



Remediation Strategy (Southern Area) Broadwater Road Site, Welwyn Garden City, AL8 6UN, UK

On behalf of:
Wheat Quarter Limited

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Annex A: Remediation Programme (Initial and Extended)

1 Introduction

1.1 Background

Earth & Marine Environmental Consultants Ltd (“EAME”) was commissioned by Wheat Quarter Limited (“the Client”) to prepare a Remediation Options Appraisal, Remediation Strategy, and Verification Plan in relation to a parcel of land located at Broadwater Road, Welwyn Garden City, AL8 6UN, UK (“the Site”) (*Figure 1.1*). It is understood that the Client is planning to redevelop the site as a mixed development with residential properties (without gardens), office, retail, and leisure elements (“Proposed Development”). This report relates solely to the southern area of the development (*Figure 1-1*).

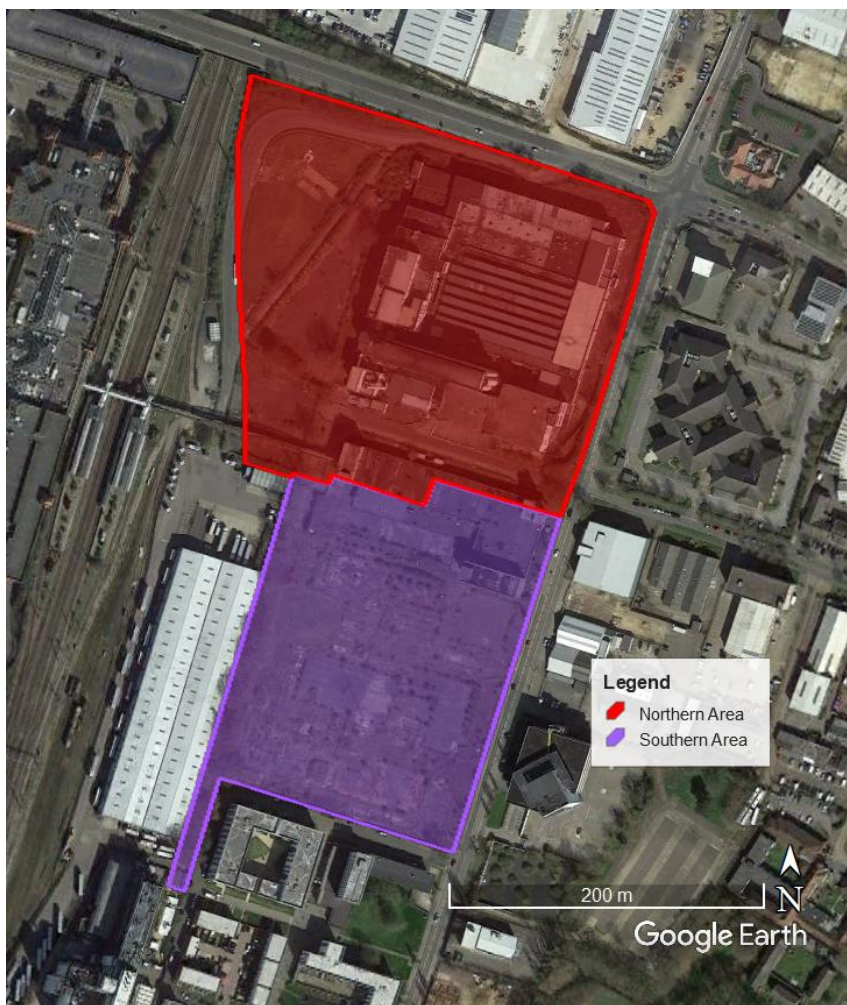


Figure 1-1: Proposed Development Area

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1.2 Site Location and Setting

The southern site is approximately 3.6 ha in area and is also accessed via Hydeway off Broadwater Road (A1000) (*Figure 1-2*). The site is located centrally within the town of Welwyn Garden City at National Grid Reference (NGR) TL 24134 12739 (51.799529, -0.20121127). The site is relatively flat and lies at an elevation of between 84 and 85 metres above ordnance datum (AOD). The Site has been cleared of all above ground structures. The following current uses were identified surrounding the southern Site:

- **NORTH** – Hydeway beyond which is the northern Site.
- **EAST** – Broadwater Road (A1000) beyond which are commercial premises and offices.
- **SOUTH** – Disused Roche Products facility (buildings Grade II listed) and multiple residential blocks.
- **WEST** – P.W Gates Distribution Ltd warehouse (southern hub) beyond which are railway lines (East Coast Mainline) associated with Welwyn Garden City station and car parking.

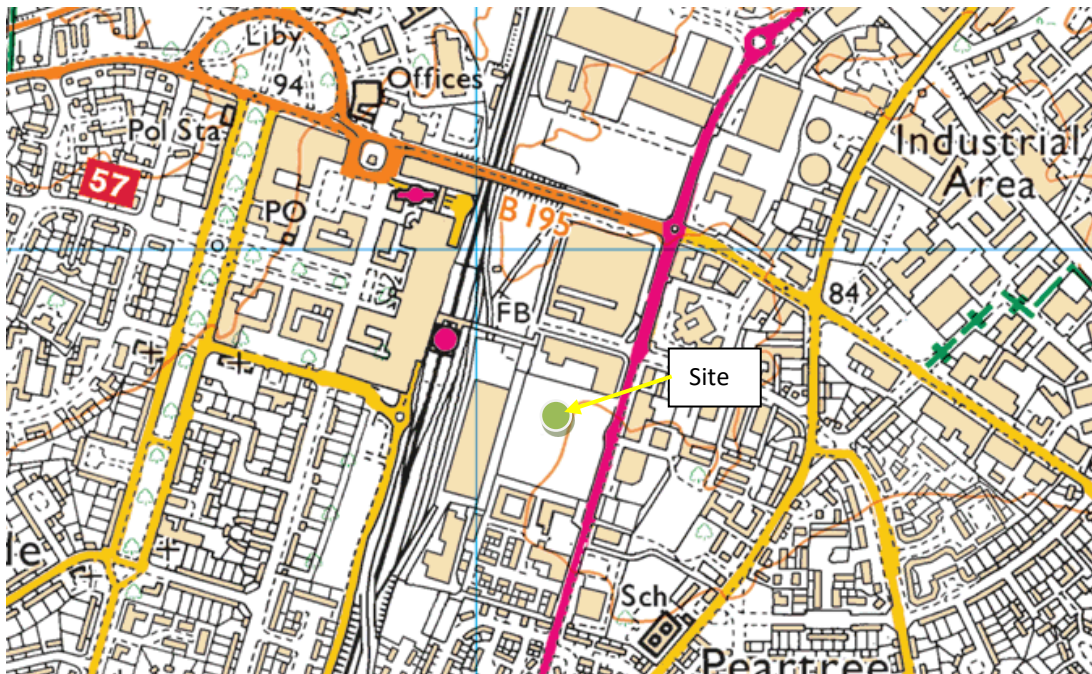


Figure 1-2: Site Location

Ordnance Survey 1: 25,000 scale map - with the permission of The Controller of Her Majesty's Stationery Office, Crown Copyright
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1.3 Site History

As part of the environmental assessment, historical maps, photographs and previous assessments were obtained and reviewed by EAME to determine the historical development of the site and identify potentially contaminative activities

The southern Site has been divided into three zones based on historic uses (*Figure 1-3*).

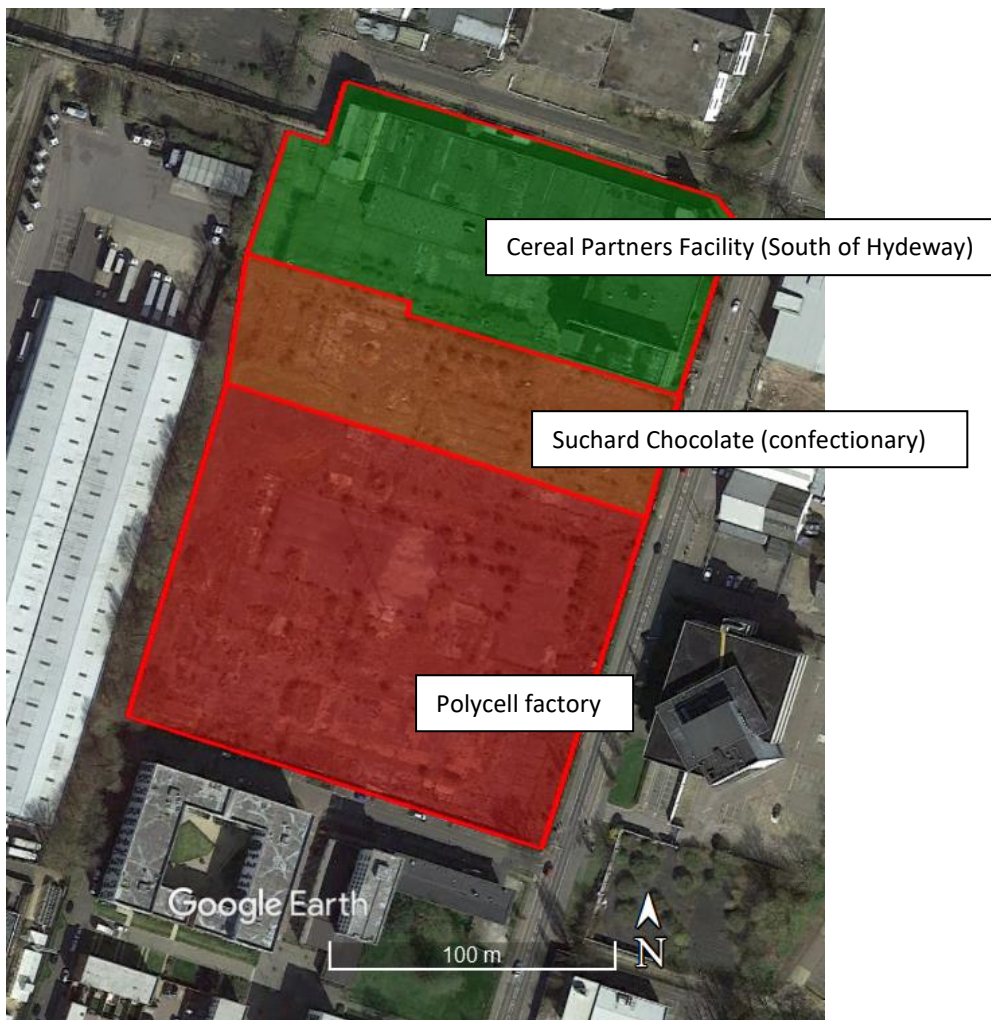


Figure 1-3: Southern Site Zoning

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The historical characteristics and potential environmental issues associated with the Polycell Factory are outlined below.

1.3.1 Polycell factory

The Site was initially developed between 1925 and 1939, with the land immediately adjoining the site to the north and south developed between 1966 and 1976. The original use of the Site was as a film studio (*Photograph 1-1*) that opened in 1928.



Photograph 1-1: *British Instructional Films (BIF) (Broadwater Road Studio)*¹

After this the site was taken over by Ardath Tobacco Company Ltd (1940s - 1960) and then by Polycell (1964). The Polycell Site ceased operation in late 1998.

A Dames and Moore Report (2000)² states that the Polycell facility produced a range of DIY products including Polyfilla and associated products, wallpaper adhesives and paint cleaning fluids. The primary operations carried out on site involved mixing of raw materials and packaging of products.

¹ http://www.ourwelwyngardencity.org.uk/content/topics/the_workplace/film_studios/film_studios

² Dames and Moore (2000). FINAL FACTUAL REPORT - POLYCELL PRODUCTS LIMITED, WELWYN GARDEN CITY FOR WILLIAMS PLC, Ref: R2779/38842-019-401/WH, 14 July 2000

There were two principal areas of production; the Polyfilla powder and paste area and the liquids area.

The Polyfilla and paste area was used primarily to produce dry products and some liquid pastes and was located at the western corner of the site. Associated with this area was a wastewater tank for receiving the washing water from the paste lines. The warehouse was adjacent to the powders and paste building and was used for storage of all products produced on the Site.

The liquids area, located at the northern end of the Site, was used to produce paint strippers and brush cleansers (*Figure 1-4*).

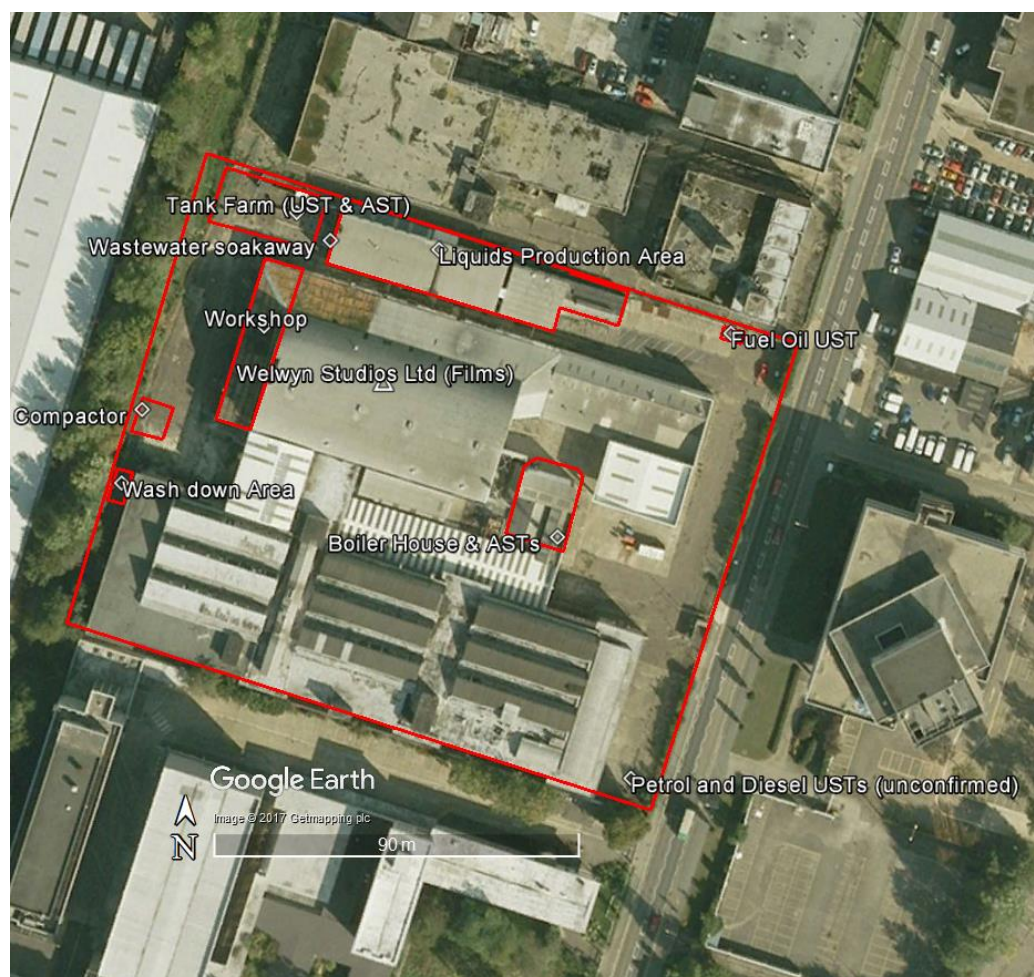


Figure 1-4: Key potential contamination sources – Polycell Factory (2006)

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Associated with the liquids area was a solvent tank farm (*Figure 1-5*) comprising 13 (six in use when the site was operational, seven redundant) underground storage tanks (USTs) and one above ground storage tank (AST).

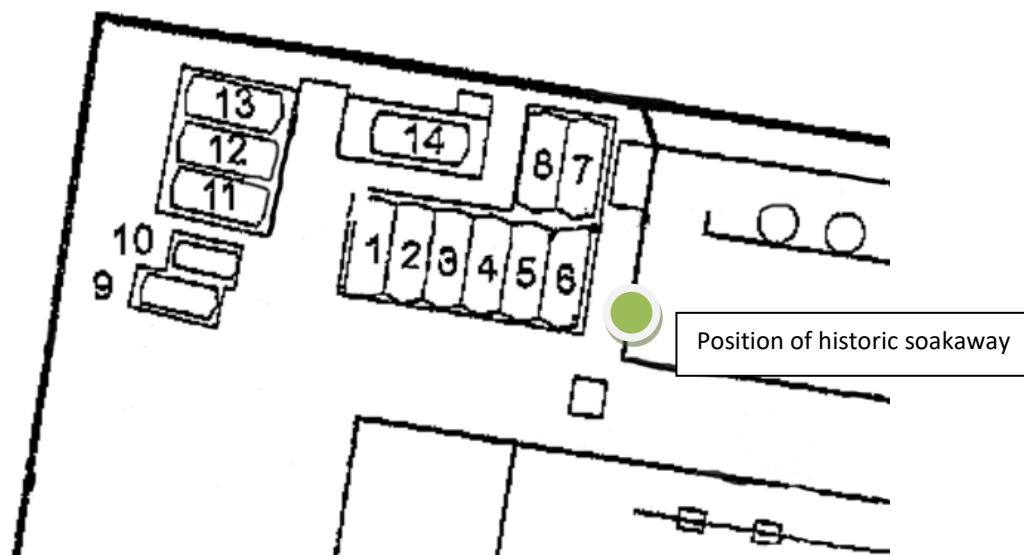


Figure 1-5: Layout of Polycell tank farm and historic soakaway³

Naphtha, white spirit and methanol were stored in the six 4,000-gallon USTs (tanks 7 & 8, 5 & 6, and 3 & 4 respectively) and methylene chloride was stored in a 6,250-gallon AST (tank 14). The seven redundant tanks have volumes ranging from 1,500 to 6,000 gallons and were used to store white spirit, derv, IPA, oxtail, naphtha, turps and methanol.

1.4 Previous Assessments

The Site has been subject to various and substantial phases of environmental assessment and remediation as outlined in *Table 1-1*.

Table 1-1: Historic Environmental Assessments and Reports

Report Date	Report	Client	Contractor	Report Status
Feb-1998	(a) Phase I Environmental Assessment (Ref. R2109)	Williams PLC	Dames and Moore	Not available

³ Modified from URS Presentation (October 2000), Polycell products Ltd, Welwyn Garden City, Findings of Site Investigations and Risk Assessment, Welwyn Hatfield Council Offices, 12th October 2000.

Report Date	Report	Client	Contractor	Report Status
Mar-1999	(b) Phase II Site Investigation (Ref. R2335)	Williams PLC	Dames and Moore	Not available
Jul-2000	(c) Final Factual Report Polycell Products Limited Welwyn Garden City (Ref. R2779/38842-019 401/WH)	Williams PLC	Dames and Moore	Partially available
Aug-2000	(d) Final Interpretative Report Risk Assessment Polycell Products Limited Welwyn Garden City (Ref. R3060/38842-024-401/WH/RJD)	Williams PLC	Dames and Moore	Partially available
Oct-2003	(e) Environmental Assessment Broadwater Road Welwyn Garden City (Ref. 2342-03)	Chinacorp PLC	Delta-Simons	Available
Nov-2004	(f) Phase II Environmental Assessment Cereal Partners Site Broadwater Road Welwyn Garden City (Ref. 2342-05)	Chinacorp PLC	Delta-Simons	Available
Dec-2005	(g) Quantitative Risk Assessment, Broadwater Road, Welwyn Garden City (Ref. 2342.06)	Tesco Stores Ltd	Delta-Simons	Available
July-2006	(h) Combined Phase I/II Environmental Assessment Cereal Partners (UK) Broadwater Road, Welwyn Garden City (Ref. 05-3046.01)	Cereal Partners (UK)	Delta-Simons	Partially available
Dec-2006	(i) Groundwater Monitoring 2006- Broadwater Road, Welwyn-Garden-City (Ref. ELM/AJF/ES/2342-07/051206/BroadwaterRd.letrep)	Chinacorp PLC	Delta-Simons	Available
Feb-2007	(j) Executive Summary Supplementary Site Investigation Cereal Partners (UK), Broadwater Road, Welwyn Garden City (Ref. 05-3046.02)	Cereal Partners (UK)	Delta-Simons	Available

Report Date	Report	Client	Contractor	Report Status
Mar-2007	(k) Technical Specification for Remediation Tender Former Polycell & Confectionary Factories Broadwater Road Welwyn Garden City (Ref. 2342-08)	Tesco Stores Ltd	Delta-Simons	Available
Dec-2008	(l) Remediation Summary Report Tank Excavation and Groundwater Monitoring Broadwater Road, Welwyn Garden City (Ref. 2342-10)	Tesco Stores Ltd	Delta-Simons	Available
May-2009	(m) Remediation Summary Report Tank Excavation and Groundwater Monitoring Broadwater Road, Welwyn Garden City (Ref. 2342-10)	Tesco Stores Ltd	Delta-Simons	Available
Feb-2010	(o) Broadwater Road, Interim Remediation Summary Report (Ref. E0711)	Delta-Simons	Bilfinger Berger Environmental Ltd	Available
Feb-2011	(p) Remediation Summary Report Ongoing Groundwater Monitoring Broadwater Road, Welwyn Garden City (Ref. 2342-10)	Tesco Stores Ltd	Delta-Simons	Available
Sep-2011	(q) Remediation Summary Report & Ongoing Groundwater Monitoring Broadwater Road, Welwyn Garden City (Ref. 2342-10)	Tesco Stores Ltd	Delta-Simons	Available
Jun-2012	(r) Remediation and Groundwater Monitoring Report Broadwater Road, Welwyn Garden City (Ref. 2342-10)	Tesco Stores Ltd	Delta-Simons	Available
May-2013	(s) Groundwater Monitoring Update Report Broadwater Road, Welwyn Garden City (Ref. 2342-10)	Tesco Stores Ltd	Delta-Simons	Available
Nov-2013	(t) Groundwater Monitoring Update Report – November 2013, Broadwater Road, Welwyn Garden City (Ref. 2342-10)	Tesco Stores Ltd	Delta-Simons	Partially Available

Report Date	Report	Client	Contractor	Report Status
Dec-2013	(u) Phase I Geotechnical Desk Study Assessment Broadwater Road, Welwyn Garden City (Ref. 2342.17)	Spen Hill Developments Ltd	Delta-Simons	Available
Oct-2014	(v) Desktop Foundation Assessment Broadwater Road West, Welwyn Garden City (Ref. 2342.18_D)	Spen Hill Developments Ltd	Delta-Simons	Available
Jan-2015	(w) Phase I Environmental Assessment, Former Shredded Wheat Factory, Broadwater Road, Welwyn Garden City (Ref. 2342.17 V2)	Spen Hill Developments Ltd	Delta-Simons	Available
Jan-2015	(x) Factual and Interpretative Geotechnical Report Former Shredded Wheat Factory, Broadwater Road, Welwyn Garden City, AL7 3AX (Ref. 2342.18_G V2)	Spen Hill Developments Ltd	Delta-Simons	Available
Mar-2016	(y) Final Post-Remediation Groundwater Monitoring Report Broadwater Road, Welwyn Garden City	Tesco Stores Ltd	Delta-Simons	Available
Mar-2018	(z) 016-1512 Wheat Quarter WGC Environmental Assessment - Southern Area REV00 (DRAFT)	Wheat Quarter Limited	EAME	Available

These reports provide good coverage and characterisation of the site and information derived from these reports is discussed below.

Welwyn and Hatfield Borough Council formally accepted the Delta-Simons Phase I Environmental Assessment (Ref. 2342.17 V2) in relation to planning application reference N6/2015/0294/PP.

1.5 Summary of Previous Works

At the time of the Site acquisition by Tesco Stores Ltd they were informed that the Site was contaminated, and the nature and extent of the contamination was confirmed by subsequent Site investigations undertaken by Delta-Simons. Delta-Simons undertook several phases of intrusive site investigation and long-term groundwater monitoring at the Site between 2003-

2016. A long-term strategy was agreed (in conjunction with the Welwyn Hatfield Council and the Environment Agency) to undertake a voluntary groundwater remediation scheme to reduce the associated environmental risks.

Delta-Simons investigations at the Site identified localised soil contamination and significant widespread groundwater contamination at depth within the Principal Chalk Aquifer. The source of the contamination was determined to be leakage from the USTs located in the north-west corner of the former Polycell factory (Zone S01).

The key contaminants identified in the groundwater at the Site comprise 'White Spirit' characterised by a mix of light end aliphatic hydrocarbons, dichloromethane, trimethylbenzene, naphthalene, ethylbenzene and xylenes. Non-aqueous phase liquid (NAPL) free product was identified on the surface of the groundwater at a depth of approximately 22 m within the Chalk within selected boreholes.

Elevated concentrations of total petroleum hydrocarbons (TPH) and volatile organic compounds (VOC) were identified within shallow Made Ground around the periphery of the tank farm. The contamination is considered to have been caused by leakages from the pipework associated with the tank farm, or from the USTs themselves, or a combination of both.

Elevated concentrations of TPH, semi-volatile organic compounds (SVOC) and VOC at depth within the Chalk, in the direction of the identified groundwater flow (primarily towards the southeast), were associated with the free product on the surface of the groundwater.

Groundwater monitoring undertaken prior to the remediation works identified that the dissolved contamination was reaching the boundaries of the Site and investigations on the adjacent CUPK land (to the north of the Site) identified deep groundwater contamination in several boreholes, which has been identified as originating from the tank farm.

1.6 Previous Remedial Activities

Given the scale and extent of the groundwater contamination at the Site a remediation strategy and monitoring programme was devised following a Detailed quantitative risk assessment (DQRA) completed by Delta-Simons in December 2005. The main objective of the remediation strategy was to remove the principal source of contamination, therefore, preventing the continued contamination of groundwater from the source area. The source was considered to comprise the tank farm and surrounding impacted shallow soils, and free product on the groundwater at depth beneath the tank farm. The secondary objective of the remediation programme was to remediate the dissolved phase groundwater contamination to the derived remedial targets, to minimise impact to the wider groundwater environment.

The remediation scheme comprised a combination of techniques to remove the source of the contamination and address the dissolved phase contamination plume across the wider Site. These included:

- **Stage 1** – Tank pull and soil excavation – completed September/October 2008;
- **Stage 2** – Soil excavation validation – completed October 2008;
- **Stage 3** – On-site ex-situ biopile remediation – completed July 2009;
- **Stage 4** – Pump and Treat groundwater remediation/Free product recovery – completed January 2011;
- **Stage 5** – Soil vapour extraction – completed January 2011;
- **Stage 6** – Oxygen Releasing Compound (ORC) injection – completed early 2011; and
- **Stage 7** – Long-term groundwater monitoring/Monitored Natural Attenuation (MNA) – October 2008 to September 2015.

In September 2015 Delta-Simons concluded that the source removal and ex-situ soil remediation was successful in removing the bulk of the soil contamination source and treating the contaminated soils. The active groundwater remediation phase was successful in removing free product from the groundwater: free product has not been recorded on the groundwater table since March 2010. In addition, the soil vapour extraction system removed approximately 70 tonnes of volatile compounds from the soils beneath the former tank farm. The results of the long-term groundwater monitoring programme indicate that the groundwater remediation scheme has been effective in significantly reducing the dissolved phase hydrocarbon and VOC contamination within the source zone and the dissolved phase plume.

It should be noted, that contamination levels within the groundwater beneath the former tank farm remain elevated in some instances. Although, overall, the identified concentrations are below the Delta-Simons derived remedial target values, there are occasional exceedances of the very low target values for n-Propylbenzene. However, as noted in Delta-Simons DQRA Report and additional modelling undertaken at the request of the Environment Agency, the remedial target value for n-Propylbenzene is (considered) overly conservative, due to the use of a default half-life value of 9×10^{99} , and this does not consider biodegradation. In hindsight, therefore, it is considered to be an unrealistic remedial target in the case of this parameter.

The results show that concentrations of contaminants within the monitoring wells down hydraulic gradient of the source area are exhibiting an overall declining trend, whereas

monitoring wells to the south of the main plume (which are less impacted), exhibit variable, but generally reduced concentrations.

Delta-Simons work at the Site was completed in September 2015 with the final report issued in March 2016.

2 Site Assessment Strategy

2.1 Scope of Works

Based on the previous Site investigations and remedial works the following staged approach was outlined within the site investigation scheme submitted to Welwyn Hatfield Borough Council (WHBC) on 29th September 2017 in relation to N6/2015/0294/PP – Planning Condition No. 1 i.e. *“A site investigation scheme, based on the submitted phase 1 Environmental Assessment (Delta-Simons ref 2342.17 V2) to provide information for a detailed assessment of the risk to all receptors that may be affected, including those off site”* (Figure 2-1).

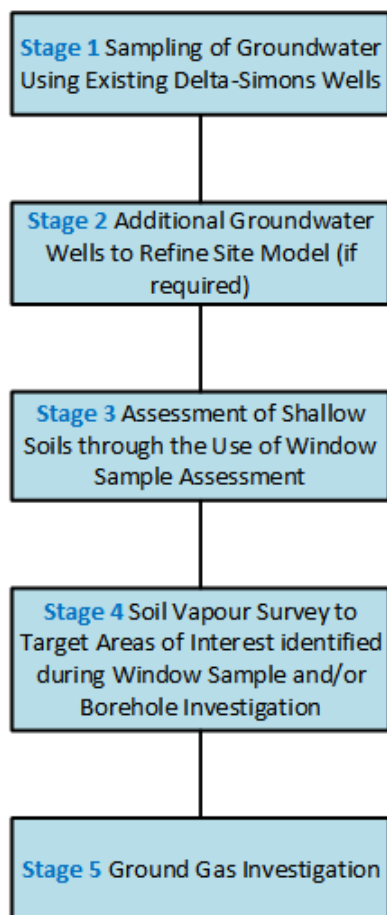


Figure 2-1: Agreed Site Investigation Scheme with WHBC

Formal acceptance of the site investigation scheme was received from Mr. Tim Croot (WHBC Environmental Health Department) on 07/11/17.

The full results of the agreed investigation are outlined within the EAME Report ‘*Environmental Assessment (Southern Area) Broadwater Road Site, Welwyn Garden City, AL8 6UN, UK (Ref. 016-1512 – REV01), September 2018*’, which is provided alongside this remediation strategy. This report also includes an assessment of Contaminant Characterisation, a Hydrogeological Conceptual Site Model and a Hydrogeological Detailed Quantitative Risk Assessment.

2.2 Consultation with the Environment Agency

Throughout the site investigation and Detailed Quantitative Risk Assessment (DQRA) process the Environment Agency (EA) has been consulted via the assigned planning liaison officer, as outlined within *Table 2-1*.

Table 2-1: EA Consultation Record

Date	Type	Notes
29/03/18	Meeting held at EA offices in WGC	Provision of draft site investigation results in relation to the groundwater conditions on the southern site.
16/04/18	Minutes provided by EA of meeting held on 29/03/18.	EA requested ConSim spreadsheets to review input criteria and assumptions.
23/05/18	Letter from EA to EAME (Ref. NE/2018/128222/04-L01)	Review of Environmental Assessment (Southern Area), Broadwater Road Site, Welwyn Garden City, AL8 6UN, UK (project reference 016-1512, Rev 00), PDF- DQRA inputs_ConSim” (ref 016-1512, Rev 00, dated March 2018), Remedial Targets Methodology (RTM) worksheets.
22/06/18	Letter from EAME to EA (Ref. 016-1512 Wheat Quarter Limited - Response to EA Letter of 23-05-18 REV00)	Review of the EA comments related specifically to the ConSim and RTM input parameters.
22/06/18	Letter from EAME to EA (Ref. 016-1512 Plutus Estates WGC EA Remediation Letter REV00)	Outlining proposed remediation works (including programme).

Date	Type	Notes
19/07/18	Letter from EA to EAME (Ref. NE/2018/128222/04-L01)	Review of Correspondence dated 22nd June 2018, re Proposed Development, Southern Area of Broadwater Road Site (EAME ref 016-1512 Wheat Quarter Limited Response to EA letter of 23-05-18 REV00), Correspondence dated 22nd June 2018, re Proposed remediation works at Broadwater Road site, Welwyn Garden City (EAME ref:01601512 Plutus Estates WGC EA Remediation Letter RECV00)
20/07/18	Letter from EAME to EA (Ref. 016-1512 Wheat Quarter Limited - Response to EA Letter of 19-07-18 REV00)	Comments regarding DQRA, proposed remedial works and betterment.
07/08/18	Letter from EA to EAME (Ref. NE/2018/128222/06-L01)	Review of Remediation Strategy (Southern Area), Broadwater Road Site, Welwyn Garden City, AL8 6UN, UK (EAME, Rev00, ref 016-1512, June 2018) and Letter dated 20th July 2018, their ref: 016-1512 Wheat Quarter Limited - Response to EA Letter of 19-07-18 REV00.

In-light of comments from the EA (19/07/18 and 07/08/8) and feedback from the remediation contractor (John F Hunt Remediation) a window of opportunity in the development programme was taken to extend the on-site remedial works by a further 2 weeks to maximise the benefits of the installed system

2.3 Initial Conclusions

The findings of the site investigation work along with data from the subsequent laboratory analysis suggest that residual petroleum hydrocarbon contamination is present in the soils and groundwater beneath the former tank farm/remediation area and that further remediation was necessary.

The groundwater beneath the site is present within the Lewes Nodular and Seaford Chalk Formations. Appraisal of groundwater monitoring data suggests that two groundwater units are present beneath the site; an upper unit within the more weathered 'putty' chalk and a deeper unit within the Principal Chalk Aquifer. The data also suggests that there is a downward head gradient between the shallow and deeper groundwater within the chalk.

This is not uncommon in the chalk where the 'putty chalk' acts a leaky confining layer between shallow groundwater contained in the putty chalk itself and the deeper groundwater within the Principal Chalk Aquifer. Based on the monitoring data groundwater flow in the chalk is interpreted to be to the south east.

Concentrations of petroleum hydrocarbons have been recorded above relevant water quality standards and, on this basis, a detailed hydrogeological quantitative risk assessment has been undertaken. Based on the petroleum hydrocarbon contaminant characteristics, key risk drivers were identified for assessment using bespoke EA approved modelling packages (RTW & ConSim v 2.5)

As with all modelling the packages the results have been used in the risk assessment to aid in professional judgement. Overall the results of the risk assessment suggest that potential impacts associated with residual soil contamination are likely to be minimal and can be disregarded for the purposes of remedial strategy design.

The results of the risk assessment also demonstrate that potential impacts on off-site groundwater quality from residual groundwater contamination are likely to be small scale and the empirical site data demonstrates a clear reduction in petroleum hydrocarbon concentrations down hydraulic gradient. However, given the recorded elevated concentrations of petroleum hydrocarbons in groundwater close to the original source area (tank farm) and the sensitivity of the Principal Chalk Aquifer it is considered prudent to apply remedial actions designed to bring about environmental betterment, taking into consideration current best practice guidance, including the principals of sustainable remediation.

Appraisal of primary and secondary lines of evidence suggests that there is potential for natural attenuation processes to be active within the groundwater contaminant plume, which are expected to continue beyond any active remedial intervention.

The remedial options and proposed strategy are set out in the remainder of this document.

3 Remedial Strategy

3.1 Introduction

CLR11 (Environment Agency, 2004) was developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. The process involves identifying, making decisions on, and taking appropriate action to deal with land contamination in a way that is consistent with government policies and legislation within the UK.

This is essentially a three-tier process comprising the following stages:

- **Stage 1 – Risk Assessment** – identification of potential risks, definition of risks and whether further assessment is required to address identified risks (if deemed significant);
- **Stage 2 – Options Appraisal** – which essentially comprises assessing and evaluating options for removing or breaking potential significant pollution linkages through detailed feasibility appraisal; and
- **Stage 3 – Implementation of Remedial Strategy** – agreeing the strategy and undertaking the identified solutions to break the pollutant linkage(s) with verification of the process. Where long term monitoring is required, review and assess the data obtained to determine whether acceptable or otherwise.

This process for assessing contamination using the appropriate tiered structure has been followed. The investigation and assessment has been completed and reported in previous documents provide good characterisation of the site conditions and environmental risks therein.

3.2 Risk Assessment

Appraisal of the groundwater analytical results suggests that the greatest impact is beneath the former tank farm area with the highest concentrations recorded in the following petroleum hydrocarbon fractions C8-C16 Aliphatics (124,000 µg/l), C8-C10 Aromatics (23,000 µg/l) and C10-C16 Aromatics (335,000 µg/l). Although the C8-C16 aliphatic fraction has been recorded at elevated concentrations in BH01-17 it is generally <LOD in other monitoring wells and is considered to have low risk ranking with the solubility of these compounds is <1mg/l. On this basis the C8-C16 aliphatic fraction is not considered to be a key risk driver.

The highest petroleum hydrocarbon concentrations have generally been recorded in the C10-16 aromatic fraction, which (according to the CL:AIRE guidance) includes high mobility

compounds such as Xylenes and Naphthalene. These have been recorded at high concentrations beneath the former tank farm area (BH01-17, 1,840ug/l). On this basis the C10-16 aromatic fraction is a key risk driver.

The analytical results suggest that Dichloromethane in groundwater is restricted to the former tank farm / remediation area. However, due to its known historical presence at the site and potential toxicity and mobility it is also considered as a key risk driver. However, in all other monitoring wells sampled concentrations of DCM were <LOD suggesting that it is a static residual legacy concentration, not actively migrating via groundwater.

In summary, the following contaminants are considered the key risk drivers at the site are C8-C10 Aromatics, C10-C16 Aromatics and Dichloromethane (DCM).

Concentrations of petroleum hydrocarbons (in the C10-C16 aromatic fractions) have been recorded above relevant water quality standards and, on this basis, a detailed hydrogeological quantitative risk assessment has been undertaken. Based on the petroleum hydrocarbon contaminant characteristics key risk drivers were identified for assessment using bespoke EA approved modelling packages (RTW & ConSim v 2.5).

As with all modelling the packages the results have been used in the risk assessment to aid in professional judgement. Overall the results of the risk assessment suggest that potential impacts associated with residual soil contamination are likely to be minimal.

Appraisal of primary and secondary lines of evidence suggests that there is potential for natural attenuation processes to be active within the groundwater contaminant plume.

3.3 Feasibility and Options Appraisal

Following the risk assessment process, which has identified potential pollutant linkages to groundwater, an appraisal of the potential options to break the potential linkages is required and has been completed. The three main concerns to evaluate at the options appraisal stage are to consider the identified potential pollutant linkages and potential remedial scenarios as follows:

- identify feasible remediation options for each relevant pollutant linkage;
- carry out an evaluation of feasible remediation options to identify the most appropriate option for any linkage; and
- produce an outline remediation strategy that addresses all relevant pollutant linkages, where appropriate by combining remediation options.

The following elements have been considered, where necessary, during the feasibility and options appraisal stage:

- degree to which risks need to be reduced or controlled;
- time within which the remediation strategy is required to take effect;
- practicability of implementing and, where appropriate, maintaining the strategy;
- technical effectiveness of the strategy in reducing or controlling risks;
- durability of the strategy (*i.e.*, will it provide a robust solution over the design life?);
- sustainability of the strategy (*i.e.*, how well it meets other environmental objectives, for example on the use of energy and other material resources, and avoids or minimises adverse environmental impacts in off-site locations, such as a landfill, or on other environmental compartments, such as air and water);
- cost of the strategy;
- benefits of the strategy – all remediation strategies should deliver direct benefits (the reduction or control of unacceptable risks) – but many have merits that extend well beyond the boundaries of the site; and
- legal, financial and commercial context within which the site is being handled including the specific legal requirements that remediation must comply with, and the views of stakeholders on how unacceptable risks should be managed.

A review of possible site-specific feasible options, according to CLR11 has been undertaken and is presented in *Table 3-1*. This has effectively evaluated the practicality, effectiveness, durability and sustainability of the potential remedial solutions.

3.3.1 Significant Pollution Linkages

The significant pollution linkage has been identified as the elevated VOCs located within the groundwater in the area around the previous tank farm (*i.e.* the area previously subject to remediation). The groundwater in this area is acting as the source, pathway and receptor. This has been agreed with the Environment Agency.

It is important to note that there are no identified human health pollution linkages between the groundwater (located at circa 23 metres below ground level) and the proposed development, so the remedial focus is betterment of the groundwater conditions.

Table 3-1: Feasibility of Remedial Options

Option	Summary of Technology	Receptor	Practicability	Durability and Sustainability	Suitability for Site Circumstances
Engineering & Physical Based Process					
Containment	Installation of grout walls or cut-off trenches to prevent or intercept groundwater flow.	Groundwater	Can be effective at shallow depths with excavation techniques or greater depths (up to 20m) with grouting or sheet-piling techniques.	Generally, not a permanent solution and does not eliminate the contaminants only holds them in place. Can generate a lot of potentially contaminated waste materials.	The contamination is very deep on the site and impeding groundwater flow in the aquifer would not be a desirable outcome. NOT PRACTICABLE
Trenching and skimming of LNAPL	Digging of trenches to intercept the LNAPL layer and use of skimmers and pumps to draw LNAPL off.	Groundwater	This is a crude but relatively effective method for shallow thick LNAPL layers.	This technique causes a lot of site disturbance and can be difficult to manage and maintain over long periods. The excavated soils will typically be contaminated and require treatment or disposal so generates a substantial waste material.	This only works in shallow conditions (less than 6m) where there is a thick defined LNAPL presence, but on this site, there is no obvious LNAPL and the contaminant horizon is 23m, well beyond the reach of any excavation technique. NOT PRACTICABLE

Option	Summary of Technology	Receptor	Practicability	Durability and Sustainability	Suitability for Site Circumstances
Targeted removal of LNAPL	Use of pumping wells and float valves and pumps to concentrate and remove LNAPL phase liquids from the groundwater surface.	Groundwater	Where there is a substantial LNAPL and this is relatively shallow, this technique can be effective.	This process can be run for a long-period of time and can run as a continuous process or batch process. It is a relatively low energy consumption process and does not introduce any materials to the environment. The recovered hydrocarbons could in some instances be exploited for energy recovery.	On this site, although the analysis results suggest an LNAPL should be present this is marginal, and one has not been identified to date. If such a layer exists it is likely to be very thin and at a depth of 23m difficult to manipulate. NOT PRACTICABLE
Groundwater Pump and Treat	Use of pumping wells to abstract contaminated groundwater and process it through a treatment plant for contaminant separation/destruction, with the residual de-contaminated water, land-spread, re-injected or discharged to sewer or watercourse.	Groundwater	This is an effective technique and can process large volumes of contaminated water to considerable depths.	This process can be run for a long-period of time and can run as a continuous process or batch process. It is a relatively low energy consumption process and does not introduce any materials to the environment. The recovered hydrocarbons could in some instances be exploited for energy recovery. From a sustainability perspective it is preferable to re-inject the treated water to the aquifer or discharge it to a watercourse rather than direct it to a sewer.	This technique can be reasonably readily applied on this site. The only issue being a logistical one in that until such a time as an appropriate abstraction licence and discharge (or re-injection) permit can be obtained the system will be limited to 20m ³ per day even though it would be capable of processing more than this. PRACTICABLE

Option	Summary of Technology	Receptor	Practicability	Durability and Sustainability	Suitability for Site Circumstances
Air Sparging	Use of air to strip volatile hydrocarbons from the groundwater which can be recovered by vacuum extraction.	Groundwater	Useful for readily accessible groundwater bodies where the principal contaminant of concern is volatile organic compounds.	A short-term targeted intervention for specific conditions it can be relatively cost-effective and does not generate any secondary wastes other than the recovered volatile hydrocarbons.	In the context of this site the contaminants are primarily LNAPL (or close concentrations to this state), but there are dissolved phase hydrocarbon fractions too which could benefit from this technique. PRACTICABLE
Biological Based Process					
Ex-situ biological treatment	This involves abstracting water and passing it through a biological treatment process to remove contaminants.	Groundwater	This is a more unusual method compared to in-situ treatment (see below) and requires a surface based biological treatment system with substantial volumetric capacity.	This is a short-term method applicable in certain situations and is relatively low energy producing low volumes of secondary waste materials.	The scale of water abstractable from this site is relatively small and the timescale for remediation is short. A scheme of this nature would not be justifiable on a site like this with the associated development constraints. NOT PRACTICABLE
In-situ biological treatment	Injection of organic matter, nutrients and microbial cultures into contaminated groundwater to promote microbial degradation, typically followed by air sparging or venting.	Groundwater	This method can be applied readily in a variety of situations and does not require the water to be abstracted.	This method is a low energy method that can be applied over a long period of time and other than recovered gaseous breakdown products produces very little secondary waste materials.	This method can be readily applied in the context of this site as the groundwater is reachable with injection wells and could respond well to biological stimulation but the period for results is long. PRACTICABLE

Option	Summary of Technology	Receptor	Practicability	Durability and Sustainability	Suitability for Site Circumstances
Chemical Based Process					
Ex-situ chemical treatment	This involves abstracting water and passing it through chemical treatment processes to remove contaminants.	Groundwater	This is a more unusual method compared to in-situ treatment (see below) and requires a surface-based water treatment system with substantial volumetric capacity.	This is a short-term method applicable in certain situations and is relatively low energy producing low volumes of secondary waste materials.	The scale of water abstractable from this site is relatively small and the timescale for remediation is short. A scheme of this nature would not be justifiable on a site like this with the associated development constraints. NOT PRACTICABLE
In-situ chemical treatment	Injection of chemical reagents into contaminated groundwater to promote microbial degradation, typically followed by air sparging or venting.	Groundwater	This method can be applied readily in a variety of situations and does not require the water to be abstracted.	This method is a low energy method that can be applied over a long period of time and other than recovered gaseous breakdown products produces very little secondary waste materials.	This method can be readily applied in the context of this site as the groundwater is reachable with injection wells and could respond well to biological stimulation. PRACTICABLE

3.4 Remedial Strategy and Objectives

The primary purpose of any remedial scheme is to lessen the impact (or potential future possibility of impact) of a known contamination situation by reference to pollutant linkages. Generally, it is not possible to remove the sensitive receptor from a situation, so effort must be focussed on source removal or pathway interruption. In the context of this site, the receptor (groundwater) is also the means of off-site migration of the contaminants (pathway). That leaves source reduction as the most applicable and effective remedial strategy and that is the primary objective of the remediation proposals for this site.

In broad terms the primary objective is that of “betterment” – reduction of the gross pollutant presence and encouragement of degradation and natural processes to reduce the overall risks to the aquifer.

3.5 Site Constraints

There are no identified site constraints in terms of accessibility as the site has been subject to demolition and full clearance. It is noted, however, that the contamination horizon that is being targeted is some 23 metres below ground level so shallow or surface-based interventions such as bulk source removal by trenching for example are not feasible, even where applicable.

3.6 Proposed Remediation Methodology

Based upon the review of options above, the optimal remedial strategy is a degree of intense targeted intervention using a combination of pump and treat and chemical injection now followed by longer term monitoring, where natural biochemical processes will take place. The proposed remediation methodology and key stages are outlined below. All works are to be undertaken and co-ordinated by John F Hunts who have extensive experience of and competence in groundwater remedial works and have experience of such in the chalk aquifer that is the subject of this remedial programme.

3.6.1 Stage 1 – Pre-trials (Basic Pump and Vac-Ex Trials)

This will comprise the provision of basic groundwater pumping trials and vac-ex trials to inform zone delineation works and define remediation parameters. The installed equipment will include base loading pneumatic pumps, air-lines, discharge hoses, rotron air movers, knock-out pots, carbon drum filters, ancillary pipework and compressor. In other words, the installations will serve both as monitoring or data gathering wells and abstraction points. During this stage all pumped groundwater will be stored within IBCs until full-scale groundwater treatment is started.

3.6.2 Stage 2 – Pre-Commencement Works

This involves the production of health and safety documentation *i.e.* risk assessment/method statement/CoSHH assessment for the main phase of works. During this process deployment of Mobile Plant Permit (MPP) to undertake the remediation and application for consent to discharge to foul sewer from Thames Water will be obtained.

3.6.3 Stage 3 – Installation of the Remediation Borehole Injection Grid

The strategy assumes approximately a 6-metre grid pattern over an area of 30 metre x 12 metre (360 m²) to coincide with the original source area (tank farm). Eighteen (18) x boreholes will be required in total to achieve this configuration. This assumes utilisation of existing borehole BH01-17 as one of the remediation boreholes therefore a total of 17 new additional boreholes will be excavated. Initially 5 of the boreholes will be utilised for delineation & remediation (drilled to a depth of circa 30m depth), with the remaining 12 new boreholes drilled to a depth of circa 28m (these will be remediation only boreholes).

All drilling will be undertaken using a Sonic Drilling Rig. All abstracted water will be temporarily stored within above ground water tanks prior to testing and eventual sewer releases (in-line with the prevailing discharge consent).

After the drilling the boreholes and the necessary well infrastructure installation, one round of groundwater monitoring will be undertaken from the delineation/remediation borehole grid (required to determine reagent dosing concentrations/flow rates). The monitoring will also include selected EAME and historic boreholes. A maximum of 28 samples shall be obtained and analysed for TPHCWG, target SVOCs, target VOC and key MNA parameters.

3.6.4 Stage 4 - Main Remediation Works

To initially mobilise any persistent non-aqueous phase liquid (NAPL) a gross source removal activity will be undertaken through the pressurized injection of proprietary reagents via the installed pipework array.

After the injection process, a Pump & Treat (P&T) System/Hydraulic Containment & Recirculation (limited capacity) process is to be undertaken. The equipment proposed will include a Water Treatment Plant, settlement tanks, oil-water interceptor, sand filters, granular activated carbon (GAC) filters, borehole pumps/hoses, pipework and manifold. Two proprietary reagent injection campaigns have been included within the programme each followed by a P&T process to remove the mobilised pollutants and breakdown products.

Where required spent GAC will be disposed of (off-site) or regenerated.

All works will be subject to environmental monitoring to include, as a minimum, VOCs, dust, PM₁₀ and noise.

Every two weeks throughout the remediation process approximately 50% of the injection wells and 5 of the wider site monitoring wells will be monitored.

A standalone factual report will be produced after the completion of this stage of the works.

3.6.5 Stage 5 – Decommissioning of the Boreholes

All 18 x boreholes utilised during the remediation process will be subject to decommissioning in-line with Environment Agency Guidance ^{4, 5} when no longer required for monitored natural attenuation.

3.7 Consents, Agreements, Permits and Licences

A mobile plant permit will be utilised at the site in-line with current Environmental Permitting requirements.

The discharge to foul sewer will be in accordance with the temporary discharge consent that is to be obtained from Thames Water.

3.8 Contingency Measures

It is necessary to have procedures in place to deal with accidents, emergencies and incidents. Environmental incidents can be defined as unexpected events which lead to, or could in different circumstances have led to, adverse effects on people, property or on environmental resources such as habitats or watercourses.

During the site works, the Contractor will implement procedures from published guidance documents for working on contaminated sites.

The following provisions will apply:

- There will always be a supervisory person on site to direct staff and respond to incidents.

⁴ Environment Agency (2006). Guidance on the design and installation of groundwater quality monitoring points, Science Report SC020093

⁵ Environment Agency (1996). Decommissioning redundant boreholes and wells, National Groundwater and Contaminated Land Centre

- Where unforeseen circumstances are encountered, works will be temporarily ceased in that area until the situation has been evaluated and an action plan agreed.
- Where the discovery of an imminent pollution threat occurs (*e.g.* a spillage) all reasonable actions shall be taken to curtail the incident (*e.g.* application of a spill kit, deployment of booms, physical intervention with dams or earth moving equipment) – provided that this response does not put individuals at risk of harm.
- The EA must also be notified where any event or incident threatens controlled waters.
- Where materials arise that are not typical of the contaminants encountered thus far the material will be sent away for full chemical analysis and the area either worked around or the material moved to a suitably contained quarantine area whilst it is being evaluated.
- If asbestos is uncovered this will be immediately reburied and the area damped down until a safe and secure method of its removal can be established.
- All incidents and emergencies will be recorded and logged along with corrective actions taken.

4 Verification

4.1 Verification Plan

The purpose of the Verification Report is to provide a detailed summary of the remedial works that were undertaken, record departures from the planned remedial strategy (if any) and the reasons why, and to provide results of monitoring and analysis to confirm that remediation works have been effective in bettering the environmental status of the site.

The Verification Report will act as documented record of the veracity and effectiveness of the remedial strategy and residual site conditions.

4.1.1 Groundwater monitoring

The primary verification activity will be extended monitored natural attenuation (MNA) of the groundwater (the main receptor) after completion of the active remediation phase *i.e.*

- Month 0 (completion of remediation)
- Bi-monthly Monitoring (until month 6) – Month 2, Month 4 and Month 6 – Monitoring of 50% of injection grid boreholes plus 5 x of the wider site monitoring wells.
- Quarterly Monitoring (until month 12) – Month 8 and Month 12 – Monitoring of 50% of injection grid boreholes plus 5 x of the wider site monitoring wells.
- 6 monthly Monitoring (until month 24) – Month 18 and Month 24 monitoring up to 5 of the wider site monitoring wells.

4.2 Remedial Targets

Remedial targets are not considered relevant as ‘betterment of the groundwater’ against the stated baseline has been agreed with the Environment Agency.

4.3 Verification Report

Upon completion of the works a verification report will be provided by EAME that contains the following items:

- Description of the efficiency of the remediation system, to include:
 - volume of groundwater abstracted and discharged;

- list of active abstraction boreholes;
 - baseline information relating to concentration of Contaminants of Concern (CoC) and key MNA information;
 - influent concentration to the Pump & Treat (P&T) system and effluent concentration prior to discharge to foul sewer; and
 - where applied, information relating to the use of proprietary chemicals to mobilise the entrapped contamination into the groundwater prior to subsequent abstraction and treatment.
- Groundwater monitoring (Month 2, 4, 6, 8, 12, 18 and 24) post completion of the remediation. All results compared to the stated baseline.

Annex A – Remediation Programme (Initial and Extended)

15th Aug 2018

REF: 17090/SH/Aug18/003

Harborough Innovation Centre
Airfield Business Park
Wellington Way
Leicester Road
Market Harborough
LE16 7WB

██████████
Wheat Quarter Limited
1 Hyde Way
Welwyn Garden City
AL7 3BY

01858 414333

By email: ██████████

Dear ██████████

RE: Proposed Extension to Remedial Works at Former Polycell Factory, Broadwater Rd, Welwyn Garden City

1.0 Introduction

During the teleconference held on 09th August 2018, John F Hunt Remediation (JFHR) were asked to provide a proposal for an extension of the groundwater remediation works at the above site.

In summary, our scope dated 11th June 2018 (the Scope) comprised the installation and operation of a groundwater remediation system until Aug 31st 2018. The Scope outlined several factors that would determine what could be achieved within this timescale, along with the identified risks.

Remediation works are currently being undertaken in accordance with the agreed Scope, programme and contract. Operations are due to cease on 31 Aug 2018. Since commencing the remediation works, JFHR have been advised that remediation works could be extended beyond 31st Aug 2018 on the basis that MHT will not be commencing construction on the 'south site' until early 2019.

We note the recent correspondence between EAME and the Environment Agency, which are set out below:

- Environment Agency letter to M. Sylvester EAME dated 19th July Ref: NE/2018/128222/04-L01;
- EAME letter to Ms Lisa Mills, Sustainable Places Planning Advisor. 20th July Ref: 016-1512;
- Environment Agency letter to M. Sylvester EAME dated 7th Aug Ref: NE/2018/128222/06-L01.

When considering the above correspondence, the Environment Agency remain concerned over the degree of betterment that will be achieved within the defined remediation Scope and programme. EAME have responded to the Environment Agency indicating that the remediation works need to be measured alongside the ongoing consideration given to achieving a balance between the degree of betterment and the overall project commercial / programme constraints.

JFHR consider that an extension to the remediation programme throughout September would substantiate the current dataset, such that a valid and justifiable approach can be made to the Environment Agency based on the overall objective of 'betterment'. We would recommend that the approach to the Environment Agency considers the principle of '*Sustainable Remediation*' as set out in the SuRF-UK guidance (<https://www.clare.co.uk/projects-and-initiatives/surf-uk>). Should it be necessary, the approach to the Environment Agency could also include a formal 'Cost Benefit Analysis' (CBA).

2.0 Works Completed to Date

The works completed to date can be summarised as:

- Installation of a remediation grid consisting 18No. (new) boreholes within the inferred source zone area. [Refer to Borehole Location Plan FLS/REM/WGC/002 Rev A, Appendix A].

Note that whilst the primary objective of these works was to install the abstraction / injection / monitoring boreholes, the works also allowed further delineation of the source area through the considered positioning of each borehole. Boreholes were positioned utilising a combination of field observations along with the ongoing sampling / testing regime;

- Installation and commissioning of the Water Treatment Plant (WTP) and abstraction infrastructure;
- Operation of the WTP and ongoing data capture, which is summarised below:
 - Operation of up to 5No. borehole pumps (4No. top loaders and 1No. bottom loader) at any one time. Note that typically 4No. pumps operate throughout the day;
 - Operation of system up to 10hours per day (including weekends). No overnight operations such that the water levels can recover (see further information in Section 3.0 on drawdown);
 - Initial pump depths set to remove free product from target boreholes through product 'skimming';
 - Targeting of specific boreholes to maximise the contaminant mass recovery - initially through NAPL removal and subsequently through the targeting of boreholes with high dissolved phase concentrations;
 - Pump depths lowered as required to achieve 'total fluid pumping' once NAPL thickness reduced;
 - Ongoing recording of groundwater levels;
 - Ongoing recording of NAPL thickness;
 - Ongoing water sampling and laboratory testing (dissolved phase and MNA parameters);
 - Headspace testing from abstracted groundwater;
 - WTP efficiency / compliance testing;
 - Flow rate measurements of abstracted groundwater.

Note the utilisation of proprietary chemical products / surfactants designed to mobilise gross contamination / NAPL prior to subsequent abstraction is scheduled for w/e 17th Aug.

As tabled in our teleconference on 09th August, we have also started to construct a 3D ground model, which will be used to present data spatially once the works are complete.

3.0 Key Findings to Date

Refer to Appendix A for Borehole Location Plan and refer to Appendix B for NAPL thickness over time.

Note that the amount of data being collected throughout the project is huge and is currently in the process of being formatted and assessed. However, as indicated in Section 2.0 of this letter report, we have obtained sufficient data to allow us to target boreholes such that we can maximise 'contaminant mass reduction'.

The key findings to date can be summarised as:

- Reduction of NAPL within boreholes showing greatest thickness notably BH36, and C2;

- Irregular and in some cases high levels (thickness) of NAPL within specific boreholes across the remediation grid, notably A5 and B5. It is currently hypothesised that the 'irregular' occurrence of NAPL across the grid is due to the nature of the chalk matrix itself, which can 'hold' contamination within both fissures and fractures. It is feasible that the remediation effort is contributing to the mobilisation of the NAPL within the remediation grid as a direct response to the pumping and abstraction regime;
- Whilst a reduction in NAPL can be observed in specific boreholes, the amount of NAPL collected in the primary separator is low;
- Significant dissolved phase concentrations across the remediation grid, showing a general downward trend in concentrations in the direction of flow of groundwater;
- Significant dissolved phase concentrations present within borehole Z5 on the northern / outer edge of the remediation grid;
- No recent rebound of NAPL thickness to date in BH36 and C2 following abstraction;
- Reduction in NAPL thickness throughout A5 and B5 following abstraction with no recent rebound;
- Low but consistent presence of NAPL within BH01-17. Note that the narrower installation within BH01-17 has prevented direct pumping of this location, but that adjacent boreholes are being targeted as an alternative;
- Low pumping yield / abstraction from boreholes resulting in 2-3m drawdown throughout the operational period. Whilst we have worked to maximise the efficiency of abstraction through low but consistent pumping rates – the drawdown observed accords with the fact that the groundwater below the target area is low yielding. Note we are currently assessing the groundwater level data to substantiate the above.

In addition, given the reducing water levels experienced within the past month, it is feasible that the groundwater does not currently coincide with the level of contamination within the chalk. It remains a key risk that once groundwater levels begin to rise as we approach the Autumn period, this may potentially mobilise NAPL currently sat above the water table.

4.0 Justification for Additional Operational Period

The results to date indicate encouraging but inconsistent trends with respect to the presence of NAPL within the target area. An extension of the remedial effort into September would help substantiate the dataset, which will in turn allow a more robust approach to the Environment Agency. This approach should consider the principles set out in SuRF-UK and as required CBA. In addition, the longer the period of operation of the treatment system, the greater the contaminant mass reduction that can be achieved for the given Scope.

JFHR would consider that extending the remedial effort throughout September would substantiate the principles of the SuRF-UK methodology, which considers the Environmental, Commercial and Social impacts of remediation. This would include a remediation approach based on the overall objective of 'betterment'. Whilst JFHR would recommend the extension of works into September, we would remind the project stakeholders of the operational constraints and risks set out in our Scope dated 11th June.

5.0 Associated Costs

The costs associated with the proposed extension are outlined in Appendix C of this letter report.

If you have any further questions, please do not hesitate to contact me.

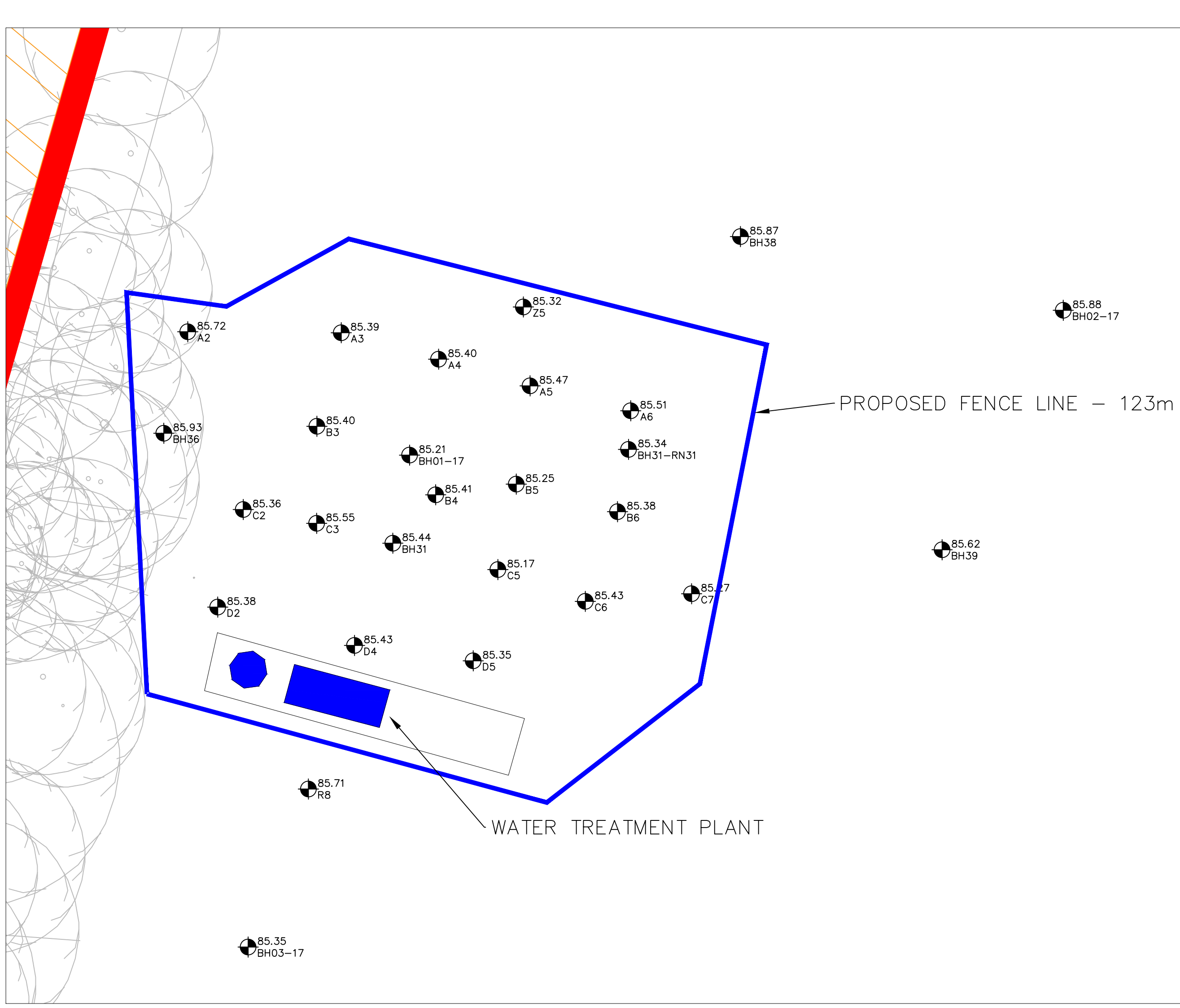
Yours sincerely,
On behalf of John F Hunt Remediation Ltd



Regional Director

Appendix A. Borehole Grid Drawing, **Appendix B.** NAPL thickness over time, **Appendix C.** Costs

Appendix A



Notes :

85.62

BH39

WELL NAME AND COVER ELEVATION

Rev	Date	Details Of Issue	Dwn	Chk

Issues And Revisions

Project :

FORMER POLYCELL SITE

Client :

WHEAT QUARTER LIMITED

Title :

TREATMENT WELL LAYOUT

Scale :	1:20	Drawn :	FL
Size :	A3	Checked :	
Sheet No. :	na	Date :	12/07/2018
Dwg No. :	FLS/REM/WGC002		Revision : A

Status: DRAFT

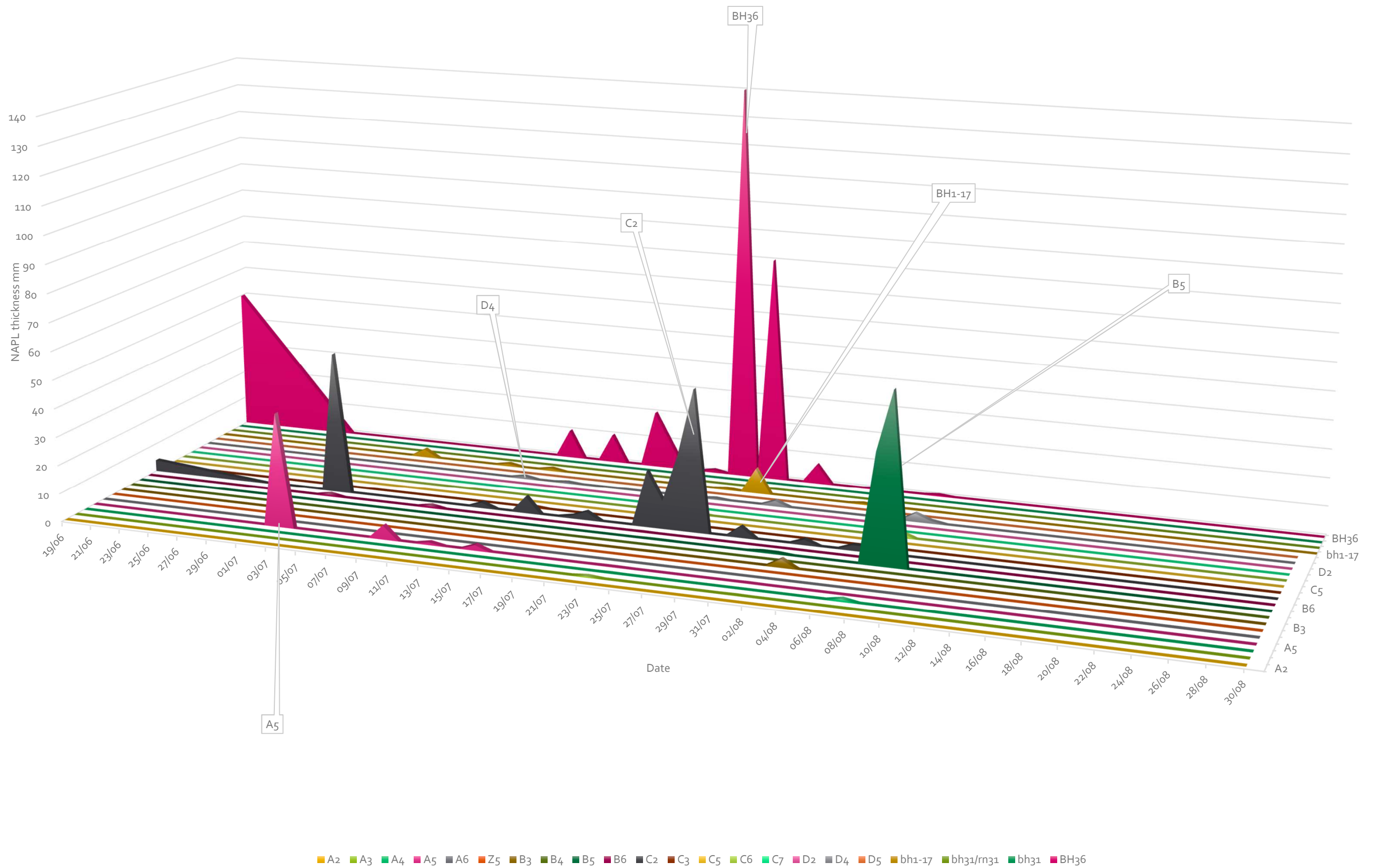
John F Hunt Remediation Limited
London Road,
Grays,
Essex,
RM20 4DB
T: 01375 366700 F: 01375 366800
E: remediation@johnfhunt.co.uk

John F Hunt

REMEDIATION Ltd

Appendix B

NAPL Thickness (mm)



Appendix C

Tender:
Former Shredded Wheat / Polycell
Groundwater Remediation - Proposed Extension. **Two Week**

Client:
Wheat Quarter Limited

Tender Nr:
17090-001

Revision:
A

Date:
15/08/18

Item	Description	Quantity	Unit	Rate	Value
	<u>Remediaiton Works</u>				
1	Mob / Demob of Welfare / Offices and Site Set-Up incl. barriers & fencing.	0	item		£
	Welfare / Offices and Site Set-Up incl. H&S items.	2	weeks		
2	Preliminaries (01/09/18 - 14/09/18) Management and labour for main groundwater remediation works incl: Principal Contractor role (H&S), Management and Support from Project Director & Contracts Manager, Site Manager, Project Manager, Site Engineer and Operatives.	2	weeks		£
3	Pump & Treat System / Hydraulic Containment & Recirculation (limited capacity) Mobilisation of all plant & equipment.	0	item	£	£ -
	Telehandler to facilitate P&T set-up	2	week	£	£
	Set-Up / Commission Water Treatment Plant.	0	item	£	£ -
	Weekly Hire: settlement tanks, oil-water interceptor, sand filters, GAC filters, borehole pumps / hoses, pipework and manifold.	2	week	£	£
	Dispose or regenerate spend GAC incl. replacement. Dispose spent sand.	1	item	£ 1	
4	Environmental Monitoring (MPP) - Remediation Process Environmental monitoring to satisfy requirements of Environmental Permits. Labour included in Item 2). Start of P&T until end of Remediation Block 1. Including but not limited to VOCs, Dust, PM10, Noise.	1	item	£	£
5	Groundwater Monitoring (MPP) - Remediation Process Fortnightly for from start of P&T till end of Remediation Block 1. Approx. 50% of injection grid boreholes plus 5No. wider monitoring boreholes.	1	item	£	
6	Factual Report (works to date) Assumptions Full access to the main source area and wider monitoring boreholes. The charge related to the disposal of water to foul sewer has <u>not been included</u> . This will be charged at £0.80/m3. The charge related to the re-injection of treated water to ground has not been allowed. This will be charged at £1.00/m3.	0	item	£	£
				Tender Sum:	<u>£</u>

Tender: Former Shredded Wheat / Polycell
Groundwater Remediation - Optional PetroCleanze Addition

Tender Nr: 17090-001

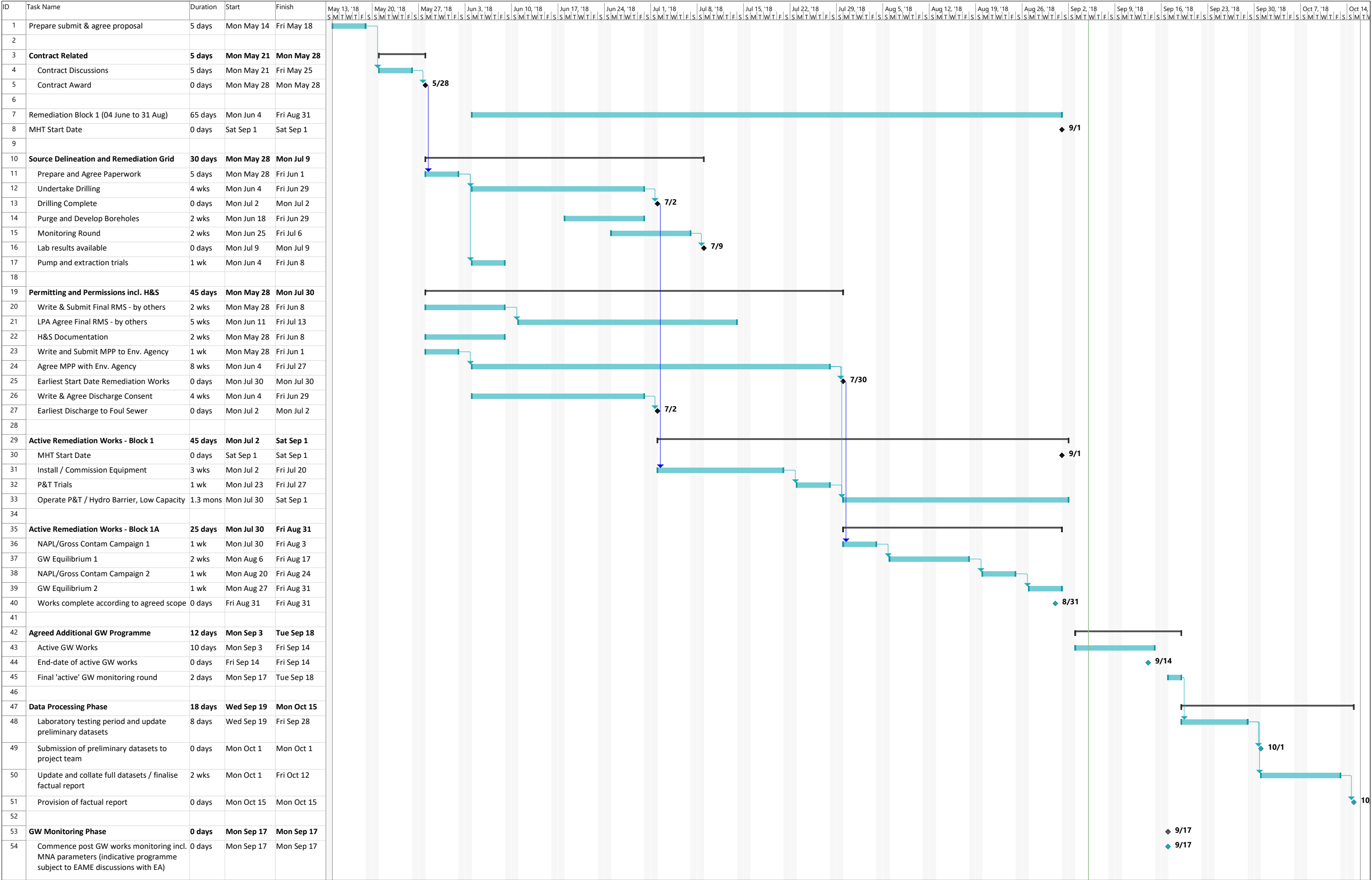
Client: Wheat Quarter Limited

Revision: A

Date: 15/08/18

Item	Description	Quantity	Unit	Rate	Value
1	NAPL / Gross Source Removal				
	Mobilisation of all injection plant and equipment.	0	item	£	£ -
	Telehandler to move reagents from COSHH store to remediation areas.	0	weeks	£ -	
	Provision of pressurised injection infrastructure incl. (but not limited to) pipework, manifolds, pumps, fittings, mixing vessels and bunds etc.	1	item	£	£
	Provision of chemical reagents to immobilise NAPL / gross contamination prior to removal by P&T (Item 2). <u>Assumes 2No. campaigns.</u>	1	item	£	

Tender Sum: £



Project: Shredded Wheat Progr
Date: Wed Sep 5

Task

Split

Milestone

.....

◆

Summary

Project Summary

Inactive Task

Inactive Milestone

Inactive Summary

Manual Task

Duration-only

Manual Summary Rollup

Manual Summary

Start-only

Finish-only

External Tasks

External Milestone

Deadline

Progress

Manual Progress

11 June 2018

REF: 17090/SH/April18/003

Harborough Innovation Centre
Airfield Business Park
Wellington Way
Leicester Road
Market Harborough
LE16 7WB

██████████
Wheat Quarter Limited
7 St. Johns Rd
Harrow
Middlesex
HA1 2EY

01858 414333

By email: ██████████

Dear ██████████

RE: Remediation Approach and Price for Groundwater Remediation at the Former Polycell Factory, Broadwater Rd, Welwyn Garden City

Further to recent discussions between project stakeholders, this letter sets out the scope of works to be undertaken at the former Polycell Factory, Welwyn Garden City.

The following points were discussed and agreed during our teleconference on 24 May 2018, and provided the basis of your instruction to proceed with the works:

- 1) You have advised that no active groundwater treatment works can be undertaken post 01 Sept 2018;
- 2) You have advised that ongoing monitoring and the final decommissioning of the remediation boreholes can continue post 01 Sept 2018;
- 3) JFHR accept no design and verification responsibility for the groundwater remediation works;
- 4) All discussions and agreements with the regulators prior to, during and post groundwater treatment will remain with EAME. This includes relevant pre-commencement planning conditions, and final remediation verification and planning sign-off;
- 5) JFHR will provide factual information relating to the efficiency of the remediation system. This will include;
 - Volume of groundwater abstracted and discharged;
 - List of active abstraction boreholes;
 - Baseline information relating to concentration of Contaminants of Concern and key MNA information;
 - Influent concentration to the Pump & Treat (P&T) system and effluent concentration prior to discharge to foul sewer;
 - If applied, information relating to the use of proprietary chemicals to mobilise the entrapped contamination into the groundwater prior to subsequent abstraction and treatment;
- 6) We are providing a price to install a grid of monitoring, abstraction and remediation boreholes within the main source area. We are providing a borehole grid on an approximate 30m x 12m @ 6m spacing, this being based solely on the information provided by EAME. This amounts to a maximum of 17No. additional boreholes to a maximum depth of 28m. Borehole positions may be altered based on the ground conditions encountered;
- 7) Once installed, we have allowed to install and commission a P&T remediation system to allow the treatment of abstracted groundwater prior to the discharge to foul sewer;
- 8) We are limited to abstract a maximum of 20m³ / day. This may be further constrained by the volume that can be agreed with Thames Water to allow discharge to foul sewer;
- 9) Any changes to the volumes that can be abstracted and discharged over and above that detailed in Item 8) will be subject to additional Environmental Permits. The application and agreement of these additional Environmental Permits are not possible to obtain within the stipulated time frame;
- 10) The operational time allocated for the operation of the P&T system prior to 01 Sept will be driven by the agreement date with the Environment Agency (EA) for the deployment of the

Mobile Plant Permit (MPP). We have indicated a time of 8-weeks upon submission to the MPP to the EA for agreement – this is based on our current understanding of workload within the EA permitting office. JFHR are not responsible for the MPP agreement date. The agreement date will determine how long the P&T system can be operated prior to 01 Sept;

- 11) We have allowed for a maximum of two applications of a proprietary chemical designed to help mobilise the gross contamination into the groundwater, such that it can be subsequently abstracted for treatment. Depending on how the groundwater reacts to the first application, will determine whether the second application is feasible prior to 01 Sept 2018. Volume and concentration of the proprietary chemical applied will be low due to the time constraints. Applying too much of this chemical will risk mobilising the plume;
- 12) We have not allowed for any further chemical treatment to the groundwater over and above Item 11);
- 13) We have allowed for monitoring of the groundwater for up to 1-year post 01 Sept 2018, including rebound monitoring. We are not responsible for subsequent groundwater remediation (P&T) post 01 Sept 2018 including any rebound;
- 14) We have not included for a Demolition Manager or associated attendances within these costings and if required then we would forward the associated costs.

Our costs undertake the works are included in Appendix A. Our programme to undertake the works is included in Appendix B.

It was discussed during our teleconference on 24 May 2018 that additional boreholes may be excavated on site to investigate and satisfy the comments presented by the Environment Agency in their letter dated 23 May 2018 (Ref: NE/2018/128222/04-L01).

Any additional investigation work to satisfy the Environment Agency should be proposed by EAME as part of their role as Environmental Consultant, and is not covered in the current agreed scope. Should these additional works be carried forward, John F Hunt Remediation (JFHR) will submit a price to undertake the drilling works based on the EAME proposal.

It was also discussed during our teleconference on 24 May 2018 that the programme end date (01 Sept 2018) could be extended. JFHR would reiterate that the longer the P&T system can operate, the more evidence can be collected to support the principle of 'betterment'. Should it be feasible that the programme end date can be extended, JFHR would submit a price for the continued operation of the P&T system including if applicable the application of additional proprietary chemicals.

Yours sincerely,
On behalf of John F Hunt Remediation Ltd



Regional Director

Appendix A. RevF Price dated 11 June 2018
Appendix B. Programme Rev4

Appendix A

Programme Item	Description		Start	Finish	Duration	Week Commencing																									
						Monday, May 14, 2018	5/21/2018	5/28/2018	6/4/2018	6/11/2018	6/18/2018	6/25/2018	7/2/2018	7/9/2018	7/16/2018	7/23/2018	7/30/2018	8/6/2018	8/13/2018	8/20/2018	8/27/2018	9/3/2018	September 2018	December 2018	March 2019	June 2019	September 2019	October 2019			
11	Health & Safety Documentation		Monday, May 28, 2018	Friday, June 1, 2018	1																										
17	Pump and Extraction Trials		Monday, June 4, 2018	Friday, June 8, 2018	1																										
23	Write & Submit MPP		Monday, May 28, 2018	Friday, June 1, 2018	1																										
26	Consent for Discharge to Sewer		Monday, June 4, 2018	Saturday, June 9, 2018	1																										
12	Mobilisation of Sonic Drilling Rig & Equipment for Borehole Injection Grid	E	Monday, June 4, 2018	Saturday, June 9, 2018	1																										
12	Installation of Remediation Borehole Injection Grid	E	Monday, June 4, 2018	Friday, June 29, 2018	5																										
12	Management of the Works		Monday, June 4, 2018	Friday, June 29, 2018	5																										
14	Site Based Staff for Remediation Borehole Injection Grid	E	Monday, June 18, 2018	Friday, June 29, 2018	3																										
15	Chemical Testing		Monday, June 25, 2018	Friday, July 6, 2018	3																										
30	Block 1 Remediation Works - Mobilisation	E	Monday, July 2, 2018	Friday, July 6, 2018	1																										
30	Welfare for Block 1 Remediation Works	E	Monday, June 25, 2018	Saturday, September 1, 2018	10																										
33	Management for Block 1 Remediation	E	Monday, June 25, 2018	Saturday, September 1, 2018	10																										
30	Mobilisation for Block 1 Remediation	E	Monday, June 25, 2018	Friday, June 29, 2018	1																										
31	Attendant Plant - Telehandler		Monday, July 2, 2018	Friday, July 27, 2018	4																										
30	Commission WTP		Monday, June 25, 2018	Friday, June 29, 2018	1																										
33	Hire of WTP		Monday, June 25, 2018	Saturday, September 1, 2018	10																										
34	Disposal of GAC		Monday, August 27, 2018	Friday, August 31, 2018	1																										
33	Environmental Monitoring		Monday, July 23, 2018	Friday, August 31, 2018	6																										
32	Groundwater Monitoring		Monday, July 23, 2018	Friday, August 31, 2018	6																										
32	Factual Report - Works to 31st August 2018	E	Monday, September 3, 2018	Friday, September 7, 2018	1																										
35	Mobilisation for Block 1A Remediation	E	Monday, July 23, 2018	Friday, July 27, 2018	1																										
	Attendant Plant - Telehandler		Monday, July 23, 2018	Friday, September 7, 2018	7																										
	Provision of Injection Infrastructure	E	Monday, July 23, 2018	Friday, July 27, 2018	1																										
36	Provision of Chemical Reagents - Campaign 1	E	Monday, July 30, 2018	Friday, August 3, 2018	1																										
	Provision of Chemical Reagents - Campaign 2	E	Monday, August 20, 2018	Friday, August 24, 2018	1																										
	Bi-monthly Groundwater Monitoring		September 2018, December 2018 & March 2019																												
	Quarterly Groundwater Monitoring		June 2019 & September 2019																												
	Factual Groundwater Monitoring Report	E	October 2019																												
	Borehole Decommissioning		September 2019																												
			Weekly Total																												
			Monthly Total																												
			Cumulative Project Total																												

Tender: *Former Shredded Wheat / Polycell
Groundwater Remediation*

Tender Nr: *17090-001*

Client: *Wheat Quarter Limited*

Revision: *F*

Date: 11/06/2018

COLLECTION PAGE

Item	Description				Value
1	Pre-Trials (basic pump and vac-ex)				
2	Pre-Commencement Works				
3	Injection Grid (30m x 12m with approx. 6m grid spacing)				
4	Active GW Remediation (Remediation Block 1 completing 31 Aug 2018)				
6	Groundwater Monitoring				
7	Decommissioning of boreholes				

Tender Sum: £

Item	Description	Quantity	Unit	Rate	Value
	<u>Basic Pump / Vac-Ex Trials</u> Provision of basic groundwater pumping trials and vac-ex trials to inform zone delineation works and remediation parameters Supply of equipment incl. base loading pneumatic pump, air-lines, discharge hoses, rotron air movers, knock-out pots, carbon drum filter, ancillary pipework, compressor.	1	item		£
1	Staff to undertake site works. Incl. as part of injection grid works.			incl.	
2	Management of works / reporting. Incl. as part of injection grid works.			incl.	
3					
	Assumptions Full access to the main source area. No allowance has been made for disposal. Water will be pumped to IBCs for storage until main GW remediaton works.				
Tender Sum:					£

Tender: Former Shredded Wheat / Polycell
Groundwater Remediation**Client:** Wheat Quarter Limited**Tender Nr:** 17090-001**Revision:** F**Date:** 11/06/2018**Pre-Commencement**

Item	Description	Quantity	Unit	Rate	Value
	<u>Pre-Commencement</u>				
1	H&S Documentation: Risk Assessment / Method Statement / COSHH Assessment	1	item		
2	Deployment of Mobile Plant Permit (MPP) to undertake the remediation works	1	item		
3	Apply for consent to discharge to foul sewer	1	item		
	Comments JFHR are not responsible for the time taken for the EA to review / agree the MPP Remediation strategy and verification plan by others				
				Tender Sum:	£

Tender: Former Shredded Wheat / Polycell
Groundwater Remediation

Client: Wheat Quarter Limited

Tender Nr: 17090-001

Revision: F

Date: 11/06/2018

Injection Grid

Item	Description	Quantity	Unit	Rate	Value
	<u>Remediation Borehole Injection Grid</u> Assumes approx. 6m grid pattern and overall area of 30m x 12m (360m ²). 18No. boreholes required in total. Assumes utilisation of existing BH01-17 as a remediation borehole therefore a total of 17No additional boreholes to excavate. Initial 5No. boreholes will be utilised for delineation & remediation (circa 30m depth), with remaining 12No. to circa 28m (remediation only boreholes). Provision of Sonic Drilling Rig to excavate 17No. delineation / remediation boreholes in the source zone area. Estimated depth 28m - 30m. Incl: mobilisation, plant, labour and installations. Includes mobilisation of water tanks for collection of contaminated GW.	1	item		
1	Borehole installations. 17No. boreholes to circa 28m. Assumed installation - 90x75mm HDPE well, 2mm slot, gravel, bentonite (up to 200mm bore), borehole caps, valve assembly, flush covers.	1	item	incl.	incl.
2	Site based staff to cover trials, delineation boreholes, well development and testing incl. Engineer and Operatives.	1	item		
3	Develop wells to allow borehole monitoring.	1	item		
4	Management of the works and technical input (Project Manager, Project Director H&S).	1	item		
5	Welfare unit to cover the drilling works.	1	item		
6	<u>1No. Groundwater Monitoring Round</u> 1No. baseline groundwater monitoring round. Samples taken from the delineation / remediation borehole grid (required to determine reagent concentrations / flow rates), in addition to selected EAME and historic boreholes. Max. 28No. Boreholes incl. Provision of Environmental Engineer and Operative for sampling works.	1	item	incl.	incl.
7	Undertaking of chemical tests incl. TPHCWG, target SVOCs, target VOC and key MNA parameters.	1	item		
8	Assumptions Full access to the main source area and wider monitoring boreholes. Demo contractor will not be on site, therefore provision of self-contained unit included. No disposal of water from drilling works has been allowed. It is assumed that this will be stored in tanks until the main remediation works. Assumes Remediation Eng. / Op. can act as Site Manager.				

Tender Sum: £

Tender: Former Shredded Wheat / Polycell
Groundwater Remediation

Client: Wheat Quarter Limited

Tender Nr: 17090-001

Revision: F

Date: 11/06/2018

Active Groundwater Remediation

Item	Description	Quantity	Unit	Rate	Value
1	<u>Block 1 Remediation Works</u> Mob / Demob of Welfare / Offices and Site Set-Up incl. segregation barriers & fencing as required. Welfare / Offices and Site Set-Up incl. H&S items.	1 10	item weeks		
2	Block 1 - Preliminaries (02/07/18 - 31/08/18) Management and labour for main groundwater remediation works incl: Principal Contractor role (H&S), Management and Support from Project Director & Contracts Manager, Site Manager, Project Manager, Site Engineer and Operatives.	10	weeks		
3	Block 1 - Pump & Treat System / Hydraulic Containment & Recirculation (limited capacity) Mobilisation of all plant & equipment. Telehandler to facilitate P&T set-up Set-Up / Commission Water Treatment Plant. Weekly Hire: settlement tanks, oil-water interceptor, sand filters, GAC filters, borehole pumps / hoses, pipework and manifold. Dispose or regenerate spend GAC incl. replacement. Dispose spent sand.	1 4 1 10 1	item week item week item		
4	Environmental Monitoring (MPP) - Remediation Process Environmental monitoring to satisfy requirements of Environmental Permits. Labour included in Item 2). Start of P&T until end of Remediation Block 1. Including but not limited to VOCs, Dust, PM10, Noise.	1	item		
5	Groundwater Monitoring (MPP) - Remediation Process Fortnightly from start of P&T till end of Remediation Block 1. Approx. 50% of injection grid boreholes plus 5No. wider monitoring boreholes.	4	item		
6	Factual Report (works to date) Assumptions Full access to the main source area and wider monitoring boreholes. The charge related to the disposal of water to foul sewer has <u>not been included</u> . This will be charged at £0.80/m3. The charge related to the re-injection of treated water to ground has not been allowed. This will be charged at £1.00/m3.	1	item		

Tender Sum: £

Tender:
Former Shredded Wheat / Polycell Groundwater Remediation

Client:
Wheat Quarter Limited

Tender Nr:
17090-001

Revision:
F

Date: 11/06/2018

Active Groundwater Remediation

Item	Description	Quantity	Unit	Rate	Value
1	Block 1 - NAPL / Gross Source Removal				
	Mobilisation of all injection plant and equipment.	1	item		
	Telehandler to move reagents from COSHH store to remediation areas.	8	weeks		
	Provision of pressurised injection infrastructure incl. (but not limited to) pipework, manifolds, pumps, fittings, mixing vessels and bunds etc.	1	item		
	Provision of chemical reagents to immobilise NAPL / gross contamination prior to removal by P&T (Item 2). <u>Assumes 2No. campaigns.</u>	1	item		
Tender Sum: £					

Tender: *Former Shredded Wheat / Polycell
Groundwater Remediation*

Tender Nr: 17090-001

Date: 11/06/2018

Monitoring

Client: *Wheat Quarter Limited*

Revision: *F*

Item	Description	Quantity	Unit	Rate	Value
1	Groundwater Monitoring trends / potential rebound. Assumes 9-months post remediation GW monitoring.				
	A Bi-monthly until 6-months. Approx. 50% of injection grid boreholes plus 5No. wider monitoring boreholes.	3	item		
	B Quarterly until 12-months. Approx. 50% of injection grid boreholes plus 5No. wider monitoring boreholes.	2	item		
2	Factual Groundwater Monitoring Report	1	item		
	Assumptions Full access to identified monitoring boreholes. Agreement will need to be made as to end of active remediaiton monitoring and commencement of MNA. JFHR are not responsible for MNA monitoring incl. sign-off.				

Tender Sum: £

Tender: *Former Shredded Wheat / Polycell
Groundwater Remediation*

Tender Nr: 17090-001

Client: *Wheat Quarter Limited*

Revision: *F*

Date: 11/06/2018

Decommissioning

Item	Description	Quantity	Unit	Rate	Value
	<u>Decommissioning of Boreholes</u>				
	Mobilisation of plant & equipment	1	item		
	Provision of plant, equipment and labour to decommission boreholes installed as part of the remediation works.	18	item		
	Assumptions				
	Full access to remediation boreholes within source area.				
	No allowance has been made to decommission the wider historic / monitoring boreholes.				

Tender Sum: £

Appendix B

