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EXECUTIVE SUMMARY

Ramboll UK Limited (Ramboll) was instructed by Watkin Jones & Son Limited to develop the Remediation Strategy for the Thames Quarter development at King's Meadow, Reading, RG1 8BN. The report is required in connection with the proposed development of the site by the Client for residential apartment end use.

The Remediation Strategy follows a number of assessments that are typically undertaken to evaluate the contamination status of a site. Past assessments have included:

- a Preliminary Risk Assessment (including Conceptual Site Model);
- Phase II site investigation;
- a Generic Quantitative Risk Assessments for human health purposes; and
- a Detailed Quantitative Risk Assessment for controlled waters purposes.

There has also been historic remediation completed at the site due to a leak of oil into the ground.

This Remediation Strategy continues on from previous remediation activities that were completed at the site under earlier remediation strategies for works known as the Short Term and Mid Term Works relating to a previous pollution incident. This Remediation Strategy covers the Long Term Works that are required to finish clean-up of the previous pollution incident. This also presents the remediation requirements associated with the development of the site for residential end use including clean capping requirements for landscaped areas.

The previous remediation works were undertaken in 2014 and 2015. These works included the removal of an underground waste oil storage tank; excavation of visibly impacted soils; and the installation of sumps for the removal of free phase product. Limited areas of impact do remain on site where there were constraints in the extent of the remedial excavation (e.g. due to buildings and services). In certain discrete areas further remediation is required.

Site Investigation Results, Site Wide Data Interpretation and Controlled Waters Detailed Quantitative Risk Assessment

2017 SI Results

The most recent site investigation of December 2017 has identified very little evidence of significant contamination to be present on-site other than where residual contamination is known to be present associated with the leak. Free phase product has been identified in very discrete areas in parts of the site that are identified for remediation in this strategy.

Across the majority of the site dissolved phase TPH contamination was detected below the laboratory detection limits in twenty two of twenty four wells other than in WS407 where an oil sheen was present on alluvial groundwater and free phase product was observed in soils. TPH was also detected in one of five chalk boreholes at a concentration of 0.17mg/l but was not detected in the overlying river terrace deposits or alluvium in this area.

Due to the residual presence of PAHs and metals in the Made Ground clean capping will be required in future landscaped areas.

Low ground gas concentrations were detected with no flow rate consistently detected. The site has been characterised as Characteristic Situation 1. Therefore, ground gas protection measures are not considered to be required for the proposed development.

Site Wide Data Interpretation

In this Remediation Strategy all previous soil data has been reviewed to identify if contamination is present in soil and groundwater outside of the oil leak remediation area. This has identified one location

immediately to the north of the remediation area where creosote odours and timber were identified and soil concentrations exceeded human health targets. The most recent groundwater data is considered to be representative of the current risks to future residents and controlled waters.

Controlled waters Detailed Quantitative Risk Assessment (DQRA)

A previous Controlled waters DQRA was completed in December 2014 that provided an assessment of risks to the wider aquifer and the River Thames from residual on-site contamination relating to the pollution incident. A 'compliance point' was modelled 50m from the site. This was completed after the Source Removal Works and before the Mid Term Works.

The DQRA modelled five areas of residual soil contamination and an area of dissolved phase groundwater contamination - both in the area of the leak. The contamination included in the model was then partly remediated under the Mid Term Works and very little evidence of TPH sorbed to soil or dissolved in groundwater has been encountered in the most recent site investigation. It should be noted that the removal of free phase product entrained in soils and floating on groundwater has always been an inherent remedial requirement for the site and that discrete product remains in certain areas. As a conservative approach therefore the existing DQRA is considered to be appropriate to inform the remedial targets for soil and groundwater under the Long Term Works. Furthermore, due to the future residential use for the majority of TPH contaminants the soil and groundwater remedial targets for soil and groundwater media are based on human health criteria, which in many cases are more stringent than controlled waters values.

Long Term Works

The remediation proposed to be undertaken under the Long Term Works will involve:

- **Proof Dig:** A proof dig will take place as part of the demolition works prior to the start of the remediation works. This will remove much of the existing site drainage including the oil / water interceptors and manhole chambers that were associated with the motor showroom and where residual oil was very locally encountered previously up against the concrete surround of these structures. Ramboll will attend site during these works.
- **Delineation:** In the areas where remediation is known to be required or evidence of potentially contamination that may require remediation has been identified the area of impact will be delineated through trial pits and trenches prior to the formation of the main remediation excavations.
- **Remediation of Soil:** impacted soil will be excavated incrementally and removed from site for disposal. Excavations will be backfilled with 'clean' imported aggregate. Unimpacted soils will be retained for placement back into the excavation in sequence.
- **Extraction of Free Phase Product:** free phase product will be removed through excavation where it is present entrained in soils and skimmed from the surface of the groundwater (where present). The Contractor will be required to validate that all free phase product has been removed. The Contractor may propose to encapsulate or immobilise free phase product if it is identified to remain beneath the culvert where it is not possible to remove such contamination through excavation. This will require a written method statement for such work and for this to be agreed with the Environment Agency (EA).
- **Groundwater Treatment:** residual dissolved phase petroleum hydrocarbon contamination may be present locally in areas where free phase product was present and excavation works have taken place. In these areas the Contractor may apply a treatment chemical to the groundwater to reduce hydrocarbon concentrations.
- **Validation:** the Contractor undertaking the work will be required to produce records during the works to validate that the works have been completed successfully. This will include records of field observations, taking soil validation samples at set frequencies, confirmation

that free phase product has been removed and groundwater sampling once the works are complete.

- **Verification:** Ramboll will provide independent verification that the works have been completed in line with the Remediation Strategy through field observations, soil samples and undertaking groundwater sampling prior to piling.

On completion of the Long Term Works a validation report will be prepared by the Contractor and a verification report will be prepared by Ramboll. It is acknowledged Planning Condition 07 (Remediation Validation) will require the development to be complete and all landscaping installed before the condition can be fully signed off. This is anticipated to be several months after the Long Term Works remediation has been completed and therefore separate validation and verification reports will be prepared on completion of the Long Term Works to provide the regulatory authorities with a record of the ground conditions at the time of completion of the works.

It is further acknowledged that piling activities will take place soon after the remediation works. Initial discussions have taken place with the EA and the EA has agreed that the piling works can take place once two groundwater sampling rounds spaced one week apart have been completed from selected monitoring wells to verify that the groundwater remedial targets have been met. A Foundation Works Risk Assessment will need to be in place to inform the piling work as well.

Development Led Works

Based on the results of the site investigation and from review of all available soil data for the site the majority of the site will not present a significant risk to future residential users where hardstanding and buildings cap the site and prevent direct contact or mobilisation of soil dust.

Due to the presence of residual soil contamination, as is the case for many urban sites, where soft landscaping is proposed a capping layer of 'clean' imported landscaped material will be required. Prior to import to site the Contractor will be required to confirm the source of the material and to provide chemical analysis to confirm that the material is suitable for use at the site. The depth and chemical quality of the material will also be verified on-site. A separate report will be prepared providing the validation information.

No ground gas protection measures are considered to be necessary based on the site investigation results.

The design of potable water supply pipes will also require agreement with the local water company.

1. INTRODUCTION

1.1 Instruction

Ramboll UK Limited (Ramboll) was instructed by Watkin Jones & Son Limited (the “Client”) to develop a Remediation Strategy for the Thames Quarter development at King’s Meadow, Reading, RG1 8BN (the “site”). The report is required in connection with the proposed development of the site by the Client for residential apartment end use.

The Remediation Strategy follows a number of assessments that are typically undertaken to evaluate the contamination status of a site. Past assessments have included:

- a Preliminary Risk Assessment (including Conceptual Site Model);
- Phase II site investigations;
- a Generic Quantitative Risk Assessments for residential human health purposes; and
- a Detailed Quantitative Risk Assessment for controlled waters purposes that covers the residual contamination from the oil leak.

Previous remediation strategies have been implemented at the site in relation to a pollution incident in 2013, these are referred to as the Short Term or Source Removal Works and Mid Term Works. This Remediation Strategy continues on from those earlier strategies and covers the Long Term Works that are required to finish clean-up associated with the previous pollution incident.

This Remediation Strategy also considers the condition and remedial requirements for the wider site and the mitigation measures that will be required to develop the site to residential end use (referred to herein as development led remediation activities).

The current site location, boundary, and proposed layout are presented in Figures 1, 2 and 3, Appendix 1.

1.2 Remediation Objectives

The remediation objectives are two-fold:

1. To complete the remediation of the former pollution incident and ensure that the post remediation soil and groundwater conditions do not potentially represent a future significant risk to controlled waters.
2. To ensure the site does not represent a risk to future residents in the context of Part 2A of the Environmental Protection Act 1990.

The current contamination status of the site, proposed remediation methods and criteria, timelines and validation criteria are presented in this report.

1.3 Proposed Development and Planning Permission

The site is being developed under Reading Borough Council Planning Permission Number 162166, which was permitted on the 6th December 2016.

The Planning Permissions covers the:

- *“Erection of a part 12 storey, part 23 storey building comprising 315 apartments in a mix of studio, one-bedroom, two-bedroom and 3-bedroom units; residents' lounges, tech-hub, dining room, and cinema room, various rooftop outdoor amenity spaces, concierge/reception with coffee meeting area, residents' storage facilities, postroom, ancillary back-of-house facilities, 315 secure cycle parking spaces, 49 car parking spaces, landscaping, and associated works. Demolition of existing multi-storey car park.”*

Of particular note in relation to ground contamination assessment, there are strips of soft landscaping proposed in the north of the site and two landscaped islands proposed in the west of the site. The remainder of the site will be covered by buildings and hardstanding cover. Also of note, there are no residential apartments located at ground floor level which will be occupied by an entrance hall, cycle store, plant rooms, post room, a concierge space and car parking area.

The Planning Permission contains conditions that in summary require:

- Condition 06 contamination (characterisation).
- Condition 07 contamination (remediation scheme).
- Condition 08 contamination (implementation of remediation).
- Condition 09 contamination (unexpected contamination).
- Condition 10 land gas (site investigation).
- Condition 11 land gas (remediation scheme).
- Condition 12 land gas (implementation of remediation).
- Condition 13 piling method statement (in line with the EA Foundation Works Risk Assessment guidance).

A Preliminary Risk Assessment and Phase II Environmental Site Investigation (ESI) have been prepared by Ramboll in January 2018 that are intended to discharge Planning Conditions 06 and 10. This report has been prepared to support discharge of Planning Condition 07. It should be noted that the Phase II ESI did not identify a requirement for ground gas protection and therefore a remediation scheme for land gas risks and implementation of remedial measures for land gas risks as required by Planning Conditions 11 and 12 are not considered by Ramboll to be required.

The specific requirement of Condition 07 is as follows:

- *No development shall take place until a detailed remediation scheme to bring the site to a condition suitable for the intended use by removing unacceptable risks to human health, buildings and other property (i.e. off-site) and the natural and historical environment has been submitted to and approved in writing by the Local Planning Authority. The scheme must include all works to be undertaken, proposed remediation objectives and remediation criteria, an appraisal of remedial options, and proposal of the preferred option(s), and a timetable of works and site management procedures. The scheme must ensure that the site will not qualify as contaminated land under Part 2A of the Environmental Protection Act 1990 in relation to the intended use of the land after remediation.*

1.4 Constraints and Limitations

This report has been prepared for the exclusive use of Watkin Jones and Son Limited and should not be used in whole or in part by any third parties without the express permission of Ramboll in writing.

The Remediation Strategy is designed to support the proposed residential development of the site. This Remediation Strategy has been produced taking into account the findings of the Ramboll site investigation, which in turn was scoped and undertaken based on the findings of previous third-party site assessments and previous remediation works on-site.

Ramboll's 2018 Phase II ESI report and this Remediation Strategy does not address geotechnical / structural constraints of the area requiring remediation. Furthermore in this respect, the geotechnical and structural implications (if any) of the proposed Remediation Strategy should be reviewed by the developer's geotechnical/structural advisors.

1.5 Report Structure

The report is structured as follows:

The report is structured as follows:

- Section 2: provides a description of the site, it's setting and environmental context;
- Section 3: summarises the source characterisation works that have taken place to date;
- Section 4: discusses the controlled waters detailed quantitative risk assessment that informs the work;
- Section 5: outlines the remedial works and considers the available remedial options;
- Section 6: sets out the strategy for remediation under the Long Term Works;
- Section 7 describes the remediation required under the Long Term Works;
- Section 8: sets out the validation criteria for the Long Term Works;
- Section 9 sets out the development led works and associated validation criteria;
- Section 10: sets out a procedure for unforeseen contamination finds during excavations into the ground;
- Section 11: provides the general environmental controls to be employed during the works;

2. SITE SETTING AND DESCRIPTION

2.1 Site Setting and History

2.1.1 Site Setting

The site is located in central Reading, in a commercial setting, approximately 140m south of the River Thames and the adjacent Vastern ditch (located 130m north from site). The site is currently in operation as a public car park. The only building present on-site is a multi-storey car park located in the south-east. A workshop and showroom associated with a motor dealership was present in the south-west of the site until this was demolished in 2016.

2.1.2 History

The site was historically in use as railway land, was then developed as a depot in the mid-1980s and from the 1980s became a motor dealership. The motor dealership caused a pollution incident at the site in 2013 when an underground storage tank leaked waste oil into the ground in the centre-east of the site. This has largely been remediated although residual contamination remains in the centre-east of the site near to where the leak took place.

2.2 Environmental Setting

2.2.1 Geology and Hydrogeology

The geological sequence encountered beneath the site is presented in Table 2.1 below.

Table 2.1: Summary of Geology and Hydrogeology				
Formation	Description	Thickness	Groundwater Depth and EA Designation	Hydrogeological Significance
Made Ground	Generally formed of inert sandy gravel or gravelly sandy with fragments of concrete and brick throughout and locally fragments of coal, clinker, slag, chalk, and plastic.	1-2m thick (up to 2.7m thick in places)	No designation	Not classified as an aquifer.
Alluvium	Grey / blue sandy clay with some fine to medium flint gravel	1.0m to 1.5m thick	Secondary A	Permeable formations with potential to support localised abstractions.
River Terrace Gravels	Very sandy light brown fine to medium flint gravel. Gravelly sand in places.	Up to 4.6 m thick	Secondary A	Permeable formations with potential to support localised abstractions.
Seaford Chalk Formation and Newhaven Chalk Formation	Identified as a white structureless chalk	Up to 200m thick	Principal	Highly permeable, with significant water storage. Able to support large abstractions.

The site is located within an EA defined groundwater Source Protection Zone (SPZ) III, which relates to the abstraction of groundwater from the Chalk at Reading University approximately 2

km south-east of the site. The Alluvial groundwater and River Terrace Deposits are not abstracted for use in the immediate vicinity of the site. Groundwater in the River Terrace Deposits and the Chalk is likely to be in direct hydraulic connectivity.

2.2.2 Hydrology

The nearest identified main surface water body is the River Thames, an inland river located 140 m north of the site. The Vastern Ditch, a surface water body that runs along the southern bank and ultimately drains into the River Thames, is located from 130m to the north of the site. A Thames Water surface water culvert runs from north to south through the site and discharges into the Vastern Ditch and the River Thames.

The ground contamination investigation and remediation works and the residual contamination that requires remediation is discussed in Section 3 below.

3. SOURCE CHARACTERISATION

This section provides a summary of the available soil and groundwater contamination information that is available for the site.

3.1 Previous Site Investigation and Remediation Works

3.1.1 RPS Site Investigation 2008

RPS undertook a site investigation in 2008 that was assessed based on a proposed residential end use for the site. This identified observations of hydrocarbon odours in soils and groundwater at three locations: WS9 (in the east of site) and WS2/WS3 (both located on the southern site boundary).

The maximum total petroleum hydrocarbon (TPH) concentration detected was at WS6 (1.6-1.9 metres below ground level (m bgl)), where 730 mg/kg was reported in a layer of Made Ground with ash and clinker present. At WS9 (2.8-3.2m bgl) 160 mg/kg of gasoline range organics (GRO) was detected in a layer where black streaking was reported in the alluvium from 2.4m bgl. A maximum polycyclic aromatic hydrocarbon (PAH) concentration of 120mg/kg was detected at WS10 (0.6-0.9m bgl).

Within groundwater, the RPS report described strong hydrocarbon (diesel) odours at WS9 and moderate odours at BH2 and BH3 (the RPS report states BH2 and BH3, although no BH3 was drilled, so it is assumed, based on later observations during groundwater monitoring made by Ramboll in WS2 / WS3, that the contamination referred to as BH2 / BH3 relates to WS2 / WS3). Maximum groundwater concentrations of TPH (190 mg/l), PAHs (1.5 ug/l) and GRO (180 mg/l) were detected at WS9 (in the east of site). All other boreholes recorded TPH at concentrations < 1mg/l on-site, apart from one that recorded 1.5mg/l. However, this was ten years ago and the most recent groundwater TPH concentrations detected by Ramboll (discussed below) recorded results below the laboratory detection limit across most of the site including the area of WS2 / WS3 and WS9.

3.1.2 Ramboll Investigation and Remediation Works

Ramboll was involved in investigation and remediation at the site between 2013 and 2015, in relation to the pollution incident. The remediation works are described in full in the Ramboll reports for the Short Term and Mid Term works, however, a summary is provided below:

Short Term Works:

- **Pollution Incident Response (late 2013):** the initial response to the pollution incident involved the removal of oil from on-site drains, emptying of the underground oil tank, and clean-up of off-site surface waters. A site investigation was undertaken that identified neat oil in the ground generally within a 5m radius from the UST and at the connection between site drainage discharge and the storm water culvert;
- **Source Removal (Summer 2014):** the UST and surrounding impacted soil was removed. Sumps were installed in the underlying aquifer and oil was extracted on a fortnightly basis. This was completed in a pre-defined area due to the presence of constraining structures. If contamination was identified to extend outside of the pre-defined areas this was agreed to be dealt with at a later time. Generally only pockets of staining were encountered outside of the pre-defined area, although free phase product was encountered adjacent to the culvert in the gravel surround.

Mid Term Works:

- Mid Term Works (June - December 2015): a second phase of remediation excavation primarily targeted the area to the immediate west of the Thames Water culvert. Contaminated pipe bedding was removed and oily contamination in the deeper gravels was also 'chased out'. The remediation works comprised the excavation of contamination over an area of approximately 88m²; this is in addition to the 117m² excavated during the Summer 2014 Source Removal works. Further extraction of free phase product took place during the works and on cessation residual product remained in Sump 1C and intermittently in Sump 1B located just to the west of the Thames Water Culvert and as shown on Figure 4, Appendix 1.

Long Term Works:

- Residual contamination remained in discrete areas following the Mid Term Works where access constraints existed and further investigation and remediation was required as part of the re-development works. The objectives, strategy and remediation criteria are set out in this strategy for the Long Term Works, as well as mitigation specifically relating to the residential development.

In summary, a significant proportion of the original leak has been remediated including the removal of the tank and surrounding contamination, and the remaining works relate to the removal of residual contamination in discrete areas with limited access to date.

3.2 Review of Previous Data

The previous RPS and Ramboll data has been reviewed against the Ramboll GACs for residential (no plant uptake) end use to understand if exceedances of the GAC are present in addition to the recent site investigation that has taken place. This has confirmed:

- RPS: two determinands were reported in exceedance (Dibenzofuran (0.41 mg/kg) in WS3 (0.3m-0.6m bgl), and Naphthalene (2.3 mg/kg) in WS9 (2.8m-3.2m bgl)).

On review of all 86 validation samples taken on a 1m grid basis across the remediation area, four samples were identified to exceed residential human health criteria – all of which were broadly from a similar location. These are:

- Short Term Works: Samples 28, 29, 30 from grid squares A9, A10 and B10 from depths of 1.2m to 1.3m bgl recorded concentrations of petroleum hydrocarbons from 3,197 mg/kg to 7,180 mg/kg, which exceed the Ramboll GAC of 1,900 mg/kg for the aromatic C21-C35 hydrocarbon fraction.
- Mid Term Works: TP 01 recorded a concentration of 3,109mg/kg at 1.2m in the western face compared to a GAC of 1,900mg/kg for the aromatic C21-C35 hydrocarbon fraction. Five further samples collected from the base and other faces of this trial pit did not exceed the Ramboll GAC. However, the western face lies immediately to the east of samples 28, 29 and 30 that are referenced in the bullet point above.
- BH202 at 0.5m bgl recorded an aromatic C21-C35 concentration of 2,200 mg/kg compared to the GAC of 1,900mg/kg¹. No visual or olfactory evidence of contamination was recorded in this location.
- Extractable Petroleum Hydrocarbons (EPH) C8-C40 data was obtained in the original pollution incident response site investigation (locations WS101-WS107 and BH101-BH103). The majority of the soil that identified petroleum hydrocarbons was excavated out during the removal of the UST. Three locations remained in-situ that recorded EPH at <30mg/kg (WS101 at 2.8m), 939 mg/kg (WS102 at 2.8m) and 1,686 mg/kg (WS107 at 2.1m). It is not possible to compare the results directly to the GAC, although given the low concentrations

¹ Data from Continued Groundwater Monitoring and Further Borehole Installation Report, Cooper Reading BMW, Reading, UK11-19458, May 2014.

and observations of heavy end contamination the exceedances are not considered to be significant in the context of the proposed development.

- The delineation investigation in January 2015 targeted the area to the north and east of the remedial excavations. This recorded:
 - BH301 – TPH was detected at 1,430mg/kg (1.7m bgl) which exceeds the Ramboll GAC for hydrocarbon bands C8-C10 Aliphatic (a detected concentration of 718.9mg/kg exceeds the GAC of 13mg/kg) and C10-C12 Aliphatic (a detected concentration of 129.4mg/kg exceeds the GAC of 120mg/kg). Samples at 1.0m and 2.5m did not exceed the GAC. The concentrations detected are considered to represent a potential risk to future residents that will require remediation.
 - BH302 – Maximum TPH detected at 66mg/kg at this location - No GAC exceedances.
 - BH303 – 6,977mg/kg detected at 1.5m bgl - material excavated out during Mid Term Works.
 - BH304 and BH305– all results <38mg/kg which did not exceed the Ramboll RAC.

In summary, the majority of the above exceedances are not considered to represent a significant risk to a future residential site user given that all apart from one of these exceedances are from the heavy end C21-C35 range petroleum hydrocarbons that do not represent a volatilisation risk in the CLEA risk assessment model. The only exceedance that potentially represents a risk to a future resident is at location BH301 where timber fragments and TPH was detected at 1,430 mg/kg at 1.7m bgl.

The most recent site investigation results (including most recent groundwater condition data and associated human health / controlled waters risks) is discussed below.

3.3 Findings of 2017 Site Investigation

A recent Phase II Environmental Site Investigation has been completed to provide a current site wide overview of the site ground conditions. This has confirmed that the majority of the site is suitable for the proposed residential apartment use. Residual contamination remains in the Made Ground as is typical for much urban development land in the UK. Where buildings and hardstanding are present this will 'cap' the contamination and ensure there are no significant risks to future residents in these areas. For areas where landscaping is present in the northern and western extremities of the site the existing ground is not of suitable chemical quality to be exposed at the ground surface and a 'clean' break layer of imported topsoil will be required.

Remediation is still required under the Long Term Works and free phase product has been identified as follows:

- in the existing Sumps 1B and 1C that are installed in the river terrace deposits.
- in WS407 where free phase product was identified in soil and groundwater in the alluvium. This is close to the historic UST fill point; and
- in WS410 where a vein of free phase product was identified in soil in the alluvium.

No further significant soil or groundwater sources of contamination have been identified in the most recent Phase II ESI (Ramboll, January 2018) outside of the previously targeted remediation areas and UST features. No evidence of significant ground contamination was encountered in locations that targeted the RPS locations WS2/WS3 and WS9. However, given the sensitivity of the site it would be prudent to undertake further trial pits in these areas as part of the remediation activities.

3.3.1 Ground Gas Risk Assessment

The most recent site investigation identified inert Made Ground across the site and additionally, low ground gas concentrations were recorded during post-investigation monitoring. The results are summarised as follows:

- Methane up to 0.2% v/v;
- Carbon dioxide up to 3.5% v/v;
- Oxygen ranged between 7.3% v/v and 20.2% v/v;
- Hydrogen sulphide was recorded at 1ppm maximum and carbon dioxide was recorded at <1ppm;

The monitoring was completed at varying atmospheric pressures, including after a fall from high to low pressure.

Two previous rounds of monitoring in 2008 identified very similar results and no positive flow readings. Overall the site is considered to represent a low risk to future residents from ground gas and specific ground gas protection measures are not considered to be required.

3.4 Summary of Pollutant Linkages

Table 3.1 below provides a summary of the post site investigation Conceptual Site Model that is detailed in full in Tale 6.2 of the ESI report (Ramboll January 2018).

Table 3.1 Summary of Pollutant Linkages	
Table Sub-Heading Left	Proposed Remediation Measure
PL1 – Dermal Contact, ingestion, inhalation of contaminated soil– future residents	Majority of site capped by building and hardstanding. Landscaped areas to be formed of clean capping soil the requirements of which are discussed in this Remediation Strategy and that will require validation.
PL2 - Contaminant volatilisation into indoor and outdoor	Removal of free phase product under Long Term Works. Removal of soils above the GAC in the area of BH301.
PL3 – Risks to off-site commercial land.	No significant risk.
PL4 – Leaching of contaminants to groundwater	Removal of free phase product under Long Term Works.
PL5 – Lateral migration of contaminants	No evidence of off-site contaminant migration has been identified. This should be verified post remediation works.
PL6 – Ground gas	No specific ground gas protection measures considered necessary.
PL7 - Leaching of contaminants into water supply pipes.	Residual petroleum hydrocarbon contamination is present and the appropriate selection of water supply pipes will require further consideration.
PL8 - Piled foundations creating pathways for contaminant migration.	Further remediation required where residual free phase product is present, then a qualitative assessment of the conditions post remediation will be required prior to piling taking place.

4. CONTROLLED WATERS DETAILED QUANTITATIVE RISK ASSESSMENT

4.1 Detailed Quantitative Risk Assessment

A previous Controlled waters DQRA was completed in December 2014 that provided an assessment of risks to the wider River Terrace Deposit / Chalk aquifer and the River Thames from on-site contamination. A 'compliance point' was modelled 50m from the site. This was completed after the Source Removal Works and before the Mid Term Works.

The DQRA modelled five areas of residual soil contamination and an area of dissolved phase groundwater contamination - both in the area of the leak. The contamination included in the model was then partly remediated under the Mid Term Works and very little evidence of TPH sorbed to soil or dissolved in groundwater has been encountered in the most recent site investigation. It should be noted that the removal of free phase product entrained in soils and floating on groundwater has always been an inherent remedial requirement for the site and that discrete product remains in certain areas. As a conservative approach therefore the existing DQRA is considered to be appropriate to inform the remedial targets for soil and groundwater under the Long Term Works.

Site specific remedial targets were developed in the DQRA for soil and groundwater to be protective of controlled waters will be used as remediation criteria in this strategy. The methodology for derivation of the remedial targets is presented in Ramboll's revised DQRA report.

The soil and groundwater remediation target values are provided in table 4.1 below.

Table 4.1 Controlled waters Remedial Target Values		
Contaminant	Soil Remedial Target (mg / kg)	Groundwater Remedial Target (mg / l)
Benzene	350	0.01
Toluene	FPP**	N/A
Ethylbenzene	FPP**	0.02
Xylene	FPP**	0.09
MTBE	400	0.012
Aliphatic C5-6	FPP**	0.145
Aliphatic C6-8	FPP**	0.15
Aliphatic C8-10	FPP**	0.18
Aliphatic C10-12	FPP**	FPP**
Aliphatic C12-16	FPP**	FPP**
Aliphatic C16-35	FPP**	FPP**
Aromatic C5-7 (Benzene)	FPP**	FPP**
Aromatic C7-8 (Toluene)	FPP**	0.01
Aromatic C8-10	FPP**	0.2
Aromatic C10-12	FPP**	0.09
Aromatic C12-16	FPP**	0.14

Table 4.1 Controlled waters Remedial Target Values		
Contaminant	Soil Remedial Target (mg / kg)	Groundwater Remedial Target (mg / l)
Aromatic C16-21	FPP**	0.14
Aromatic C21-35	FPP**	0.14
FPP** = for these values the risk assessment model limited the remedial target to be at the solubility concentration for that contaminant and therefore free phase product has been set as the remedial.		

Based on the most recent groundwater data obtained in December 2017 the only location where the soil and groundwater remedial targets were exceeded was in WS407 where a total TPH concentration of 62.8 mg/l was recorded in groundwater, free phase product was identified in soil and an oily sheen was present on the Alluvial groundwater. All other locations recorded petroleum hydrocarbon contaminants at concentrations below the laboratory method detection limit. This is consistent with the findings of groundwater monitoring rounds completed in June / December 2016 and July 2017 where no dissolved phase petroleum hydrocarbons were recorded on-site.

The removal of neat free phase product in soil and groundwater has also been set as remediation criteria for the site under the earlier remediation strategies.

5. REMEDIAL WORKS AND OPTIONS APPRAISAL

The specific remediation activities that are required on the site have been presented separately below as the Long Term Works (required to remove the residual petroleum hydrocarbon impact) and development led mitigation works that will be incorporated or inherently required to develop the site.

- **Long Term Works** - Removal of soil impacts and free phase product, where present.
- **Development-led Mitigation Works** - anticipated to comprise:
 - Capping system & landscaping.
 - Water supply pipe / service corridors.
 - Piling risk assessment and groundwater monitoring.
 - Borehole decommissioning.
 - Unexpected ground conditions.

5.1 Remedial Options

5.1.1 Long Term Works

The main remediation works that are required under this strategy are for the remediation of petroleum hydrocarbon contamination. Previous reports (Previous Source Term and Mid Term Remediation Works) have been completed principally through the excavation and removal of free phase product from the soil or extraction from the surface of the groundwater in sumps. This has successfully led to the removal of the majority of the oil that previously leaked. On this basis, a similar methodology will be used as part of the Long Term Works in an attempt to remove the residual contamination that remains.

At present there is very little evidence of dissolved phase petroleum hydrocarbon contamination in the groundwater at site. However, it cannot be entirely discounted that such contamination may be locally encountered where free phase product remains and therefore direct chemical application may occur to groundwater to provide a final 'polish' to groundwater conditions.

It is acknowledged that a major constraint exists on site with the presence of the Thames Water culvert. Oil has been previously identified in association with the bedding material (layer of gravel) around the culvert and there is a potential that oil may still remain in the bedding where the culvert runs beneath the multi-storey car park building. During the remediation works all possible steps will be taken to remove residual contamination in association with the culvert and the bedding material. However, if residual oil is present or suspected of being present beneath the culvert, and therefore remains inaccessible, there may be a need for said contamination to be encapsulated or immobilised, in order to prevent it migrating from beneath the culvert.

5.1.2 Development Led Works

The development of the site will inherently require inbuilt mitigation where buildings and hardstanding cap the site and clean landscaping is present in landscaped areas. No further appraisal of the remediation options is considered necessary.

6. LONG TERM WORKS REMEDIATION STRATEGY

The following section sets out the requirements for the remediation of the Long Term Works only. The strategy for the development led remediation works is presented in Section 7.

6.1 Roles

- Developer: Watkin Jones is the developer of the site.
- Remediation Contractor: Watkin Jones will appoint a Remediation Contractor who will undertake the physical remediation works and provide verification that the works have been completed in line with this strategy.
- Environmental Consultant: Ramboll will provide independent review and validation of the remediation works.

The EA and Reading Borough Council Environmental Health Department are involved stakeholders and will review and provide approval of the remediation works to enable discharge of the associated Planning Conditions.

6.2 Timescales

Based on the current development programme the timescales for demolition of the multi-storey car park, remediation activities and piling works are as follows:

- 15th February to 14th March 2018: Demolition phase works / proof dig.
- 28th March to 19th April: Remediation implementation.
- 20th April to 11th May: Piling mat formed.
- 14th May 2018: Start of piling.

6.3 Demolition Implementation

The demolition phase works will involve demolition of the remaining building structure on-site, which is the multi-storey car park. There will also be a proof dig of the shallow ground across the site that is intended to remove obstructions prior to piling works taking place. This will include the removal of structures such as redundant interceptors and manhole chambers. Evidence of oil has previously been recorded adjacent to an interceptor structure and manhole chamber in the north-west corner of the former remediation area. Therefore, Ramboll will attend site during the planned proof dig to observe the removal works of these structures and obtain validation samples. Further delineation and excavation may be required in these areas if residual contamination is expected to remain in the ground on completion of the proof dig. Ramboll will advise if this is required.

If residual ground contamination is identified outside of the remediation area during the proof dig, this should be recorded by the Contractor and reported to Ramboll and the Client in line with the unexpected ground condition procedures set out in Section 10, such that these areas can be investigated and potentially remediated.

Where possible the demolition Contractor will need to protect the available site investigation boreholes that are present on-site.

6.4 Long Term Works - Residual Source Removal

The remediation works are set out below. The works will be accommodated into the construction program and Ramboll understands that the proposed timeline for implementing these works will be between 28th March to 19th April 2018.

6.5 Remediation Constraints

The remaining building structures will be demolished prior to the start of the remediation works. The Thames Water culvert that runs north-south in the centre-east of the site will remain in place and is not being re-routed as part of the future development. The culvert is formed of two pipes running in parallel with a concrete section between the pipes that prevents excavation into the ground between the pipes.

It has not been possible to excavate beneath or between the two pipes in previous remediation works as this is likely to affect the integrity of the culvert, this is expected to be the case for the long Term Works also. The Remediation Contractor should ensure the culvert is not impacted during excavations into the ground. During previous excavation works it has been possible to support the culvert and excavate slightly beneath the edge of the culvert. This may be required in this phase of work.

6.6 Potential Contaminants of Concern

The previous site investigations and remediation activities have identified the potential contaminants of concern to be:

- the presence of free phase oil;
- petroleum hydrocarbons; and
- fuel species of methyl-tert-butyl-ether (MTBE) benzene, toluene, ethylbenzene and xylenes.

6.7 Remediation Criteria

The remediation criteria that will be used to validate that the remedial work are those set out in this section. The validation criteria are set out in full in Section 8.

6.8 Free Phase Product

Free phase product represents neat fuel that for the purpose of this Remediation Strategy is considered by Ramboll to be a separate discernible fuel layer floating on the groundwater table. Where recorded, free phase product will need to be removed.

It may be that a situation is identified during the remediation works where constraints prevent residual free phase product being removed (such as if free phase product is identified to be seeping from beneath the culvert or is trapped in the structure of a manhole associated with the culvert).

In such circumstances, once all possible efforts have been taken to remove the contamination through excavation and extraction (as agreed with Ramboll and the Client) the Remediation Contractor will need to agree with Ramboll, the Client and the regulatory authorities that the residual contamination can be encapsulated or immobilised in the ground. The Remediation Contractor will be required to propose a method to encapsulate or to immobilise such contamination in the ground prior to the works taking place. For example this could involve placing a bentonite seal along the section of the culvert that is affected. The Contractor should provide a detailed method statement for how this would be implemented in advance of the works. The method should also not affect the long term structural integrity of the culvert.

6.9 Soil Remedial Target Values

The remediation criteria for soil is set out in Table 6.1 below. The soil targets are compared to the Ramboll controlled waters GAC and for all contaminants of concern the residential GAC are the lower values. The GAC are therefore protective of both controlled waters and future residential receptors.

Table 6.1: Remedial Targets – Soil			
Contaminant	Controlled waters Remedial Target* (mg / kg)	Ramboll Residential GAC (mg / kg)	Soil Remedial Target^
Benzene	350	0.37	0.37
Toluene	FPP**	370	370
Ethylbenzene	FPP**	34	34
Xylene	FPP**	34	34
MTBE	400	39	39
Aliphatic C5-6	FPP**	24	24
Aliphatic C6-8	FPP**	53	53
Aliphatic C8-C10	FPP**	13	13
Aliphatic C10-12	FPP**	62	62
Aliphatic C12-16	FPP**	510	510
Aliphatic C16-21	FPP**	42,000	42,000
Aliphatic C21-35	FPP**		
Aromatic C5-7 (Benzene)	FPP**	0.37	0.37
Aromatic C7-8 (Toluene)	FPP**	340	340
Aromatic C8-10 (Xylene)	FPP**	22	22
Aromatic C10-12	FPP**	120	120
Aromatic C12-16	FPP**	1,100	1,100
Aromatic C16-21	FPP**	1,900	1,900
Aromatic C21-35	FPP**	1,900	1,900
the controlled waters soil targets are set based on the existing DQRA. ** Model restricted to solubility levels – no risk at saturation concentrations to receptor, therefore removal of Free Phase Product (FPP) is set as remedial target ^ this is the lowest of the controlled waters and residential GAC values.			

The previous remediation work at the site was completed based on the then commercial use of the site. The commercial GAC is not considered to be suitably conservative for residential use and so the previous soil sample results have been reviewed against the Ramboll GAC for residential use without private garden space (Section 3.2 above), to understand if ground contamination may remain in the ground that could represent a significant risk to a sensitive receptor (future site user). Based on this soil impacted with creosote and timber at BH301 requires remediation.

6.10 Groundwater Remedial Target Values

The remediation criteria for controlled waters were generated from the existing Detailed Quantitative Risk Assessment that informs the Long Term Works. These have been compared to the Ramboll residential GAC for volatilisation risks and the lower value of the respective GAC has

been used as the remedial target for groundwater. The proposed target values are set out in Table 6.2 below.

Table 6.2: Remedial Targets - Groundwater			
Contaminant	Controlled water Remedial Target (mg / l)	Ramboll Residential GAC (mg / l)	Groundwater Remedial Target
Benzene	0.01	0.026	0.01
Toluene	NCG	3.07	3.07
Ethylbenzene	0.02	23.4	0.02
Xylene	0.09	0.87	0.09
MTBE	0.012	1,110	0.012
Aliphatic C5-6	0.145	0.309	0.145
Aliphatic C6-8	0.15	0.204	0.15
Aliphatic C8-10	0.18	0.0074	0.01 ^
Aliphatic C10-12	FPP**	0.0049	0.01 ^
Aliphatic C12-16	FPP**	FPP**	FPP**
Aliphatic C16-35	FPP**	FPP**	FPP**
Aromatic C5-7 (Benzene)	FPP**	FPP**	FPP**
Aromatic C7-8 (Toluene)	0.01	23.4	0.01
Aromatic C8-10	0.2	0.255	0.2
Aromatic C10-12	0.09	0.874	0.09
Aromatic C12-16	0.14	2.3	0.14
Aromatic C16-21	0.14	FPP**	0.14
Aromatic C21-35	0.14	FPP**	0.14
NCG = No Criteria Generated ** = Model restricted to solubility levels – no risk at saturation concentrations to receptor, therefore removal of Free Phase Product (FPP) is set as remedial target ^ = these values have been set at the method detection limit. This is considered to be appropriate given the reduced sensitivity of the ground floor use providing access and storage only and based on our experience of similar quantitative risk assessments the residential GAC are overly conservative for residential use. For example the commercial GAC, which is likely a similar exposure scenario in terms of volatilisation risks to the proposed development would require free phase product to be present for a significant risk to exist.			

7. REMEDIATION WORKS

The Remediation Contractor will be expected to undertake the following:

- Delineation of the residual source area.
- Free phase product excavation and disposal.
- Extraction of free phase product from groundwater.
- Groundwater treatment (if required).
- Obtaining validation records, soil samples during the works and one round of post remediation groundwater monitoring from pre-selected wells.
- Produce a validation report that demonstrates that the remediation works have been completed successfully and that the remediation criteria have been met in all areas where remediation is required.

7.1.1 Delineation Investigation

Based on the previous site investigations, residual contamination has been identified and further delineation of the extent of the contamination is required through a trial pitting exercise. Figure 5 shows the locations where trial pits and / or trenches should be excavated around. The Remediation Contractor will need to provide a plan showing the locations of trial pits to Ramboll and the Client for approval prior to works taking place. There are two types of area where further delineation is required:

- areas where remediation is known to be required or is likely to be required; and
- areas where it cannot be entirely discounted that potentially significant contamination may be present based on the observations and data to date. Further trial pitting is required to provide assurance in these areas. It cannot be discounted that remediation may be needed in these areas at this point.

It may be necessary to extend the trial trenches beyond the areas shown to fully delineate contamination and it is likely that the trial pits / trenches will form the starting point for remediation excavations.

In areas where the trial pit excavations confirm that remediation is not required, visual records should be obtained of the soils observed in each pit and one soil sample taken for validation purposes. Samples should be obtained from each 1m width x 2.5m length of trial pit targeted at the horizons where potentially significant contamination was encountered previously.

The areas requiring further investigation are set out in Table 7.3 below. It should be noted that further areas may be included in this list subject to the findings of the proof dig that is expected to take place post-demolition and pre-remediation.

Table 7.3 Pollutant Linkages and Remedial Measures		
Delineation Location	Previously Identified Contamination	Reason for Area Being Targeted
1) Southern Face of 'Source Removal' Excavation.	Soil contamination meets the Remedial Target Values. No free phase product observed.	Assurance purposes (remediation cannot be discounted).
2) Western Face of 'Source Removal' Excavation.	Soil contamination meets the RTVs. Mobile free phase product in north-west corner requires removal.	Remediation Required

Table 7.3 Pollutant Linkages and Remedial Measures		
Delineation Location	Previously Identified Contamination	Reason for Area Being Targeted
3) Northern Face of 'Source Removal' Excavation.	Delineation was not considered to be necessary in this area.	No further work required.
4) Continue visits to remove accumulated oil from Sump F (risk reduction remediation). As part of the redevelopment of the site, excavate around the culvert to 'chase out' and remove remaining free phase product and contaminated soils.	Delineation and removal of contamination along the length of the western culvert that runs beneath the multi-storey car park is required.	Remediation Likely to Be Required.
5) South-East Face of Mid Term Works Remedial Investigation.	Soil contamination meets the RTVs. No free phase product was observed. However, further delineation in this area is recommended given the slightly elevated residual contaminants present on the face of the excavation.	No further work required.
6) Free Phase Product in Gravel Aquifer (Sump 1B, 1C and WS407).	Free phase product remains present in Sump 1B and 1C. Free phase product has also been identified in the alluvium in WS410 and the contamination may extend into the gravel at this location, which is close to the two sumps. Whilst previous remedial excavations have been completed in this area the Contractor will be required to excavate up to the manhole and culvert to verify contamination has not re-entered these areas.	Remediation Required.
7) Free Phase Product in Alluvium at WS407.	Further delineation of the free phase product is required in this area.	Remediation Required.
8) RPS Locations WS2 / WS3	A thin layer of free phase product was detected in WS3 in 2013. A dissolved phase petroleum hydrocarbon concentration was detected in this area in 2013 of 3.09 mg/l. However, subsequent monitoring visits did not record the presence of dissolved phase contamination or free phase product in this area. Further site investigation was targeted at this area in December 2017 and no evidence of significant petroleum hydrocarbon contamination was recorded in soils and groundwater. Dissolved phase	Assurance purposes (remediation cannot be discounted).

Table 7.3 Pollutant Linkages and Remedial Measures		
Delineation Location	Previously Identified Contamination	Reason for Area Being Targeted
	hydrocarbon concentrations were below the detection limits of the laboratory in this area in December 2017.	
9) RPS Location WS9	Black streaking and a strong hydrocarbon odour was encountered in the alluvial clay from 2.2m. Soil at 2.8m recorded 530mg/kg of TPH.	Assurance purposes (remediation cannot be discounted).
10) BH301	TPH detected at 1,430mg/kg at 1.7m bgl. Exceeds GAC for the C8-C10 Aliphatic GAC of 13mg/kg (detected concentration of 718.9mg/kg) and C10-C12 GAC of 120mg/kg (detected concentration of 129.4mg/kg). Samples at 1.0m and 2.5m did not exceed the GAC. This recorded the presence of timber fragments in the Made Ground.	Remediation Required.
11) Remaining Section of Fill Pipe	The remaining section of the fill point that runs beneath the building needs to be removed and the excavation validated.	Remediation Required

The locations described in Table 7.3 are set out in Figure 5. The Remediation Contractor should provide a delineation plan prior to the start of works that will need to be approved by the Client and Ramboll before works take place. If the trial pits in these areas identify evidence that ground contamination has migrated away from these locations the trial pits could either be extended to 'follow' and 'chase out' the contamination or further delineation trial pits be excavated so that the full extent of the contamination is identified.

As with any brownfield site it cannot be discounted that local hotspots of unexpected contamination may remain in areas of the site away from previous remediation areas or exploratory positions. Therefore, any Contractor forming excavations into the ground on-site (including the Contractor undertaking the proof dig) should be aware of the potential for unexpected contamination finds and the need to report such finds (as discussed further in Section 10).

7.1.2 Remaining UST Infrastructure

The UST and nearly all of the associated pipework has been removed. The UST fill point and a short section of pipework remains present in the area of location WS407 running to the north-east for a short section beneath the multi storey car park building. The pipework and associated impacted soils around the pipework should be removed and the excavation validated in line with the requirements of the remedial excavations discussed below. The likely location of the fill pipe is shown on Figure 5. Ramboll will attend site during the proof dig works in this area in case the fill point is removed during the proof dig.

7.2 Remediation Excavations

The areas that will require remediation will be defined more completely by the Remediation Contractor based on the delineation investigation. It is anticipated that soil contamination and entrained free phase product will be excavated, extracted from groundwater and removed from the site immediately following the delineation exercise. The method of forming and validating remedial excavations and for the removal of free phase product is provided in outline below.

7.2.1 Soil Contamination

In the majority of cases the impacted soils are present between 1m bgl and 3 m bgl. The overburden material of Made Ground and natural soil should be checked for evidence of ground contamination based on the watching brief procedure provided in Section 10 and if identified to be unimpacted should be clearly segregated local to the area of excavation for replacement back into the excavation at the depth where it was taken from prior to excavation with the Made Ground overlying the alluvium. Unimpacted Made Ground and alluvial soils should be segregated separately outside of the excavation and stored on polythene sheeting and covered to prevent rainfall ingress.

On encountering contamination that requires remediation in soil or groundwater, the Contractor should excavate down incrementally and remove the identified contamination to a maximum of 0.5m in vertical extent and then excavating laterally in that 0.5m deep section to remove the identified soil and groundwater contamination before excavating further down to remove deeper contamination (if required). Photographic records including date / time / location shown on a board should be made at each stage of the excavation. Records should also be made of the depth of groundwater seepages in the alluvium and river terrace deposits and the condition of the groundwater. i.e. whether there is evidence that groundwater is contaminated.

Lateral Extent of Remedial Excavations

The lateral extent of remedial excavations will be formed based on field observations including:

- the presence of free phase product saturated soil i.e. 'oily' soil;
- the presence of heavily stained soils i.e. black / grey / green staining; and
- strong hydrocarbon odours and PID (photo-ionization detector) readings will also be used to inform the extent of remediation excavations.

Excavations should be continued until the above indicators are no longer present. Where no further observations of significant contamination or readings are reported the excavations lateral extent will be considered to have been met and soil validation samples collected from the walls and base of the excavation. One soil sample should be taken from every 1m x 1m area of the final base / wall area. The excavation can only be backfilled once the soil validation sample chemical results have been obtained from the laboratory and meet the remediation criteria. Where validation samples exceed the remedial criteria further soil removal will be required until the criteria are met.

Ramboll will agree the final lateral and vertical extent of the soil excavations with the remediation Contractor based on field screening, observations and the results of the Contractors validation sampling. The Contractor will allow Ramboll access and provide Ramboll with machinery (i.e. an excavator) to obtain verification samples from the final remedial excavations.

Vertical Extent of Remediation Excavation

The vertical extent of the contamination will be determined when the field observations of contamination as set out in the lateral excavation section are absent or on encountering the

groundwater table of the river terrace deposits where it will not be physically possible to excavate down significantly into the gravel aquifer.

7.2.2 Removal of Free Phase Product on Groundwater

Free phase product will be extracted from the groundwater surface where encountered. The ultimate objective of the remediation excavation being formed is to remove the residual 'source' of the free phase product, either as the removal of product from the surface of the groundwater table or the excavation and removal of free phase product entrained in soils that may leach out onto the groundwater surface. The excavation must show no evidence of free phase product before it is considered to be complete and ready for sampling prior to backfilling. The Contractor will be required to install sumps in locations where free phase product was present to allow the Contractor to take samples from these locations after the excavation has been backfilled. This is only required in locations where free phase product has been present floating on groundwater.

7.2.3 Groundwater Removal from Excavations

The remediation excavation is likely to extend below the alluvial groundwater table (which is at around 1 to 2 m in the alluvium and rises to 1.5m when the gravel aquifer is struck). Dewatering will therefore become necessary to undertake the remediation excavations.

The Contractor will be required to install a water treatment system prior to excavation works commencing (including delineation trial pits). The water treatment system will likely comprise a mobile oil/water separator and granular activated carbon filter (or similar). Groundwater from remediation excavations will be pumped through this treatment system prior to discharge to foul sewer (under a temporary discharge consent from the local sewerage provider that the Remediation Contractor will need to obtain). Free phase product encountered floating on groundwater will be removed using skimmer pumps and / or oil absorbent materials until no evidence of free phase product is encountered.

7.2.4 Groundwater Treatment

Based on the most recent groundwater data the majority of the site has not been impacted by the pollution incident with either free phase product or dissolved phase contaminants. Previous remediation activities at the site have been completed including active groundwater treatment and injection of remediation compounds. Following this work there is very little evidence of dissolved phase contamination in the gravel aquifer and therefore further groundwater chemical treatment across a large area of groundwater on-site is not currently expected as part of these works. Locally treatment chemicals may be applied to groundwater in open excavations where free phase product has been removed.

When the Client and Ramboll are satisfied that all recoverable free phase product and impacted soil has been removed from such excavations the Contractor may be required to apply groundwater treatment chemicals to provide a final 'polish' to reduce concentrations of TPH in groundwater. This 'assisted' natural degradation of dissolved phase hydrocarbons will be achieved through the addition of a proprietary enhanced attenuation product (an Oxygen Release Compound or similar treatment chemical approved for use by the EA in England). The Contractor should confirm the type of treatment chemical being used and agree the use of the chemical with the EA prior to application of the chemical.

On completion of the groundwater treatment the Contractor will be required to undertake a round of groundwater monitoring from sumps installed in excavation where free phase product was present and selected boreholes installed in the alluvium and river terrace deposits to confirm that groundwater conditions do not represent a significant risk to controlled waters. The groundwater monitoring points that will need to be monitored are set out in Section 7.2.

7.2.5 Management of Change / Constraints / Unexpected Finds

If at any point the Remediation Contractor identifies a situation that will delay the remediation programme beyond the agreed completion date the Contractor will report this to the Client (Watkin Jones) and Ramboll immediately and no later than the end of the working day when said situation is identified. Likewise if a potential constraint is identified whereby the remediation programme may be delayed beyond the scheduled dates set out in Section 6.2 of this report the Contractor is also required to notify the Client immediately.

If oil contamination is identified seeping from beneath the culvert at any point the Contractor should notify the Client immediately. Prior to the works taking place the Contractor should provide a detailed Method Statement that sets out how the Contractor will either remove / immobilise / encapsulate such contamination within the timescale set in Section 6.3.

If during the works 'unexpected' contamination is encountered this should be reported to the Client immediately and no later than the end of the working day when the situation is identified.

7.2.6 Reinstatement and Material Management

Contaminated soils removed from the ground will be placed on two layers of high gauge polythene with an inter-lying plywood layer to provide both physical protection and restrict potential for contaminated leachate. The stockpiles will be covered with polythene to prevent run-off and odours.

Soils from the excavation will be classified by the remediation Contractor in line with current UK legislation and best practice guidance. The remediation Contractor will inform Ramboll of the proposed waste disposal site(s) in advance of the remediation works (including copies of carriers licences and disposal site licences).

Copies of duty of care documentation (e.g. waste transfer notes and/or hazardous waste consignment notes) will be provided as part of the Remediation Contractor validation report.

The material will be backfilled with material of a suitable chemical quality the source site details and chemical testing of the material will need to be provided to Ramboll and the Client before the material is brought to site. It is expected that the Client will specify the geotechnical requirements for the material.

8. VALIDATION OF LONG TERM WORKS

8.1.1 Validation of Remedial Works

The Remediation Contractor will be expected to provide multiple lines of evidence that the remediation work has been completed successfully, which will include, but not be limited to, the following:

- Records of the delineation investigation including a plan showing the delineation trial pit / trench locations, logs of the excavation, details of the soil samples taken, and soil analytical results.
- A site diary with brief entries for each day documenting the progress of works undertaken, validation criteria obtained each day, volumes and weights of soils, groundwater, free phase product removed that day, and any further notable observations in the context of the works.
- Photographic records of each remedial excavation to include a board showing the date / time / location / face / walls visible for each record. A record must be provided for each face and wall of each excavation.
- Schematic cross sections showing the lateral width and depth of each excavation.
- Plans showing the positions that validation samples were taken from on the base and walls of the excavations and any notable field observations.
- Validation soil samples from every 1m x 1m section of the base and wall of excavations to be tested at a UKAS accredited laboratory for TPH CWG and BTEX/MTBE. Confirmation these meet the Soil Remedial Target Values. The wall and base of each excavation will be sampled on a grid basis with a clear reference system that relates to the plans showing the sample locations.
- Records confirming the absence of free phase product in soil and floating on groundwater in the remedial excavations and surrounding boreholes.
- PID Readings from the face and walls of excavations with at least one PID reading per 1m x 1m from the wall and base of the excavation.
- Photographic records of the absence of free phase product floating on groundwater in excavations and groundwater from surrounding boreholes;
- The installation of sumps in locations where free phase product was present to verify that free phase product does not remain present at this location after the works are completed;
- Details of any groundwater treatment chemicals used, including written agreement from the EA that such chemicals can be used, their specification, volume applied and the timing of application in each remedial excavation;
- Confirmation that dissolved phase concentrations of TPH in groundwater do not represent a significant risk to controlled waters based on sampling from selected boreholes and analysis at a UKAS accredited laboratory for TPH CWG and BTEX / MTBE. Details of the sampling method and time of sampling;
- A report confirming that the remediation has been completed successfully and that the remediation objectives and criteria have been met in each remediation area.

The Remediation Contractor will be required to submit all soil and groundwater validation Samples on a 3-day turnaround to a UKAS accredited laboratory. All samples will be analysed for TPH CWG, BTEX and MTBE. All soil and groundwater samples should be sent under chain of custody documentation to a single UKAS accredited laboratory under chilled conditions that maintain the accreditation of the analysis to be completed. Composite sampling is not permitted. The laboratory, analytical methods and detection limits used by the Remediation Contractor will

be agreed with Ramboll prior to works commencing together with protocols for sample handling, preservation, storage, and transportation.

The objective of the Long Term Works is to remove all free phase product from the site and ensure that the site is suitable for its proposed use and does not represent a significant risk to controlled waters. The Contractor will be expected to confirm in their report that the remediation objective has been met.

A Completion Report will be provided by the remediation Contractor and contain the following information:

- the details and roles of all Contractors and subcontractors involved in the project;
- a description of the remedial activities with reference to relevant design documents including the method statements, detailed designs, permits, phasing etc.;
- a clear discussion of completed weight and volumes excavated and dimensions of excavations together with the volume of treated free phase product;
- a clear description of the validation data obtained as list above and how the various lines of evidence confirm that the remediation objectives have been met;
- a summary of documentation such as compliance with permits and details of exemptions, environmental monitoring data, consents, mobile treatment licence requirements etc., variations;
- details of consents for sewerage discharge for dewatering and
- information (including total amount of waste disposed of, any waste sampling results, waste transfer notes and applicable site and carriers licenses);
- details of communications with Ramboll / the Client / regulatory authorities during the remediation works;
- reference to the Health and Safety file;
- a clear statement that the remedial objectives have been completed; and
- supporting documents should include where appropriate but not limited to plans showing origin of backfilled materials in all areas of the site, analytical results, monitoring data, HS documentations, quality management documentation.

8.1.2 Third Party Verification

In addition to the above Ramboll will provide third party verification that the proposed works have been appropriately completed through on-going support during the development works and the production of a separate Verification Report for the Long Term Works and the Development Led Works (the latter is discussed in Section 8).

For this element of the Remediation Strategy Ramboll will produce a verification report which will include (but not be limited to):

- a summary of the original site conditions, with reference to the original site investigations and assessments;
- the remediation objectives and criteria;
- a summary of the remedial works;
- presentation of the Ramboll verification results (e.g. photographic records and soil validation testing for excavation);
- details of communications held with the EA and other regulators during the remediation works.

9. DEVELOPMENT LED REMEDIATION WORKS

9.1 Capping System

The proposed development will effectively cap the site and prevent direct contact with the underlying ground in areas where buildings and hardstanding are present. In areas of proposed soft landscaped a clean capping system formed of imported topsoil/subsoil will be required; the requirements for this capping layer are discussed below.

9.1.1 Landscaped Areas / Imported Material

Based on the residual presence of metals and PAHs within the Made Ground on-site, a clean capping system will be required as part of the development within soft landscaped areas at ground level to protect end users. These areas are limited to communal landscaped areas in the north and west of the proposed development.

Within communal soft landscaped areas a clean cap of 600mm is required which, subject to landscaping and planting requirements, will be formed of layers of topsoil and subsoil. A geotextile membrane is also required.

Imported materials used within the clean cap construction of communal soft landscaped areas shall be analysed chemically to ensure the material is suitable for a residential end use. This should be undertaken prior to reusing/bringing any such material onto the site according to the following sampling frequency:

- Topsoil / Subsoil – 1 sample per 150m³ (minimum of three samples per source)

The material will also be subject to on-site verification of chemical suitability by Ramboll at a rate of 1 sample per every 20 m by 20 m area of landscaping.

All materials for use in communal soft landscaped areas shall conform to the contaminant thresholds of the Ramboll residential GAC used in the Phase II ESI (Ramboll January 2018) and the requirements of the British Standard for Topsoil (BS3882:2015). All chemical testing shall be undertaken at an appropriately accredited laboratory (UKAS and MCERTs).

Verification of the thickness of clean capping installed is required at a rate of 1 inspection per 20m by 20m area of landscaping and the contractor shall maintain documentation to demonstrate that this has undertaken successfully e.g. daily records and photographic evidence for each area of soft landscaping clearly identifying the installed depth.

Whilst not strictly part of the capping system material imported for use in service corridors or as general fill for remedial excavations / piling mat should be sampled at a frequency of 1 sample per 150m³ and results compared in the first instance to the Ramboll residential GAC. All imported soil or aggregates will be free from asbestos, metals, plastics, wood, glass, tarmac, paper and odours associated with contaminated soils.

Note. The frequencies set out in this section should be confirmed with Watkin Jones / Ramboll prior to reuse / import of materials based on site specific conditions and confirmation of the imported material source site. There may also be geotechnical specification requirements for such material (which will be specified separately by the Client), Separate certification is required for each type of material utilised. Where recycled aggregates are sourced, the producer of the aggregate must show the material has been fully recovered and is no longer a waste. To do this the producer must follow the quality protocol for the production of aggregate from inert waste, as outlined by WRAP. Virgin quarried material may be used on-site subject to confirmation of the source and specification of the material.

Documentation on the source, quantity and testing results shall be retained on-site for inspection and subsequent inclusion in the verification report. The Contractor shall retain records on the location, depth of excavations and how/where any imported material is placed.

The Contractor will be responsible for retaining accurate records of all imported material in accordance with the Validation Criteria set out herein and outlined in Section 7.4

9.2 Piling Risk Assessment / Groundwater Monitoring

It is understood that the site will require piled foundations. The future piling design should take account of the post remediation ground conditions in the form of a Foundation Works Risk Assessment. This will be completed and provided to the EA for approval prior to piling works taking place on-site.

Based on the most recent discussions with the EA prior to piling works taking place the EA expects that two rounds of groundwater monitoring will be completed from selected existing boreholes installed into the Alluvium, River Terrace Deposits, and Chalk aquifer. These groundwater monitoring rounds are to be spaced one week apart, and the results provided to the EA for verification as soon as they become available in the form of a letter report. Once the piling works are complete a final round of groundwater monitoring is proposed to validate that the piling has not changed the groundwater conditions on-site significantly. The same boreholes will have been sampled by the remediation Contractor at the end of the remediation works.

Figure 6 presents the boreholes that are proposed for sampling from these groundwater bodies and the boreholes are listed out as follows for each groundwater body:

Alluvium:

- Location of WS407 (Contractor to install validation well or sump on completion of remedial excavation).
- Location of WS409 (Contractor to install validation well or sump on completion of remedial excavation).
- Location of WS410 (Contractor to install validation well or sump on completion of remedial excavation).
- WS412 (to be protected during the works).

Gravels:

- One sump in location of Sump 1b / 1C (Contractor to install validation well or sump on completion of remedial excavation).
- BH301 / BH302 (to be protected during the works as down gradient of the remediation area).
- BH403 / BH404 / BH405 (to be protected during the works as down gradient of the remediation area).

Chalk boreholes:

- BH1 / BH2 / CP02 / CP03 (to be protected during the works).

Potentially other locations may be included on this list subject to the findings of the proof dig / delineation investigations / remediation works. Ramboll will confirm if additional wells need to be sampled prior to any sampling activities taking place. On completion of the piling works a further round of sampling will take place.

There are a number of boreholes installed in the underlying aquifers that are not proposed for use and that are therefore as a precaution recommended to be decommissioned prior to piling works taking place to reduce the number of pathways from ground level to the aquifers on-site. The method of decommissioning the boreholes should be agreed with the EA in advance of the

works and take into account EA Document 'Good Practice on Decommissioning Redundant Boreholes and Wells'.

The Contractor shall agree the Method Statement of the works with Ramboll and Watkin Jones prior to works starting.

9.3 Unforeseen Contamination Finds

For Contractors undertaking excavations into the ground during the development led works such as for service corridors or landscaped areas the Contractor should be aware of the requirements to report unforeseen contamination as reported in Section 10.

9.4 Validation Criteria

The validation criteria for the development led works are set out below:

- Soils removed from the site to form the landscape areas will need to be classified for appropriate disposal and confirmation of the disposal site provided prior to material being removed from the site. Waste duty of care documentation will be required prior to disposal.
- Imported topsoil / subsoil will need to be tested prior to import to site for a suite of analysis relevant to the import site history at a rate of 1 sample per 150m³ of imported material.
- All imported topsoil / subsoil chemical analysis results must meet the Ramboll residential GAC prior to import to the site.
- Visual records of the depth of topsoil / subsoil being placed should be made during the works including as a minimum photographic records and volumes of material placed into excavations.
- The Contractor shall retain records on the location, depth of excavations and how/where any imported material is placed.
- Verification samples will be collected by Ramboll at a rate of 1 samples per 20m x 20m areas of landscaping.
- The source of material imported for use in service corridors or to form the piling matt or to fill remedial excavations should also be confirmed prior to import to site and appropriate testing provided prior to import to confirm the material is suitable for use on-site.
- Two rounds of groundwater sampling will take place prior to piling works taking place on-site, the results will be compared to the groundwater remedial targets and provide in a letter report. One round will be completed once the piling works are complete.
- Contractors undertaking excavations on-site will be required to provide a 'Watching Brief' procedure and state if such unexpected contamination was encountered or not. If unexpected contamination is encountered the Contractor should report this to the Client, provide information on the nature of the contamination and a record of how the contamination was dealt with, including records of soil validation sampling and disposal records.

Based on the Contractor records and Ramboll's own observations Ramboll will prepare a verification report that documents the above works on completion of all works.

10. UNFORESEEN CONTAMINATION FINDS

For all works where Contractors are expected to excavate into the ground each Contractor will be required to provide a method statement prior to the works taking place to document how the Contractor will identify report and manage any unexpected areas of contamination encountered during demolition and/or earthworks.

Potentially contaminated materials are those which via visual or olfactory evidence may be suspected to be contaminated (i.e. the presence of unusually stained soils, odours or deleterious materials for example asbestos fibres).

The unforeseen contamination protocol is likely to include:

The Contractor stopping work in that area and immediately informing the Client and Ramboll to discuss the proposed action;

The Contractor liaising with the Client and Ramboll in the first instance and thereafter potentially the statutory authorities to agree proposals for dealing with this material;

The implementation of measures to remove contaminated materials (where feasible) for segregation, storage or stockpiling (of soils) within a bunded and polythene covered area whilst testing is undertaken. Contaminated liquids should be stored in suitable containers;

A record should be made of the volume of material removed and the extent of any required excavation;

The full extent of the contaminated material must be excavated until the Contractor is confident the material has been removed based on multiple lines of evidence (potentially including visual observations, field readings and laboratory testing) validated by a suitably qualified engineer;

Undertake laboratory testing of representative samples from the base and sides of the excavation (minimum of 1 sample per 1m x 1m face / base and testing of the material for a suitable suite of contaminants. The suite and chemical criteria for verification are to be defined in consultation with Ramboll and the regulatory authorities based on the nature of the contamination encountered;

Discussion with the Client and Ramboll of potential remedial measures and if required treatment on-site or disposal off-site in accordance with current waste regulations. Records including laboratory analytical certificates, waste transfer notes, consignment notes and volumes requiring removal should be retained by the Contractor.

It will be necessary to retain all records relating to testing, quantity, depth and location of the material identified. Where such material is re-used, it will be necessary to demonstrate suitability through appropriate chemical testing and to retain records on where this material was placed.

If this material is removed off-site, then in addition to records on the source area outlined above, it will also be necessary to retain duty of care records relating to waste transfer notes, quantities and the receiving site.

11. GENERAL SITE ENVIRONMENTAL CONTROLS

The following provides a summary of the expected general controls that will be in place during works on the site. As the works will largely be undertaken by Contractors on behalf of Watkin Jones the requirements are provided on the basis that Contractors working on the project will adhere to these requirements (where relevant to the works being undertaken).

11.1 Permits and Licences

With respect of the oil contamination removal and any further 'remediation' activities (if required e.g. if unexpected contamination is encountered) the Contractors involved will be required to obtain and provide as evidence to Watkin Jones all relevant licences, exemptions, consents and deployment forms relevant to the remediation works being completed prior to works commencing. If necessary, the Contractor shall comply with and give all notices required by any regulation or by-law applicable to the works, including the reuse of material on-site.

Also if necessary, the Contractor will obtain the necessary permits for all equipment in terms of potential nuisance (e.g. noise and odour) and agree these with the relevant regulatory authorities (e.g. EA, Local Authority).

The Contractor will also be responsible for obtaining a consent from Thames Water for undertaking excavation work near to the culvert.

11.2 Environmental Management and Good Working Practice

Environmental management issues throughout the life of the works are to be governed or guided by a number of 'standards' (e.g. CIRIA132 and HSG66), including:

- those contained in legislation;
- those established by industry codes of practice; and
- those that are specific to commitments made in surveys, commitments made during regulatory consultation and measures as may be set out in conditions/contract or in other licences and consents.

During the site works, the appointed Contractors will implement procedures from published guidance documents for working on contaminated sites, in accordance with relevant construction industry practices, EA guidance, industry-accepted standards of 'good working practice' and relevant legislation.

Specifically in relation to environmental management the Contractor will implement procedures in accordance with the Control of Water Pollution from Construction Sites CIRIA C532 guidelines (CIRIA 2001) and the CIRIA Guide to Good Practice on Site during the developments of Contaminated Land, as well as relevant EA Pollution Prevention Guidelines.

11.3 Environmental Monitoring

11.3.1 Dust, Odour and Vapour

The Contractors will be required to consider the need for dust, odour, hydrocarbon vapour, and asphyxiant gas controls and to provide details of any appropriate environmental controls and monitoring to prove its effectiveness during the works. This will include agreeing monitoring criteria with the regulatory authorities (if considered necessary).

11.3.2 Noise

Good practice will apply to potentially noisy operations. In particular:

- Plant and equipment used for the works will be properly maintained, silenced where appropriate, and operated to prevent excessive noise. Plant should be certified to meet any relevant EC Directives/UK/BS5228 standards.
- Guidance in relevant British Standards will be applied.
- Static construction plant (e.g. compressors and generators, if required) will be installed and appropriately enclosed or screened unless the location can be shown not to require it.
- Items of plant operating on the site in intermittent use will be shut down in the intervening periods between uses.

11.3.3 Vehicle Cleanliness

The Contractors will take all reasonable measures to prevent, as far as is practically possible, the deposit or tracking of mud or debris arising from the remediation areas onto other areas of the site and onto public areas outside of the site (this will include public highways and areas of public access).

The following procedures will be put in place by the Contractors working on the site:

- all vehicles shall be inspected prior to departure and where necessary loose material removed and wheels washed;
- drivers will inspect their vehicles prior to leaving the site and ensure that their loads are secure; and
- any loads of spoil or fill shall be adequately sheeted to prevent spillage on public roads or on the site premises.

11.3.4 Fuel and Hazardous Substances Storage

All liquids and solids of a potentially hazardous nature (e.g. diesel fuel, oils, solvents) will be stored in dedicated hard surfaced areas agreed with the Client, including secondary containment (e.g. bunding) in accordance with current guidance and statutory requirements.

The Contractor will establish within the site an area for the refuelling of plant and vehicles away from any water courses or site drainage. The fuelling area shall be kept clean at all times. Any spillages or leaks of fuel or other hazardous substances will be cleaned up immediately by the Contractor. No refuelling will be carried out outside the refuelling area and the Contractor will have in place contingency arrangements for dealing with spillages.

All equipment containing fuel/oils (e.g. pumps and generators) will be placed on drip trays and these will be maintained by the Contractor to remove standing water as appropriate to their correct operation and containment of the plant in question.

11.4 Soil Stockpiling

The Contractor will stockpile excavated 'uncontaminated' soils and excavated 'impacted soils' separately. If required, imported 'uncontaminated' soils will also be stockpiled separately. The Contractor is required to prevent mixing of 'uncontaminated' soils from soils excavated in other areas of the site to ensure that 'uncontaminated' soils are available to backfill the excavations which they were derived from.

Stockpiled materials will be stored and handled by the Contractor in consideration of the nature of the materials and the potential to impact the surrounding environment (e.g. the control of surface water run-off, leachate, and dusts). This will include stockpiling excavated soils in designated areas of hardstanding (to be identified by the Contractor on a plan). In addition, 'contaminated' stockpiles will be required to be placed on impermeable sheeting. The Contractor should also make arrangements to suitably cover the stockpiles to minimise rainwater water

ingress. Arrangements will also be required to handle and appropriately dispose of rainwater and contaminated water run-off from stockpiles and remediation areas. Stockpile design and management will be the responsibility of the Contractor.

11.5 Waste Disposal

11.5.1 Solid Waste

All material removed and disposed of off-site will be undertaken in accordance with the Duty of Care requirements of the Environmental Protection Act 1990, including the Waste (England and Wales) Regulations 2011. This includes any general waste (e.g. timber pallets, impermeable sheeting, office waste, absorbent pads) arising from the remedial works.

If impacted soils require off-site disposal the Contractor will be responsible for sorting and segregating the waste soil into appropriate waste classification streams, supported by relevant chemical testing and Duty of Care documentation. The Contractor will classify the waste and ensure it is disposed to a landfill or treatment facility licensed to accept that waste. The Contractor will be required to segregate material in order that 'uncontaminated' overburden may be disposed of under a lesser waste classification, if off-site disposal is required.

The Contractor will provide a valid copy of the waste transfer certificate / consignment note for each load of material which exits the site for off-site disposal during the works, including proof of receipt of the material at the landfill or other disposal site.

Loading of vehicles by the Contractor shall be performed in an organised manner so as to prevent the escape of contaminants and materials. All vehicles will be appropriately designed to hold the waste without release during transit, sheeted, and cleaned externally, prior to leaving site. The Contractor will take all reasonable and applicable measures to prevent the escape of material during loading and transportation. The Contractor will be responsible for determining the need for and implementing compliance with transportation regulations for hazardous wastes, as applicable.

Identification of hazardous materials including for example asbestos containing materials (if encountered), will be subject to site contingency plans, health & safety and risk assessment/method statement procedures for their identification, handling, removal and disposal.

11.5.2 Liquid Waste

Free phase hydrocarbons will require disposal off-site in accordance with the Duty of Care requirements and handling requirements detailed above. If the Contractor proposes to remove groundwater this will need to be disposed of appropriately, potentially to foul sewer with the necessary consents in place.

11.5.3 Re-use of Materials

Where materials are to be re-used on-site this should be undertaken under the CL:AIRE Development Industry Code of Practice (CoP) and will include the preparation of a Materials Management Plan (MMP). The MMP will provide a robust and auditable trail to monitor where the materials originate from through to their final destination, including temporary storage or stockpiling as necessary. The Contractor will be required to prepare an MMP that can be novated to Watkin Jones for use in future works (if required).

11.6 Health and Safety

11.6.1 Overview

The Contractor will be responsible for ensuring the works are undertaken in accordance with applicable Health and Safety legislation and for ensuring that all necessary measures are put in place during the works, including:

- access and egress;
- site accommodation and welfare;
- site working hours;
- utility services and buried services (including drawings of underground services);
- site security;
- Contractor induction requirements;
- CDM roles and requirements;
- Health and Safety document provision, including the provision of with method statements and risk assessments for the various activities associated with the works; and
- site security arrangements.

11.6.2 Utilities

The Contractor will be required to make its own arrangements for a self-sufficient operation (for example its own provision of mobile generators and bowser water supplies).

Particular care shall be exercised for any work close to drainage and the Thames Water culvert (including surface water, trade effluent and foul) water systems and measures shall be put in place by the Contractor to intercept contaminated run-off (if generated) during the remediation works.

The Contractor will be responsible for locating, marking out and avoiding all underground and above ground services within the remediation areas. The integrity of the services is required to be maintained during the works, or reinstated following the works.

11.6.3 Remediation Contractor's Method Statements

Prior to undertaking any of the elements of the remedial strategy the Contractor undertaking the works shall supply to Watkins Jones / Ramboll thorough Method Statement(s) and associated Risk Assessments for each activity of the works. This shall include, but not be limited to, delineation investigations, forming excavations, treatment and extraction of groundwater, chemical treatment of groundwater, shoring up and excavation around the culvert edges, soil disposal routes, free phase product removal and disposal, details of all temporary works, specialist Contractors, including waste operators and landfill operators, sourcing backfill material, backfilling excavations, sampling and chemical analysis and any other supporting documentation required to undertake the ground remediation works.

APPENDIX 1 FIGURES

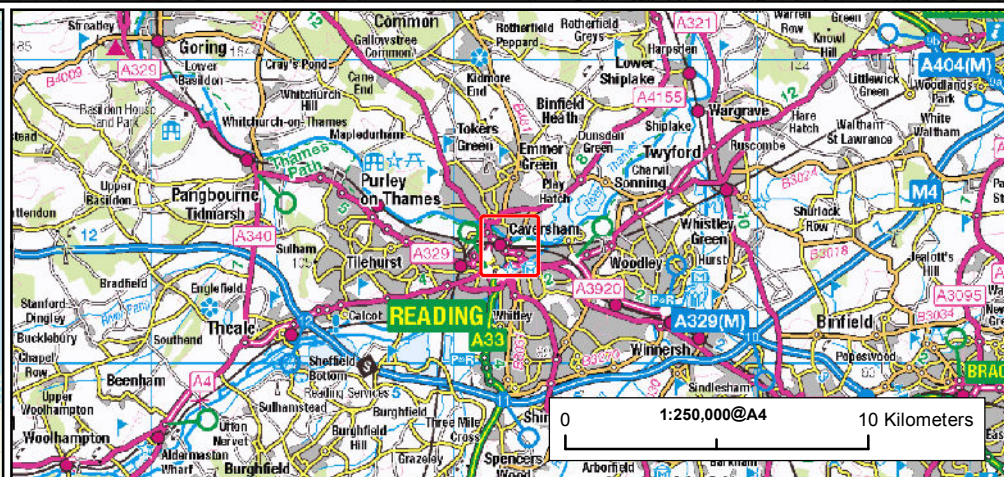
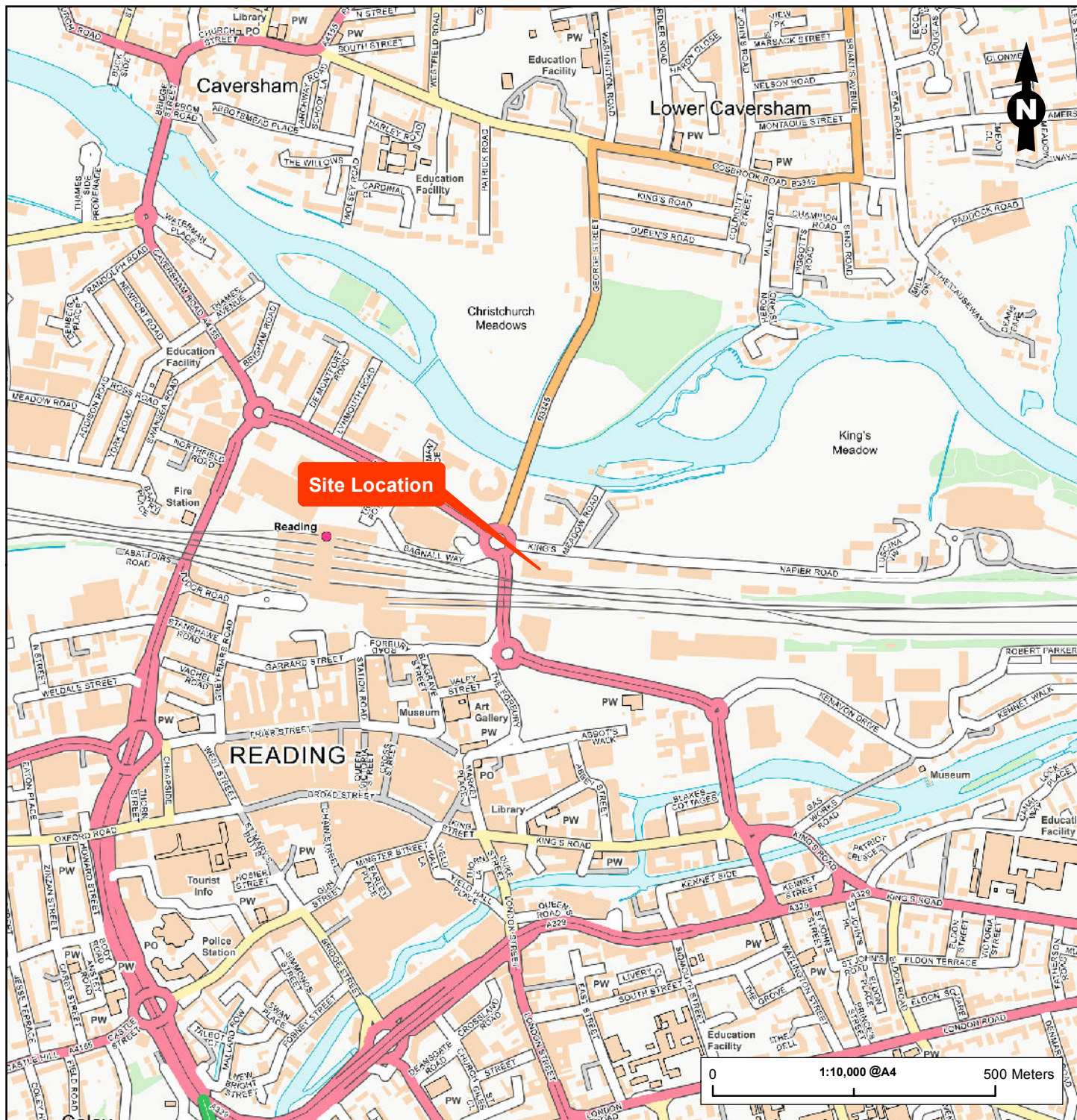
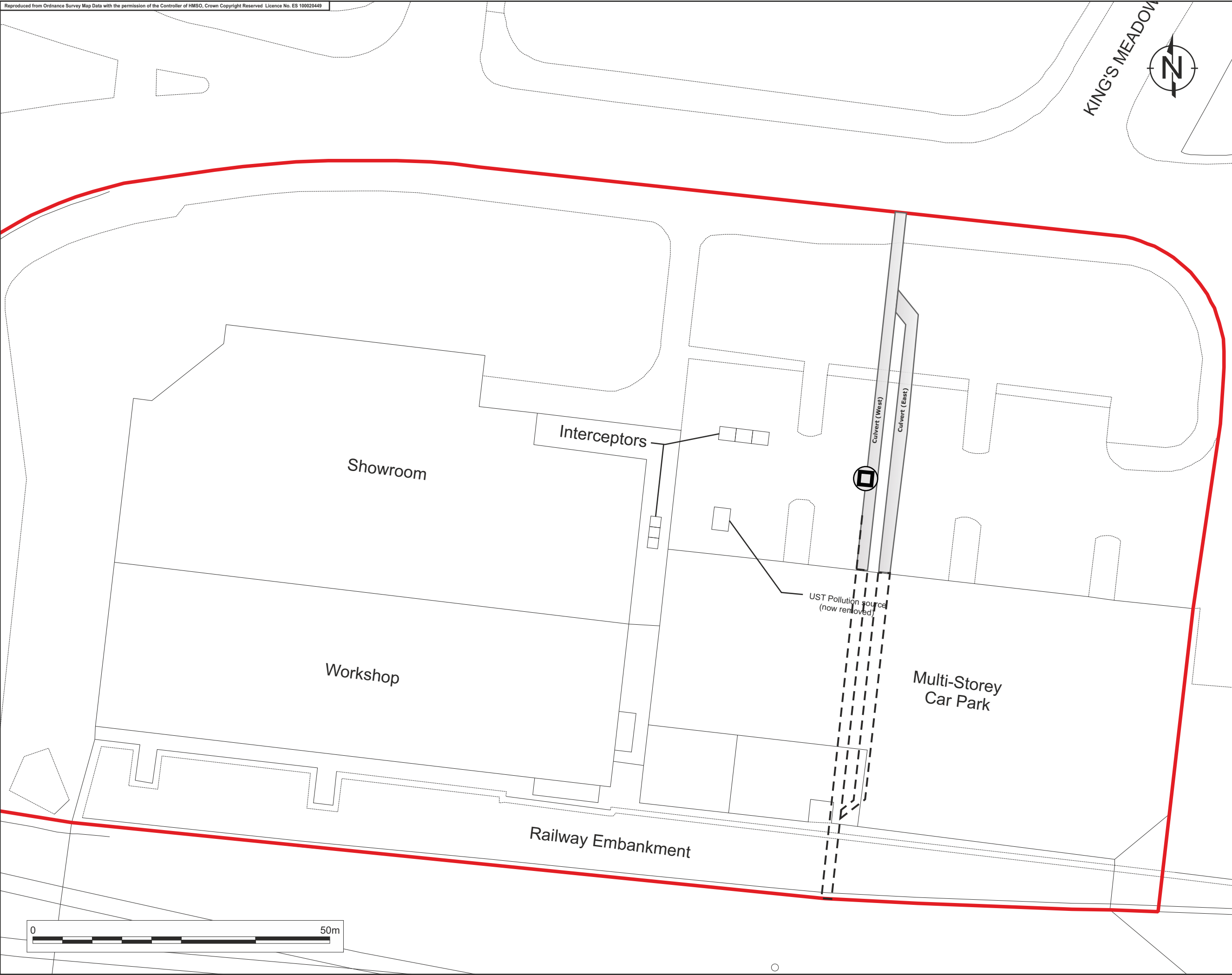
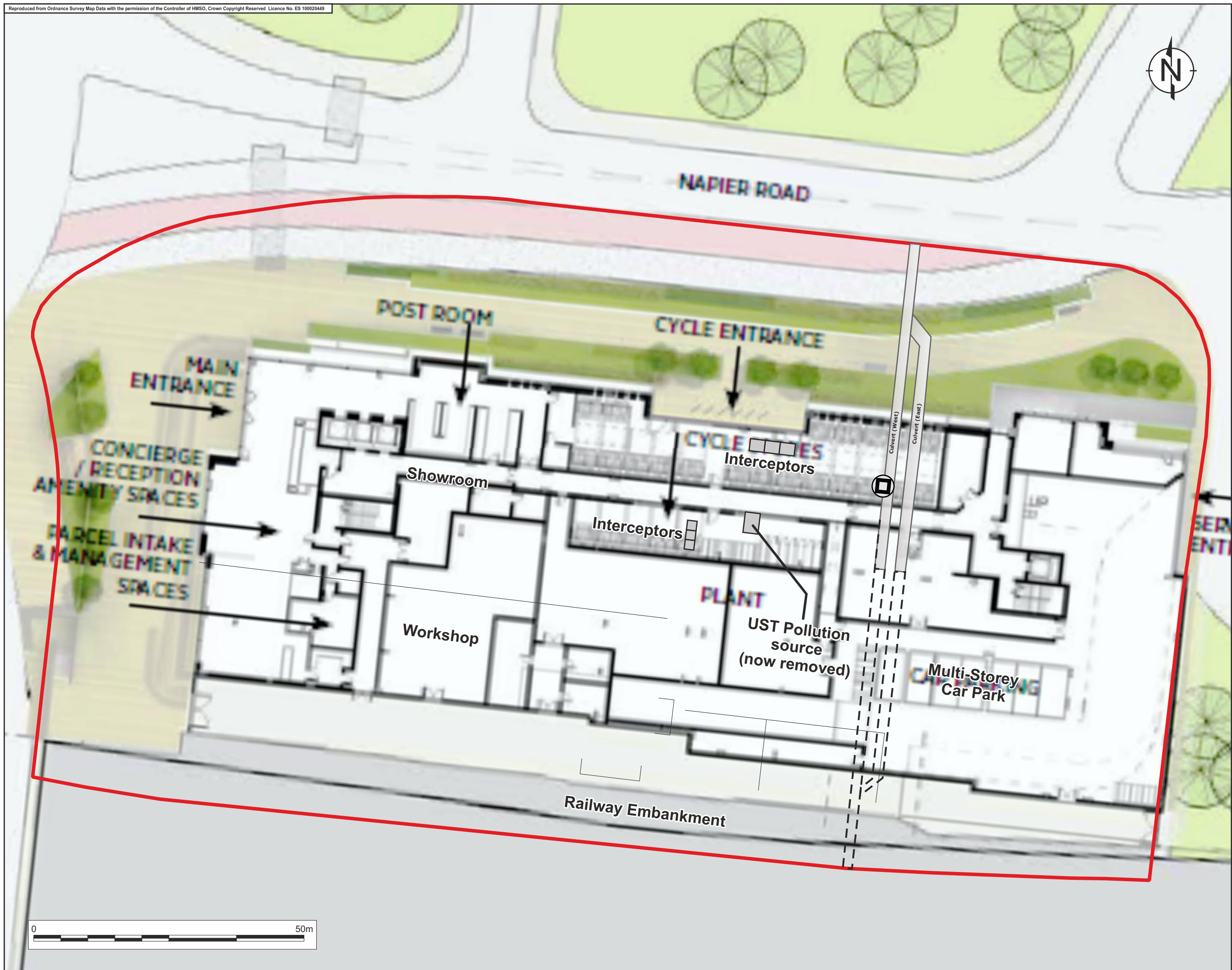


Figure Title Figure 1: Site Location	Project Name Thames Quarter, Kings Meadow Road, Reading	Date February 2018	
Project Number 1700001374	Client Watkin Jones & Son Limited	Scale As shown	
		Issue 1	



Key	
	Site Boundary
Title Figure 2: Site Layout	
Project No. 1700001374	
Site	Thames Quarter, Kings Meadow Road, Reading
Client	Watkin Jones & Son Limited
Date	February 2018
Scale	1:400 @ A3
Issue	1
Drawn by MI	



Key
Site Boundary

Title Figure 3:
Proposed Development
Layout

Project No. 1700001374

Site Thames Quarter,
Kings Meadow Road,
Reading

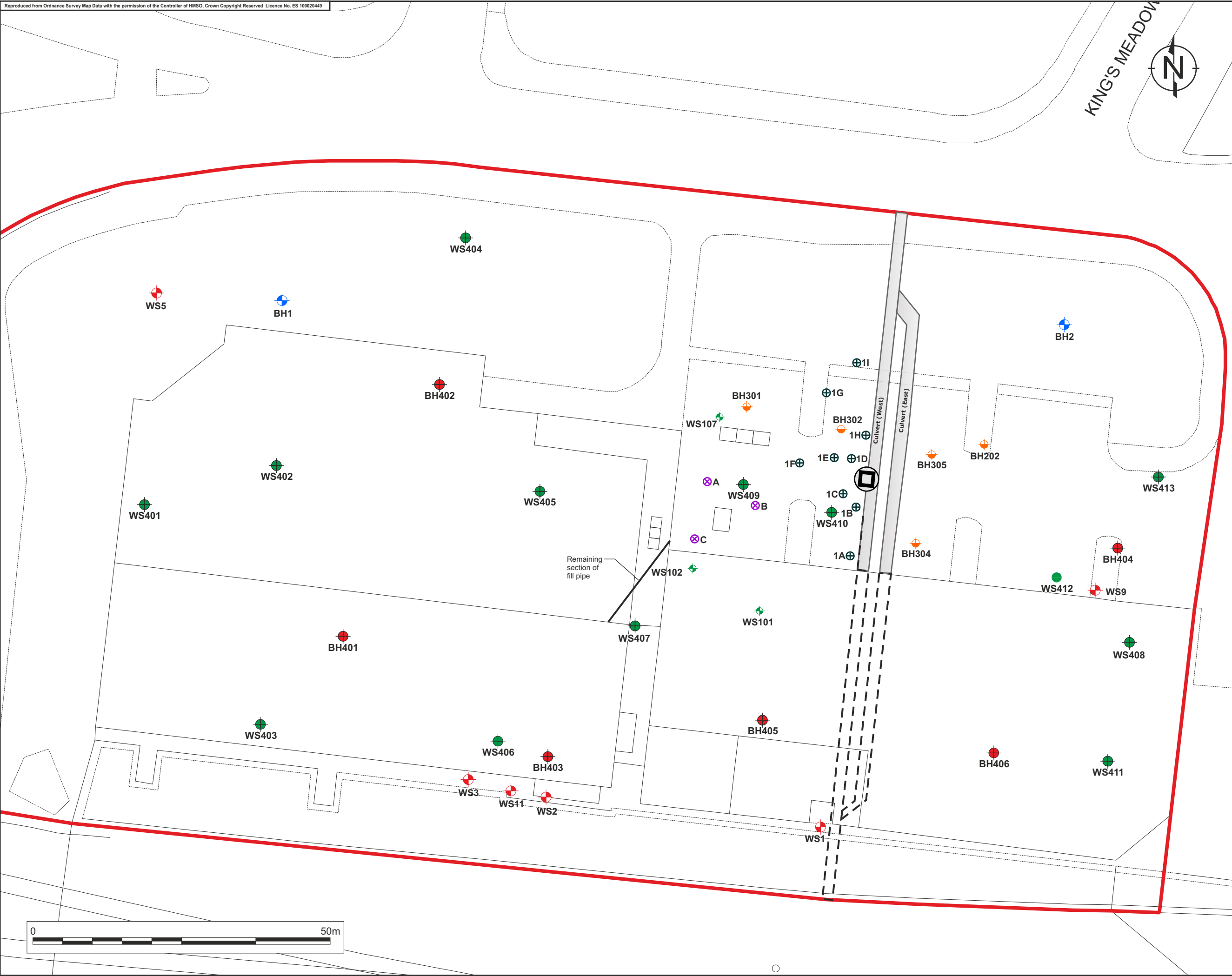
Client Watkin Jones & Son
Limited

Date February 2018

Scale Not to scale

Issue 1 Drawn by BVK

RAMBOLL



Key

- Site Boundary
- 2017 Ramboll Environ Window Sample
- 2017 Ramboll Environ Borehole
- RPS Shell + Auger
- RPS window sample borehole with installation
- Ramboll Environ window sample borehole with installation
- Ramboll Environ rotary borehole
- Ramboll Environ rotary borehole sump for product removal
- Ramboll Environ gravel targeted sump installed during Source Removal remediation works

Mid-Term Works

- Ramboll Environ gravel targeted sump installed during Mid Term remediation works

Title Figure 4:
Borehole Location Plan

Project No. 1700001374

Site Thames Quarter,
Kings Meadow Road,
Reading

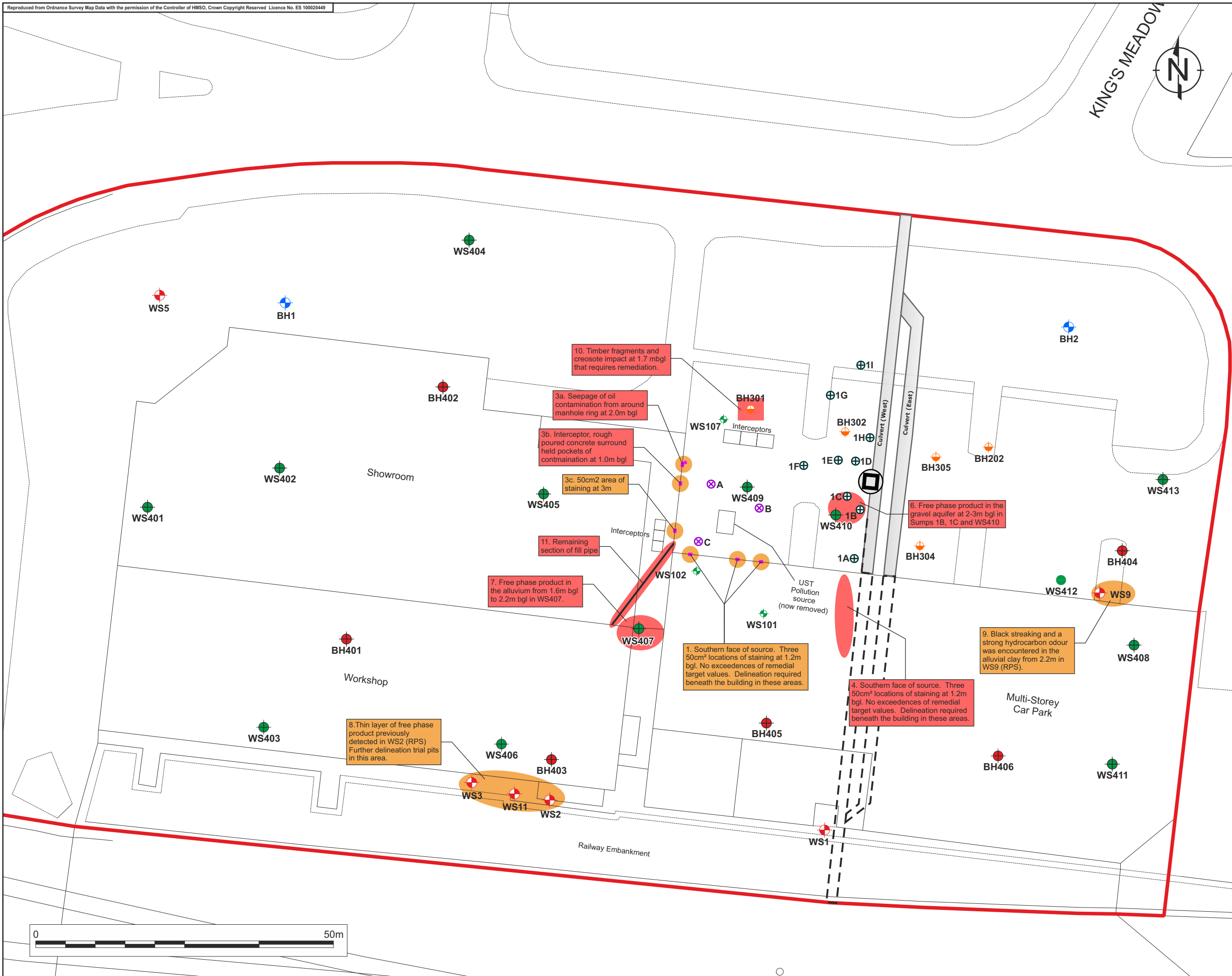
Client Watkin Jones & Son
Limited

Date February 2018

Scale 1:400 @ A3

Issue 1 **Drawn by** BVK

RAMBOLL



- | | |
|---|--|
|  | Site Boundary |
|  | 2017 Ramboll Environ Window Sample |
|  | 2017 Ramboll Environ Borehole |
|  | RPS Shell + Auger |
|  | RPS window sample borehole with installation |
|  | Ramboll Environ window sample borehole with installation |
|  | Ramboll Environ rotary borehole |
|  | Ramboll Environ rotary borehole sump for product removal |
|  | Ramboll Environ gravel targeted sump installed during Source Removal remediation works |
| Mid-Term Works | |
|  | Ramboll Environ gravel targeted sump installed during Mid Term remediation works |
|  | Delineation Required |
|  | Delineation & Remediation Required |

Title	Figure 5: Delineation and Remediation Locations
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Project No. 1700001374

Site	Thames Quarter, Kings Meadow Road, Reading
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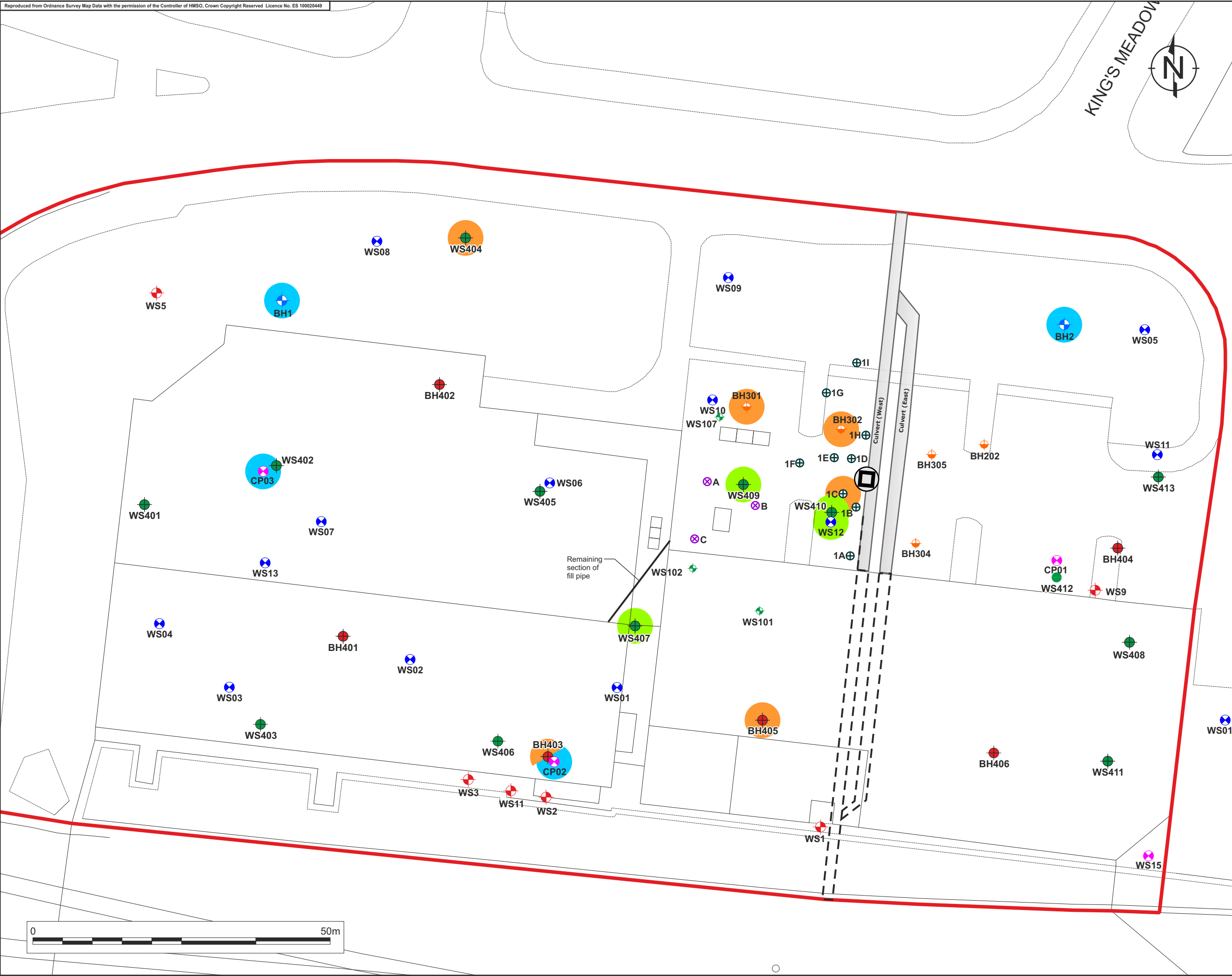
Client	Watkin Jones & Son Limited
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Date February 2018

Scale 1:400 @ A3

Issue	1	Drawn by	BVK
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Key	
	Site Boundary
	2017 Ramboll Environ Window Sample
	2017 Ramboll Environ Borehole
	RPS Shell + Auger
	RPS window sample borehole with installation
	Ramboll Environ window sample borehole with installation
	Ramboll Environ rotary borehole
	Ramboll Environ rotary borehole sump for product removal
	Ramboll Environ gravel targeted sump installed during Source Removal remediation works
Mid-Term Works	
	Ramboll Environ gravel targeted sump installed during Mid Term remediation works
	Tier Consultants window sample borehole
	Tier Consultants cable percussive borehole
	Alluvium
	Gravels
	Chalk boreholes
Title Proposed Groundwater Monitoring Locations for Remedial Validation	
Project No. 1700001374	
Site Thames Quarter, Kings Meadow Road, Reading	
Client Watkin Jones & Son Limited	
Date February 2018	
Scale 1:400 @ A3	
Issue 1	Drawn by BVK