidance, and best practice current at the time of its publication. Peter Brett Associates LLP (PBA) does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and the report should be returned to us and reassessed if required for re-use after one year from date of publication. Following delivery of the report PBA has no obligation to advise the Client or any other party of such changes or their repercussions.

Some of the conclusions in this report may be based on third party data. No guarantee can be given for the accuracy or completeness of any of the third party data used. Historical maps and aerial photographs provide a “snap shot” in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times.

The conclusions and recommendations made in this report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be taken into account in any analysis and reporting.

It should be noted that groundwater levels, groundwater chemistry, surface water levels, surface water chemistry, soil gas concentrations and soil gas flow rates can vary due to seasonal, climatic, tidal and man made effects.

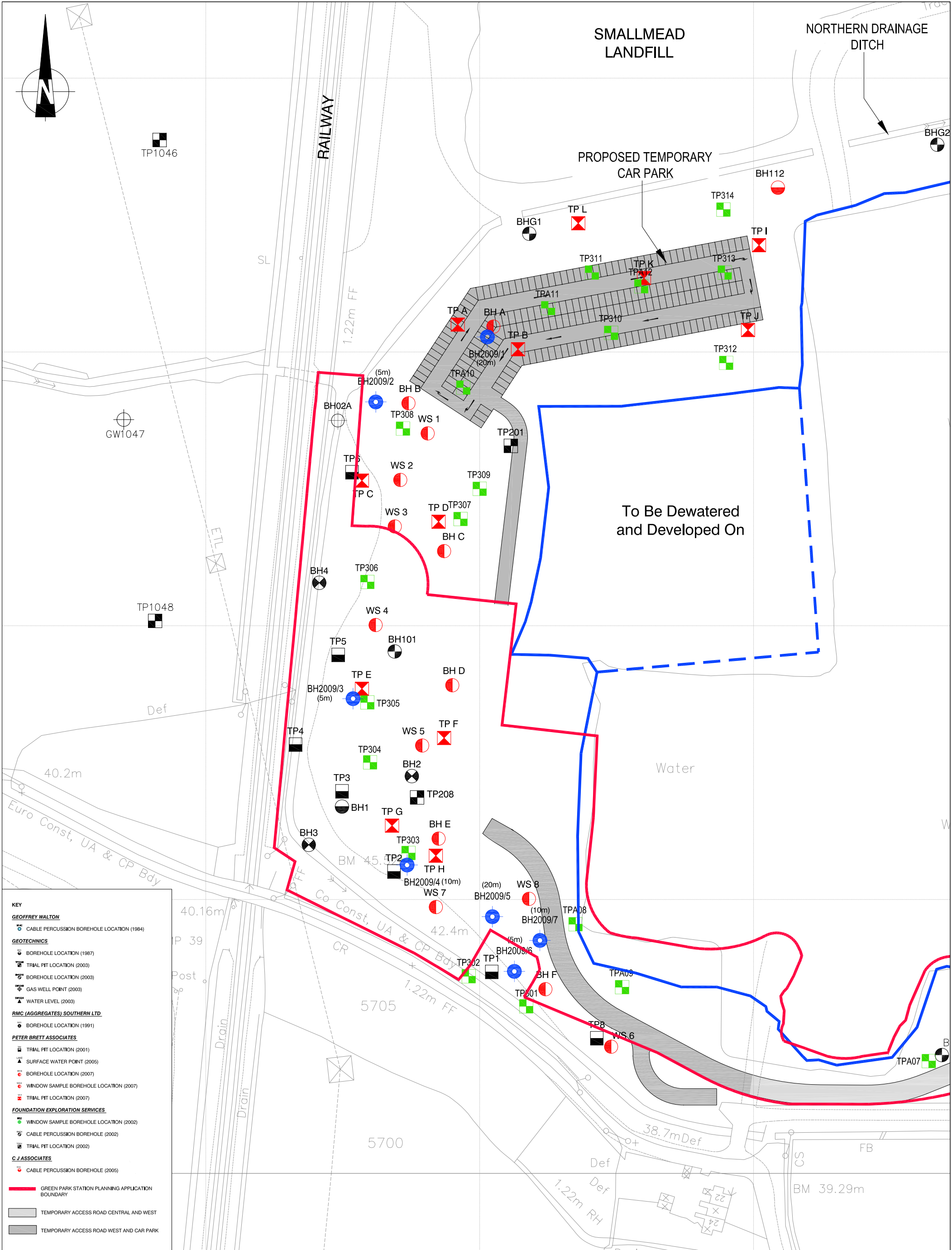
This report has been written for the sole use of the Client stated at the front of the report in relation to a specific development or scheme. The conclusions and recommendations presented herein are only relevant to the scheme or the phase of project under consideration. This report shall not be relied upon or transferred to any other party without the express written authorisation of PBA. Any such party relies upon the report at its own risk.

The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not taken into account the perceptions of, for example, banks, insurers, other funders, lay people, etc, unless the report has been prepared specifically for that purpose. Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.

Public or legal consultations or enquiries, or consultation with any Regulatory Bodies (such as the Environment Agency, Natural England or Local Authority) have taken place only as part of this work where specifically stated.

9 References

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- IGS 1978. Hydrogeological Map Sheet 7 (Southwest Chilterns and Berkshire and Malborough Downs). Institute of Geological Sciences (IGS).
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- PBA 2001 Report on Ground Investigation for Cable Laying at Clembins Waste Transfer Station, Reading prepared for Prudential Property Investment Managers Ltd (10729 dated 2001).
- PBA 2002 Geoenvironmental Investigation for Phase III, Green Park, Reading prepared for Prudential Property Investment Managers Ltd (11321/300 dated August 2002).
- PBA 2007A Gas and Water Quality Monitoring report for Green Park Village (technical index 13.3) prepared for St Edward Homes (11321/133D dated July 2007).
- PBA 2007B Phase 1 and 2 Ground Condition Assessment, Clembins waste transfer station site, Reading prepared for Bucknell Brothers Group (19372/004 dated September 2007).
- PBA 2008A Report on hydrogeological risk assessment for Green Park Village prepared for St Edward Homes (11321/1023 dated January 2008)
- PBA 2008B Phase 2 Supplementary Geoenvironmental Ground Condition Assessment for the Pingemead Industrial Estate prepared for St Edward Homes (11321/1028 dated April 2008).
- PBA 2009A Report on Ground Condition Assessment – Phase 1 and 2, Green Park Station Temporary Access Road and Car Park prepared for John Laing Plc (11321/1035B dated February 2009).
- PBA 2009B Report on Supplementary Phase 2 Ground Investigation and Tier 2 Risk Assessment prepared for PRUPIM (11321/1034 dated June 2009).
- PBA 2009C Phase 2(d) Report on Targeted Ground Investigation (Contamination Hotspots WS8 and BHC) prepared for PRUPIM (11321/1046 dated October 2009).



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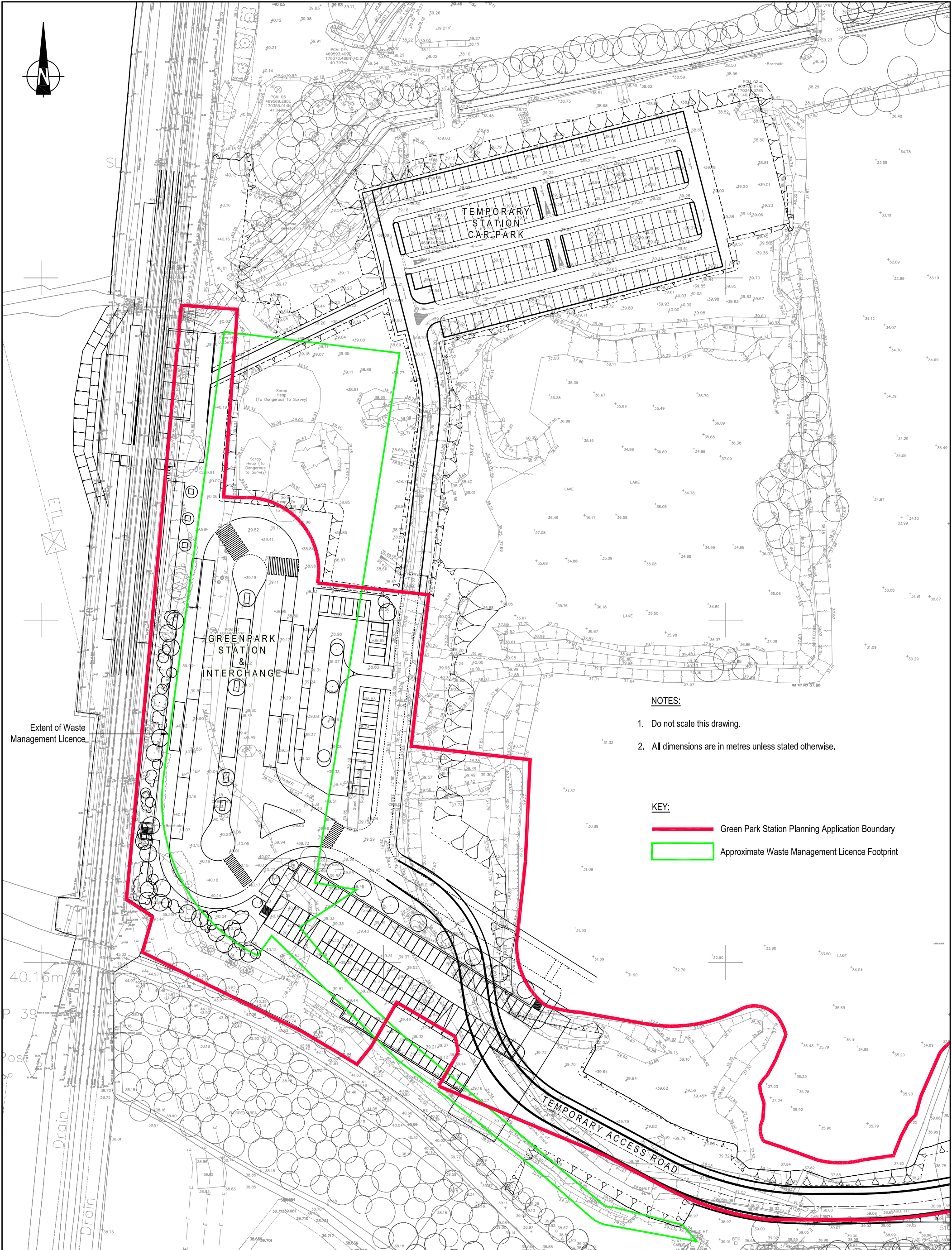
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GREEN PARK STATION (2010)

EXPLORATORY HOLE LOCATION PLAN

Date	21.01.2008
A3 Scale	1:1250
Drawn by	DJM
Checked by	JG
Figure Number	1



NOTES:

- 1. Do not scale this drawing.
- 2. All dimensions are in metres unless stated otherwise.

KEY:

- Green Park Station Planning Application Boundary
- Approximate Waste Management Licence Footprint



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SCALING NOTE: Do not scale from this drawing. If in doubt, ask.
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GREEN PARK STATION (2010)
FOOTPRINT OF WASTE MANAGEMENT
LICENCE IN RELATION TO
GREEN PARK STATION

Mark	Revision	Drawn	Date	Chkd
Drawing Status				
Date of 1st Issue	18.02.2010	Drawing Number		Revision
A3 Scale	1:1000	Figure 2		
Drawn by	MJP			
Checked by	JS			



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	PRUPIM		Scale	Not to Scale
			Drawn by	DJM
			Checked by	CC
			Revision	-
			Figure 3	

19th November 2009



Peter Brett Associates LLP
Caversham Bridge House
Waterman Place
Reading
Berkshire
RG1 8DN

For the attention: Catherine Copping

Environmental Health and Licensing

West Berkshire District Council
Council Offices
Faraday Road Newbury
Berkshire RG14 2AF

Our Ref: 09/02231/EP_O

Your Ref:

Please ask for: Rosemary Green
Direct Line: 01635 503242/ 01635 519074
Fax: 01635 519172
e-mail: rjgreen@westberks.gov.uk

Dear Catherine

Greenpark Phase 3 Railway Station – 07/02570/COMIND

Further to your recent submission of the Detailed Remedial Strategy Issue 2 Rev 02 I can confirm that the remedial strategy proposed to address the risk to human health is accepted in principle.

Yours sincerely

Rosemary Green
Senior Environmental Health Officer

(172)

APS
e Copping
20 NOV 2009

Catherine Copping

From: George, Rebecca [Rebecca.George@reading.gov.uk]
Sent: 09 November 2009 14:46
To: Catherine Copping
Subject: RE: GreenPark Station - remedial strategy

Hi Catherine,

Thank you for sending me a copy of the proposed remediation strategy for Green Park Station. Having reviewed it I am happy with the proposed measures, and have advised the planning officer of this.

Many thanks,
Rebecca

Rebecca George
Senior Technical Officer
Environmental Protection
Reading Borough Council
0118 939 0325 (x72325)

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Mr Justin Turvey
Reading Borough Council
Development Control
Civic Centre
Reading
Berkshire
RG1 7TD

Our ref: WA/2009/107395/01-L02
Your ref: 09/02013/APPCON
Date: 29 January 2010

Dear Mr Turvey

**DETAILS PURSUANT TO CONDITIONS 20, 21, 22 AND 23 OF CONSENT
09/01494/VARIAT
GREEN PARK STATION, READING**

I am writing further to my letter of 07 January 2010 in relation to this application because I have noticed that there was an error in my previous response.

We initially advised that we did not consider sufficient information had been submitted to you in relation to condition 21. However, having re-reviewed the condition requirements and the information submitted by the applicant, we now consider the condition requirements have been met.

As such, we are happy to recommend that condition 21 could be discharged.

Please accept my apologies for this error.

Yours sincerely

Sarah Green
Planning Liaison Technical Specialist

Direct dial 01491 828485
Direct fax 01491 834703
Direct e-mail sarah.green@environment-agency.gov.uk

cc Drivers Jonas,
Peter Brett Associates

Environment Agency
Red Kite House, Howbery Park, Crowmarsh Gifford, Oxon, Wallingford, OX10 8BD.
Customer services line: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk
End

Mr Justin Turvey
Reading Borough Council
Development Control
Civic Centre
Reading
Berkshire
RG1 7TD

Our ref: WA/2009/107395/01-L01
Your ref: 09/02013/APPCON
Date: 07 January 2010

Dear Mr Turvey

**DETAILS PURSUANT TO CONDITIONS 20, 21, 22 AND 23 OF CONSENT
09/01494/VARIAT
GREEN PARK STATION, READING**

Thank you for consulting us on this matter. We have reviewed the following reports submitted by the applicant.

Detailed Remediation Strategy Ref. 11321/1046 Issue 2
Targeted Ground Investigation – Phase 2(d) Ref. 11321/1046 RTP 1 (SI) Rev 01

We are able to recommend that the majority of the requirements of condition 20 have been met regarding contamination investigation. However, the final part of the condition requires a site completion report to be submitted which is still outstanding. We do not know whether the required remediation has been carried out yet.

The applicant is also seeking discharge of conditions 21, 22 and 23 but no detail in accordance with these conditions has been submitted with this application.

We still need to see confirmation of the remediation that has been carried out, results of post remedial groundwater analysis for samples taken from borehole WS8 and evidence to demonstrate whether elevated Manganese in this location is consistent with background levels in the surrounding area.

We will be happy to review any further detail that is submitted in relation to these points.

Environment Agency
Red Kite House, Howbery Park, Crowmarsh Gifford, Oxon, Wallingford, OX10 8BD.
Customer services line: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk
Cont/d..

Your ref:

Our ref: 11321/4000 CBH/CC

17th August 2010

J Turvey Esq
Reading Borough Council,
Civic Centre,
Reading
RG1 7AE

Dear Justin

GREENPARK RAILWAY STATION – RE-SUBMISSION OF PLANNING APPLICATION

Further to the submission of the Green Park Village (GPV) planning application on 3 August 2010, we are now in the process of preparing an application relating to the Reading Green Park Railway Station (RGPRS), Interchange and Multi-Storey Park and Ride Car Park (the car park).

The purpose of this further application is to:

- 1 obtain Planning Permission for a permanent car park which fits with the retained lake configuration and associated access road alignment reflected in the current GPV application; and,
- 2 extend the life of the RGPRS application which is due to expire in December 2010 (07/01108/FUL and 07/02570/COMIND).

The RGPRS application will be identical to the current, extant Planning Permission in all respects with the exception of the re-configured car park. The revised proposals will provide a car park that has a reduced footprint, but which will be consequently higher in order to continue to accommodate 200 spaces.

Against this context, the purpose of this letter is to confirm our proposed approach in respect of ground conditions as outlined below – for expediency we are copying this to the relevant regulatory bodies who have dealt with the ground condition issues to date.

In respect of ground conditions the application will be submitted with a list of currently available reports (list enclosed). Unless requested we do not propose to re-issue these reports, obviously if you require additional/replacement copies we will be pleased to provide paper/electronic copies.

As the new application is essentially a re-submission of the currently permitted development we do not see that ground conditions will prevent Planning Permission being granted. We would however expect any conditions attached to the new permission to reflect the additional work undertaken since the last application and also the agreements in principle we have reached regarding understanding of ground conditions and how any associated risks are to be managed. Under the

current permission we are at the point where we have an agreed remediation strategy in place with only the remedial works identified in the strategy (plus any unforeseen) to be undertaken and verification reporting to be provided.

We therefore propose that a greatly reduced and refined set of conditions are appropriate for ground conditions under the new application and suggest the following which has been adapted from the Model Conditions issued for consultation in March 2010:-

A. Implementation of Approved Remediation Scheme

The remediation scheme shall be implemented in accordance with the approved remediation scheme. Within [Y]months of the completion of measures identified in the approved remediation scheme, a validation report (that demonstrates the effectiveness of the remediation carried out) must be submitted to the Local Planning Authority.

B. Reporting of Unexpected Contamination

In the event that contamination is found at any time when carrying out the approved development that was not previously identified it must be reported in writing within [Z] days to the Local Planning Authority. The developer is to carry out tests and investigations to determine the extent and effect of the unexpected contamination and report to the Local Authority. Once the Local Planning Authority has agreed the part of the site affected by the unexpected contamination development must be halted on that part of the site.

A report specifying the measures to be taken to remediate the site to render it suitable for the development hereby permitted shall be submitted to and approved in writing by the local planning authority. The site shall be remediated in accordance with the approved measures before further work is undertaken in the affected part of the site.

If you have any questions please do not hesitate to contact the undersigned (DD 01189520214).

Yours sincerely,,

Catherine Copping

For and on behalf of

PETER BRETT ASSOCIATES LLP

Copy to:-

- Sarah Green Environment Agency (Thames West), Red Kite House, Howbery Park, Wallingford, OX10 8BD
- Gillian Davies Environment Agency (Thames West), Red Kite House, Howbery Park, Wallingford, OX10 8BD
- Rebecca George Environmental Protection, Reading Borough Council, Civic Centre, Reading RG1 7AE

- Rose Green, Environmental Health Officer, West Berkshire District Council, Council Offices, Market Street, Newbury, RG14 5LD
- John Cooper, Director, Drivers Jonas Deloitte, 5 New York Street, Manchester, M1 4JB
- John Share PBA LLP
- Tony Sheach PBA LLP

LIST OF REPORTS

- PBA 1998 Geoenvironmental and Geotechnical Scoping Study, Bucknell Land Option, Reading prepared for Bucknell Brothers Group (04107 dated 1998).

This scoping study comprised a desk based investigation which gathered geoenvironmental and geotechnical information on the site and other land owned by Bucknell Holdings nearby. An intrusive investigation was not undertaken as part of this study.

- PBA 2001 Interim Report on Ground Investigation for Cable Laying at Clembins Waste Transfer Station, Reading prepared for Prudential Property Investment Managers Ltd (10729 dated June 2001).

This report presents the findings of ground investigation along the route of a proposed electric cable adjacent to the railway line. The investigation involved the excavation of nine trial pits, two boreholes and five window sample boreholes. Soil and groundwater testing was carried out on a number of samples.

- PBA 2002 Geoenvironmental Investigation for Phase III, Green Park, Reading prepared for Prudential Property Investment Managers Ltd (11321/300 dated August 2002).

This investigation involved the excavation of 18 trial pits and the drilling of 19 boreholes and seven window sample locations. The investigation targeted the wider Phase III area of GreenPark and included soil and groundwater chemical testing along with ground gas monitoring. A geoenvironmental risk assessment and geotechnical assessment was also carried out.

- PBA 2007A Technical Index 13.3 Gas and Water Quality Monitoring report for GreenPark Village (technical index 13.3) prepared by PBA for St Edward Homes (11321/133D dated July 2007).

This report presents the findings of a long term ground gas and groundwater/surface water quality monitoring programme to assess whether lateral migration of potential pollutants from Smallmead landfill is taking place.

- PBA 2007B Phase 1 and 2 Ground Condition Assessment, Clembins waste transfer station site, Reading prepared for Bucknell Brothers Group (19372/004 dated September 2007).

This investigation involved the excavation of twelve trial pits and the drilling of six boreholes and eight window sampler boreholes and included soil and groundwater chemical testing along with ground gas monitoring. A geoenvironmental Tier 1 and Tier 2 risk assessment was carried out as part of this assessment.

- PBA 2008A Report on Hydrological Risk Assessment (GreenPark Village) prepared for St Edward Homes (11321/1023 dated January 2008).

Report assessing the impacts of dewatering the Trout Lakes.

- PBA 2008B Phase 2 Supplementary Geoenvironmental Ground Condition Assessment for the Pingemead Industrial Estate Reading prepared for St Edward Homes (11321/1028 dated April 2008).

The targeted investigation comprised the drilling of seven boreholes with installations for the purpose of gas and groundwater monitoring.

- PBA 2009A Report on Ground Condition Assessment – Phase 1 and 2, GreenPark Station Temporary Access Road and Car Park prepared for John Laing Plc (11321/1035B dated February 2009).

This investigation involved the excavation of twelve trial pits along the course of a proposed temporary access road and car park. The report presents the findings of a Tier 1 and Tier 2 risk assessment and included an assessment of previous data gathered from the application land.

- PBA 2009B Report on Supplementary Phase 2 Ground Investigation and Tier 2 Risk Assessment prepared for PRUPIM (11321/1034 dated June 2009).

A supplementary ground investigation comprising the excavation of fourteen trial pits to investigate the near surface ground conditions and the drilling of seven new boreholes to a maximum depth of 20.0m bgl with standpipe installations targeting specific strata. The report includes an investigation along the eastern edge of the existing railway (Scott Wilson 2007) comprising 12 exploratory hole locations. The presence of loose ash is noted in exploratory holes TP3, TP4 and the slip trenches. The CSM and risk assessment were refined and an outline remedial strategy prepared.

- PBA 2009C Report on Phase 2(d) – Targeted Ground Investigation (Contamination “Hotspots” WS8 and BHC).

The investigation comprised 11 exploratory holes to investigate ground conditions in two potential “hotspot” locations with the aim of assessing whether the ground conditions could be impacting groundwater quality. The groundwater quality in both locations was identified as impacted by ammoniacal nitrogen and also by polycyclic aromatic hydrocarbons in WS8. It was concluded that the source of the ammoniacal nitrogen was likely to be natural (degradation of residual organic material) and that the shallow soil (to 1mbgl) in the vicinity of WS8 was impacted by hydrocarbons.

Catherine Copping

From: Catherine Copping
Sent: 16 September 2010 14:29
To: 'Turvey, Justin'; 'George, Rebecca'
Cc: John Cooper; Jessica Stanley; John Share
Subject: RE: Green Park Station - PBA letter
 Rebecca/Justin

There will be no infiltration drainage and therefore we do not consider the car park to generate risk. The construction design is to be finalised and therefore you might want to retain the conditions regarding use of piled foundations.

Trust this is acceptable

Regards

Catherine Copping

From: Turvey, Justin [mailto:Justin.Turvey@reading.gov.uk]
Sent: 15 September 2010 14:25
To: Jessica Stanley
Cc: John Cooper; Catherine Copping
Subject: FW: Green Park Station - PBA letter

From: George, Rebecca

Sent: 15 September 2010 11:49

To: Turvey, Justin

Subject: RE: Green Park Station - PBA letter

Hi Justin,

I am happy with the proposed refined conditions, as the remediation strategy has previously been approved (09/0102/APPCON GreenPark Phase 3 - Railway Station Report on Detailed Remedial Strategy, doc ref 11321/1046, 05 Nov 2009) - see my memo dated 9 November 2009. This is assuming that the changes to the car park will not affect the risks from contaminated land, which seems unlikely but it would be good to have this confirmed by the applicant.

We will need to add appropriate timescales to the proposed conditions as in the letter it is written as Y months and Z days. Were there timescales specified in the original permission?

Thanks

Rebecca

-----Original Message-----

From: Turvey, Justin

Sent: 14 September 2010 15:59

To: George, Rebecca

Subject: RE: Green Park Station - PBA letter

Thanks.

From: George, Rebecca

Sent: 14 September 2010 15:57

To: Turvey, Justin

Subject: RE: Green Park Station - PBA letter

Hi Justin,

Sorry, I have been busy with the festival then on leave until this week. Will send you

04/10/2010

comments today or tomorrow if that is okay.

Thanks

Rebecca

From: Turvey, Justin

Sent: 14 September 2010 15:32

To: George, Rebecca

Subject: RE: Green Park Station - PBA letter

Have you been able to look at this yet?
 Justin.

From: Turvey, Justin

Sent: 09 September 2010 13:08

To: George, Rebecca

Subject: Green Park Station - PBA letter

Rebecca,

You were sent a copy of this letter by PBA last month - do you have any comments on the suggestions?

Justin.

Justin Turvey

Principal Planning Officer

Planning Services, Reading Borough Council

Civic Centre, Reading RG1 7AE

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JOB number	Drawing number	Number	Pt.
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LANDSCAPING SHOWN IS INDICATIVE
SEE 'PLACE' LANDSCAPE PROPOSALS FOR DETAILS

Introduction

The aim of the PBA methodology is to define our approach and ensure that (i) it is systematic and objective, (ii) it provides for the assessment of uncertainty, (iii) it provides a rational, consistent, transparent framework and (iv) it provides a defensible basis for the assessment. To this end, technical documentation has been reviewed and the essential features assimilated to generate the PBA methodology for ground condition assessment.

Legislation

The Environment Act 1995 introduced Part IIA into the Environmental Protection Act 1990. Part IIA, its accompanying regulations and Statutory Guidance contained in DETR Circular 02/2000 came into force in England in April 2000. Part IIA defines contaminated land as "land which appears to the Local Authority in whose area it is situated to be in such a condition that, by reason of substances in, on or under the land that significant harm is being caused, or there is a significant possibility that such harm could be caused, or pollution of controlled waters is being, or likely to be, caused". It should be noted that the definition does not include all land that has been impacted by contamination even though such contamination may be relevant in the context of other legislation or redevelopment works. The legislation was extended in August 2006 to include radiological hazards (now referred to as Part 2A). For the purposes of Part 2A assessments, situations where harm is to be regarded as significant are (i) chronic or acute toxic effect, serious injury or death to humans, (ii) irreversible or other adverse harm to the ecological system, (iii) substantial damage to, or failure of buildings, (iv) disease, other physical damage or death of livestock or crops, and (v) pollution of controlled waters.

Ground condition/contamination is a material planning consideration and guidance (PPS 23 2004) has been considered during the preparation of this methodology. The principle planning objective is to ensure that any unacceptable risks to human health, buildings and other property and the natural and historical environment from the contaminated condition of the land are identified so that appropriate action can be considered and taken to address those risks. The Local Planning Authority (LPA) has to be satisfied that there is sufficient information about the condition of the land, its impacts and the availability of viable remedial options.

Approach

The CLR11 promotes a staged approach to the assessment of ground quality/conditions and details three tiers of risk assessment:-

- Tier 1 - preliminary – a qualitative assessment forming part of a Phase 1 report,
- Tier 2 - generic - a quantitative assessment using published criteria to screen site specific ground condition data forming part of a Phase 2 report
- Tier 3 - detailed – a quantitative assessment involving the generation of site specific assessment criteria

Each tier of risk assessment comprises the following four stages:-

1. Hazard Identification – identifying potential contaminant sources on and off site;
2. Hazard Assessment – assessing the potential for unacceptable risks by identifying what pathways and receptors could be present, and what pollutant linkages could result (forming the Conceptual Site Model (CSM));
3. Risk Estimation – estimating the magnitude and probability of the possible consequences (what degree of harm might result to a defined receptor and how likely); and
4. Risk Evaluation – evaluating whether the risk needs to be, and can be, managed.

The PBA approach to risk estimation involves identifying the magnitude of the potential consequence (taking into account both the potential severity of the hazard and the sensitivity of the receptor) and the magnitude of the likelihood i.e. the probability (taking into account the presence of the hazard and the receptor and the integrity of the pathway). This approach is promoted in current guidance such as R&D 66 (NHBC 2008).

The PBA approach is that if a pollution linkage is identified then it represent a potential risk which requires further consideration and either (1) remediation / direct risk management or (2) further tiers of assessment. Subsequent tiers require additional information and the refinement of the CSM.

PBA Methodology for Ground Condition Assessment

The PBA methodology provides an estimate of the level of risk, it does not identify a risk level at which the risk is considered “significant” and/or “unacceptable” as this is dependant on the view of the individual / stakeholder. For example; to a risk adverse stakeholder even a risk level of “very low” may be considered unacceptable and as such this stakeholder may require risk management options to be implemented.

Identification of Pollutant Linkages

The underlying principle to ground condition assessment is the identification of *pollutant linkages* in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements:-

- A source/hazard – a substance or situation which has the potential to cause harm or pollution;
- A pathway – a means by which the hazard moves along / generates exposure; and
- A receptor/target – an entity which is vulnerable to the potential adverse effects of the hazard.

The *Conceptual Site Model* identifies the types and locations of potential contaminant sources/hazards and potential receptors and potential migration/transportation pathway(s).

Hazard Identification

A hazard is a substance or situation that has the potential to cause harm. Hazards may be chemical, biological or physical (e.g. explosive gases). The potential for hazards to be present is determined from consideration of the previous or ongoing activities on or near to the site in accordance with the criteria presented in the **Table 1**.

Table 1: Criteria for Classifying Hazards

Classification/Score	Definition (potential for generating contamination/gas based on Land Use)
Very Low 1	Land Use: greenfield Contamination: None. Gas generation potential : Inert Made Ground
Low 2	Land Use: residential, retail or office use, recent small scale industrial. Contamination: None or locally slightly elevated concentrations. Gas generation potential : Alluvium or dock silt
Moderate 3	Land Use: railways, collieries, scrap yards, light industry, engineering works. Contamination: Locally elevated concentrations. Gas generation potential : Pre 1960's landfill
High 4	Land Use: gas works, chemical works, heavy industry, non-hazardous landfills. Contamination: Possible widespread elevated concentrations. Gas generation potential : Shallow mine workings
Very High 5	Land Use: hazardous waste landfills. Contamination: Likely widespread elevated concentrations. Gas generation potential : Domestic landfill post 1960

NOTE the classification for gas generation potential is based on CIRIA C665

Receptor Identification

The potential receptors (for both on site and adjoining land) that will be considered are:

- Human Health – including current and future occupiers, construction and future maintenance workers, and neighbouring properties/third parties;
- Ecological systems; ^{*1}
- Controlled waters ^{*2} – including surface water and groundwater;
- Property, Animal or Crop (existing or proposed) - including buildings, service lines and pipes, crops, livestock, pets, woodland; and
- Archaeological sites and ancient monuments.

^{*1} internationally or nationally designated sites (as defined in the statutory guidance (Draft Circular on Contaminated Land, DETR, 2000)) “in the local area” will be identified as potential ecological receptors. A search radius of 1, 2 or 5km will be utilised depending on the site specific circumstances (see also pathway identification). The Environment Agency has published an ecological risk assessment framework (EA 2008) which promotes (as opposed to statutorily enforces) consideration of additional receptors to include locally protected sites and protected or notable species. These additional potential receptors will only be

PBA Methodology for Ground Condition Assessment

considered if a Phase 1 habitat survey, undertaken in accordance with guidance (JNCC 1993), is commissioned and the data provided to PBA. It should be noted that without such a survey the Tier 1 risk assessment may conclude that the identification of potential ecological receptors is inconclusive (see Specification).

*² the definition of "pollution of controlled water" has been amended by the introduction of Section 86 of the Water Act 2003. For the purposes of Part 2A groundwater does not include waters above the saturated zone and our assessment does not therefore address perched water other than where development causes a pathway to develop.

If a receptor is taken forward for further assessment it will be classified in terms of its sensitivity, the criteria for which are detailed in Table 2. Table 2 has been generated using descriptions of environmental receptor importance/value given in various guidance documents including R&D 66 (NHBC 2008) and Transport Analysis Guidance (based on DETR 2000). Human health and buildings classifications have been generated by PBA using the attribute description for each class.

Table 2: Criteria for Classifying Receptor Sensitivity/Value

Classification/Score	Definition
Very Low 1	Receptor of limited importance Groundwater: Non aquifer Surface water: GQA Grade F Ecology: No local designation Buildings: Replaceable Human health: Unoccupied/limited access
Low 2	Receptor of local or county importance with potential for replacement Groundwater: Minor aquifer Surface water: GQA Grade D/E Ecology: local habitat resources Buildings: Local value Human health: Industrial
Moderate 3	Receptor of local or county importance with potential for replacement Groundwater: Major aquifer Surface water: GQA Grade B/C Ecology: County wildlife sites, Areas of Outstanding Natural Beauty (AONB) Buildings: Area of Historic Character Human health: Commercial
High 4	Receptor of county or regional importance with limited potential for replacement Groundwater: Source protection zone 2 Surface water: GQA Grade A Ecology: SSSI, National or Marine Nature Reserve (NNR or MNR) Buildings: Conservation Area Human health: Open spaces and uses where children are present
Very High 5	Receptor of national or international importance Groundwater: Source protection zone 1 Surface water: GQA Grade A Ecology: Special Areas of Conservation (SAC and candidates), Special Protection Areas (SPA and potentials) or wetlands of international importance (RAMSAR) Buildings: World Heritage site Human health: Residential

Pathway Identification

The exposure pathway and modes of transport that will be considered are presented in the **Table 3**.

For ecological systems the Tier 1 will assess the viability of the mode of transport given the site specific circumstances not specific pathways. As with receptor identification it should be noted that without a habitat survey the Tier 1 risk assessment may conclude that the risk to potential ecological receptors is inconclusive (see Specification).

Table 3: Exposure Pathway and Modes of Transport

Receptor	Pathway	Mode of transport
Human health	Ingestion	Fruit or vegetable leaf or roots
		Contaminated water
		Soil/dust indoors
		Soil/dust outdoors
	Inhalation	Particles (dust / soil) – outdoor
		Particles (dust / soil) - indoor
		Vapours – outdoor - migration via natural or anthropogenic pathways
		Vapours - indoor - migration via natural or anthropogenic pathways
	Dermal absorption	Direct contact with soil
		Direct contact with waters (swimming / showering)
		Irradiation
Groundwater	Leaching	Gravity / permeation
	Migration	Natural – groundwater as pathway Anthropogenic (e.g. boreholes, culverts, pipelines etc.)
Surface Water	Direct	Runoff or discharges from pipes
	Indirect	Recharge from groundwater
	Indirect	Deposition of wind blown dust
Buildings	Direct contact	Sulphate attack on concrete, hydrocarbon corrosion of plastics
	Gas ingress	Migration via natural or anthropogenic paths
Ecological systems	See Notes	Runoff/discharge to surface water body
	See Notes	Windblown dust
	See Notes	Groundwater migration
	See Notes	At point of contaminant source
Animal and crop	Direct	Wind blown or flood deposited particles / dust / sediments
	Indirect	Plants via root up take or irrigation. Animals through watering
	Inhalation	By livestock / fish - gas / vapour / particulates / dust
	Ingestion	Consumption of vegetation / water / soil by animals

Risk Estimation

Risk estimation classifies what degree of harm might result to a receptor (defined as consequence) and how likely it is that such harm might arise (probability). The consequence classification is generated by multiplying the hazard classification score and the receptor sensitivity score. This approach follows that presented in the republished R&D 66 (NHBC 2008). The classifications detailed in Table 4 have been adapted from Table 6.3 presented in CIRIA C552 and A4.3 in R&D 66.

Table 4: Classification of Consequence (score = magnitude of hazard and sensitivity of receptor)

Classification Score	Examples
Severe 20-25	Human health effect - exposure likely to result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Equivalent to EA Category 1 incident (persistent and/or extensive effects on water quality leading to closure of potable abstraction point or loss of amenity, agriculture or commercial value. Major fish kill. Ecological effect - short-term exposure likely to result in a substantial adverse effect. Catastrophic damage to crops, buildings or property
Medium 10-16	Human health effect - exposure could result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - equivalent to EA Category 2 incident requiring notification of abstractor Ecological effect - short-term exposure may result in a substantial adverse effect. Damage to crops, buildings or property
Mild 6-9	Human health effect - exposure may result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - equivalent to EA Category 3 incident (short lived and/or minimal effects on water quality). Ecological effect - unlikely to result in a substantial adverse effect. Minor damage to crops, buildings or property. Damage to building rendering it unsafe to occupy (for example foundation damage resulting in instability).
Minor 1-5	No measurable effect on humans. Protective equipment is not required during site works. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects to crops, buildings or property. The loss of plants in a landscaping scheme. Discolouration of concrete.

The criteria for classifying probability are set out in Table 5 which is taken directly from CIRIA C552 (Table 6.4). Probability considers the integrity of the exposure pathway.

Table 5: Classification of Probability

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is already evidence at the receptor of harm / pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter-term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that

PBA Methodology for Ground Condition Assessment

	an event would occur even in the very long-term.
--	--

The resulting risk is estimated for each receptor using the matrix given in Table 6 which is taken directly from CIRIA C552 (Table 6.5).

Table 6: Classification of Risk (Combination of Consequence and Probability)

Probability	Consequence			
	Severe	Medium	Mild	Minor
High likelihood	Very high	High	Moderate	Low
Likely	High	Moderate	Moderate/low	Low
Low likelihood	Moderate	Moderate/low	Low	Very low
Unlikely	Moderate/low	Low	Very low	Very low

Risk Evaluation

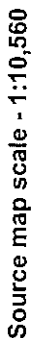
In order to put the risk classification into context the likely actions are detailed in Table 7 which is taken directly from CIRIA C552 (Table 6.6).

Table 7: Description of Risks and Likely Action Required

Risk Classification	Description
Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer-term.
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

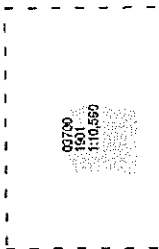
References

- NHBC & CIEH, 2008 R&D Publication 66 Guidance for the safe development of housing on land affected by contamination.
- CIRIA 2001 C552 Contaminated land risk assessment – a guide to good practice.
- CIRIA 2008 C655 Assessing risks posed by hazardous ground gases to buildings.
- EA 2004 CRL 11 Model Procedures for the Management of Land Contamination.
- ODPM 2004 Planning Policy Statement 23 (PPS 23):Planning and Pollution Control.
- DETR 2000 Methodology for Multi Modal Studies. Volume 2 Section 4 The Environmental Objective.
- EA 2008 Ecological Risk Assessment Science Report Series SC070009 published by the Environment Agency (EA).
- JNCC 1993 Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit prepared by the Joint Nature Conservancy Council (JNCC)

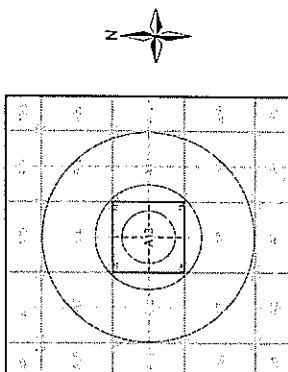


The historical maps shown were reproduced from maps produced during the time that the scale adopted for England, Wales and Scotland in the 1840's was. At that time a 2:50 scale was adopted for mapping urban areas; these maps were used to produce the 1:10,000 maps. The published date given therefor is 1854, although the maps were often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in joining the maps. In the late 1940's, a Provisional Edition was produced, in which the 1:10,000 mapping from a number of sources. The maps appear unfinished – with all military camps and other strategic sites removed. These maps were initially overlaid with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A

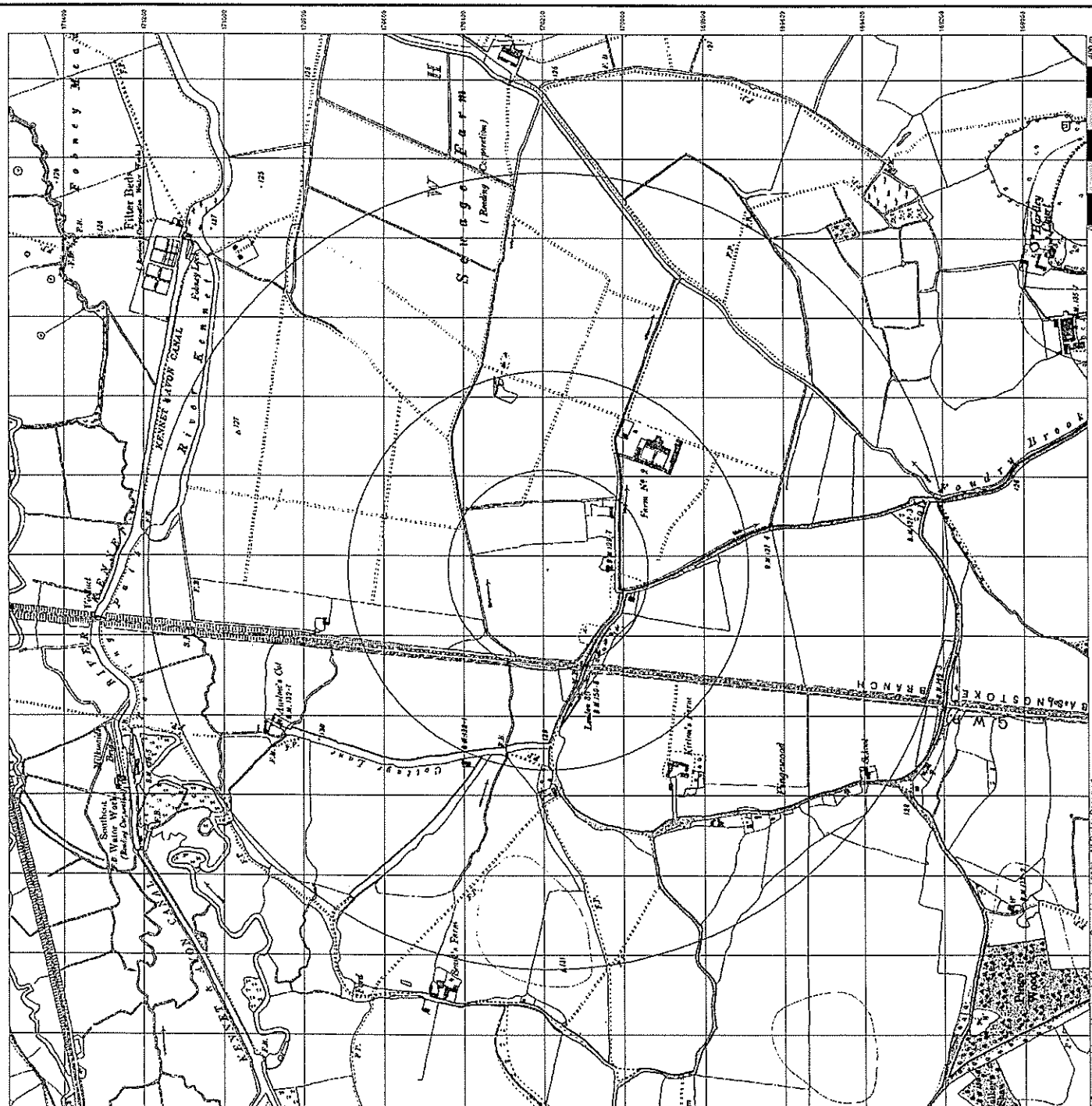


Order Details

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Search Buffer (m): 1000

Site Details

Site at 469500, 170100

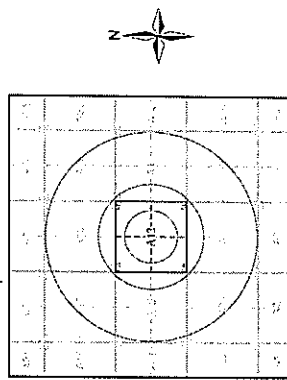


The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:10,560 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published data given therefore is often some years later than the surveyed data. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

037NW	037NE
1938	1938
1:10,560	1:10,560
037SW	037SE
1938	1938
1:10,560	1:10,560

Historical Map - Slice A

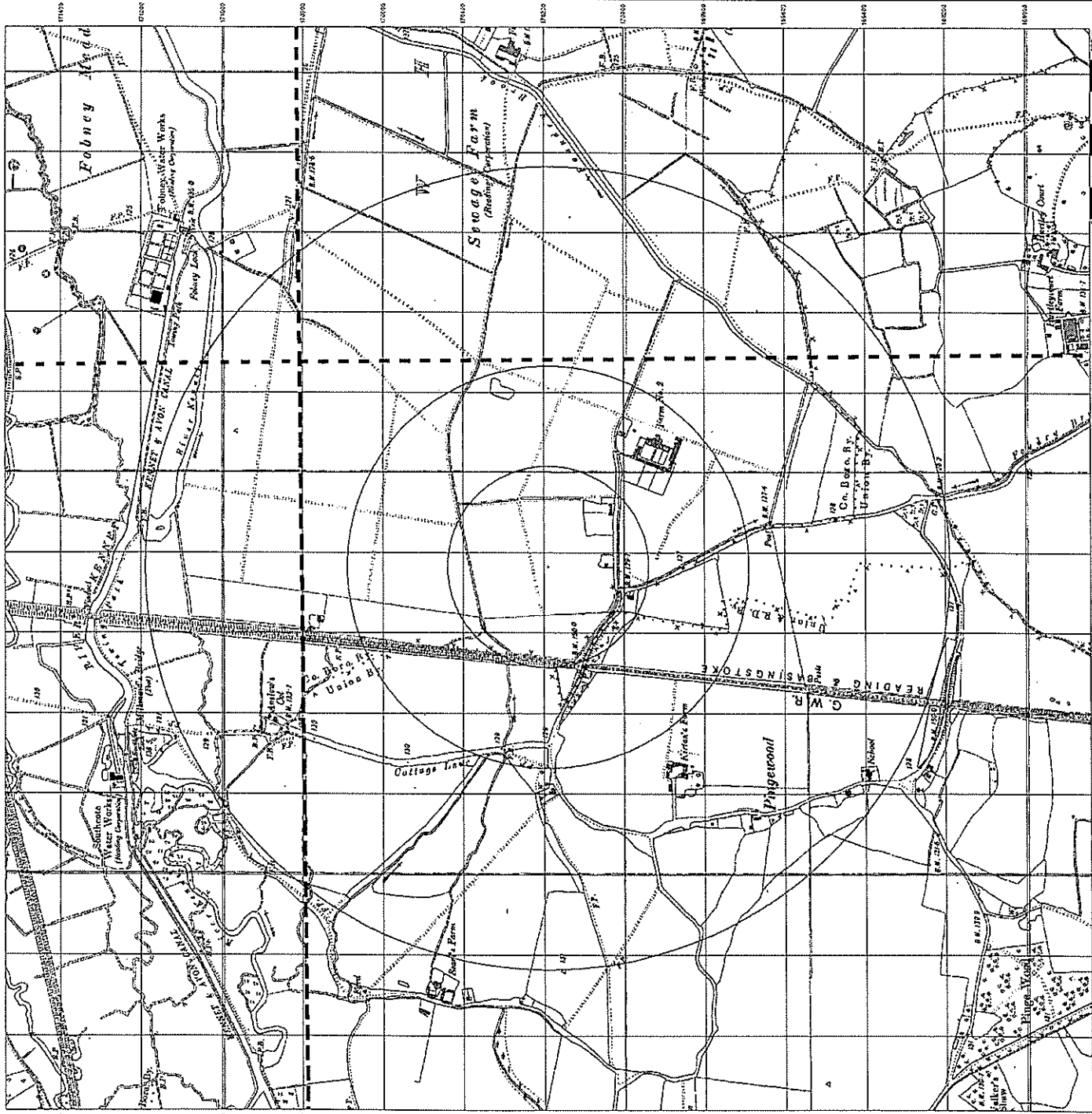


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Site Details

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Ordnance Survey Plan Published 1961 - 1962

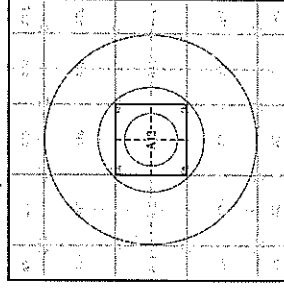
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the Ordnance Survey, which were used for mapping urban areas, these maps were used to update the 1:10,000 maps, which were often some years later than the surveyed data. Before 1838, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,000 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overlaid with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

SU75SE	SU77SW
1961	1962
1:10,560	1:10,560
SU69NE	SU76NW
1961	1961
1:10,560	1:10,560

Historical Map - Slice A



Order Details

Order Number: 27350089 1.1
Customer Ref: 1132110355
National Grid Reference: 469770, 170190
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Site at 469500, 170100



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Fax: 0644 844 0651
Web: www.entrack.co.uk



Ordnance Survey Plan Published 1971 - 1976

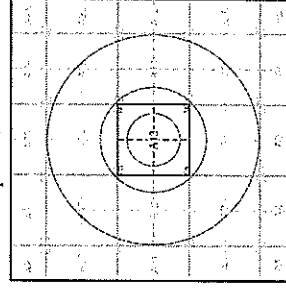
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1940's. In 1954 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,000 maps. The published date given therefore is the date of the update. Before 1954, all OS maps were based on the Cassini Projection. In the late 1940's, all OS maps were reprojected to the Transverse Mercator Projection. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,000 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overlaid with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

SUT7SE	SUT7SW
1976	1973
1:10,000	1:10,000
SUE7NE	SUE7NW
1972	1971
1:10,000	1:10,000

Historical Map - Slice A



Order Details

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Customer Ref: 1132170355
National Grid Reference: 469770, 170190
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

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10k Raster Mapping Published 2008

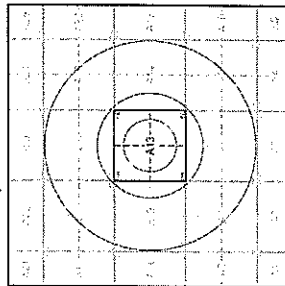
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which is the highest resolution digital map data available in the UK. The data is high resolution and is derived from aerial photography. It includes all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)

SURPSE	SUR7SW
2008	2008
1:10,000	1:10,000
SURONE	SUR7NW
2008	2008
1:10,000	1:10,000

Historical Map - Slice A



Order Details

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National Grid Reference: 469770, 170190

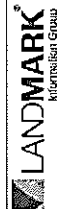
Site: A

Site Area (Ha): 0.01

Search Buffer (m): 1000

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13 May 2010

Waste

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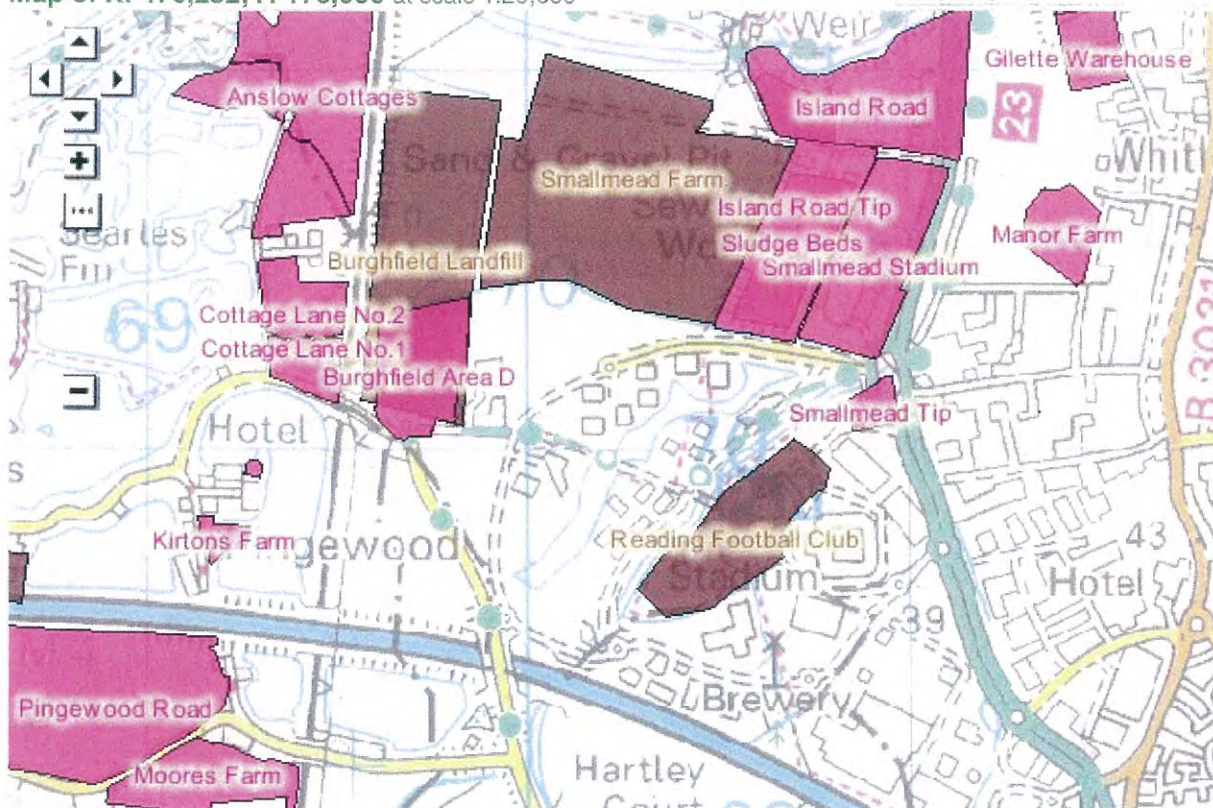
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Overview map:

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- Rivers](#)[River Basin
Management Plans
- Lakes](#)[River Basin
Management Plans
- Coastal Waters](#)[River Basin
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Map of X: 470,232;Y: 170,096 at scale 1:20,000

Map Legend



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Active landfills are sites with a current licence that are still accepting waste, or are no longer accepting waste but still being actively managed.

Historic landfills are sites that are now closed and may date back to early records.

Waste regulation

We regulate waste management through a system of licences. Find out how to get the correct licence here, get data on waste and find out if there are any rules applying to household waste.

Waste facts and figures

The UK produces about 220 million tonnes of controlled wastes per year. Find out about waste incineration, hazardous waste, recycling and landfill.

AAA

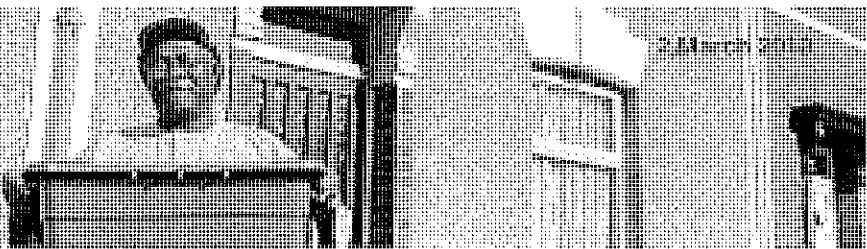
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Environment Agency



What's in your backyard?

Historic landfill

Site details:

Site name	Cottage Lane No.1	8U 694 702
Site address	Pingewood, Berkshire	
Site operator	closed	
Licence no.	0 No lic.	

Types of waste buried:

A 'Yes' is shown in the right hand box where there is evidence that the type of waste may have been buried. If there is no evidence or no data currently available, then the box is left blank.

Inert: Waste which remains largely unaltered once buried such as glass, concrete, bricks, tiles, soil and stones.	Yes
Industrial: Waste from a factory or industrial process. It excludes waste from mines, quarries and agricultural wastes.	Yes

Filed 1977-81

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Search

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Environment
Agency

2 March 2010

What's in your backyard?

Historic landfill

Site details:

Site name	Cottage Lane No.2	SU 694 703
Site address	Pingewood, Berkshire	
Site operator		Closed
Licence no.	0 54/12 / 4/17	Returned

Types of waste buried:

A 'Yes' is shown in the right hand box where there is evidence that the type of waste may have been buried. If there is no evidence or no data currently available, then the box is left blank.

Inert:

Waste which remains largely unaltered once buried such as glass, concrete, bricks, tiles, soil and stones.

Yes

Site Filed 1977-89

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▲ WATER LEVEL (2003)

RMC (AGGREGATES) SOUTHERN LTD

W21 ○ BOREHOLE LOCATION (1991)

PETER BRETT ASSOCIATES

TP2 ■ TRIAL PIT LOCATION (2001)

LAKE ▲ SURFACE WATER POINT (2005)

BH E ○ BOREHOLE LOCATION (2007)

WS 8 ○ WINDOW SAMPLE BOREHOLE LOCATION (2007)

TP F ■ TRIAL PIT LOCATION (2007)

FOUNDATION EXPLORATION SERVICES

WS2 ○ WINDOW SAMPLE BOREHOLE LOCATION (2002)

BH G4 ○ CABLE PERCUSSION BOREHOLE (2002)

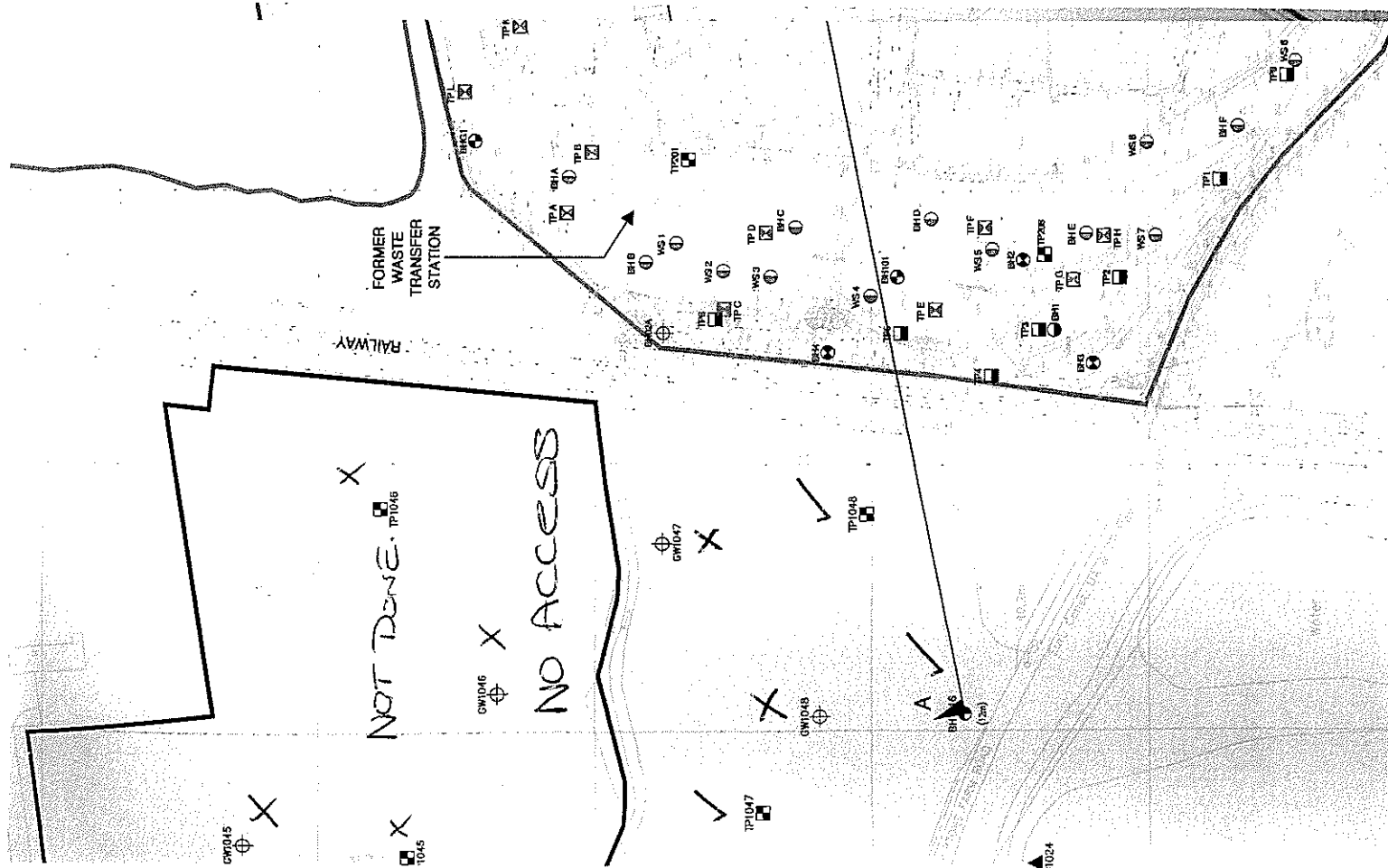
TP201 ■ TRIAL PIT LOCATION (2002)

C J ASSOCIATES

G14 ○ CABLE PERCUSSION BOREHOLE (2005)

┌ CROSS SECTION LINES

┐ SITE BOUNDARY



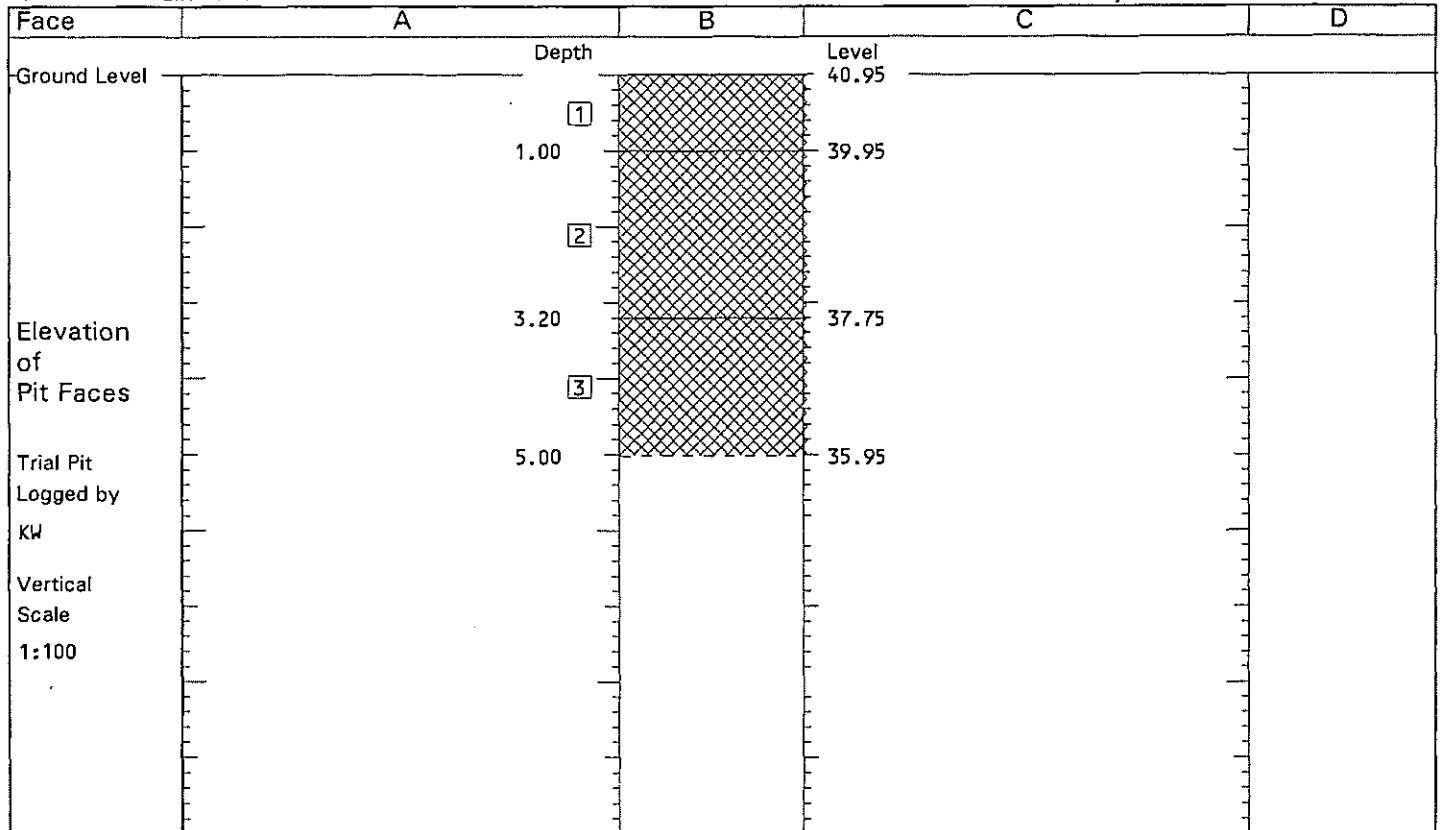
TRIAL PIT RECORD

Project KENNET VALLEY PARK PROJECT

Engineer PETER BRETT ASSOCIATES

Trial Pit **TP1047**
 Coordinates 469371.3E 170239.1N
 National Grid
 Project No PC030538

Client PRUDENTIAL PROPERTY INVESTMENT MANAGEMENT



Samples and Tests			Strata			
Depth	Type	Strength kN/m ²	Face B Depth	Stratum Number	Description	Geological Classification
0.30	J		1.00	1	Dark brown sandy gravelly clay. Gravel is angular to subrounded fine to coarse flint, brick cobbles, metal and concrete.	MADE GROUND.
1.20 2.10	B J		3.20	2	Grey green brown mottled black sandy very gravelly clay. Gravel is angular to subrounded fine to coarse of flint, limestone, chalk, brick, concrete, metal, a roll of carpet and timbers. Between 2.00-2.20m, pocket of grey green sandy gravelly clay with bricks. At 2.60m, tarmac. At 3.20m, concrete.	MADE GROUND.
3.60 4.20 4.90	J J B		5.00	3	Grey white mottled black sandy gravelly clay. Gravel is angular to subrounded fine to coarse chalk, flint, brick, concrete and tarmac. Between 4.10-4.40m, pocket of soft brown grey sandy slightly gravelly clay. Gravel is angular to subrounded fine to coarse brick, flint and chalk with timber fragments. At 4.70m, concrete blocks and metal sheeting. Below 4.70m, becoming grey clay.	MADE GROUND.

Excavation				Dimensions	Groundwater
Date Excavated	08/09/03	Date Backfilled	08/09/03		Below 3.50m, slight seepage.
Plant	JCB 3CX				
Shoring	None				
Stability	Slight caving in chalky clay.				

Remarks

geotechnics

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres.

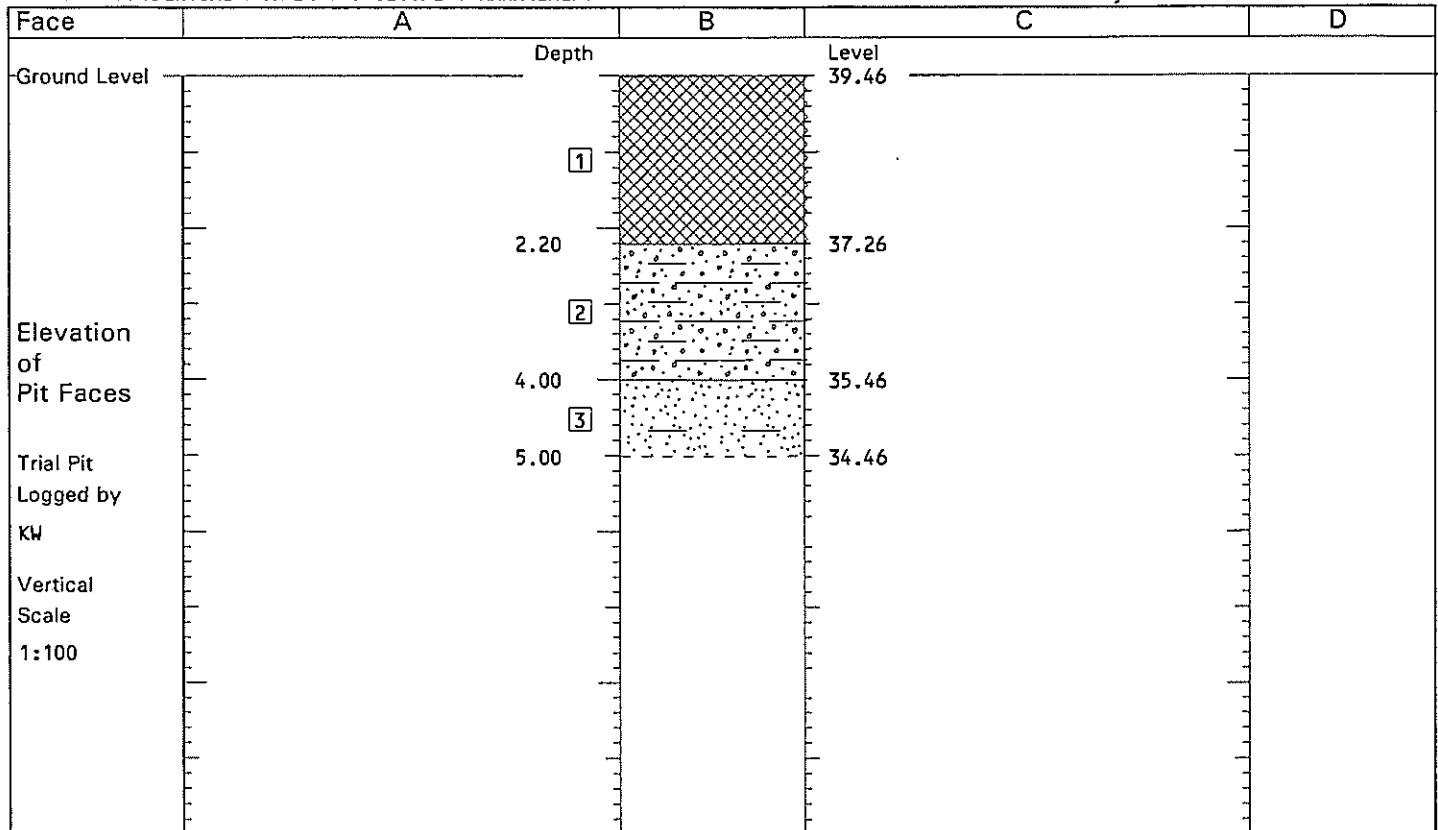
TRIAL PIT RECORD

Project KENNET VALLEY PARK PROJECT

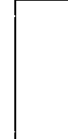
Engineer PETER BRETT ASSOCIATES

Trial Pit **TP1048**
 Coordinates 469482.4E 170203.3N
 National Grid
 Project No PC030538

Client PRUDENTIAL PROPERTY INVESTMENT MANAGEMENT



Samples and Tests			Strata			
Depth	Type	Strength kN/m ²	Face B Depth	Stratum Number	Description	Geological Classification
0.40 1.40	J B				Brown mottled orange brown and black sandy slightly gravelly clay/silt. Gravel is angular to subrounded fine to coarse flint, brick, glass, metal and chalk with occasional pockets of light brown sand and blocks of concrete.	MADE GROUND.
			2.20	1	At 1.80m, pocket of black clay with tarmac and burnt timber.	
2.30 2.80 3.90	J J J				Soft green grey mottled brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse flint.	
			4.00	2	At 2.70m, becomes very gravelly.	
					At 3.90m, becomes brown grey and very gravelly.	
4.10 5.00	B J		5.00	3	Grey mottled brown clayey SAND.	

Excavation				Dimensions	Groundwater
Date Excavated	08/09/03	Date Backfilled	08/09/03		At 2.80m, seepage.
Plant	JCB 3CX				
Shoring	None				
Stability	Collapse in gravel at 3.00m.				

Remarks



Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres.

BOREHOLE RECORD - Cable Percussion

Sheet 1 of 2

Project KENNET VALLEY PARK PROJECT

Engineer PETER BRETT ASSOCIATES

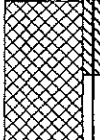
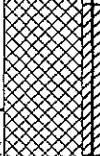
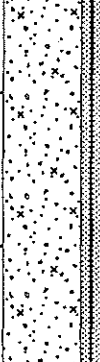
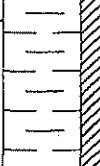
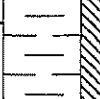
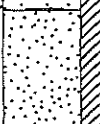
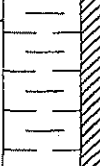
Borehole BH1016

Coordinates 469406.7E 170165.1N

National Grid

Client PRUDENTIAL PROPERTY INVESTMENT MANAGEMENT

Project No PC030538

Sampling				Properties			Strata			
Depth	Sample Type	Depth Cased	Depth to Water	Strength kN/m ²	W %	SPT N	Description	Depth	Legend	Level m
0.00 - 0.95	B						Dark brown clayey sand and gravel. Gravel is subangular fine to coarse brick, flint, chalk and clinker with occasional cobbles of brick. MADE GROUND.	G.L.		39.96
1.00	J							0.95		39.01
1.20 - 1.65	J					11	Dark grey and black silty/clayey gravelly sand. Gravel is subangular to subrounded fine to coarse flint, quartzite and brick. MADE GROUND.			
1.20 - 1.65	S									
1.20 - 1.65	B									
1.80	J						Below 1.80m, soft dark grey clay pockets.			
2.20 - 2.65	B	2.15				46	Dense brown, grey and white slightly silty very sandy GRAVEL. Gravel is angular to subrounded fine to coarse flint.	2.30		37.66
2.20 - 2.65	S									
3.00	J						Between 3.20-4.80m, becoming medium dense.			
3.20 - 3.65	B	3.15	2.45			30				
3.20 - 3.65	C									
4.00	J									
4.20 - 4.65	B	4.15	3.30			18				
4.20 - 4.65	C									
5.00	J						Stiff green grey oxidising to brown CLAY.	4.80		35.16
5.55 - 6.00	U38	5.50	3.50	127	21.0		Stiff red brown and grey sandy CLAY.	5.60		34.36
6.00 - 6.15	J						Grey and brown fine SAND.	6.00		33.96
6.50	J						Below 6.50m, becomes clayey/silty.			
7.05 - 7.50	J	7.00	3.80			20	Stiff brown and grey CLAY. Becomes very stiff with depth.	6.80		33.16
7.05 - 7.50	S									
7.05 - 7.50	B									
8.00	J							8.00		31.96

Boring				Progress				Groundwater				
Depth	Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	am (A) Date pm (P)	Depth Struck	Depth Cased	Depth after 20 mins	Depth Sealed	Remarks on Groundwater
1.20	200mm	Inspection Pit.	CR	Start	7.00	3.80	10/09/03	2.30	2.15	2.28		
3.00	150mm	Cable Percussion.	CR	8.30	7.00	3.80	P10/09/03					
12.00		Cable Percussion.	CR	8.30	7.00	3.80	P11/09/03					
				12.00	11.50	5.30	P11/09/03					
				End			11/09/03					

Remarks

Inspection pit hand excavated to 1.20m.
50mm standpipe installed, risings 12.00-5.60m, seal 5.60-4.80m,
slotted pipe and filter 4.80-2.30m, seal 2.30-1.30m,
concrete and cover 0.50m-G.L.
** Drillers Description.

geotechnics

Logged by: EA

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres.

Scale: 1:50

BOREHOLE RECORD - Cable Percussion

Sheet 2 of 2

Project KENNET VALLEY PARK PROJECT

Engineer PETER BRETT ASSOCIATES

Borehole BH1016

Coordinates 469406.7E 170165.1N

National Grid

Client PRUDENTIAL PROPERTY INVESTMENT MANAGEMENT

Project No PC030538

Sampling				Properties			Strata			
Depth	Sample Type	Depth Cased	Depth to Water	Strength kN/m ²	W %	SPT N	Description	Depth	Legend	Level m
							As on preceding sheet	8.00		31.96
8.55 - 9.00 8.55 - 9.00 8.55 - 9.00	J S B	8.50	4.50			29	Below 8.50m, red brown and grey mottled.			
9.50	J									
10.05- 10.50	U41	10.00	4.30	99	27.0					
10.50- 10.65	J									
11.00	J									
11.55- 12.00 11.55- 12.00	J S	11.50	5.30			38		12.00		27.96

Boring				Progress				Groundwater				
Depth	Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	am (A) Date pm (P)	Depth Struck	Depth Cased	Depth after 20 mins	Depth Sealed	Remarks on Groundwater
1.20 3.00 12.00	200mm 150mm	Inspection Pit. Cable Percussion. Cable Percussion.	CR CR CR	Start 8.30 8.30 12.00 End	7.00 7.00 11.50	3.80 3.80 5.30	10/09/03 P10/09/03 P11/09/03 P11/09/03 11/09/03	2.30	2.15	2.28		

Remarks

Inspection pit hand excavated to 1.20m.
50mm standpipe installed, arisings 12.00-5.60m, seal 5.60-4.80m,
slotted pipe and filter 4.80-2.30m, seal 2.30-1.30m,
concrete and cover 0.50m-GL.
** Drillers Description.



Logged by: EA

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres.

Scale: 1:50

Rationale for the Selection of Generic Assessment Criteria

1 Introduction

The aim of this document is to present an explanation for the selection of the generic assessment criteria routinely used by PBA. Any deviation from these criteria and selection of criteria for parameters not covered in this document will be described in the report text. The report will also comment on the appropriateness of the criteria for any specific project objectives or ground conditions.

The document is divided into some introductory text and individual discussions on soils, water and soil gases.

2 Contaminated Land Legislation and Definition

The statutory regime for the identification and remediation of contaminated land came into effect on 1 April 2000 by bringing into force Part 2A of the Environmental Protection Act 1990. Part IIA was inserted into the 1990 Act by Section 57 of the Environment Act 1995. The definition was further revised with respect to pollution of controlled waters on 1st October 2004 by bringing in an amendment under Section 86 of the Water Act 2003.

The Contaminated Land Regime reflects the UK Government's stated objectives of achieving sustainable development through the "suitable for use approach". This consists of three elements:

- i) Ensuring that land is suitable for its current use;
- ii) Ensuring that land is made suitable for any new use, as planning permission is given for that new use; and
- iii) Limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land for which planning permission is being sought.

Contaminated Land for the purpose of Part 2A is defined as "any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, 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 caused or there is a significant possibility of such pollution being caused".

The planning system uses a slightly different definition for contaminated land which is currently provided within Annex 2 of Planning Policy Statement 23: Planning and Pollution Control

(ODPM, 2004). The term "land affected by contamination" is used which covers cases where "the actual or suspected presence of substances in, on or under the land may cause risk to people, properties, human activities or the environment, regardless of whether or not the land meets the statutory definition in Part IIA".

3 Principles of the Tiered Approach to Risk Assessment

The principle of risk assessment underlines the determination of whether the land is contaminated land. The risk assessment includes the development of a conceptual site model that describes the types and locations of contamination source(s), potential receptor(s) and potential migration/transportation pathway(s) that may link the identified source(s) to the identified receptor(s). The methodology is endorsed in relevant technical guidance (e.g. DETR, 2000a, EA, 2002 and EA, 2006a).

A tiered approach to land assessment is outlined as follows:

Tier 1 Preliminary Risk Assessment - a qualitative assessment informed by a Phase 1 study comprising of a desk study and walkover.

Tier 2 Generic Risk Assessment - a quantitative assessment of site-specific data by comparison to generic assessment criteria (GAC) informed by a Phase 2 study comprising intrusive investigation and laboratory testing.

Tier 3 Detailed Risk Assessment (DQRA) - comprising a quantitative risk assessment by comparison to site-specific assessment criteria (SSAC).

The guidance advocates that each tier of assessment should be undertaken in a step-wise approach until the level of risk posed by the site is fully understood and deemed to be acceptable. Thus if a Tier 1 assessment concludes that the risks associated with the site are acceptable, no further assessment is required. Similarly, where unacceptable risks can be ruled out by a Tier 2 assessment, then there is no need for a Tier 3 assessment.

Under PPS23 it is necessary to determine whether there are likely to be any contamination issues on the site prior to submitting an application for planning consent. Some local authorities are requiring a minimum of a Phase 1 containing a Tier 1 Preliminary Risk Assessment for applications where the development is sensitive or sensitive receptors are present. Where contamination is known or likely it may be necessary to undertake an intrusive investigation

to collect site-specific data before an application can be made.

4 Tier 2 Generic Assessment Criteria

The Tier 2 risk assessment involves the use of published generic criteria to “screen” the site-specific contamination testing data and identify potential hazards to specific receptors. Guidance on available generic assessment criteria (GAC) is given in CRL 11 (EA, 2004). The following text identifies the criteria routinely adopted by PBA for screening the risk to specific receptors. Where this general approach is not appropriate for any one site, alternative assessment criteria will be presented in the report text.

4.1 General Notes

It should be noted that in general, GAC have been developed using highly conservative assumptions to screen out sites that definitely would not present a problem. Where sites fail the criteria this may not necessarily mean that the site represents an unacceptable risk for the particular management context in which decisions have been made.

It is stressed that the exceedance of a Tier 2 GAC does not necessarily indicate that a site is statutorily contaminated or unsuitable for use (CLAN2-05) and that whilst GAC provide an aid to decision-making, they do not replace the need for sound professional judgement in risk assessment (EA, 2006b).

It should be noted that any PBA interpretation of contamination test results is based on a scientific and engineering appraisal. The perceptions of, for example, banks, insurers, lay people etc are not taken into account.

Any summary tables included in this Appendix are produced for ease of reference to the criteria, they do not in any way replace the documents of origin (which are fully referenced) and which should be read to ensure appropriate use and interpretation of the data.

4.2 Tier 2 Screening Values for Assessing Soils

Potential Harm to Human Health The criteria which are routinely used by PBA as Tier 2 soil screening values are presented in Table 1.

Cautionary Note The production of authoritative contaminated land guidance in the UK is currently incomplete. DEFRA has yet to produce a comprehensive list of assessment criteria that on its own, would be sufficient to enable the assessment of the potential risks posed by soil contaminants (to human health). A number of industry-driven initiatives have developed in recent months in order to increase the amount of contaminated land guidance available to

practitioners. This has led to the publication of a series of non-statutory non-Governmental contaminated land assessment criteria. (It should be noted that the published DEFRA guidance is also non-statutory).

PBA has reviewed these publications and has taken a pragmatic view to the use of various criteria in the assessment of human health risk from contaminated land. Where we consider that non-Governmental criteria are authoritative and robust, we will refer to such criteria in our assessment of soil contamination. Because such criteria are not published by the UK Government, they are not beyond scrutiny and may be subject to challenge by a regulatory body or their representative. If the use of selected generic assessment criteria is challenged, it may be necessary to carry out detailed modelling to generate site-specific assessment criteria.

Former Soil Guideline Values (2002) Technical guidance with respect to the human health element of the assessment of contamination in soils was released by the Environment Agency (EA) in March 2002 via the ‘contaminated land exposure assessment’ (CLEA) regime (EA, 2002).

The CLEA regime provided generic Soil Guideline Values (SGVs) for a limited number of contaminants for a variety of different land use classes. The regime was incomplete in terms of the range of contaminants listed in CLR8 (EA, 2002) and prior to July 2008, SGVs had only been published for 10 substances (arsenic, cadmium, chromium, lead, mercury, nickel, selenium, ethylbenzene, toluene and phenol).

On 22 July 2008 DEFRA announced the withdrawal of the existing SGVs to coincide with the release of a revised and updated version of the CLEA model (the original version of which was used to devise the original SGVs). The Environment Agency (EA) is currently in the process of deriving new SGVs using the updated CLEA model. The first tranche of this work was published in March 2009.

New (2009) SGVs that have been published are generally similar to the withdrawn SGVs (i.e. they still represent conservative threshold numbers below which no significant risk of harm to human health is likely to be present). Consequently, in the absence of replacement SGVs, there is no reason whatsoever to suggest that the former SGVs should be considered technically unsound and since both practitioners and regulators require a framework to continue working within, the former SGVs will still be used to assist in the interpretation of relevant geoenvironmental testing results until such time that they have been formally replaced by DEFRA.

An exceedance of a 2002 SGV indicates that further assessment via a site specific risk

Rationale for the Selection of Generic Assessment Criteria

assessment may be needed.

Soil Guidance Values (2009) On 31 March 2009, the EA took the first of an intended series of steps towards re-releasing SGVs calculated using the latest version of the CLEA model (CLEA v 1.04). SGVs were published for six substances (benzene, toluene, ethylbenzene and xylene (BTEX compounds) and mercury and selenium) (EA, 2009). The specified land uses were residential with plant uptake, allotments and industrial/commercial. Subsequently SGVs have been published for a further four substances (arsenic, nickel, cadmium and phenol) for residential with plant uptake, allotments and industrial/commercial land use. These SGVs will be used by PBA as Tier 2 assessment criteria.

CLSD Generic Assessment Criteria (GAC) It is noteworthy that the SGVs generated by the CLEA model for organic compounds are dependent on the amount of organic matter present in the soil (a lower SGV is generated for soils with lower organic matter contents since organic matter acts to immobilise organic contaminants). The SGVs published by the EA for BTEX compounds and phenol assume that the 'host' soil has 6% organic matter.

PBA recognises that UK soils often have organic matter concentrations below 6% and that it may therefore not be conservative to use the published SGVs for BTEX compounds when assessing the potential risks from these chemicals. The on-line Contaminated Land Strategies Digest (CLSD) formed a consortium of ten practitioners (including representatives from local authorities), to prepare generic assessment criteria for a number of contaminants at more conservative organic matter contents of 1% and 3% for the same end uses. Ten independent professionals reproduced the same criteria using the EA's latest CLEA model and latest CLEA guidance and PBA independently verified the results published using the latest CLEA model. These criteria will be used by PBA where appropriate.

In addition the CLSD consortium derived generic assessment criteria (GAC) for selected substances for another end use, that being residential without plant uptake (CLSD, 2009).

CIEH Generic Assessment Criteria (GAC) In December 2006, GAC for 31 substances were published by the Chartered Institute of Environmental Health (CIEH) (LQM and CIEH, 2006) using the then current version of the CLEA software, (CLEA UK beta version 1.0 (or CLEA UK) released in November 2005). The work was repeated in 2009 using the latest CLEA model and the results were published in July 2009. These GAC are considered to be conservative, authoritative and scientifically based by PBA and will be used as Tier 2 assessment criteria where

we test for these substances in soil. This practice will continue until such time that DEFRA derive and publish formal SGVs to replace these criteria.

Potential Harm to the Built Environment PBA use the following primary guidance to assess the significance of soil chemistry with respect to its potential to harm the built environment.

- i) Site Preparation and Resistance to Contaminants and Moisture. Approved Document C (BRE 2004);
- ii) Concrete in aggressive ground SD1 (BRE 2005); and
- iii) Technical guidance on the assessment of soil chemistry with respect to its potential to corrode plastic service pipes has been published by the Water Regulations Advisory Scheme (WRAS, 2002). PBA use this guidance to assess the significance of various chemical testing results on plastic construction materials where required.

Potential to Harm Ecosystems, Animals, Crops etc The criteria which are routinely used by PBA as Tier 2 screening values are given in Table 3. PBA use the following primary guidance to assess the significance of soil chemistry with respect to its potential to harm ecosystems.

- i) Ecological Risk Assessment (ERA) Science Report Series SC070009, published by the Environment Agency, Bristol (EA, 2008);
- ii) Consultation on Soil Screening Values for Assessing Ecological Risk, issued by the Environment Agency, Bristol (EA, 2008);
- iii) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing (ICRCL 70/90, 1990);
- iv) Code of Practice for Agricultural Use of Sewage Sludge (DOE, 1993); and
- v) Protecting our Water, Soil and Air. A Code of Good Agricultural Practice for farmers, growers and land managers. (DEFRA, 2009).

Note on Appropriate Use of Assessment Criteria The assumptions used within the CLEA model for deriving the former SGVs, and those that will be used to derive future SGVs, are both numerous and complex and the appropriateness of these assumptions requires confirmation on a site-specific basis.

Any GACs which have been derived using the current or previous CLEA model are not applicable where soils are provided with a cap. In such instances, the adequacy and effectiveness of the cap needs to be determined using for example the appropriate Building Research Establishment guidance (Tedd et al., 2004).

Note on Mercury Assessment Mercury can exist in a number of different forms in the environment including inorganic, elemental and organic.

Rationale for the Selection of Generic Assessment Criteria

Mercury is most commonly found in its inorganic state and it is very rare to find significant concentrations of elemental and organic mercury unless there is a process related source of one of these other forms relevant to the site in question. PBA undertake routine analytical testing to determine total mercury content. Total mercury includes both inorganic and elemental forms of the metal.

The hazard identification stage of the risk assessment process is used to assess whether further speciation of mercury into its elemental and organic forms is necessary and these additional tests are not routinely specified.

Situations where it is desirable to determine the proportions of different forms of mercury might include sites where potential industrial sources of mercury have been identified, or where initial screening tests have revealed unusually high concentrations of total mercury.

In these cases, concentrations of inorganic, elemental and organic mercury can be assessed against specific Soil Guideline Values published by the Environment Agency.

4.3 Tier 2 Screening Values for Assessing Controlled Waters

Potential Harm to Human Health The criteria which are routinely used by PBA as Tier 2 water screening values are given in Table 2. PBA use the following primary guidance to assess the significance of water chemistry with respect to its potential to harm human health where appropriate.

- i) The Water Supply (Water Quality) Regulations 2000 (DETR (2000b);
- ii) Guidelines for drinking-water quality, World Health Organisation (WHO, 1993); and
- iii) The Surface Water (Abstraction for Drinking Water) (Classification) Regulations (DoE, 1996); and subsequent amendments.

Although not specific to the UK the WHO guidelines for drinking water quality are utilised as they incorporate more organic parameters than listed in the Water Supply (Water Quality) Regulations. The WHO system provides a guideline value for substances that are considered to be carcinogenic based on a concentration in drinking water associated with an excess lifetime cancer risk of 10^{-5} (one additional cancer per 100,000 of the population ingesting drinking water containing the substance at or above the guideline value for 70 years).

A number of the prescribed concentrations listed in the Water Supply Regulations have been set for reasons other than their potential to cause harm to human health. The concentrations of some elements are controlled because they may taint potable water with an undesirable taste, odour or

colour or may potentially deposit precipitates in water supply pipes.

Potential to Harm Controlled Waters Controlled Waters are namely rivers, estuaries, coastal waters, lakes and groundwaters, but not perched waters. There are no official or statutory limits on acceptable concentrations of contaminants in groundwater in the UK.

There are statutory limits on acceptable concentrations of contaminants in surface water in the UK. Limits have been published in the form of Environmental Quality Standards (EQSs) which are available for fresh, estuarine and marine waters. EQSs have been derived under the requirements of the EC Dangerous Substances Directive (EC, 1976) that classifies substances as List I and List II. Standards for List I substances have been defined in 'daughter' Directives to the EC Dangerous Substances Directive. The Dangerous Substances Directive requires that standards for List II substances are derived by the member states. The UK has set EQSs for List II substances (derived by WRc plc, Swindon) and these are published on the Environment Agency website (EA, 2004). The Environment Agency has a legal obligation to ensure that statutory EQSs are met.

The criteria which are routinely used by PBA as Tier 2 screening values are given in Table 2. PBA use the following primary guidance to assess the significance of water chemistry with respect to its potential to harm Controlled Waters.

- i) the Water Supply (Water Quality) Regulations (DETR, 2000); and
- ii) Environmental Quality Standards (EQSs).

The results from any eluted liquids will be compared to appropriate assessment criteria depending on the receptor of concern.

4.4 Tier 2 Screening Guidance for Assessing Soil Gases

Risk Assessment Approach Guidance on the assessment of risks specifically for sites located adjacent to Landfill Sites has been published by the Environment Agency (EA, 2004d). A tiered approach to assessing risk is advocated by the guidance. This allows the level of detail in a risk assessment to be proportionate to the nature and complexity of the risk.

The Tier 1 Risk Screening methodology advocated by the Environment Agency (EA) guidance document (EA, 2004d) should:

- i) Identify complete source-pathway-receptor linkages;
- ii) Screen out insignificant risks;
- iii) Prioritise the risks and receptors; and
- iv) Provide an initial assessment of the potential impacts at a receptor.

Rationale for the Selection of Generic Assessment Criteria

A Tier 2 assessment comprises the quantitative analysis of risk following the collection and analysis of soil gas monitoring data.

Guidance on suitable methodologies for the collection of gas monitoring data is provided in CIRIA Report C665 (CIRIA, 2007).

Guidance Available PBA use the following primary guidance to assess the significance of soil gas chemistry with respect to its potential to harm human health.

- i) Assessing risks posed by hazardous gases to buildings C665 (CIRIA 2007);
- ii) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. (NHBC 2007);
- iii) Code of practice for the characterization and remediation from ground gas is affected developments (BSI, 2007); and
- iv) Waste Management Paper No. 27 (DoE, 1991).

Waste Management Paper No. 27 (DoE, 1991) defines what constitutes a "significant quantity" of gas. WMP27 advises that a site producing (i) Methane concentrations in excess of 1% by volume and with a flow rate of greater than 15 litres per hour; or (ii) Carbon dioxide in excess of 1.5% by volume in air and with a flow rate of greater than 22 litres per hour would be considered as a significant source of soil gas.

Guidance on quantifying the risks from hazardous soil gases to properties and their occupiers is provided in CIRIA, 2007 (commercial developments), NHBC, 2007 (low rise residential developments) and British Standard BS 8485:2007. These documents provide guidance on gas monitoring methods and strategy, the assessment of risk posed by soil gases and mitigating the risks posed by soil gases during site development.

PBA use gas concentrations and borehole flow data in order to obtain the gas screening value (GSV) for methane and carbon dioxide at the site. The GSV can be used to establish the characteristic situation of the site as detailed in CIRIA C665 and in order to make recommendations for gas protection measures for buildings if required.

Radon In addition to the guidance listed above, PBA use the following primary guidance to assess the significance of the radon content of soil gas.

- i) Radon: guidance on protective measures for new dwellings. Report BR211 (BRE, 1999); and
- ii) Radon Atlas of England, R290 (NRPB, 1996).

5 References

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Rationale for the Selection of Generic Assessment Criteria

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Rationale for the Selection of Generic Assessment Criteria

Table 1: Tier 2 Screening Criteria for the Assessment of the Significance of Potential Contaminant Concentrations in Soil – Protection of Human Health

Determinand	Allotments mg/kg	Residential with plant uptake mg/kg	Residential without plant uptake mg/kg	Commercial/ Industrial mg/kg
Metals/Metalloids				
Arsenic	43 ^a	32 ^a	35 ^f	640 ^a
Beryllium	55 ^c	51 ^c	-	420 ^c
Boron	45 ^c	291 ^c	-	192,000 ^c
Cadmium	1.8 ^a	10 ^a	117 ^f	230 ^a
Chromium (trivalent)	34,600 ^c	3000 ^c	-	30,400 ^c
Chromium (hexavalent)	2.1 ^c	4.3 ^c	-	35 ^c
Copper	524 ^c	2330 ^c	-	71,700 ^c
Lead	-	450 ^b	450 ^b	750 ^b
Mercury (elemental)	1 ^a	26 ^a	-	26 ^a
Mercury (inorganic)	80 ^a	170 ^a	235 ^f	3600 ^a
Methyl Mercury	8 ^a	11 ^a	-	410 ^a
Nickel	230 ^a	130 ^a	130 ^f	1800 ^a
Selenium	120 ^a	350 ^a	595 ^f	13000 ^a
Vanadium	18 ^c	75 ^c	-	3160 ^c
Zinc	618 ^c	3750 ^c	-	665,000 ^c
BTEX Compounds (1%, 3% and 6% SOM)^d				
Benzene	0.02 ^f / 0.04 ^f / 0.07 ^a	0.08 ^f / 0.18 ^f / 0.33 ^a	0.27 ^f / 0.56 ^f / 1.0 ^f	28 ^f / 57 ^f / 95 ^a
Toluene	22 ^f / 60 ^f / 120 ^a	120 ^f / 320 ^f / 610 ^a	600 ^f / 1500 ^f / 2700 ^f	870 ^f / 2200 ^f / 4400 ^a
Ethylbenzene	16 ^f / 45 ^f / 90 ^a	65 ^f / 180 ^f / 350 ^a	165 ^f / 450 ^f / 840 ^f	520 ^f / 1400 ^f / 2800 ^a
Xylenes (m-xylene)	28 ^f / 80 ^f / 160 ^a	42 ^f / 120 ^f / 230 ^a	53 ^f / 145 ^f / 285 ^f	475 ^f / 1300 ^f / 2600 ^a
Polycyclic Aromatic Hydrocarbons (1%, 2.5% and 6% SOM)^d				
Acenaphthene	34 ^c / 85 ^c / 200 ^c	210 ^c / 480 ^c / 1000 ^c	-	85000 ^c / 98000 ^c / 100000 ^c
Acenaphthylene	28 ^c / 69 ^c / 160 ^c	170 ^c / 400 ^c / 850 ^c	-	84000 ^c / 97000 ^c / 100000 ^c
Anthracene	380 ^c / 950 ^c / 2200 ^c	2300 ^c / 4900 ^c / 9200 ^c	-	530000 ^c / 540000 ^c / 540000 ^c
Benzo(a)anthracene	2.5 ^c / 5.5 ^c / 10 ^c	3.1 ^c / 4.7 ^c / 5.9 ^c	-	90 ^c / 95 ^c / 97 ^c
Benzo(a)pyrene	0.60 ^c / 1.2 ^c / 2.1 ^c	0.83 ^c / 0.94 ^c / 1.0 ^c	-	14 ^c / 14 ^c / 14 ^c
benzo(b)fluoranthene	3.5 ^c / 7.4 ^c / 13 ^c	5.6 ^c / 6.5 ^c / 7.0 ^c	-	100 ^c / 100 ^c / 100 ^c
benzo(g,h,i)perylene	70 ^c / 120 ^c / 160 ^c	44 ^c / 46 ^c / 47 ^c	-	650 ^c / 660 ^c / 660 ^c
benzo(k)fluoranthene	6.8 ^c / 14 ^c / 23 ^c	8.5 ^c / 9.6 ^c / 10 ^c	-	140 ^c / 140 ^c / 140 ^c
Chrysene	2.6 ^c / 5.8 ^c / 12 ^c	6.0 ^c / 8.0 ^c / 9.3 ^c	-	140 ^c / 140 ^c / 140 ^c
Dibenzo(a,h) anthracene	0.76 ^c / 1.5 ^c / 2.3 ^c	0.76 ^c / 0.86 ^c / 0.90 ^c	-	13 ^c / 13 ^c / 13 ^c
Fluoranthene	52 ^c / 130 ^c / 290 ^c	260 ^c / 460 ^c / 670 ^c	-	23000 ^c / 23000 ^c / 23000 ^c
Fluorene	27 ^c / 67 ^c / 160 ^c	160 ^c / 380 ^c / 780 ^c	-	64000 ^c / 69000 ^c / 71000 ^c
Indeno(1,2,3-cd)pyrene	1.8 ^c / 3.8 ^c / 7.1 ^c	3.2 ^c / 3.9 ^c / 4.2 ^c	-	60 ^c / 61 ^c / 61 ^c
Naphthalene	4.1 ^c / 9.9 ^c / 23 ^c	1.5 ^c / 3.7 ^c / 8.7 ^c	-	200 ^c / 480 ^c / 1100 ^c
Phenanthrene	16 ^c / 38 ^c / 90 ^c	92 ^c / 200 ^c / 380 ^c	-	22000 ^c / 22000 ^c / 23000 ^c
Pyrene	110 ^c / 270 ^c / 620 ^c	560 ^c / 1000 ^c / 1600 ^c	-	54000 ^c / 54000 ^c / 54000 ^c
Aliphatic/Aromatic Hydrocarbons (1%, 2.5% and 6% SOM)^d				
TPH Aliphatic >C5-6	740 ^c / 1700 ^c / 3900 ^c	30 ^c / 55 ^c / 110 ^c	-	3400 ^c / 6200 ^c / 13000 ^c
TPH Aliphatic >C6-8	2300 ^c / 5600 ^c / 13000 ^c	73 ^c / 160 ^c / 370 ^c	-	8300 ^c / 18000 ^c / 42000 ^c
TPH Aliphatic >C8-10	320 ^c / 770 ^c / 1700 ^c	19 ^c / 46 ^c / 110 ^c	-	2100 ^c / 5100 ^c / 12000 ^c
TPH Aliphatic >C10-12	2200 ^c / 4400 ^c / 7300 ^c	93 ^c / 230 ^c / 540 ^c	-	10000 ^c / 24000 ^c / 49000 ^c

Rationale for the Selection of Generic Assessment Criteria

Determinand	Allotments mg/kg	Residential with plant uptake mg/kg	Residential without plant uptake mg/kg	Commercial/ Industrial mg/kg
TPH Aliphatic >C12-16	11000 ^c / 13000 ^c / 13000 ^c	740 ^c / 1700 ^c / 3000 ^c	-	61000 ^c / 83000 ^c / 91000 ^c
TPH Aliphatic >C16-35	260000 ^c / 270000 ^c / 270000 ^c	45000 ^c / 64000 ^c / 76000 ^c	-	1600000 ^c / 1800000 ^c / 1800000 ^c
TPH Aliphatic >C35-44	260000 ^c / 270000 ^c / 270000 ^c	45000 ^c / 64000 ^c / 76000 ^c	-	1600000 ^c / 1800000 ^c / 1800000 ^c
TPH Aromatic >C5-7 (benzene)	13 ^c / 27 ^c / 57 ^c	65 ^c / 130 ^c / 280 ^c	-	28000 ^c / 49000 ^c / 90000 ^c
TPH Aromatic >C7-8 (toluene)	22 ^c / 51 ^c / 120 ^c	120 ^c / 270 ^c / 611 ^c	-	59000 ^c / 110000 ^c / 190000 ^c
TPH Aromatic >C8-10	8.6 ^c / 21 ^c / 51 ^c	27 ^c / 65 ^c / 151 ^c	-	3700 ^c / 8600 ^c / 18000 ^c
TPH Aromatic >C10-12	13 ^c / 31 ^c / 74 ^c	69 ^c / 160 ^c / 346 ^c	-	17000 ^c / 29000 ^c / 34500 ^c
TPH Aromatic >C12-16	23 ^c / 57 ^c / 130 ^c	140 ^c / 310 ^c / 593 ^c	-	36000 ^c / 37000 ^c / 37800 ^c
TPH Aromatic >C16-21	46 ^c / 110 ^c / 260 ^c	250 ^c / 480 ^c / 770 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
TPH Aromatic >C21-35	370 ^c / 820 ^c / 1600 ^c	890 ^c / 1100 ^c / 1230 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
TPH Aromatic >C35-44	370 ^c / 820 ^c / 1600 ^c	890 ^c / 1100 ^c / 1230 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
TPH Aliphatic + Aromatic >C44-70	1200 ^c / 2100 ^c / 3000 ^c	1200 ^c / 1300 ^c / 1300 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
Chlorinated Hydrocarbons (1%, 2.5% and 6% SOM)^d				
1,2-dichloroethane	0.0046 ^c / 0.0083 ^c / 0.016 ^c	0.0054 ^c / 0.0080 ^c / 0.014 ^c	-	0.71 ^c / 1.0 ^c / 1.8 ^c
1,1,1 Trichloroethane (TCA)	48 ^c / 110 ^c / 240 ^c	6.2 ^c / 13 ^c / 28 ^c	-	700 ^c / 1400 ^c / 3100 ^c
1,1,1,2 Tetrachloroethane	0.79 ^c / 1.9 ^c / 4.4 ^c	0.90 ^c / 2.1 ^c / 4.8 ^c	-	120 ^c / 260 ^c / 590 ^c
1,1,1,2 Tetrachloroethane	0.41 ^c / 0.89 ^c / 2.0 ^c	1.4 ^c / 2.9 ^c / 6.3 ^c	-	290 ^c / 580 ^c / 1200 ^c
Tetrachloroethene (PCE)	1.6 ^c / 3.7 ^c / 8.7 ^c	0.94 ^c / 2.1 ^c / 4.8 ^c	-	130 ^c / 290 ^c / 660 ^c
Tetrachloromethane (Carbon tetrachloride)	0.16 ^c / 0.37 ^c / 0.85 ^c	0.018 ^c / 0.039 ^c / 0.089 ^c	-	3.0 ^c / 6.6 ^c / 15 ^c
Trichloroethene (TCE)	0.43 ^c / 0.95 ^c / 2.2 ^c	0.11 ^c / 0.22 ^c / 0.49 ^c	-	12 ^c / 25 ^c / 55 ^c
Trichloromethane (chloroform)	0.36 ^c / 0.70 ^c / 1.5 ^c	0.75 ^c / 1.3 ^c / 2.7 ^c	-	110 ^c / 190 ^c / 370 ^c
Vinyl Chloride (Chloroethene)	0.00055 ^c / 0.0010 ^c / 0.0018 ^c	0.00047 ^c / 0.00064 ^c / 0.00099 ^c	-	0.063 ^c / 0.081 ^c / 0.12 ^c
Pesticides and Other Organic Compounds (1%, 2.5% and 6% SOM)^d				
Aldrin	1.3 ^c / 2.6 ^c / 4.0 ^c	1.7 ^c / 2.0 ^c / 2.1 ^c	-	54 ^c / 54 ^c / 54 ^c
Atrazine	0.037 ^c / 0.085 ^c / 0.2 ^c	0.24 ^c / 0.56 ^c / 1.3 ^c	-	870 ^c / 880 ^c / 880 ^c
Dichlorvos	0.044 ^c / 0.091 ^c / 0.20 ^c	0.29 ^c / 0.6 ^c / 1.3 ^c	-	842 ^c / 872 ^c / 893 ^c
Dieldrin	0.13 ^c / 0.32 ^c / 0.73 ^c	0.69 ^c / 1.4 ^c / 2.2 ^c	-	90 ^c / 91 ^c / 92 ^c
Endosulfan	0.47 ^c / 1.2 ^c / 2.7 ^c	2.9 ^c / 7.0 ^c / 16 ^c	-	2310 ^c / 2990 ^c / 3390 ^c
Carbon Disulphide	4.8 ^c / 10 ^c / 23 ^c	0.10 ^c / 0.20 ^c / 0.44 ^c	-	12 ^c / 23 ^c / 50 ^c
Chlorobenzene	5.9 ^c / 14 ^c / 32 ^c	0.33 ^c / 0.73 ^c / 1.7 ^c	-	59 ^c / 130 ^c / 310 ^c
Hexachloro-1,3-butadiene	0.25 ^c / 0.61 ^c / 1.4 ^c	0.21 ^c / 0.51 ^c / 1.2 ^c	-	32 ^c / 69 ^c / 120 ^c
Hexachlorobenzene	0.18 ^c / 0.42 ^c / 0.92 ^c	0.59 ^c / 1.0 ^c / 1.4 ^c	-	48 ^c / 53 ^c / 55 ^c
Pentachlorobenzene	1.2 ^c / 3.1 ^c / 7.1 ^c	5.2 ^c / 10 ^c / 17 ^c	-	650 ^c / 770 ^c / 830 ^c
Pentachlorophenol	0.084 ^c / 0.21 ^c / 0.49 ^c	0.55 ^c / 1.3 ^c / 2.96 ^c	-	1200 ^c / 1300 ^c / 1400 ^c
Phenol (1, 3, 6% SOM)	66 ^f / 158 ^f / 280 ^a	184 ^f / 316 ^f / 420 ^a	310 ^f / 441 ^f / 519 ^f	3200 ^a

Notes

- a Soil Guideline Value (2009)
- b Soil Guideline Value (2002)
- c Generic Assessment Criteria (LQM & CIEH 2009)
- d Where three values are presented, SGV/GAC for soils with SOM of 1%, 2.5% and 6% or 1%, 3% and 6% are given as detailed in the table. SOM denotes Soil Organic Matter.

Rationale for the Selection of Generic Assessment Criteria

- f Generic Assessment Criteria generated using CLEA v 1.04 by an independent contaminated land working group and independently verified by PBA (CLSD, 2009)

Rationale for the Selection of Generic Assessment Criteria

Table 2: Tier 2 Screening Criteria for the Assessment of the Significance of Potential Contaminant Concentrations in Groundwater and Surface Water

Parameter	Water abstracted for potable use	Water not abstracted for potable use
	Water Supply (Water Quality) Regulations 2000	Environmental Quality Standards (EQSs)
Arsenic (µg/l)	10	50
Cadmium (µg/l)	5	5
Chromium (µg/l)	50	5 to 250
Lead (µg/l)	25 (10 from 25/12/13)	4 to 250
Mercury (µg/l)	1	1
Selenium (µg/l)	10	-
Nickel (µg/l)	20	50 to 200
Zinc (µg/l)	-	8 to 500
Antimony (µg/l)	5	-
Boron (µg/l)	1000	2000
Copper (µg/l)	2000	1 to 28
Iron (µg/l)	200	1000
Manganese (µg/l)	50	-
Vanadium (µg/l)	-	20 to 60
pH (pH units)	6.5 to 10	6.0 to 9.0
Electrical Conductivity (µS/cm)	2500	-
Ammoniacal nitrogen (mg/l)	0.5	0.015
Sulphate (mg/l)	250	400
Chloride (mg/l)	250	250
Total Phenol (mg/l)	0.5	30 (300)
Nitrate (mg/l)	50	-
Cyanide (mg/l)	50	-
PAHs (EPA 16) (µg/l)	0.1	-
Benzo(a)pyrene (µg/l)	0.01	-
SVOCs:		
Hexachlorobenzene (µg/l)	-	0.03
Hexachlorobutadiene (µg/l)	-	0.1
Phenol (µg/l)	-	30 (300)
VOCs:		
Chloroform (µg/l)	-	12
1,2-Dichloroethane (µg/l)	3	10
1,1,1-Trichloroethane (µg/l)	-	100 (1000)
Trichloroethene (µg/l)	10	10
1,1,2-Trichloroethane (µg/l)	-	400 (4000)
Tetrachloroethene (µg/l)	10	10
Styrene (µg/l)	-	50 (500)
Benzene (µg/l)	1	30 (300)
Toluene (µg/l)	-	50 (500)
Vinyl Chloride (µg/l)	0.5	-
Xylene (µg/l)	-	30

Notes

- Some organic contaminants are given two EQS values. These values relate to an acceptable annual average concentration followed in brackets by a maximum admissible peak concentration.
- Where a range is presented e.g. for vanadium, different EQSs relate to different alkalinity (hardness) values for the water sample being tested.

Rationale for the Selection of Generic Assessment Criteria

Table 3 Tier 2 Screening Criteria for the Assessment of the Significance of Potential Contaminant Concentrations in Soil – Protection of Ecological Systems

Parameter	ICRCL 70/90 ^a			Proposed SSVs ^b	The Soil Code ^c
	Threshold ^d	Maximum			
		Livestock	Crop Growth		
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)pyrene				0.15	
Arsenic	50	500	1000		50
Cadmium	3	30	50	1.15	3
Chromium				21.1	400
Copper	250	500	250	88.4	80/ 100/ 135/ 200 ^e
Fluoride	500	1000			500
Lead	300	1000		167.9	300
Mercury				0.06	1
Molybdenum					4
Nickel				25.1	50/ 60/ 75/ 110 ^e
Pentachlorobenzene				0.029	
Pentachlorophenol				0.6	
Selenium					3
Tetrachloroethene				0.01	
Toluene				0.3	
Zinc	1000	3000	1000	90.1	200/ 200/ 200/ 300 ^e

Notes

- Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) 70/90 Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 1st edition 1990.
- Proposed Soil Screening Values (SSVs) – Consultation, Environment Agency 2008. Threshold which if exceeded prompts further assessment.
- Maximum permissible concentration of potentially toxic elements from The Soil Code revised 1998 – Code of Practice for the Protection of Soil MAFF October 1998.
- Concentrations are for contamination derived from mine spoil. In other situations the speciation may be more available. Factors include total concentration, speciation, particle size, pH, species of plant, type of animal/grazing habit.
- Where four values are presented, concentrations are for soils with pH values 5.0-5.5/ 5.5-6.0/ 6.0-7.0/ >7.0

GREEN PARK STATION, READING
TABLE SUMMARISING SOIL RESULTS AND HIGHLIGHTING EXCEEDANCES ABOVE CRITERIA FOR PROTECTION OF HUMAN HEALTH

Analyte	Units	Assessment Criteria										TPE	TPE	TPF	TPG	TPG	TPG	TPH	WS4	WS4	WS5	WS6	WS7	WS8	WS8	WS8	BH2	BH3	TP1	TP2	TP2	TP3	TP4	TP5	TP6	TP8	TP208	TP208	TP208	TP301	TP301	TP302
		A	B	C	D	E	F	G	H	I	J	0.3	0.9	0.7	0.5	0.7	1.2	0.5	0.4	2.5	0.45	0.3	1.8	2.5	3.5	4.25	0.8	0.6	0.05	0.3	1.6	0.3	0.3	0.6	0.8	0.6	0.2	0.6	1.1	0-0.4	1.8-2.2	0.6-1
Stones BG 2.6/3.0												18	8	9.3	9.8	8.4	13	7.3	5.4	7.1	4.3	5.8	3	3.5	2.5															44	76	16
Moisture content at 30 C	%											2	14	15	12	6.9	12	12	10	38	16	5.6	10	15	15	21													15	5.9	20	
Arsenic as As, dry weight	mg/kg	43	32	640									4.9	5	5.8	7.6	20	7.9	3.5	14	3.1		7.9		8.1	8.5	10.8	12.9	18.9	4.7	8.8	16.1	10.6	9.1	23.1	18	6	10	7	3	5	
Beryllium as BE, dry weight	mg/kg				55	51	420					0.63			0.9				0.3						0.73													0.5		0.9		
Boron as B, hot water sol dw	mg/kg				45	291	192000																													2	1	1				
Cadmium as Cd, dry weight	mg/kg	1.8	10	230									0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5		0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.2	0.2	0.2	
Chromium as Cr, dry weight	mg/kg	34600	3000	30400									15	9.8	11		27	18	16	5.6	26	6.5		25		27	32	17	34	23	8	20	25	27	19	34	44	47	32	16	9.5	29
Copper as Cu, dry weight	mg/kg				524	2330	71700						12		9				5.5							18	26	20	17	28	9	23	27	20	21	85	39	10	19	25		16
Lead as Pb, dry weight	mg/kg	450*	450*	750*									24	15	11		250	78	53	10	34	15		37		50	60	67	39	34	50	72	62	109	35	34	94	18	47	61	4	27
Mercury as Hg, dry weight	mg/kg	80	170	3600									0.28	0.25	0.25		0.88	0.31	0.25	0.25	0.25		0.38		0.47	0.5	0.2	0.2	0.2	0.2	0.3	0.4	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	
Nickel as Ni, dry weight	mg/kg	230	130	1800									15	10	23		17	19	11	7.6	16	8.2		14		15	16	14	21	24	7	16	16	17	19	36	23	13	16	15	7.1	33
Selenium as Se, dry weight	mg/kg	120	350	13000									0.33	0.3	0.3		0.38	0.3	0.3	0.9	0.3	0.3		0.48		0.35	0.5	0.5	0.6	1.2	0.5	0.5	0.7	0.5	0.5	0.5	0.5	0.5	0.5	3	3	3
Vanadium as Vn, dry weight	mg/kg				18	75	3160						20		23				10						25														27		46	
Zinc as Zn, dry weight	mg/kg				618	3750	665000						57		35				13						69	90	83	64	54	97	95	115	89	59	77	139	34	77	120		74	
Cyanide (Total)	mg/kg																									1	1	1	1	2.6	1.4	2	1	2	1	1	2.5	2.5	2.5			
Organic matter	%												5.5		0.67				9.7						4.4														1.8	-	1.8	
Phenol, Total	mg/kg			3200				66	184										0.75																				0.15	-	0.15	
Sulphate (Total) as SO4	%												0.11		0.18				0.24						0.06				1	1	1	1	1	1	1				1.5	-	0.087	
pH	pH Units											8.6	8.3		9.3				8.7	8.4	8.5				8.1	7.5	8.4	7.7	8	7.6	8.2	7.7	9.5	8.2	7.5	7.91	7.96	7.93	8.03	-	8.45	
Benzene								0.02	0.08	28																																
Toluene								22	120	870																																
Ethylbenzene								16	65	520																																
Xylene								28	42	475																																
>C5 to C6 Aliphatic	mg/kg				740	30	3400										0.11																									
>C6 to C8 Aliphatic	mg/kg				2300	73	8300										0.17																									
>C8 to C10 Aliphatic	mg/kg				320	19	2100										0.11																									
>C10 to C12 Aliphatic	mg/kg				2200	93	10000										1.1																									
>C12 to C16 Aliphatic	mg/kg				11000	740	61000										21																									
>C16 to C35 Aliphatic	mg/kg				260000	45000	1600000										450																									
>C35 to C44 Aliphatic	mg/kg				260000	45000	1600000										390																									
Total Aliphatic	mg/kg																870																									
>C5 to C7 Aromatic	mg/kg				13	65	28000										0.011																									
>C7 to C8 Aromatic	mg/kg				22	120	59000										0.011																									
>C8 to C10 Aromatic	mg/kg				8.6	27	3700										0.11																									
>C10 to C12 Aromatic	mg/kg				13	69	17000										6.7																									
>C12 to C16 Aromatic	mg/kg				23	140	36000										66																									
>C16 to C21 Aromatic	mg/kg				46	250	28000										17																									
>C21 TO C35 Aromatic	mg/kg				370	890	28000										1000																									
>C35 to C44 Aromatic	mg/kg				370	890	28000										1600																									
Total Aromatic	mg/kg																2700																									
Total EPH Aliphatic/Aromatic	mg/kg									1000		150				3500							99														479	129	145	450		
TPH by GC (>C6-C10)	mg/kg											59											56																			
TPH by GC (>C10 - C20)	mg/kg											59											56																			
TPH by GC (>C20-C40)	mg/kg											150											99																			
TPH by GC (>C6 - C40)	mg/kg											150																														
TPH (Chromatogram)	TEXT																																									
naphthalene	mg/kg				4.1	1.5	200										0.5																				0.186	0.056	0.115	0.17		
acenaphthylene	mg/kg				28	170	84000										0.5																							0.062		
acenaphthene	mg/kg				34	210	85000										0.5																							0.18		
fluorene	mg/kg				27	160	64000										0.5																			0.217	0.027	0.05	0.16			
phenanthrene	mg/kg				16	92	22000										0.8																							1.2		
anthracene	mg/kg				380	2300	530000										0.5																							0.29		
fluoranthene	mg/kg				52	260	23000																																			

GREEN PARK STATION, READING
TABLE SUMMARISING SOIL RESULTS AND HIGHLIGHTING EXCEEDANCES ABOVE CRITERIA FOR PROTECTION OF HUMAN HEALTH

Analyte	Units	Assessment Criteria										TP302	TP303	TP303	TP304	TP304	TP305	TP305	TP306	TP306	TP306	TPA08	TPA09
		A	B	C	D	E	F	G	H	I	J	1.2-1.7	0.6-0.8	1.8-2.2	0-0.4	0.7-1.2	0-0.4	0.6-0.9	0.3-0.6	0.6-1.2	1.5-2	1.3-2.0	1.7-2.0
Stones BG 2.6/3.0	%											17	34	39	28	8.4	43	64	58	22	61	16	54
Moisture content at 30 C	%											22	84	130	20	93	85	67	7.5	33	14	13	11
Arsenic as As, dry weight	mg/kg	43	32	640								4	8	4	8	14	8	5	7	6	5	6	9
Beryllium as BE, dry weight	mg/kg				55	51	420							0.4	0.6			0.4	0.4		0.4	0.4	
Boron as B, hot water sol dw	mg/kg				45	291	192000																
Cadmium as Cd, dry weight	mg/kg	1.8	10	230								0.2	0.2	0.2	0.2	0.2	1.1	0.2	0.2	0.2	0.2	0.2	0.3
Chromium as Cr, dry weight	mg/kg	34600	3000	30400								18	24	17	17	24	16	13	8.2	26	6.8	17	11
Copper as Cu, dry weight	mg/kg				524	2330	71700							15	20			6	6		6	13	
Lead as Pb, dry weight	mg/kg	450*	450*	750*								72	190	38	190	9	96	11	11	30	6	25	17
Mercury as Hg, dry weight	mg/kg	80	170	3600								0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Nickel as Ni, dry weight	mg/kg	230	130	1800								15	20	11	15	16	12	9.5	7.9	18	5.3	12	13
Selenium as Se, dry weight	mg/kg	120	350	13000								3	3	3	3	3	3	3	3	3	3	3	3
Vanadium as Vn, dry weight	mg/kg				18	75	3160							20	29			23	14		8.7	24	
Zinc as Zn, dry weight	mg/kg				618	3750	665000							86	93			27	20		14	46	
Cyanide (Total)	mg/kg																						
Organic matter	%											-	-	5.1	2.4	-	-	0.48	0.86	-	1.0	1.6	
Phenol, Total	mg/kg			3200				66	184			-	-	0.15	0.15	-	-	0.15	0.15	-	0.15	0.15	
Sulphate (Total) as SO4	%											-	-	0.50	0.30	-	-	0.17	0.040	-	0.036		
pH	pH Units											-	-	7.72	8.26	-	-	8.39	7.84	-	8.20	8.15	
Benzene								0.02	0.08	28													
Toluene								22	120	870													
Ethylbenzene								16	65	520													
Xylene								28	42	475													
>C5 to C6 Aliphatic	mg/kg				740	30	3400						0.01						0.01				
>C6 to C8 Aliphatic	mg/kg				2300	73	8300						0.01						0.01				
>C8 to C10 Aliphatic	mg/kg				320	19	2100						0.01						0.01				
>C10 to C12 Aliphatic	mg/kg				2200	93	10000						0.01						0.01				
>C12 to C16 Aliphatic	mg/kg				11000	740	61000						0.1						0.1				
>C16 to C35 Aliphatic	mg/kg				260000	45000	1600000						190						10				
>C35 to C44 Aliphatic	mg/kg				260000	45000	1600000						120						8				
Total Aliphatic	mg/kg												310						18				
>C5 to C7 Aromatic	mg/kg				13	65	28000						0.01						0.01				
>C7 to C8 Aromatic	mg/kg				22	120	59000						0.01						0.01				
>C8 to C10 Aromatic	mg/kg				8.6	27	3700						0.01						0.01				
>C10 to C12 Aromatic	mg/kg				13	69	17000						0.01						0.01				
>C12 to C16 Aromatic	mg/kg				23	140	36000						5.4						0.1				
>C16 to C21 Aromatic	mg/kg				46	250	28000						20						3				
>C21 TO C35 Aromatic	mg/kg				370	890	28000						250						48				
>C35 to C44 Aromatic	mg/kg				370	890	28000						240						26				
Total Aromatic	mg/kg												510						76				
Total EPH Aliphatic/Aromatic	mg/kg									1000	1500					35	570						
TPH by GC (>C6-C10)	mg/kg																						
TPH by GC (>C10 - C20)	mg/kg																						
TPH by GC (>C20-C40)	mg/kg																						
TPH by GC (>C6 - C40)	mg/kg																						
TPH (Chromatogram)	TEXT																						
naphthalene	mg/kg				4.1	1.5	200					1.7	0.1			0.022	0.044						
acenaphthylene	mg/kg				28	170	84000					0.97	0.1			0.005	0.076						
acenaphthene	mg/kg				34	210	85000					3.7	0.1			0.014	0.054						
fluorene	mg/kg				27	160	64000					4.1	0.1			0.012	0.056						
phenanthrene	mg/kg				16	92	22000					20	0.8			0.054	0.89						
anthracene	mg/kg				380	2300	530000					6.6	0.25			0.01	0.27						
fluoranthene	mg/kg				52	260	23000					29	2.5			0.031	1.8						
pyrene	mg/kg				110	560	54000					24	2.9			0.024	1.4						
benzo(a)anthracene	mg/kg				2.5	3.1	90					13	1.4			0.03	0.82						
chrysene	mg/kg				2.6	6	140					12	1.5			0.015	0.83						
benzo(b)fluoranthene	mg/kg				3.5	5.6	100					11	0.94			0.016	1.2						
benzo(k)fluoranthene	mg/kg				6.8	8.5	140					7.9	1.2			0.025	0.52						
benzo(a)pyrene	mg/kg				0.6	0.83	14					14	1.5			0.012	0.9						
indeno(123cd)pyrene	mg/kg				1.8	3.2	60					7.6	0.1			0.011	0.55						
dibenzo(ah)anthracene	mg/kg				0.76	0.76	13					2.7	0.87			0.008	0.14						
benzo(ghi)perylene	mg/kg				70	44	650					8.5	0.86			0.01	0.72						
PAH (Total)	mg/kg											170				0.21	10						
PCB (as Aroclors)	mg/kg																						
1,2-dichloroethane	mg/kg				0.0046	0.0054	0.71																
1,1,1 Trichloroethane (TCA)	mg/kg				48	6.2	700																
1,1,1,2 Tetrachloroethane	mg/kg				0.79	0.9	120																
1,1,2,2 Tetrachloroethane	mg/kg				0.41	1.4	290																
Tetrachloroethene (PCE)	mg/kg				1.6	0.94	130																
Tetrachloromethane					0.16	0.018	3																
Tetrachloroethene (TCE)	mg/kg				0.43	0.11	12																
Trichlormethane (Chloroform)	mg/kg				0.36	0.75	110																
Vinyl Chloride (Chloroethene)	mg/kg				0.00055	0.00047	0.063																
Asbestos	TEXT																						
Floride	mg/kg																						
Molybdenum	mg/kg																						

- Assessment Criteria**
A - Soil Guideline Value (SGV) for Allotments
B - SGV for Residential with Plant Uptake
C - SGV for Commercial/Industrial
D - LQM Generic Assessment Criteria (GAC) for Allotments
E - LQM GAC for Residential with Plant Uptake
F - LQM GAC for Commercial/Industrial
G - Contaminated Land Working Group (CLWG) GAC for Allotments
H - CLWG GAC for Residential with Plant Uptake
I - CLWG GAC for Commercial/Industrial
J - PBA Internal Screening Value

*Lead - Soil Guideline Value 2002

TABLE SUMMARISING WATER RESULTS AND HIGHLIGHTING RESULTS ABOVE CONTROLLED WATER PROTECTION CRITERIA

			RTD (UG)	RTD (UG)	RTD (UG)	RTD (UG)	RTD (UG)	RTD (UG)	RTD (UG)	RTG (UG)	MG (MG)	MG (UG)	MG (UG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	MG (MG)	
			Assessment Criteria		BH2009/03	BH2009/03	BH2009/03	BH2009/06	BH2009/06	BH2009/06	BH2009/06	BH3	BHF	BHF	BHD	BHD	BHE	BHE	BHE	BHE	WS8	WS8	WS8
Analyte	Units	A	B	27/03/09	07/04/09	05/05/09	27/03/09	07/04/09	05/05/09	18/08/09	17/05/2001	27/06/2007	11/07/2007	27/06/2007	11/07/2007	27/06/2007	11/07/2007	13/01/09	28/01/09	13/01/09	28/01/09	18/08/09	
Arsenic	µg/l	10	50	1.4	1.7	1.30	1.9	2.5	0.8	2.2	12	3.2	9.4	3.0	7.8	1.0	1.4	0.75	5	7.5	7	5.4	
Cadmium	µg/l	5	5	0.22	0.22	0.22	0.22	0.22	0.22	0.22	1	0.5	0.5	0.5	0.5	0.5	0.5	0.22	1	0.22	1	0.88	
Chromium *	µg/l	50	50	3	1	2	4	1	3	1	20	12	21	24	66	14	10	3	4.95	17	12	3	
Lead *	µg/l	25	20	0.6	0.4	0.4	0.7	0.5	0.4	0.5	20	2.8	1.0	3.8	1.0	2.3	1.0	2.5	5	2.4	5	1.6	
Mercury	µg/l	1	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.01	0.05	0.01	0.05	0.01	
Selenium	µg/l	10	-	1	1	1	3	2	1	2	10	2	2.5	12	17	1.8	1.9	1	5	13	11	5	
Nickel *	µg/l	20	200	3.3	3.4	1.5	3.8	4.6	2.7	4.2	20	11.0	4.5	30.0	20.0	10.0	2.0	2.8	5	15	43	11	
Zinc *	µg/l	-	125	8	5	5	12	12	5	9	39	11	5	29	24	7.8	5	11	9	24	13	6	
Antimony	µg/l	5	-	1.5	0.75	0.75	0.75	0.75	0.75	0.75		1.0	1.0	1.2	1.2			0.75	2.0	0.75	1.0	15.0	
Boron	µg/l	1000	2000	20	20	20	48	20	22		188	390	190	480	530			79	160	270	330		
Copper *	µg/l	2000	28	2.0	1.6	1.6	3.7	1.7	1.6	5.5	20	5	5.0	5	5.0			7.8	5	7.5	5	3.8	
Iron	µg/l	200	1000	50	50	50	59	57	50	150	16145	2	2	11000	950			710	80	37000	38000	5000	
Manganese	µg/l	50	-	250	250	250	730	710	730	520	1754	900	1	2900	1		1	690	440	4000	3300	1800	
Vanadium	µg/l	-	26	2	2	1	4	4	3	5		10	10	10	10			1	5.0	5	5	4	
pH	µg/l	6.5-10	6	8.30	8.36	7.75	8.63	8.28	7.58	8.63	7.3	6.80	6.90	6.70	6.80	7.00	6.90	7.17	7.3	7.02	6.8	7.76	
Electrical Conductivity	µS/cm	2500	-	460	470	450	820	860	850	630	1393	860	740	1500	1900	530	630	630	1090	2800	2710	2000	
Amminiacal Nitrogen	mg/l	0.5	0.015	0.8	0.7	0.7	3.2	3.0	2.9	2.7	3.65	3.0	3.4	0.4	11.0	1.7	2.0	1.5	0.66	19	18	19	
Sulphate	mg/l	250	400	27	25	11	120	130	130	20	137	480	130	40	630	65	66	73	420	99	120	560	
Chloride	mg/l	250	250	29	30	33	38	38	36	35	80	33	44	39	130	33	37	32	22	84	71	36	
Total Phenol	mg/l	0.5	30	0.01	0.01	0.01	0.01	0.01	0.01		696	1.2	3	5.6	4.7	1.2	3.3	0.01	0.01	0.01	0.01		
Nitrate	mg/l	50	-																				
Cyanide	mg/l	50	-																				
PAHs (EPA16)	µg/l	0.2	-	0.14	0.1	0.1	0.21	0.63	0.1	0.1		0.26	0.32	0.12	0.2	0.27	0.3	0.095	0.095	3.5	2.9	0.031	
Benzo(a)pyrene	µg/l	0.01	-	0.009	0.011	0.009	0.009	0.48	0.009	0.009		0.0095		0.0095			0.095	0.009	0.1	0.009	0.1	0.08	
Naphthalene	µg/l	-	10	0.1	0.1	0.1	0.1	0.1	0.1			0.11		0.062			0.094	0.1	0.1	0.75	0.1		
Hexochlorobenzene	µg/l	-	0.03									1		1			1						
Hexachlorobutadiene	µg/l	-	0.1									1	1	1	1								
Phenol	µg/l	-	30									1.2		1		1							
Chloroform	µg/l	-	12									1	1	1	1								
1,2-Dichloroethane	µg/l	3	10									1	1	1	1								
1,1,1-Trichloroethane	µg/l	-	100									1	1	1	1								
Trichloroethene	µg/l	10	10									1.8	1	1.9	1								
1,1,2-Trichloroethane	µg/l	-	400									1	1	1	1								
Tetrachloroethene (PCE)	µg/l	10	10									1	1	1	1								
Styrene	µg/l	-	50									1	1	1	1								
Benzene	µg/l	1	30	10	10	10	10	10	10	10		1	1	1	1				5	10	5	10	
Toluene	µg/l	-	50	10	10	10	10	10		10		1	1	1	1				5	10	5	31	
Vinyl Chloride	µg/l	0.5	-									1	1	1	1								
Xylene	µg/l	-	30	10	10	10	10	10	10	10		3	3	3	3				5	10	5	10	
TPH	µg/l	10		9.95	9.95	9.95	9.95	9.95	9.95	9.95	1100	9.95	80	9.95	120	9.95	100	9.5	9.5	33	100	31	
BOD	mg/l	8		1	1	1	1	2	1	1		10	7.5	11	18			5	3	17	4.7	77	

- KEY
- A - Drinking Water Standards (DWS)
- B - Environmental Quality Standards (EQS) for freshwaters
- C - EQS in hard water areas protective of sensitive aquatics
- D - PBA Initial Screening Value
- E - BOD CQA Grade 'Fair'
- MG - Made Gound
- RTD - River Terrace Deposits
- LMB - Lambeth Group
- CHK - Upper Cretaceous Chalk
- UG - Up Gradient
- MG - Mid Gradient
- DG - Down Gradient

GREEN PARK STATION, READING

TABLE SUMMARISING WATER RESULTS AND HIGHLIGHTING RESULTS ABOVE CONTROLLED WATER PROTECTION CRITERIA

				LMB (MG)	LMB (MG)	LMB (MG)	LMB (DG)	LMB (DG)	LMB (DG)	CHK (DG)	CHK (DG)	CHK (DG)	Surface	Surface	Surface	Surface
		Assessment Criteria		BH2009/04	BH2009/04	BH2009/04	BH2009/07	BH2009/07	BH2009/07	BH2009/05	BH2009/05	BH2009/05	Ditch 01	Lake 01	Lake	Ditch
Analyte	Units	A	B	27/03/09	07/04/09	05/05/09	27/03/09	07/04/09	05/05/09	27/03/09	07/04/09	05/05/09	13/01/09	13/01/09	28/01/09	28/01/09
Arsenic	µg/l	10	50	0.75	0.78	0.75	0.87	0.75	0.75	3.1	0.75	0.75	1.7	1.1	5	5
Cadmium	µg/l	5	5	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	1	1
Chromium *	µg/l	50	50	3	1	2	3	1	2	2	1	1	1	1	4.95	4.95
Lead *	µg/l	25	20	0.6	0.4	0.4	0.8	0.4	0.4	0.8	0.4	0.4	2.4	2.7	5	5
Mercury	µg/l	1	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05
Selenium	µg/l	10	-	1	1	1	6	1	1	22	1	1	2	1	5	5
Nickel *	µg/l	20	200	3.4	2.7	2.2	11	2.5	1.5	4.8	1.8	1.5	1.6	3.3	5	5
Zinc *	µg/l	-	125	19	8	5	56	12	5	10	5	5	6	8	5	7
Antimony	µg/l	5	-	1.0	6.5	0.75	9.4	0.75	0.75	1.4	5.3	0.8	0.75	0.75	1.0	1.0
Boron	µg/l	1000	2000	20	20	20	20	20	20	130	140	150	48	57	60	58
Copper *	µg/l	2000	28	1.6	1.6	1.6	9.7	1.6	1.6	3.3	1.6	1.6	7.0	6.7	5	5
Iron	µg/l	200	1000	50	3900	1700	550	6600	50	50	50	50	93	50	25	25
Manganese	µg/l	50	-	360	390	390	710	510	430	34	28	40	71	56	43	42
Vanadium	µg/l	-	26	1	1	1	1	2	1	2	3	1	1	1	5.00	5.0
pH	µg/l	6.5-10	6	8.27	8.26	7.42	8.09	8.35	7.37	8.26	8.58	8.02	7.82	7.99	8.1	7.8
Electrical Conductivity	µS/cm	2500	-	720	750	790	1000	710	690	1700	720	710	390	430	469	443
Amminiactal Nitrogen	mg/l	0.5	0.015	0.4	0.5	0.4	1.1	0.7	1.4	1.0	0.6	0.6	0.4	0.4	0.07	0.07
Sulphate	mg/l	250	400	63	67	67	160	65	76	350	77	58	16	25	49	31
Chloride	mg/l	250	250	70	73	75	120	58	54	270	60	54	32	34	33	32
Total Phenol	mg/l	0.5	30	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Nitrate	mg/l	50	-													
Cyanide	mg/l	50	-													
PAHs (EPA16)	µg/l	0.2	-	0.1	0.1	0.1	4.9	2.9	0.99	0.22	0.1	0.1	1	1	ND	ND
Benzo(a)pyrene	µg/l	0.01	-	0.009	0.009	0.009	0.015	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.1	0.1
Naphthalene	µg/l	-	10	0.1	0.1	0.1	0.96	0.33	0.1	0.19	0.1	0.1	1	1	0.1	0.1
Hexochlorobenzene	µg/l	-	0.03													
Hexachlorobutadiene	µg/l	-	0.1													
Phenol	µg/l	-	30													
Chloroform	µg/l	-	12													
1,2-Dichloroethane	µg/l	3	10													
1,1,1-Trichloroethane	µg/l	-	100													
Trichloroethene	µg/l	10	10													
1,1,2-Trichloroethane	µg/l	-	400													
Tetrachloroethene (PCE)	µg/l	10	10													
Styrene	µg/l	-	50													
Benzene	µg/l	1	30	10	10	10	10	10	10	10	10	10			5	5
Toluene	µg/l	-	50	10	10	10	10	10	10	10	10	10			5	5
Vinyl Chloride	µg/l	0.5	-													
Xylene	µg/l	-	30	10	10	10	10	10	10	10	10	10			5	5
TPH	µg/l	10		9.95	9.95	9.95	9.95	9.95	9.95	9.95	9.95	9.95	9.5	9.5	9.5	9.5
BOD	mg/l	8		1	2	1	1	1	1	88	13	12	5	3	3.2	5

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