

GROUND INVESTIGATION

NO 3840/17

LAND ADJACENT TO THE MAYFIELD AREA

THE HENLEY ROAD CEMETERY

CAVERSHAM BERKSHIRE

FOR

PROPOSED CEMETERY EXTENSION

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1 INTRODUCTION

- 1.1 This investigation was commissioned by Reading Borough Council, to assess the suitability for further burials of a triangular section of open land adjacent to the Mayfield area of the existing Henley Road Cemetery.
- 1.2 The Contamination Assessments have been carried out with reference to Environment Agency guidance on Assessing the Groundwater Pollution Potential of Cemetery Developments (2004), Environment Agency Groundwater Protection Guidance for Cemeteries (March 2017) as well as the Code of Practice for Site Investigations BS5930.

2 SITE DETAILS

Site Location

- 2.1 This site is located about 2.7km north east of central Reading on the northern side of the River Thames. The site centre is located at grid reference 47440E 175620N. The post code reference for the cemetery is RG4 5LP.

Brief Description

- 2.2 The area under consideration is approximately 10045m² and is a triangular shaped, section of land on the south-western boundary of the Henley Road Cemetery (aka Reading Cemetery) lying directly south of the newer Mayfield section of the cemetery and its car park.
- 2.3 At the time of our investigation the site was an open area of cut grass used by locals for dog walking.

3 REQUIRED GROUND CONDITIONS FOR BURIALS

- 3.1 The issues around the suitability of the ground for new burials is discussed in the Environment Agency guidance documents - Assessing the Groundwater Pollution Potential of Cemetery Developments (2004).
- 3.2 Previous guidance titled *GP3 - Groundwater Protection: Principles and practice (version 1.1 August 2013)* was withdrawn in 14 March 2017 and replaced by new Environment Agency guidance titled - *Groundwater Protection & Water Quality 14 March 2017*. (<https://www.gov.uk/government/collections/groundwater-protection>).

Contaminants of Concern

- 3.3 Decomposition of corpses in graves liberates various compounds which pose a risk to groundwater and drinking supplies. These range from embalming fluids containing chemicals such as Formalin and compounds associated with the decay of the cadaver such as Nitrates and Phosphates together with a collection of compounds liberated at trace levels such as metals, hydrocarbons (mostly Squalene from skin and hair) and lipids and fatty acids from fat in the cadaver.

- 3.4 The Environment Agency guidance suggests that the primary process governing the production, release and potential migration of pollutants from a buried corpse is microbial decay. Research has shown that within 10 years most of Nitrates and Ammonia have degraded to below detection limits.
- 3.5 Toxic metals absorbed by the body such as Cadmium and Lead would slowly leach out of the grave however, with respect to the protection of groundwater, the expected concentrations are not generally present at high enough concentrations to affect groundwater, even if an individual had had died from heavy metal poisoning.
- 3.6 Traditional burials required the corpse to be placed at such a depth where foraging animal will not be attracted to the grave. This was generally accepted as being six feet deep (1.828m). The other main requirement is that the grave contains any microbial activity so that levels fall well before the water reaches any water supplies. Many spring systems and shallow wells are therefore more vulnerable to microbial pollution problems than deep wells or boreholes.
- 3.7 On this basis guidance suggests that burials in waterlogged ground should not be carried out since this will slow the decay process and possibly lead to Methane and Hydrogen Sulphide generation. Generally, a large unsaturated zone above groundwater level is preferable since significant attenuation of the grave contaminants occurs in these soils.
- 3.8 In accordance with the EA guidance (Cemeteries and Burials; Prevent Groundwater Pollution March 2017), all cemetery burials should be at least 250 metres from any well, borehole or spring supplying water for human consumption or used in food production at least 30 metres from any spring or watercourse not used for human consumption or not used in food production and at least 10 metres from any field drain, including dry ditches.

- 3.9 Additional requirements state that all graves must have at least 1 metre clearance between the base of the grave and the top of the water table – they shouldn't have any standing water in them when dug. They should not be dug in bedrock or areas susceptible to groundwater flooding and be deep enough so at least 1 metre of soil will cover the top of the coffin or body.
- 3.10 The Environment Agency considers sites with the potential for 100 burials a year or more, to be a high risk to groundwater.

Assessment Methodology

- 3.11 New cemeteries and extensions must comply with minimum groundwater protection requirements (EA 2017). The first stage (Tier 1) is to define the geological, hydrological, hydrogeological and topographic scene, as well as the current and historic land use to ensure that the criteria discussed above have been met.
- 3.12 Where higher risks are determined at Tier 1 stage, a Tier 2 assessment will be required which considers simple pollutant flux and water balance calculations, such as dilution at the water table. This may lead on to a tier 3 assessment which considers the possible use of more sophisticated models to assess attenuation and the results of off-site monitoring.
- 3.13 On this basis, we have carried a desk study investigation of the area which has allowed a Tier 1 assessment to be carried out. Although this site is not expected to exceed 100 burials in any one year (31 per year are planned), we have proceeded to determine the underlying geology using boreholes and trial pits, we have monitored and recovered water samples from well pipes installed in those boreholes and carried out permeability tests at expected burial depths in trial graves.

4 DESK STUDY

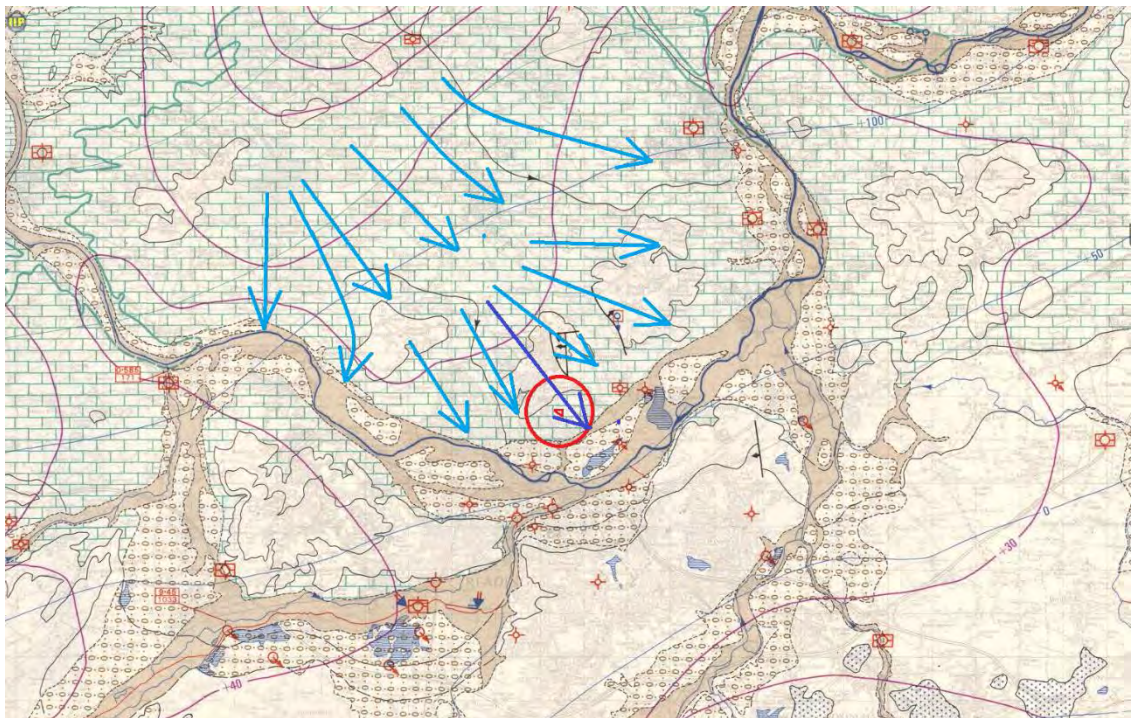
Published Geology

- 4.1 The British Geological Survey Map, Sheet Number 268, shows the site to be underlain by the Lynch Hill Gravel Member (River Terrace Deposit). These sands and gravels were deposited during extreme flood events associated with the Ice Ages and often the extents of the terrace that were furthest from the river, were subject to overbank floods and the deposition of significant amounts of clay and silt.
- 4.2 Below these superficial deposits lies the Upper Chalk Group comprising the Seaford and Newhaven Chalk Formations (the mapping does not differentiate between the two). Borehole data from the BGS shows that deep boreholes in the area encountered chalk with flints to at least 80m below ground level. This shows that the Middle Chalk is at least 80m below ground level in this area.
- 4.3 Exposures of the Lambeth Group deposits are shown to the north of the site, capped by the Black Park Gravel Formation. To the south of the site the maps show the Lynch Hill Gravel Member at exposure.

Published Hydrogeology

- 4.4 The Environment Agency Groundwater Maps (<http://maps.environment-agency.gov.uk>) which have replaced the old Groundwater Vulnerability mapping show the site to be underlain by 'bedrock' deposits (Upper Chalk Group) which are designated as a Principal Aquifer. The superficial Lynch Hill Gravel deposits are part of a wider secondary aquifer.

- 4.5 1 to 100,000 Institute of Geological Sciences Hydrogeological mapping for South West Chilterns and the Berkshire and Marlborough Downs shows the groundwater within the Chalk to be expected at a level of between 30m and 40m AOD.
- 4.6 Given that the site lies at approximately 58m AOD implies that groundwater lies between 20m and 30m below ground level at the site location. Interpolating between contours and noting that groundwater levels equal the water levels in the nearby River Thames we suspect that the groundwater level in the Chalk below the site is at a level of about 28m below ground level.



Above, an extract of the 1 to 100,000 Institute of Geological Sciences Hydrogeological mapping for South West Chilterns and the Berkshire and Marlborough Downs.

- 4.7 The direction of the contours (in purple above) indicates that the movement of the groundwater in the Upper Chalk is south eastward, as shown by the inferred blue arrows.
- 4.8 We would expect any water perched on clayey horizons within the Lynch Hill Gravel to also be moving south east, given the topography.

- 4.9 The level of the groundwater in the Upper Chalk is shown to be at the same as the River Thames. This shows that the Chalk probably adds basal flow to the river (i.e. not surface water drainage). The contours also show that aquifer groundwater to the south of the river flows northward towards the River Thames. The River Thames therefore marks the lowest point of the Phreatic table where groundwater issues and joins the surface water system. Any contamination of the groundwater would affect the wider aquifer and environments downstream along the River Thames.

Topography and Hydrology



Above a copy of the 1 to 50,000 scale map rendered according to the height data given on these maps. (Note the vertical scale is greatly exaggerated and makes Reading look like somewhere in the Alps. This is simply to allow the topography to be visualised)

- 4.10 The site lies on the northern side of the Thames Valley with ground levels falling gently to the southeast and the River Thames. The higher levels of this slope lie to the north and are shown to be slightly steeper. The area on which the site lies corresponds with a river terrace flanking the northern side of the river.
- 4.11 To the south of the site, at a level some 19m lower than the terrace on which the site lies, is the floodplain of the River Thames.

Migration of Surface Water and Groundwater

- 4.12 We would expect the capping of Lambeth Group deposits to the north of the site to be largely impermeable sands and clays. Surface water would be expected to run off these deposits and enter the ground at the boundary of clayey and gravel deposits. From there we would expect waters to then percolate downward into the underlying Chalk and assuming the geological mapping is correct into the superficial deposits, which are present.
- 4.13 If any superficial deposits are present which contain clayey layers (typical for terrace gravel deposits flanking the River Thames) we would expect some shallow groundwater to be present and moving downhill towards the River Thames.



Above an extract of the 1 in 10,000 scale Ordnance Survey maps for the area

- 4.14 Mapping shows the site area to lie just to the north east of a residential area which borders the wider cemetery area. The only drainage systems present are associated with the hardstanding lying directly to the north of the site. No remnant field ditches were noted on our initial walkover survey.

4.15 We have also noted the allotments on the north-western side of the proposed new cemetery area which were seen to be active at the time of our investigations. The wider area to the north west of the site (seen to be the catchment area for groundwater and surface waters flowing south east to the River Thames), was seen to be mostly residential.

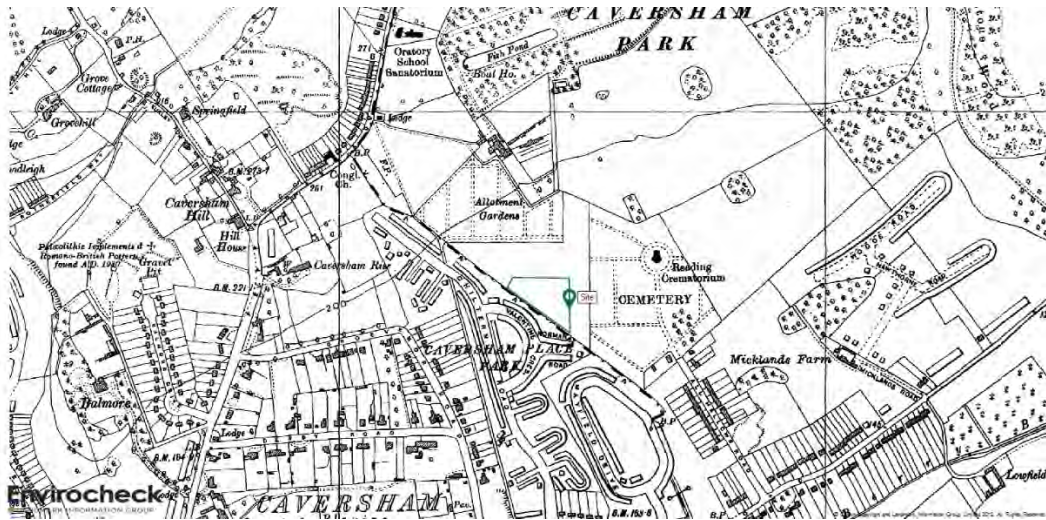
Historic Records



1878-81



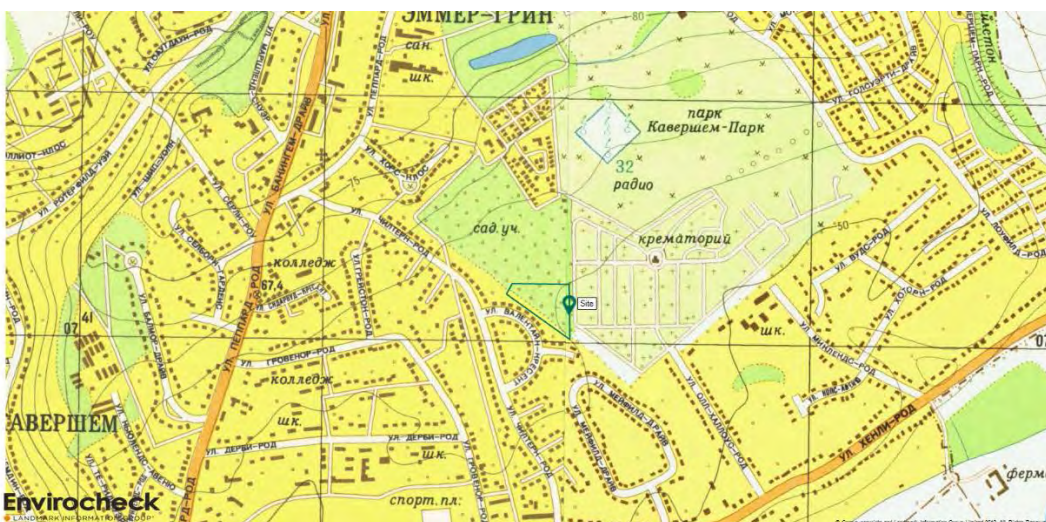
1913



1938



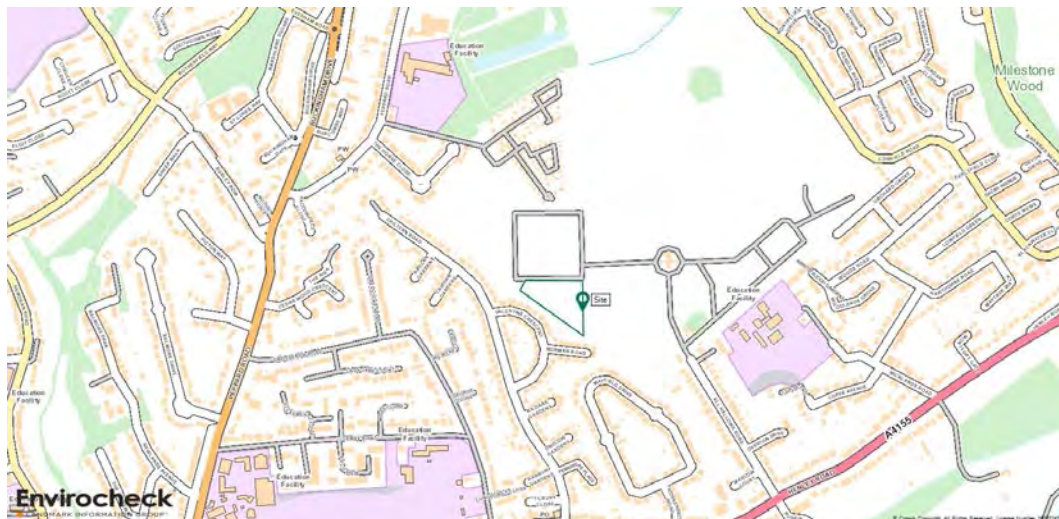
1964-75



1990



1999

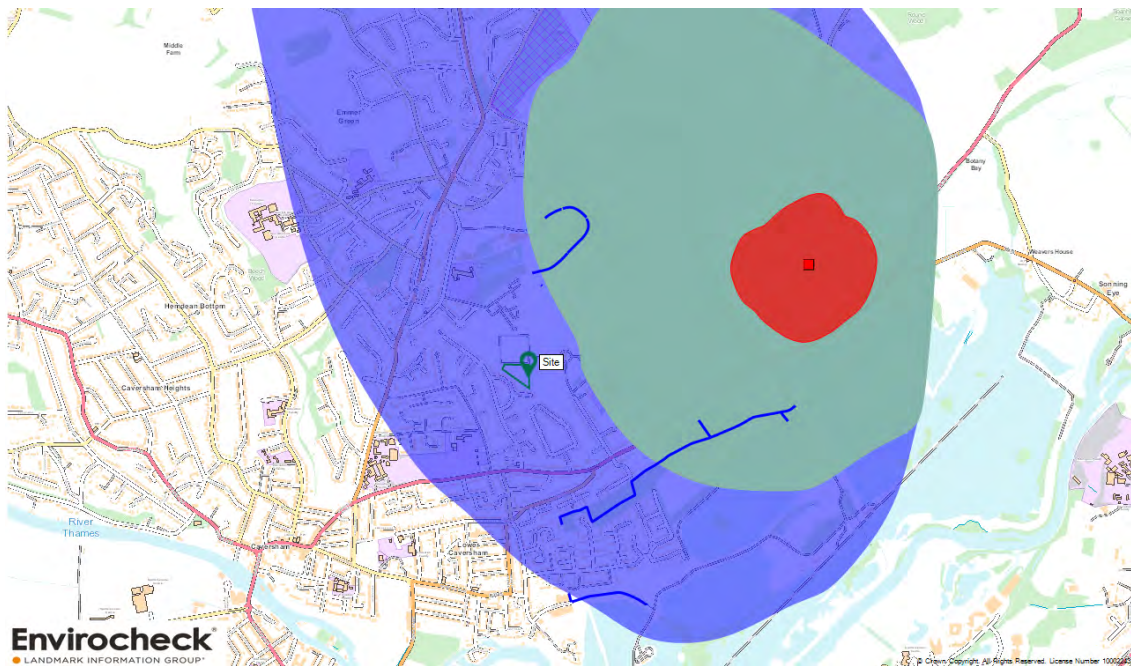


2017

4.16 The historic maps show that this area was formerly a park to a large country house (Caversham Park House) since at least 1882. Looking further back records show that Walter Giffard, a distant relative of William the Conqueror, was given the estate after the 1066 Conquest. Mapping and other historical sources of information do not indicate that this land was ever excavated or used in any industrial activities which would preclude disturbing the ground in that area.

4.17 The mapping also shows that the site did not historically contain any water courses or flood channels which are still active or channels which have been infilled.

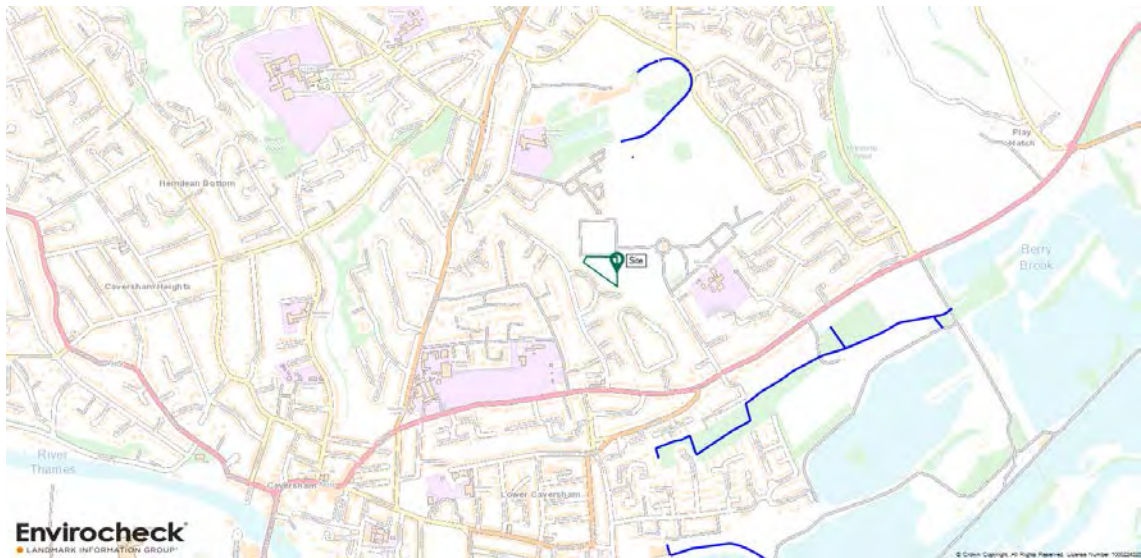
Water Abstractions



Above, a map showing the source protection zones around the abstraction at Play Hatch

- 4.18 The site is indicated by the database information to overlie a principal or major aquifer and the nearest abstractions for direct public potable water supply was at Play Hatch over 1.8km to the east of the site.
- 4.19 This was a Thames Water Utilities Ltd direct public potable water supply being drawn from the Upper Chalk. The site was seen to lie within the Zone III protection area around this abstraction.
- 4.20 The protection areas around the abstraction were skewed toward the expected groundwater flow direction in the Chalk Aquifer showing that the areas to the north west of the abstraction posed the most risk to the water supply.
- 4.21 This suggests that the new cemetery area could affect the groundwater being abstracted at Play Hatch, if the Chalk is at the surface over the site area with no superficial soils present.

Watercourses (Controlled Waters)

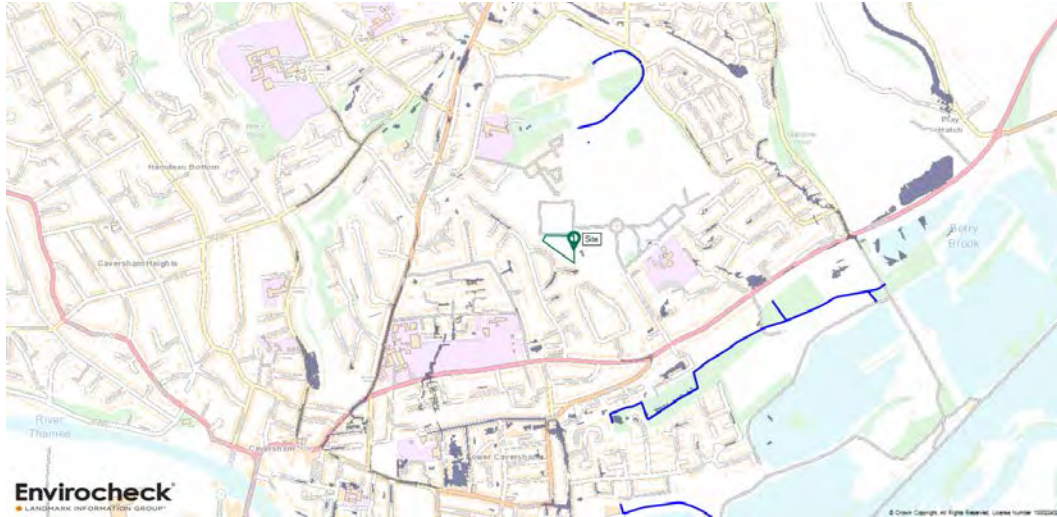


Above, a map showing water network lines

- 4.22 This area is generally developed and old streams tend to be covered in culverts and drains below the houses and roads however, historic maps show few such drains apart from the Berry Brook lying to the south of the site. The 1878-81 1 in 2500 scale map shows this brook and indicates that the water course flows towards to north east.
- 4.23 Modern maps show the extent of what remains of this stream as a boundary ditch. The north-eastern extent of the stream, as shown on the 1878-81 map, has been cut off by large gravel pits (Caversham Lakes).
- 4.24 We can see from modern maps that the brook now partly drains to these lakes (or accepts water from these lakes) via points just beyond a bridge on the access road to Caversham Lakes before carrying on north east, on the northern side of the River Thames flood plain. Eventually the Berry Brook feeds various wetland areas to the south east of Shiplake which then join the River Thames at Shiplake.
- 4.25 We can see that shallow groundwater and surface water from the cemetery would flow south to south eastward and normally be intercepted by the many road drains to the south of the cemetery. These drains would be expected to be linked to the Berry Brook.

4.26 Given that this brook appears to be providing drainage to roads and residential areas and regardless of the wider effects of the cemetery, we would suspect that the water is of low quality.

Flooding



Above, the 1 in 30-year re-occurrence flood map



Above, the 1 in 1000-year re-occurrence flood map

4.27 The flood maps above are generated using data from the Environment Agency and shows that the proposed new section of cemetery is not considered liable to floods.

Sensitive Land Use

- 4.28 The closest nature reserve called Clayfield Copse was noted 1.2km north of the site. This copse lies uphill from the site on the impermeable exposure of the Lambeth Group and we would not expect the new cemetery to pose any risks to this nature reserve.
- 4.29 The site was not shown to lie near to, or within, any Sites of Special Scientific Interest (SSSI), Special Protection Areas (SPA) or Areas of Outstanding Natural Beauty (AONB).
- 4.30 In accordance with the EC Nitrates Directive DEFRA has designated this area as a Nitrate Vulnerable Zone (NVZ). These locations are where the threat of Nitrate rich runoff into rivers and watercourses is most acute. Farms and other activities may be subject to a Statutory Management Requirement to control Nitrate runoff in these areas.

5 TIER 1 QUALITATIVE ASSESSMENT

Abstractions for Potable Public Supply

- 5.1 All cemetery burials should be at least 250 metres from any well, borehole or spring supplying water for human consumption or used in food production (EA March 2017).
- 5.2 Our investigations have shown that the closest abstraction for potable supply lies 1.8km to the east of the site at Play Hatch in Sonning. We would note that the suspected flow direction for groundwater below the cemetery is not toward this abstraction.

Watercourses

- 5.3 Environment Agency guidance (March 2017) states that new cemeteries should lie at least 30 metres from any spring or watercourse not used for human consumption or not used in food production and at least 10 metres from any field drain, including dry ditches.

- 5.4 The mapping shows that the closest watercourse downhill from the cemetery was the Berry Brook which lies 630m to the south of the proposed new cemetery area. No field drains or ditches were noted crossing or 10m away from the proposed site. The only drainage was the network of surface water drains in the residential area to the south west. Groundwater from below grave depth would not be expected to enter these drains

Depth to Groundwater

- 5.5 Additional requirements set out in the Environment Agency guidance (March 2017) states that all graves must have at least 1 metre clearance between the base of the grave and the top of the water table – they shouldn't have any standing water in them when dug.
- 5.6 The Hydrogeological data shows that groundwater should be at least 20m below the ground below the site (this is later confirmed by 3 deep boreholes). Groundwater is not expected to lie within the depth of the grave excavations (later confirmed by excavation of trial graves).

Geology

- 5.7 Environment Agency guidance (March 2017) states that graves should not be dug in bedrock. Bedrocks are often fractured and these fractures are significant conduits for water and any contaminants present. In particular, microbial contamination is less of a problem for fine soils which act like a filter. Bedrock fractures however, provide little of this filtering action. The bedrock of most concern in this area is the Upper Chalk whose water is abstracted for potable public supply.

- 5.8 The expected geology in this area includes a significant thickness of superficial clays and gravels above the Chalk bed rock. (this is later confirmed by 3 deep boreholes) The permeability of these superficial deposits is expected to be minimal.

Flood Risk

- 5.9 Environment Agency guidance (March 2017) states that graves should not be dug in areas susceptible to groundwater flooding.
- 5.10 Environment Agency flood data shows that the proposed area is not susceptible to even the most extreme floods (i.e. 1 in 1000 year events).

Proposed Burial Rates

- 5.11 The expected interment rate for this new area is 31 per year with a total of 165 to be achieved by 2029. This rate of burial does not qualify this proposed cemetery as posing a high risk to groundwater.

6 GROUND INVESTIGATION

Scope of Works

- 6.1 Three light cable percussive boreholes (also known as shell and auger boreholes) were drilled at locations shown on the attached plans, this drilling method uses a large (6m high) tripod rig which lifts and drops heavy cutting tools, samplers and bailers to advance the borehole.
- 6.2 Drilling can be carried out within steel casing tubes which prevent the sides of the borehole collapsing. The rigs are able to penetrate waterlogged granular soils and clays ranging from soft alluvium to hard clays and mudstones.

- 6.3 Undisturbed samples can be recovered and insitu Standard Penetration Tests (SPT) can be carried out. This drilling method can be modified to prevent boreholes allowing contaminated surface soils or groundwater to enter sensitive deposits such as chalk aquifers (double casing).
- 6.4 Well pipes were installed into each borehole comprising slotted pipe surrounded by flint pea shingle. The upper 1m of the pipe was solid unslotted pipe, the gap between the pipe and the clayey sides of the borehole were filled with a sealing clay (bentonite). This ensured that surface water would not enter the borehole. The top of the well pipe was then finished with a cast iron cover to protect the borehole well but also to allow access.
- 6.5 Three trial pits which could be described as trial graves were excavated at locations shown on the attached site plan. The trial pits were progressed by stripping thin layers to form a short trench of approximately the same proportions and depth as a proposed grave. The trial pits were left open for a short period to allow any groundwater response to be monitored.
- 6.6 Soakage tests were then carried out in the trial pits using the BRE365 methodology using water from a large lorry mounted bowser. After a suitable measuring datum was established the pits were filled rapidly from the bowser. Once filled to about 1.0m below ground level, the falling water level was measured with respect to elapsed time.

Ground Conditions

- 6.7 The boreholes showed that the site was underlain by a series of superficial deposits consistent with River Terrace deposits which directly overlie the Upper Chalk Formation which lies at a depth of about 5.0m below the site.

- 6.8 The trial pits all encountered a brown silty clay. In TP1 this was to the full depth of the trial pit at 1.8m (grave depth). In TP2 the brown clay became gravelly at a depth of 1.8m and in Trial Pit TP3 the clay started to show signs of gravel at a depth of 1.6m. The bases of Trial Pits TP2 and TP3 were however, predominantly clayey.
- 6.9 Borehole BH1 encountered a series of brown silty clays to a depth of 5.2m. The clays sandwiched a layer of brown clayey gravel from 3.4m depth to 4.6m depth. In borehole BH2, the depth of the superficial deposits was 3.9m and comprised a layer of brown silty clay to 1.7m overlying brown and paler yellow brown clayey gravels, resting on the top of the Chalk at 3.9m. Borehole BH3 revealed the thinnest layer of the brown silty clay which extended to a depth of 1.6m. Below that lay horizons of clayey gravel to a depth of 5.4m where the Chalk was met.
- 6.10 All three boreholes then penetrated unstructured chalk to depths of 17m below ground level. This material comprised chalk gravel in dominant matrix of chalk fines. Beyond that depth some evidence of structure was noted.

Groundwater

- 6.11 None of the boreholes encountered any water perched above or within the Lynch Hill Gravel deposit which was seen to include horizons of clay. Groundwater was struck in all three boreholes at depths of 19.2m in BH1, 19.5m in BH2 and 19.5m in BH3. Subsequent monitoring from July 2016 until June 2017 showed very little change in this level.

		Drilled	July 2016	January 2017	June 2017
BH1	57.0mAOD	19.2mbgl	19.2mbgl	19.6mbgl	19.5mbgl
BH2	56.7mAOD	19.5mbgl	19.6mbgl	19.7mbgl	19.7mbgl
BH3	56.2mAOD	19.5mbgl	19.6mbgl	19.8mbgl	19.8mbgl

6.12 The water levels in the boreholes tend to confirm the data shown on the Hydrogeological mapping which shows that the overall movement at depth in the Chalk was to the south east and that the depth to ground water was between 20m and 30m.

Permeability Tests

6.13 The permeability tests were carried out in the trial pits which were all excavated to a depth of 1.8m which was the proposed grave depth for this site. Water was then introduced into the pits to a depth of about 1m below ground level. The falling levels were then recorded vs time.

6.14 In order to calculate a percolation or infiltration rate we have favoured the use of BRE365 type calculation which considers the surface area as well as the falling water level and gives a flow velocity measured in metres per second.

6.15 The rate of infiltration was seen to be very slow with the pits showing a slow change in water level over the duration of the tests. In order to calculate an infiltration rate, it was necessary within the calculations to extrapolate the data to give a time when the pits actually emptied. In reality, we were not able to leave the pits open for the extrapolated 54 days required to reach the $\frac{1}{4}$ full level.

6.16 This has determined infiltration rates as follows:

Pit No.	Infiltration rate
TP1	$2.73 \times 10^{-6} \text{m/s}$
TP2	$2.41 \times 10^{-6} \text{m/s}$
TP3	$1.13 \times 10^{-5} \text{m/s}$

6.17 Discounting the slower values, we would recommend that the fastest rate from TP3 ($1.13 \times 10^{-5} \text{m/s}$) should be taken as the worst case and used in the assessments that follow. As discussed, this infiltration rate is based on extrapolated data, to obtain full drainage of the all the pits, we would have needed to leave all three open for a period of at least 54 days.

7 OVERALL PERMEABILITY

- 7.1 The boreholes and trial pits showed that the uppermost layers of soils at this site, seen to a depth of at least 1.6m depth (in Trial Pit TP3). These clays were relatively impermeable and we would expect them to allow little rainwater/surface-water to percolate down into the lower soils. Some porewater movement could be expected resulting in damper layers where the gravel content increases (1.6m in Trial Pit TP3).
- 7.2 Water entering the underlying gravel deposits from excavations, down the sides of nearby foundations and along root paths will percolate downward. The boreholes did not encounter any perched levels of water in these deposits and we suspect water to move through these clayey gravels at a rate similar to that seen in the soakage tests in Trial Pit TP3.
- 7.3 At depths of between 3.9m and 5.2m the strata changes to chalk. The boreholes showed that the material was structureless (i.e. not bedrock chalk) comprising chalk gravel in a dominant matrix of chalk fines. The structureless horizons of the Chalk Formations are weathered zones which do not preserve the fractures and exhibit the same permeability as the fractured Chalk. In all three boreholes, no evidence was found of any structured chalk until depths of 17m below ground level.
- 7.4 The structured chalk is highly permeable and can sustain high water velocities often resulting in weathering and opening or widening of the fractures. Where water is concentrated into the fractured chalk at the edges of overlying caps of clay for example, swallow holes or solution features can form.
- 7.5 Overall there is a significant unsaturated zone below these graves comprising at least 17m thickness of less permeable deposits.

8 GROUNDWATER ANALYSIS

- 8.1 The results of three rounds of monitoring are appended. The analysis has considered a list of heavy metals, ammoniacal nitrogen, phosphorous compounds, and chemical and biological oxygen demand. All of the heavy metals considered in the analysis were all at concentrations below the limits set out in the drinking water regulations.
- 8.2 Ammoniacal Nitrogen (as ammonium) was initially detected at elevated levels in BH3 (0.05mg/litre) whilst below detection limits of 0.03mg/litre in BH2 and BH1. The sample of Jan 2017 showed that the ammonium levels were all below detection limits. The samples of June 2017 showed that the concentrations in all three boreholes were at the limit of detection. Given that the UK Drinking Water regulations limit for Ammoniacal Nitrogen is 0.5mg/litre we can see that there is no current threat to drinking water supplies being detected by these boreholes.
- 8.3 Formaldehyde was not detected in the initial round of tests in July 2016. Subsequent analysis omitted to test for this compound however, as a background value for future assessment of the actual effect of this cemetery, this figure is of value.
- 8.4 Phosphorous based compounds are a typical decay product as discussed. The current UK Drinking Water Regulations give a value of 2.2mg/litre for dissolved phosphorous compounds which was not exceeded.

Conclusions

- 8.5 On the basis of the analysis carried out, we can see that all the potential contaminants considered in the analysis were within the limits set out for UK Drinking Water supplies. The conclusion is that the groundwater below this site and upstream from this site, is of good quality.

9 TIER 2 QUANTITATIVE ASSESSMENT

Natural Background (up-gradient) Groundwater / Surface Water Quality

- 9.1 The background or upstream water quality is considered to be good on the basis of the groundwater samples recovered in July 2016, January 2017 and June 2017.
- 9.2 We saw no potential sources of contamination to the north of the site in the catchment area for contaminants which could migrate onto this site.

Points of Compliance

- 9.3 Water percolating into the ground from the proposed new graves at this site would move downward. The boreholes have shown that perched water moving laterally downhill through the superficial deposits was not present. Very little contamination would therefore be expected to move laterally south and into the Berry Brook.
- 9.4 On this basis, we consider that the ground water in the Chalk that underlies this site will be the receiving water. The closest abstraction from this aquifer to the site is at Play Hatch some 1.8km away. We have therefore selected this as the point of compliance.

Calculations

- 9.5 To assess the impact of new burials at this site on the abstraction for potable public supply at Play Hatch to the east we have made the following estimates.
- 9.6 Although only 31 burials are proposed per year, the total interment proposals are for 165 burials by 2029. Our calculations are based on the whole proposed area being contaminated at levels only to be expected within a grave.
- 9.7 We have assumed the cross-sectional length of the cemetery, perpendicular to groundwater flow is 85m and 150m in line with the flow.

- 9.8 The contours on the hydrogeological mapping show that there is a difference in groundwater level of 10m to 20m between the site and Play Hatch, which lies 1.8km to the east. Assuming a 20m difference, this gives a hydraulic gradient (i) of 0.01.
- 9.9 The fastest infiltration rate (K) in the superficial deposits was 1.13×10^{-5} m/s. Rates in the structured chalk aquifer will be far greater and we have used a typical value for structured chalk of up to 5.8×10^{-5} m/s (Lewis, 1989 & BGS CR/06/160N 2006).
- 9.10 The contaminant of most concern is Ammonium. Given the expected generation of 0.9kg of ammonium in the first year (EA March 2017) we have estimated that this would create a hotspot in a volume of soil of 2m by 1m by 0.3m (height of coffin). Assuming a bulk density of 2.0Mg/m³, this equates to 1200kg of soil. Assuming that the coffin has no effect and that the contaminants can rapidly spread throughout the basal 0.3m of backfill to the grave, the ammonium concentration in the soil would be 750mg/kg.
- 9.11 We have assumed a Henry' law constant of 60 mol/kg*bar. The soil water partition coefficient (K_d) for ammonium in chalk has been taken as 1.67 – 1.20ml/g.
- 9.12 For this assessment, we have assumed that the graves are to lie at or just above groundwater level and not 19m above groundwater, as shown by our boreholes.
- 9.13 In reality, any contaminant would take a considerable time to percolate down through 20m of soil. Normally Darcy's Law and figures for dilution and dispersion are used to predict the impact on an abstraction or sensitive watercourse.
- 9.14 Calculations are based on conductivity of the soil (K), the sectional area of the soil mass and the hydraulic gradient. In this case the hydraulic gradient is vertical and the cross-sectional area of the descending plume changes with depth. This widening of the plume in an unsaturated environment is dependent on the soil types present and cannot be readily predicted.

9.15 We have also noted that the downward velocity of water (and solutes) in an unsaturated sediment decreases rapidly relative to that if it were fully saturated (Perry and Green). We have not therefore been able to sensibly estimate the attenuation during percolation into the aquifer some 20m below, hence the assumption that the groundwater level is high.

Quantitative Assessment (EA Rem T Worksheet Tier 1)

9.16 Using the Environment Agency Remedial Target Spreadsheet at Tier 1 stage to define a target soil concentration for Ammonium, based on preserving groundwater concentration of no more than 0.5mg/litre, the calculations show that a suitable target would be 5.5mg/kg.

9.17 This is significantly exceeded by the expected concentration (in the first year) of 750mg/kg. This figure does not consider plume effects such as dilution, breakdown or the lateral spread. The spreadsheets are appended.

Quantitative Assessment (EA Rem T Worksheet Tier 3)

9.18 This stage of the assessment considers the effect on a distant point of compliance such as the Play Hatch abstraction. We assume that the cemetery lies directly up gradient of the abstraction and as discussed, we have assumed that there is no attenuation zone between the base of the graves and the groundwater.

9.19 The target concentration for Ammonium in the ground, in order to be protective of the Play Hatch abstraction is $5.93 \times 10^{+69}$ mg/kg, this significantly exceeds the expected 750mg/kg based on expected ammonium generation rates. Such a high (non-rational) value is indicative of a very small potential effect on the groundwater abstraction. The Rem T spreadsheets are appended.

9.20 On the basis of these calculations we do not consider that the cemetery poses any risks to water abstracted from the Play hatch borehole.

10 CONCLUSIONS

10.1 The initial Tier 1 assessment has shown that all of the initial conditions with respect to geological, hydrological, hydrogeological and topographic scene, as well as the current and historic land use have been met.

10.2 Tier 2 assessments included the excavation of trial graves and construction of deep borehole wells has shown that there is a significant attenuation zone and confirmed the geological assessments at Tier 1 level.

10.3 Soakage or infiltration tests in trial graves showed that the rate at which water left the pits was not fast and were indicative of highly impermeable soils.

10.4 Estimates at Tier 2 level of the contaminant levels that could be tolerated by the closest potable water abstraction show that the expected contaminant concentrations were most unlikely to affect the abstraction.

10.5 The well pipes have been preserved so that monitoring can be continued after the first round of interments has taken place.

10.6 We would note that the well pipes bridge the gap between the surface soils and the lower aquifer. We would recommend that burials are kept away from the boreholes by a notional 10m exclusion zone. This will need to be maintained until the boreholes are no longer required and can be decommissioned and sealed.

11 NOTES

- 11.1 Third party information was used in the preparation of this report and Terramech Investigations Ltd. cannot guarantee the accuracy or completeness of this information.
- 11.2 There may be other sources of information not included in those listed that hold data relevant to the investigations undertaken at the site that could materially affect the conclusions made in this report.
- 11.3 The investigation report and the opinion expressed therein are also based on the ground conditions encountered during the site work and on the results of tests made in the field and laboratory. However, there may be special conditions prevailing at the site which have not been disclosed by the investigations and which have not been taken into account in this report.
- 11.4 Groundwater levels can vary significantly from those observed during this investigation and the range of potential variation has not been defined by ongoing monitoring via installed observation wells.
- 11.5 The conclusions in this report represent our professional opinion, these conclusions have been drawn up with the greatest care to ensure that all apparent issues were addressed properly in accordance with applicable UK guidance and accepted practice.

Written



J.R. Puzyna BEng (Hons)
For and on behalf of
Terramech Investigations Ltd

Checked



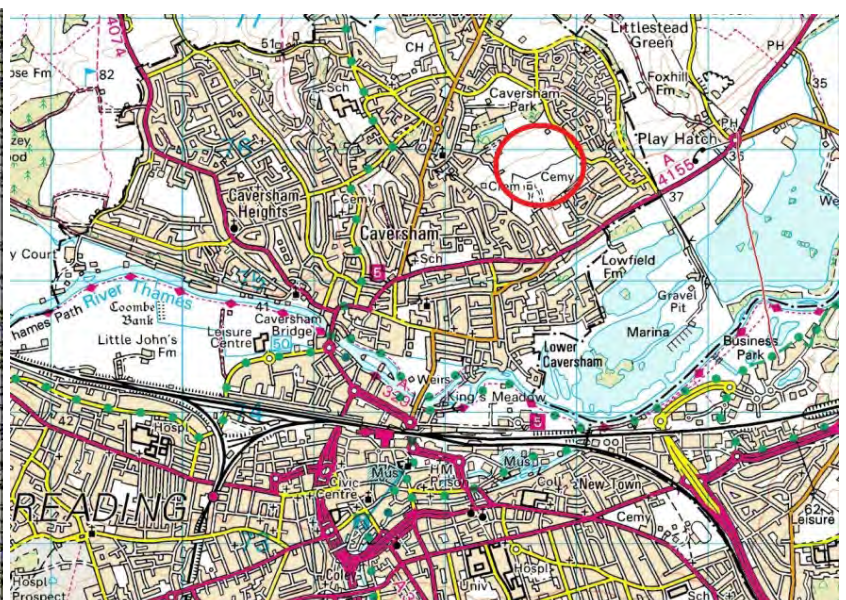
M.J. Hollow BSc (Hons)
For and on behalf of
Terramech Investigations Ltd

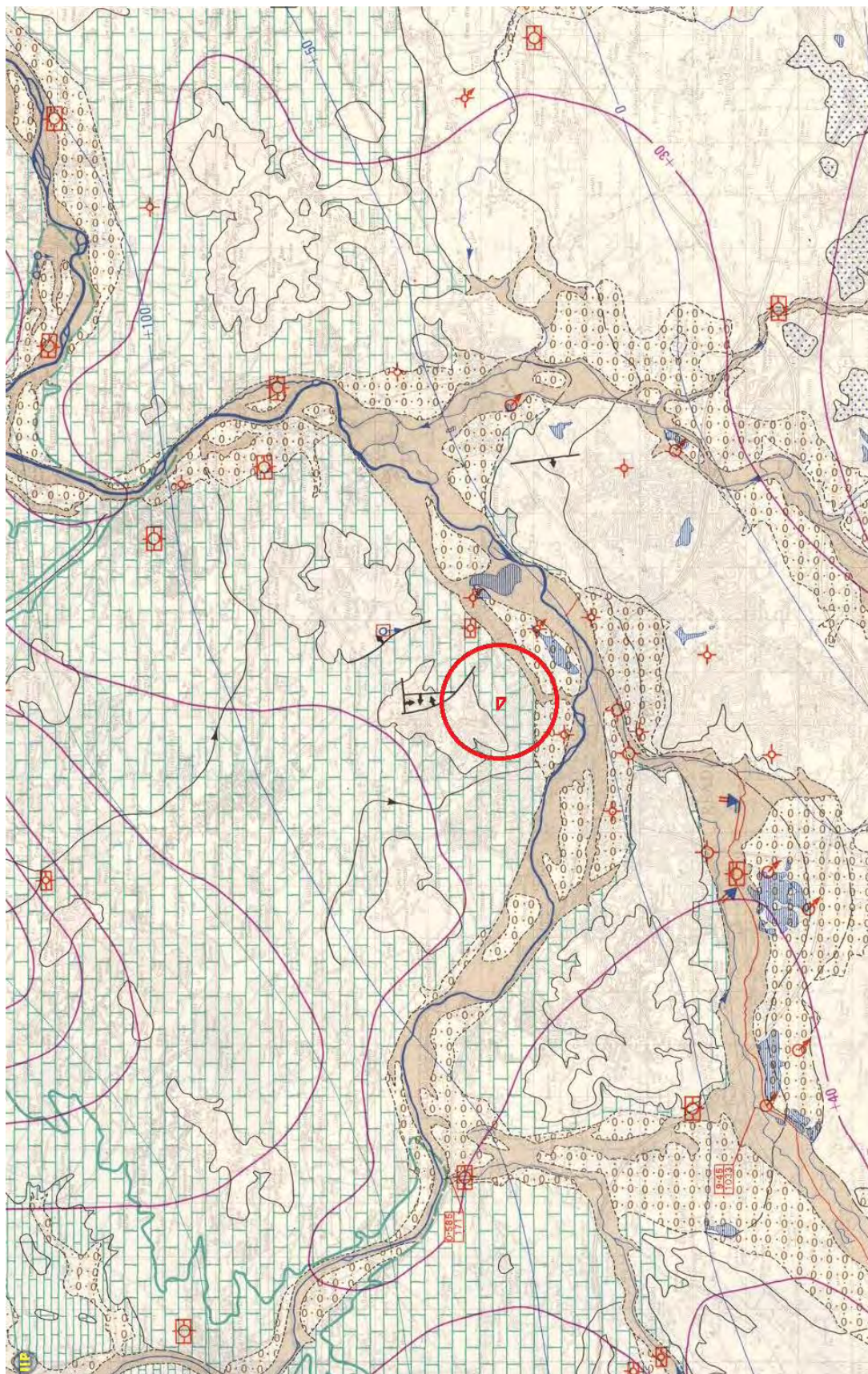
JRP/MJH

1 August, 2017

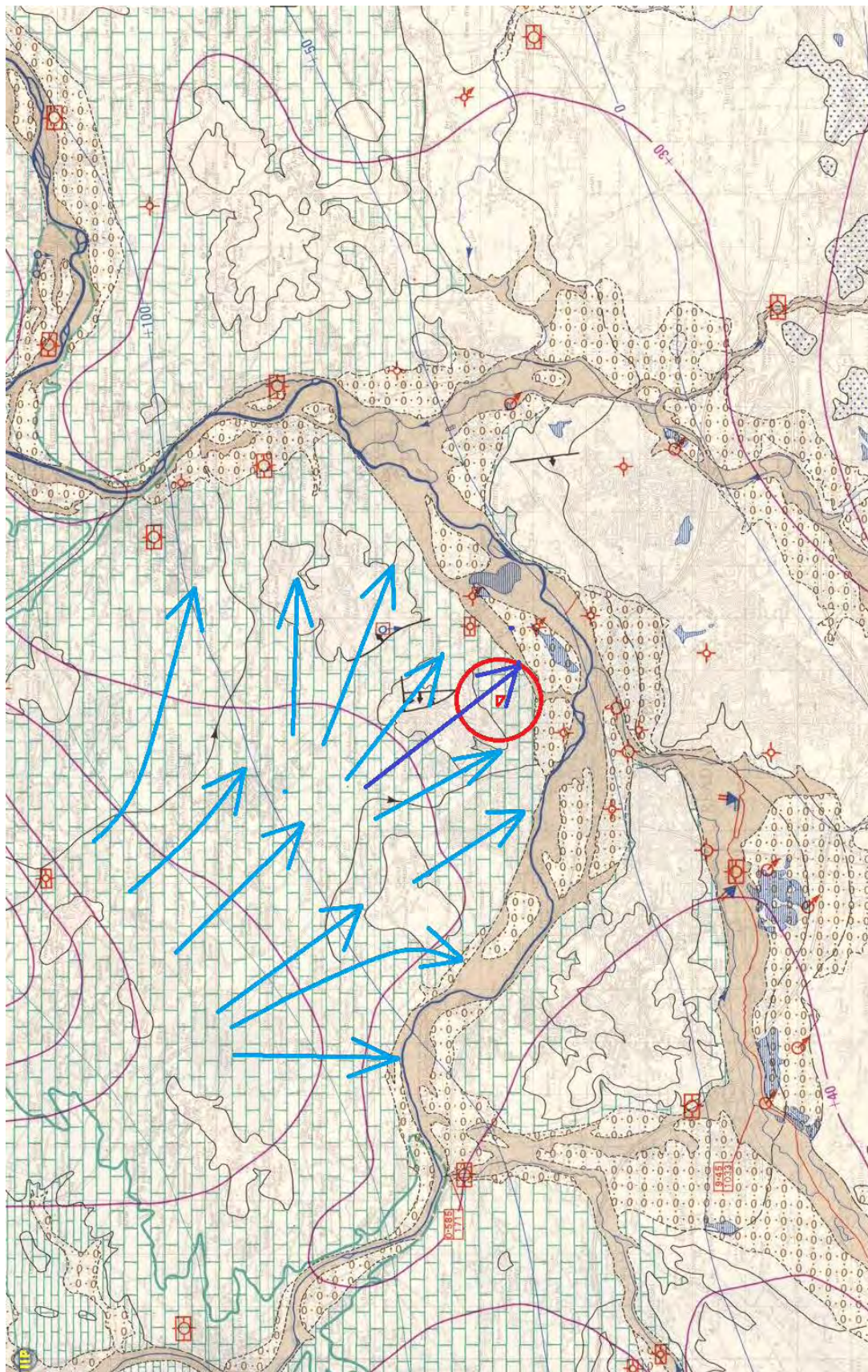
**GROUND INVESTIGATION
NO 3840/17
LAND ADJACENT TO THE MAYFIELD AREA
THE HENLEY ROAD CEMETERY
CAVERSHAM BERKSHIRE
FOR
PROPOSED CEMETERY EXTENSION**

FIGURES





Above, an extract of the 1 to 100,000 Institute of Geological Sciences Hydrogeological mapping for South West Chilterns and the Berkshire and Marlborough Downs,



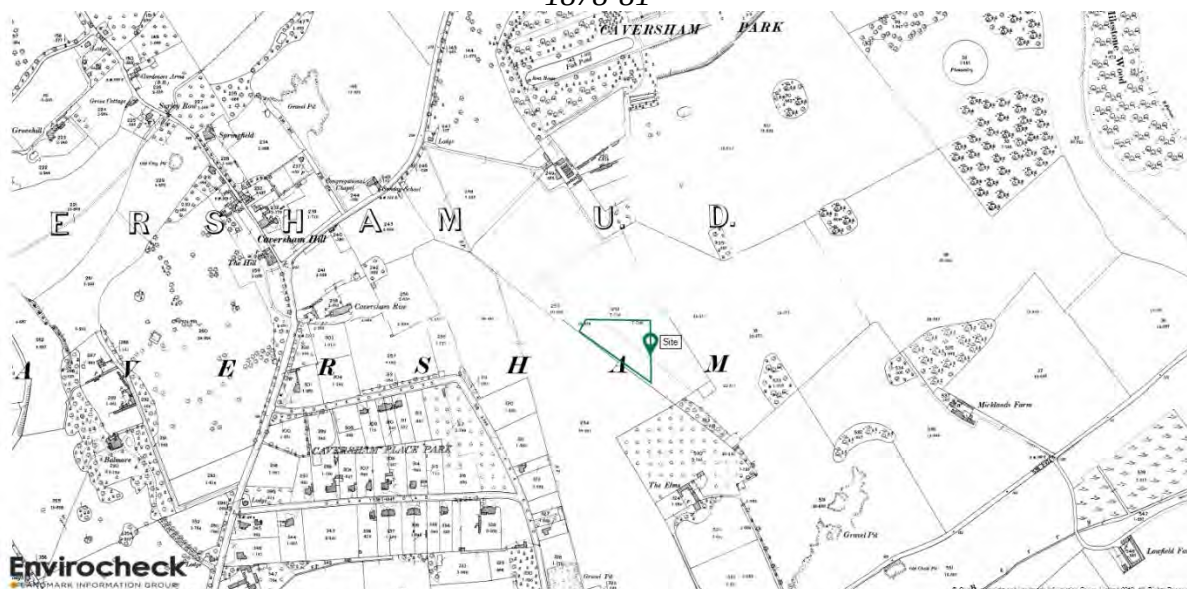
Above, an extract of the 1 to 100,000 Institute of Geological Sciences Hydrogeological mapping for South West Chilterns and the Berkshire and Marlborough Downs,



Above copies of the 1 to 50,000 scale map rendered according the height data given on these maps. (Note the vertical scale is greatly exaggerated)



1878-81



1898-99

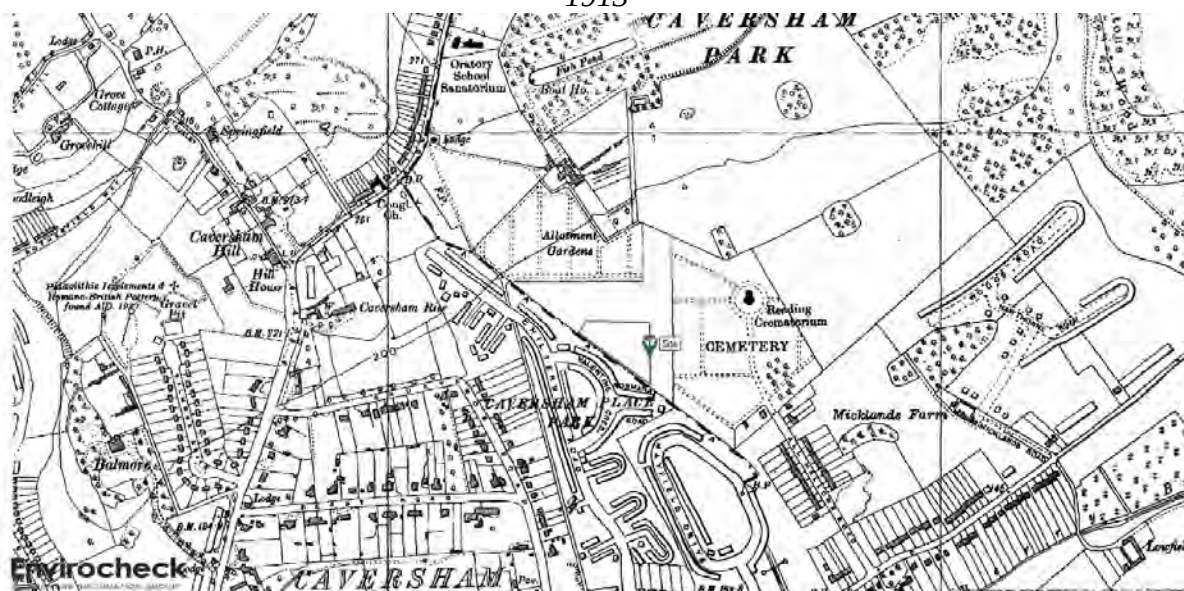


1901

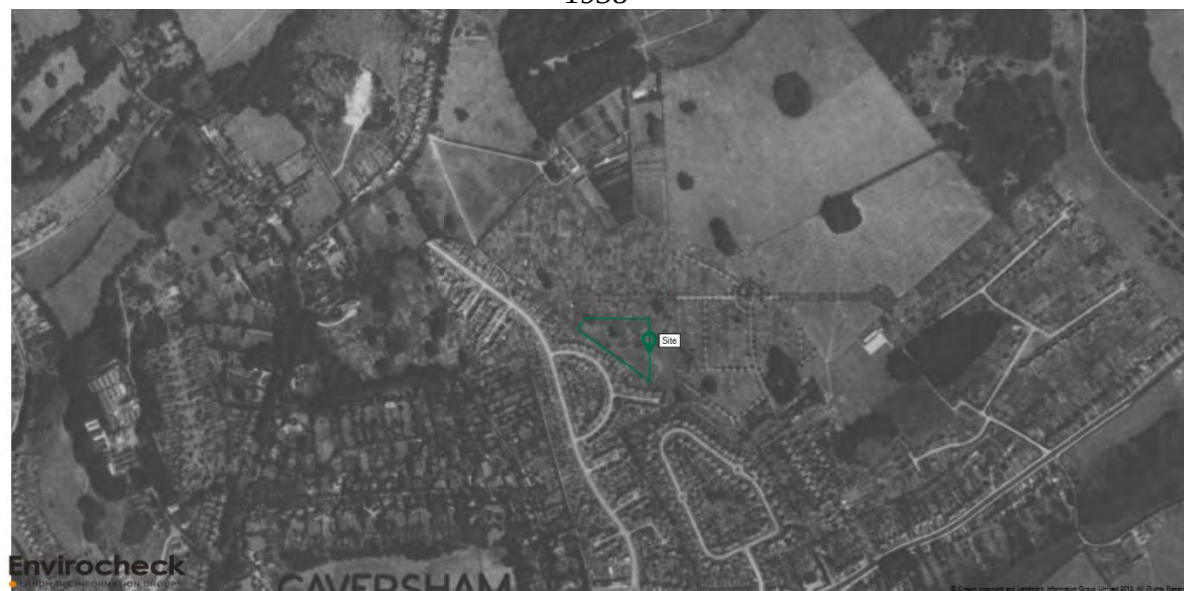
DATE: 31.07.17



1913



1938



1947



1956-68



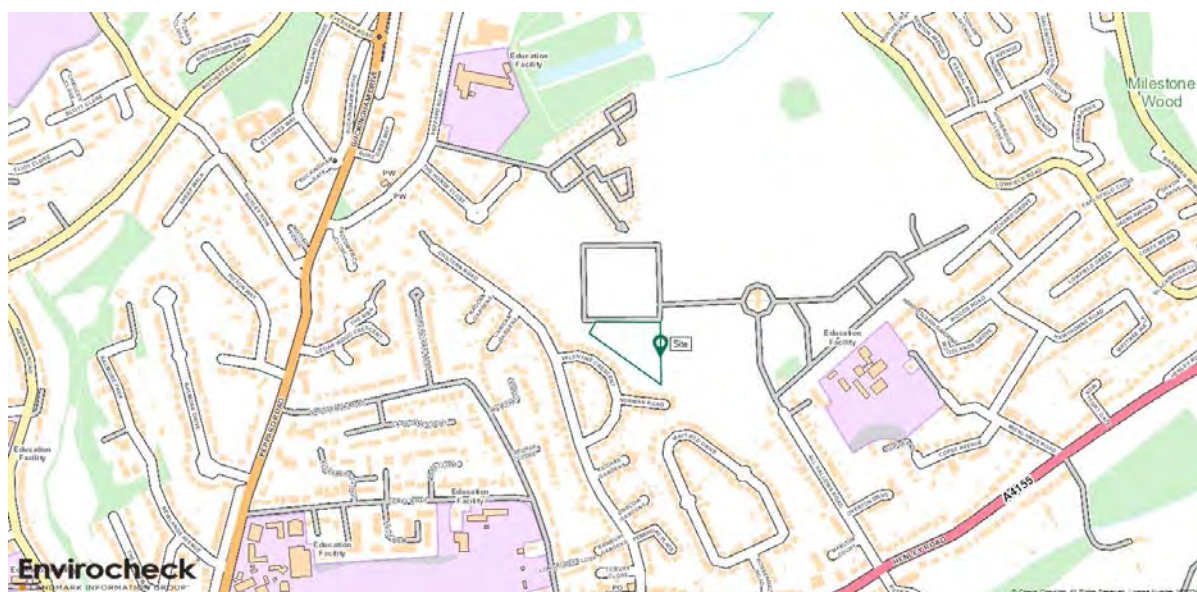
1964-75



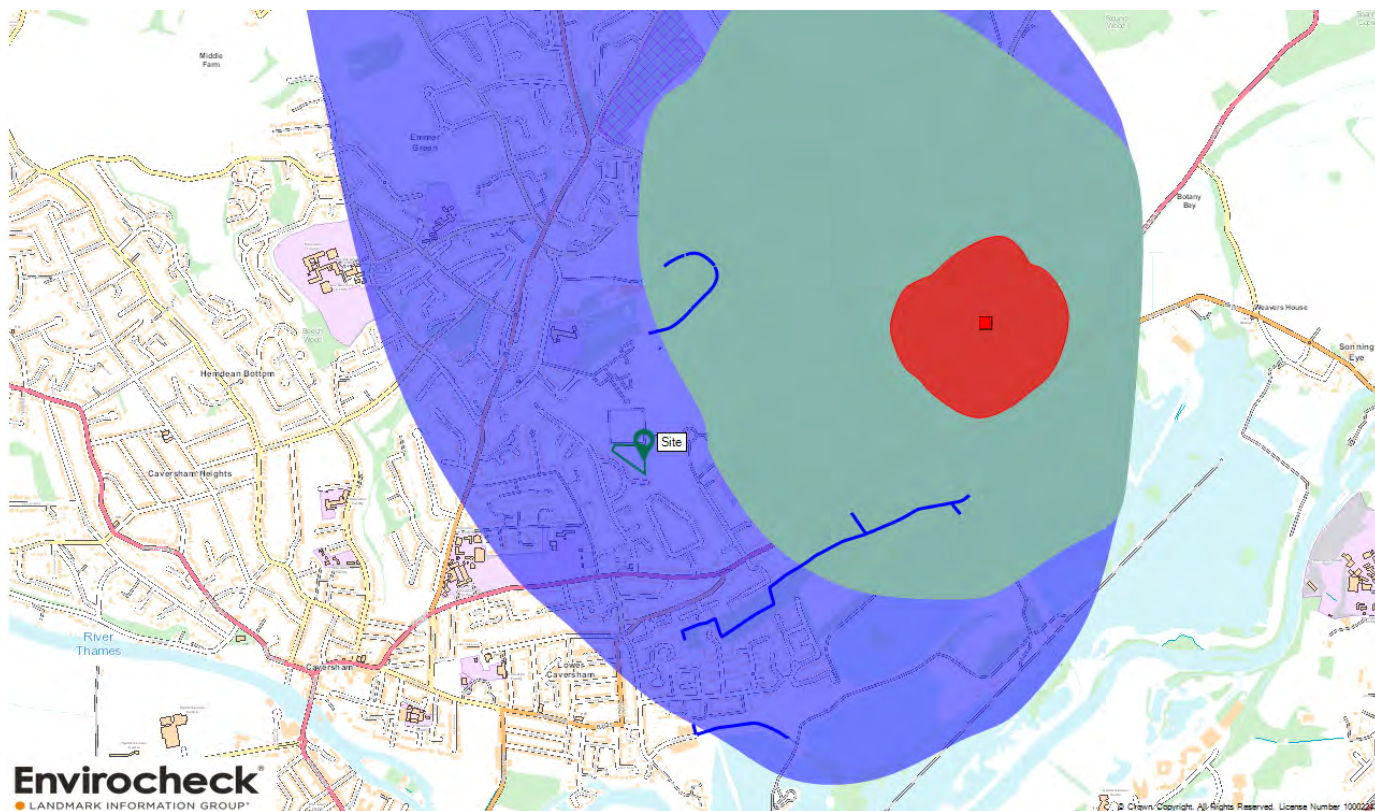
1990



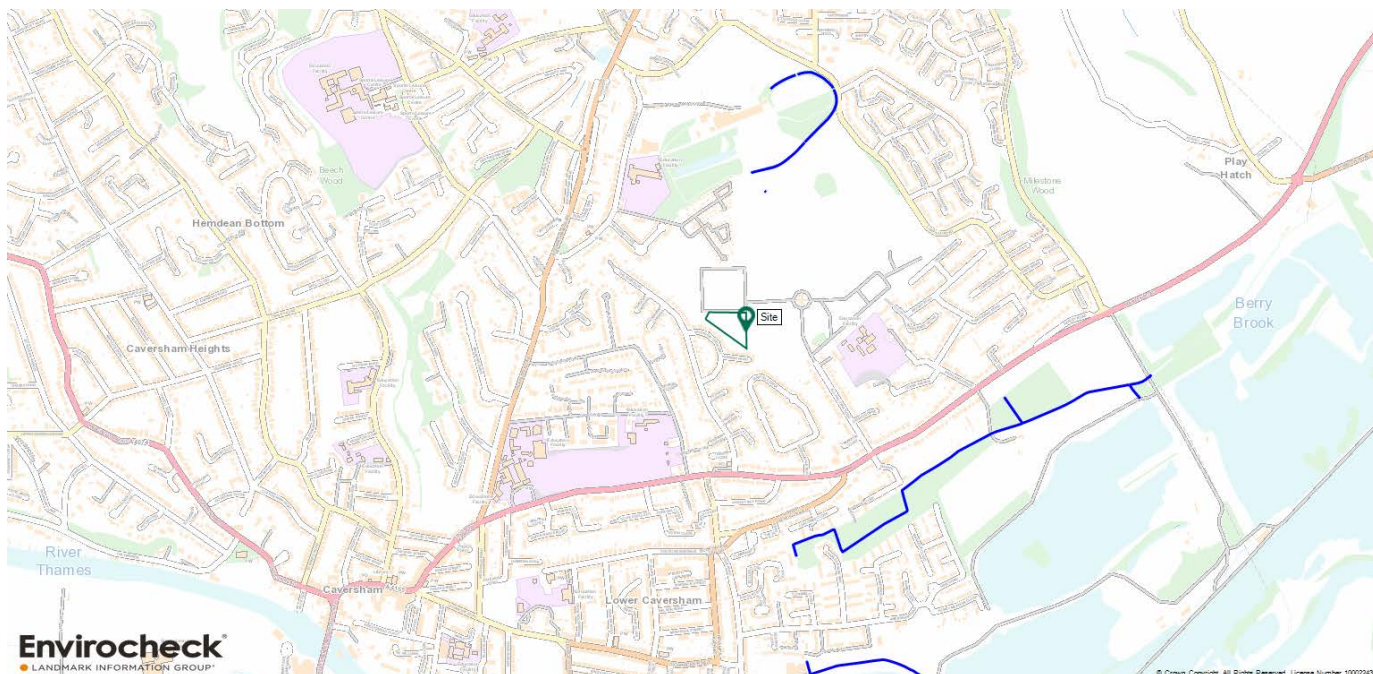
1999



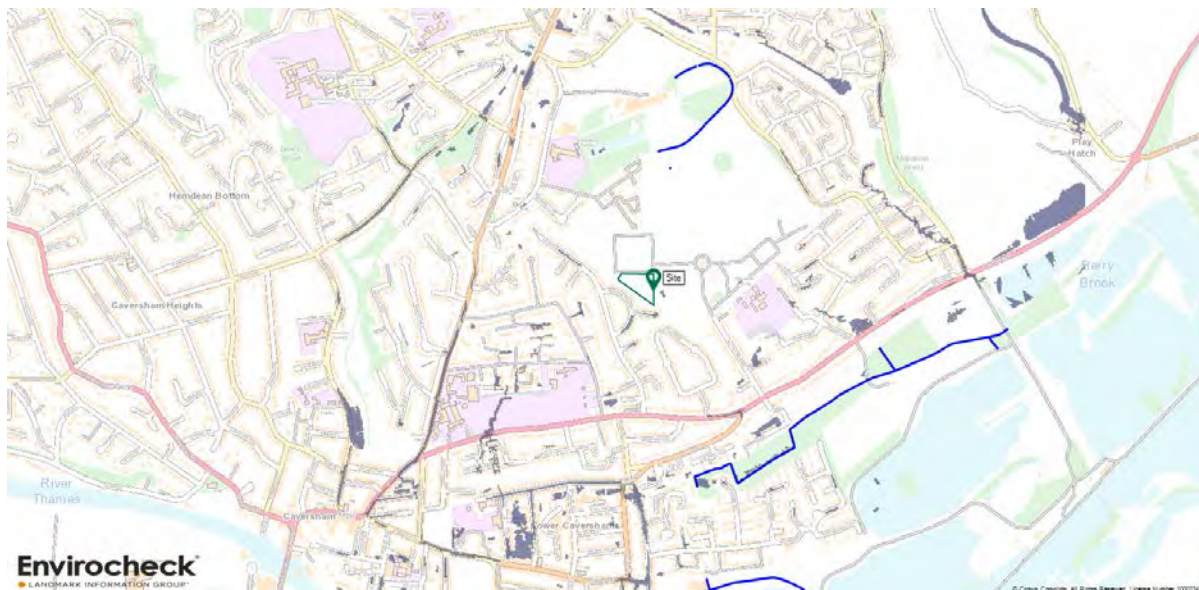
2017



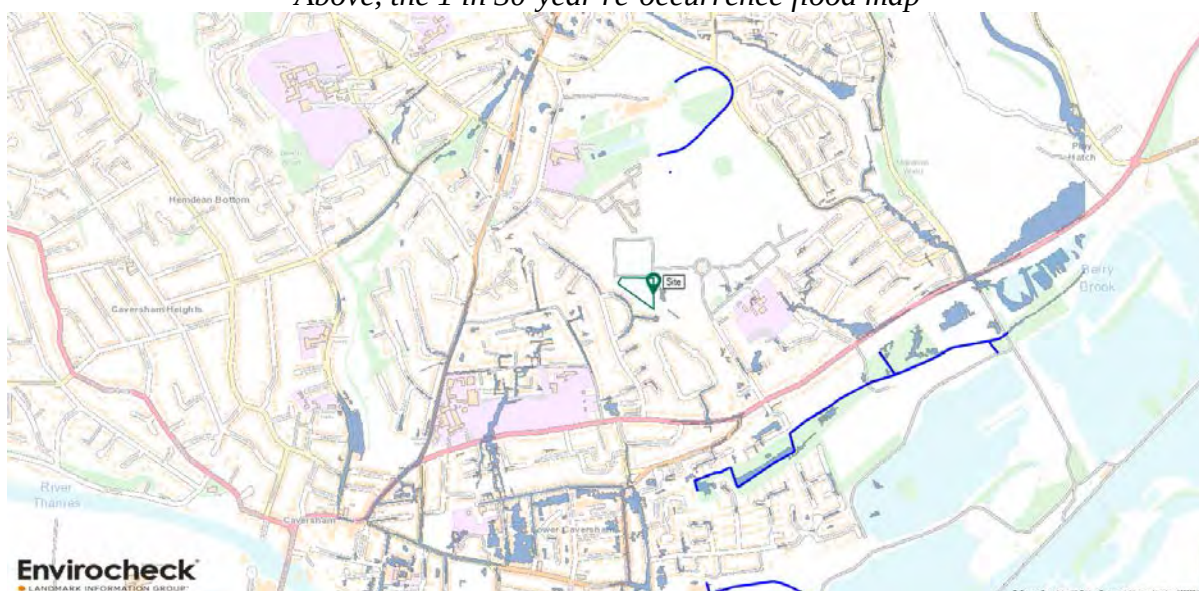
Above, a map showing the source protection zones around the abstraction at Play Hatch



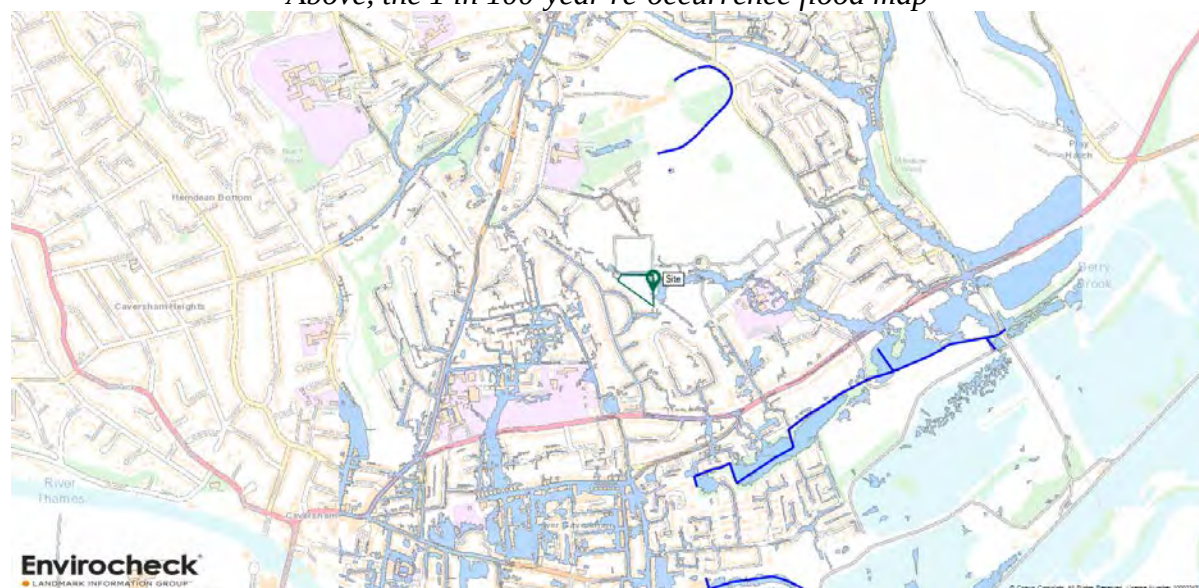
Above, a map showing water network lines



Above, the 1 in 30-year re-occurrence flood map



Above, the 1 in 100-year re-occurrence flood map



Above, the 1 in 1000-year re-occurrence flood map



Above Trial Pit TP1



Above Trial Pit TP1



Above Trial Pit TP2



Above Trial Pit TP2



Above Trial Pit TP3

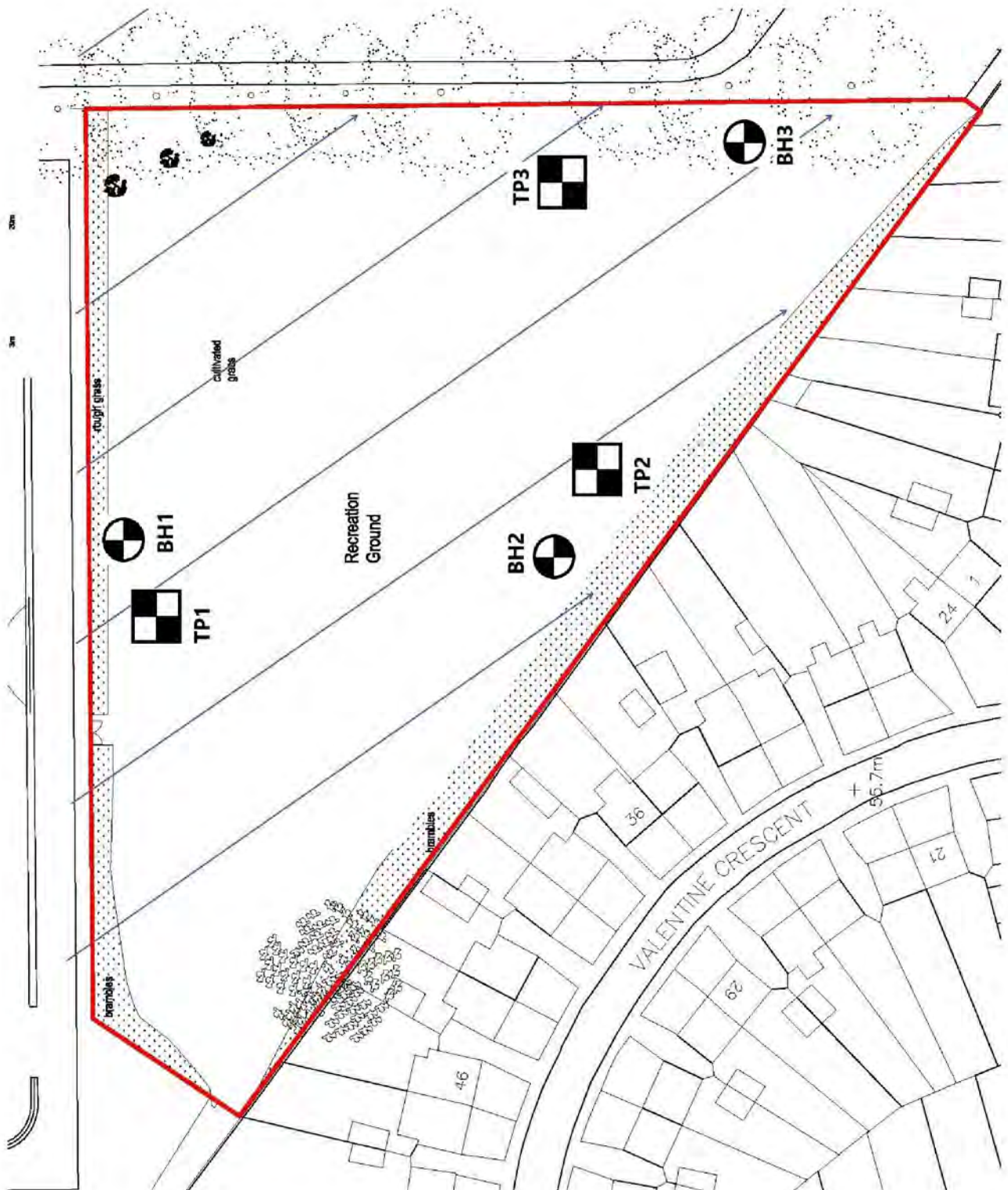


Above Trial Pit TP3

**GROUND INVESTIGATION
NO 3840/17
LAND ADJACENT TO THE MAYFIELD AREA
THE HENLEY ROAD CEMETERY
CAVERSHAM BERKSHIRE
FOR
PROPOSED CEMETERY EXTENSION**

APPENDIX A

BOREHOLE & TRIAL PIT LOCATION AND RECORDS



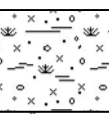
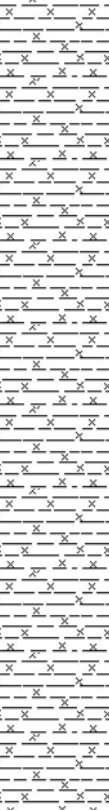
PAGE: 2

DATE:18.05.16

JOB 3840

ADD. BURIAL GROUND - HENLEY ROAD CEM.

TRIALPIT
TP1

DESCRIPTION	REDUCED	DEPTH	LEGEND	SAMPLE		THICKNESS	SPT	REMARKS
	LEVEL m			TYPE	DEPTH			
Grass over brown sandy TOPSOIL		0.00				0.20		
Firm to stiff orange brown silty CLAY		0.20				1.60		
		1.80						Falling Head Soakage test carried out
								Groundwater not encountered



TERRAMECH INVESTIGATIONS LIMITED
183 LONG LANE TILEHURST READING

REMARKS: Trial pit carried out using a small track laying excavator

U100=100mm dia. UNDISTURBED SAMPLE
B=BULK SAMPLE W=WATER SAMPLE

U38=38mm dia. UNDISTURBED SAMPLE
SPT=STANDARD PENETRATION TEST

D=SMALL DISTURBED SAMPLE
CPT=CONE PENETRATION TEST

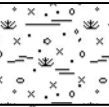
PAGE: 3

DATE:18.05.16

JOB 3840

ADD. BURIAL GROUND - HENLEY ROAD CEM.

TRIALPIT
TP2

DESCRIPTION	REDUCED	DEPTH	LEGEND	SAMPLE		THICKNESS	SPT	REMARKS
	LEVEL m			TYPE	DEPTH			
Grass over brown sandy TOPSOIL		0.00				0.20		
Firm to stiff orange brown silty CLAY with occasional flint gravel at base		0.20				1.80		Falling head soakage test carried out
		2.00						Groundwater not encountered



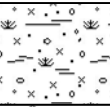
TERRAMECH INVESTIGATIONS LIMITED
183 LONG LANE TILEHURST READING

REMARKS: Trial pit carried out using a small track laying excavator

U100=100mm dia. UNDISTURBED SAMPLE
B=BULK SAMPLE W=WATER SAMPLE

U38=38mm dia. UNDISTURBED SAMPLE
SPT=STANDARD PENETRATION TEST

D=SMALL DISTURBED SAMPLE
CPT=CONE PENETRATION TEST

DESCRIPTION	REDUCED	DEPTH	LEGEND	SAMPLE		THICKNESS	SPT	REMARKS
	LEVEL m			TYPE	DEPTH			
Grass over brown sandy TOPSOIL		0.00				0.20		
Firm to stiff orange brown silty CLAY		0.20				1.40		
Firm orange brown silty slightly gravelly CLAY. Gravel is fine to medium rounded to subangular flint		1.60				0.40		Groundwater not encountered
		2.00						



TERRAMECH INVESTIGATIONS LIMITED
183 LONG LANE TILEHURST READING

REMARKS: Trial pit carried out using a small track laying excavator

U100=100mm dia. UNDISTURBED SAMPLE
B=BULK SAMPLE W=WATER SAMPLE

U38=38mm dia. UNDISTURBED SAMPLE
SPT=STANDARD PENETRATION TEST

D=SMALL DISTURBED SAMPLE
CPT=CONE PENETRATION TEST

PAGE: 5

DATE:18.05.16

JOB 3840

ADD. BURIAL GROUND - HENLEY ROAD CEM.

BOREHOLE
BH1

DESCRIPTION	REDUCED	DEPTH	LEGEND	SAMPLE		THICKNESS	SPT	REMARKS
	LEVEL m			TYPE	DEPTH	m		
TOPSOIL		0.00				0.20		
Firm brown silty CLAY		0.20		D	1.00	2.30		
				D	2.00			
Firm to stiff, orange brown silty CLAY		2.50		D	3.00	0.90		
Brown clayey GRAVEL . Gravel is fien to coarse, subrounded flint		3.40		D	4.00	1.20		
Stiff, brown sandy silty CLAY		4.60		D	5.00	0.60		
Off-white with orange brown staining, putty CHALK with flints throughout (estimated CIRIA grade Dm)		5.20		D	6.00			
				D	7.00	4.00		
				D	8.00			
				D	9.00			
Firm to stiff, off-white putty CHALK with rock chalk. (estimated CIRIA Grade Dc)		9.20		D	10.00			
				D	11.00			
				D	12.00			
				D	13.00	8.10		
				D	14.00			
				D	15.00			
				D	16.00			
				D	17.00			
Stiff/hard off-white rock CHALK (estimated CIRIA grade C4)		17.30		D	18.00			
				D	19.00	3.70		Water strike
		19.20w		D	20.00			
				D	21.00			Installation details: 1m plain pipe with bentonite surround; 20m slotted pipe with gravel surround; total depth 21m



TERRAMECH INVESTIGATIONS LIMITED
183 LONG LANE TILEHURST READING

REMARKS: Soil descriptions taken from drillers logs only

U100=100mm dia. UNDISTURBED SAMPLE
B=BULK SAMPLE W=WATER SAMPLE

U38=38mm dia. UNDISTURBED SAMPLE
SPT=STANDARD PENETRATION TEST

D=SMALL DISTURBED SAMPLE
CPT=CONE PENETRATION TEST

PAGE: 6

DATE:18.05.16

JOB 3840

ADD. BURIAL GROUND - HENLEY ROAD CEM.

BOREHOLE
BH2

DESCRIPTION	REDUCED	DEPTH	LEGEND	SAMPLE		THICKNESS	SPT	REMARKS
	LEVEL m			TYPE	DEPTH	m		
TOPSOIL		0.00				0.15		
Firm brown silty CLAY		0.15		D	1.00	1.55		
Brown clayey GRAVEL . Gravel is fine to coarse subrounded flint.		1.70		D	2.00	1.10		
Brown mottled light yellowish brown clayey GRAVEL . Gravel is fine to coarse subrounded flint and occasional fine to medium subrounded chalk		2.80		D	3.00	1.10		
Firm off-white with orange brown staining putty CHALK with flints throughout (estimated CIRIA grade Dm)		3.90		D	4.00			
				D	5.00			
				D	6.00	3.40		
				D	7.00			
Firm to stiff off-white with orange brown staining putty CHALK with rock chalk gravel and occasional flints (estimated CIRIA grade Dc)		7.30		D	8.00			
				D	9.00			
				D	10.00			
				D	11.00			
				D	12.00	9.80		
				D	13.00			
				D	14.00			
				D	15.00			
Stiff/hard off-white CHALK with occasional flints (estimated CIRIA grade C4)		17.10		D	16.00			
				D	17.00			
				D	18.00			
				D	19.00			
		19.50w		D	19.00	4.90		Water strike
				D	20.00			
				D	21.00			
		22.00		D	22.00			Installation details: 1m plain pipe with bentonite surround; 21m slotted pipe with gravel surround; total depth 22m



TERRAMECH INVESTIGATIONS LIMITED
183 LONG LANE TILEHURST READING

REMARKS: Soil descriptions taken from drillers logs only

U100=100mm dia. UNDISTURBED SAMPLE
B=BULK SAMPLE W=WATER SAMPLE

U38=38mm dia. UNDISTURBED SAMPLE
SPT=STANDARD PENETRATION TEST

D=SMALL DISTURBED SAMPLE
CPT=CONE PENETRATION TEST

 TERRAMECH INVESTIGATIONS LIMITED 183 LONG LANE TILEHURST READING	REMARKS: Soil descriptions taken from drillers logs only		
	U100=100mm dia. UNDISTURBED SAMPLE B=BULK SAMPLE W=WATER SAMPLE	U38=38mm dia. UNDISTURBED SAMPLE SPT=STANDARD PENETRATION TEST	D=SMALL DISTURBED SAMPLE CPT=CONe PENETRATION TEST

**GROUND INVESTIGATION
NO 3840/17
LAND ADJACENT TO THE MAYFIELD AREA
THE HENLEY ROAD CEMETERY
CAVERSHAM BERKSHIRE
FOR
PROPOSED CEMETERY EXTENSION**

APPENDIX B

GROUNDWATER ANALYSIS



Jones Environmental Laboratory

Registered Address : Unit 3 Deeside Point, Zone 3, Deeside Industrial Park, Deeside, CH5 2UA. UK

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Terramech Investigations Ltd
183 Long Lane
Tilehurst
Reading
Berkshire
RG31 6YW

Tel: +44 (0) 1244 833780

Fax: +44 (0) 1244 833781



Attention :	Matthew Hollow
Date :	18th July, 2016
Your reference :	3840
Our reference :	Test Report 16/11364 Batch 1
Location :	Reading Cemetery
Date samples received :	8th July, 2016
Status :	Final report
Issue :	1

Three samples were received for analysis on 8th July, 2016 of which three were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Bruce Leslie
Project Co-ordinator

Matrix : Liquid

Location: Reading Cemetery

Contact: Matthew Hollow

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 16/11364

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 (UKAS) accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Please include all sections of this report if it is reproduced

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 16/11364

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7 and 6010B	PM14	Analysis of waters and leachates for metals by ICP OES. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7 and 6010B	PM14	Analysis of waters and leachates for metals by ICP OES. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes			
TM51	Formaldehyde determination by reaction with Ammonium Ions and acetylacetone which is analysed spectrophotometrically.	PM0	No preparation is required.				
TM57	Modified US EPA Method 410.4. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometrically.	PM0	No preparation is required.	Yes			
TM58	Modified USEPA methods 405.1 and BS 5667-3. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand.	PM0	No preparation is required.	Yes			



Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Terramech Investigations Ltd
183 Long Lane
Tilehurst
Reading
Berkshire
RG31 6YW

Tel: +44 (0) 1244 833780

Fax: +44 (0) 1244 833781



Attention :	Matthew Hollow
Date :	15th February, 2017
Your reference :	3840
Our reference :	Test Report 17/7631 Batch 1
Location :	Reading Cemetery
Date samples received :	28th January, 2017
Status :	Final report
Issue :	1

Three samples were received for analysis on 28th January, 2017 of which three were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Phil Sommerton BSc
Project Manager

Client Name: Terramech Investigations Ltd

Reference: 3840

Location: Reading Cemetery

Contact: Matthew Hollow

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 177631

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
SA	ISO17025 (SANAS) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 17/7631

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes			
TM38/TM125	Total Nitrogen/Organic Nitrogen by calculation	PM0	No preparation is required.				
TM57	Modified US EPA Method 410.4. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometrically.	PM0	No preparation is required.	Yes			
TM58	Modified USEPA methods 405.1 and BS 5667-3. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand.	PM0	No preparation is required.	Yes			
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO ₂ and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1. Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			



Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

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Zone 3
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Terramech Investigations Ltd
183 Long Lane
Tilehurst
Reading
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RG31 6YW

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Fax: +44 (0) 1244 833781



Attention :	Matthew Hollow
Date :	29th June, 2017
Your reference :	3840
Our reference :	Test Report 17/10690 Batch 1
Location :	Reading Cemetery
Date samples received :	21st June, 2017
Status :	Final report
Issue :	1

Three samples were received for analysis on 21st June, 2017 of which three were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Phil Sommerton BSc
Project Manager

Client Name: Terramech Investigations Ltd **Matrix :** Liquid

Reference: 3840

Location: Reading Cemetery

Contact: Matthew Hollow

Matrix : Liquid

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 17/10690

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

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% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

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DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

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Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
SA	ISO17025 (SANAS) accredited - South Africa.
B	Indicates analyte found in associated method blank.
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M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 17/10690

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes			
TM38/TM125	Total Nitrogen/Organic Nitrogen by calculation	PM0	No preparation is required.				
TM57	Modified US EPA Method 410.4. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometrically.	PM0	No preparation is required.	Yes			
TM58	Modified USEPA methods 405.1 and BS 5667-3. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand.	PM0	No preparation is required.	Yes			
TM59	Determination of Dissolved Oxygen using the Hach HQ30D Oxygen Meter	PM0	No preparation is required.				
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO2 and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1. Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			

**GROUND INVESTIGATION
NO 3840/17
LAND ADJACENT TO THE MAYFIELD AREA
THE HENLEY ROAD CEMETERY
CAVERSHAM BERKSHIRE
FOR
PROPOSED CEMETERY EXTENSION**

APPENDIX C

REMEDIAL TARGET SPREADSHEETS



R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Date of Workbook Issue: April 2002

This worksheet has been produced in combination with the document 'Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources' - Environment Agency R&D Publication 20, (1999).

Users of this worksheet should always refer to the User Manual, to R&D Publication 20 and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

© Environment Agency, 2002. (Produced by the Agency's National Groundwater and Contaminated Land Centre and Envirospire)

This calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the NGWCLC.

All rights reserved. You will not modify, reverse compile or otherwise dis-assemble the worksheet.

Liability: The Environment Agency does not promise that the worksheet will provide any particular facilities or functions. You must ensure that the worksheet meets your needs and you remain solely responsible for the competent use of the worksheet. You are entirely responsible for the consequences of any use of the worksheet and the Agency provides no warranty about the fitness for purpose or performance of any part of the worksheet. We do not promise that the media will always be free from defects, computer viruses, software locks or other similar code or that the operation of the worksheet will be uninterrupted or error free. You should carry out all necessary virus checks prior to installing on your computing system.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error

Details to be completed for each assessment			
Site Name:	Reading Cemetery		
Site Address:	All Hallows Road		
Completed by:	Julian		
Date:	30-Jul-17	Version:	x.xx
Contaminant	Ammonium		
Target Concentration (C_T)	0.5 mg/l	Origin of C_T:	UK Drinking Water Regs

This worksheet can be used to determine remedial targets for soils (Worksheets Tier 1 Soil, Tier 2 Soil and Tier 3 Soil) or to determine remedial targets for groundwater (Tier 3 Groundwater). For Tier 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Tier 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menu or require a "0", "1" or "2" to be entered. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The worksheet also calculates a number of frequently used hydrogeological equations.

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a



Tier 1 - Soil

Select the Method of calculating the soil water
Partition Co-efficient by using the Pull down menu
below

User specified value for partition coefficient

Contaminant	Ammonium
Target concentration	C _T 0.5 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	6.00E-01	fraction	30% m/c den 2.0g/cm3	This sheet calculates the Tier 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Tier 1 remedial target to determine the need for further action.
Air filled soil porosity	θ _a	3.00E-01	fraction		
Bulk density of soil zone material	ρ	2.00E+00	g/cm ³	Thomlinson 6	
Henry's Law constant	H	6.00E+01	dimensionless	US dept of Commerce	

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d	1.67E+00	l/kg	EA scho0705bjiz-e-e
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}		fraction	
Organic carbon partition coefficient	K _{oc}		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			

Soil water partition coefficient used in Tier Assessment K_d 1.67E+00 l/kg Specified value

Site being assessed: Reading Cemetery
Completed by: Julian
Date: 30-Jul-17
Version: x.xx

Calculated Parameters

Tier 1 Remedial Target	5.49E+00	mg/kg	(for comparison with soil analyses)
LTC1	0.5	mg/l	(for comparison with leachate test results)

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a



Tier 2 - Soil

Contaminant
Target concentration C_T Ammonium 0.5 mg/l from Tier 1

This sheet calculates the Tier 2 remedial target for soils (mg/kg) or for pore water (mg/l). Three options are included dependent on the identified in receptor (groundwater, surface water, or groundwater abstraction). In general the assessment should be for groundwater below the site.

Select Target for Tier 2 Soil Assessment (click on brown cell below, then on pull-down menu)

Groundwater flow below site

The measured soil concentration as mg/kg or pore water concentration should be compared with the Tier 2 remedial target to determine the need for further action. Equations presented in R&D Pub. 20

Input Parameters	Variable	Value	Unit	Source of parameter value
Infiltration	Inf	5.00E-05	m/d	Lewis, 1989 – BGS CR/06/160N 2006
Area of contaminant source	A		m ²	
Length of contaminant source in direction of groundwater flow	L	1.50E+02	m	measured
Saturated aquifer thickness	da	8.00E+01	m	Play Hatch Borehole
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.00E-05	m/d	Lewis, 1989 – BGS CR/06/160N 2006
Hydraulic gradient of water table	i	1.00E-02	fraction	Hydrogeological mapping
Width of contaminant source perpendicular to groundwater flow	w	8.50E+01	m	measured
Background concentration of contaminant in groundwater beneath site	Cu	3.00E-02	mg/l	17-10690 Report.pdf
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone depth	Mz	2.00E+01	m	BH1, BH2 and BH3 used in tier assessment
Calculated mixing zone depth	Mz		m	used in tier assessment (Equation presented in Table 4.5, R&D Pub. 20)
Abstraction rate	Q		m ³ /d	
Background concentration of contaminant in groundwater entering borehole	Cu		mg/l	
Surface water flow upstream of discharge points under low flow conditions	Qu		m ³ /d	
Background concentration of contaminant in receiving watercourse	Cu		mg/l	

Calculated Parameters

Dilution Factor	DF	1.00E+00		
Tier 2 Remedial Target	LTC2	5.01E-01	mg/l	For comparison with measured pore water concentration. This assumes Tier 1 Remedial Target is based on Target Concentration.
Groundwater flow below site		or 5.49E+00	mg/kg	For comparison with measured soil concentration. This assumes Tier 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor) C_c 0.00E+00 mg/l

Calculated concentration within receptor (dilution only) 0.00E+00 mg/l Groundwater flow below site

Site being assessed: Reading Cemetery
Completed by: Julian
Date: 30-Jul-17
Version: x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Soil

Input Parameters	Variable	Value	Unit	Source
Contaminant		Ammonium		from Tier 1
Target Concentration	C _T	0.5	mg/l	from Tier 1
Dilution Factor	DF	1.00E+00		from Tier 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks	Equations in R&D Pub. 20
-------------	--------------------------

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer)

Half life for degradation of contaminant in water

Calculated decay rate

Width of plume in aquifer at source

Plume thickness in aquifer at source

Bulk density of aquifer materials

Effective porosity of aquifer

Hydraulic gradient

Hydraulic conductivity of saturated aquifer

Distance to compliance point

Distance (lateral) to compliance point perpendicular to flow direction

Distance (depth) to compliance point perpendicular to flow direction

Time since pollutant entered groundwater

Parameters values determined from options

Partition coefficient

Longitudinal dispersivity

Transverse dispersivity

Vertical dispersivity

Source of parameter value

EA March 2017

same as site

2

Thomlinson 6

measured

time variant options only

see options

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Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Note: For Non-polar, Calculates Kd as: Kd = Koc * f_{oc}

Calculates Kd as: Kd = Koc,n[1 + 10pH-pKa]-1 + Koc,[1-(1 + 10pH-pKa)-1]

Enter if specify partition coefficient (option)

Soil water partition coefficient

Enter for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

Organic carbon partition coefficient

Enter for ionic organic chemicals (option)

Sorption coefficient for related species

Sorption coefficient for ionised species

pH value

Acid dissociation constant

Soil water partition coefficient

Define dispersivity (click brown cell and use pull down list)

Calculate dependant on distance to compliance point (0),

specify dispersivity (1), or calc after Xu & Eckstein (2) ?

Longitudinal dispersivity

Transverse dispersivity

Vertical dispersivity

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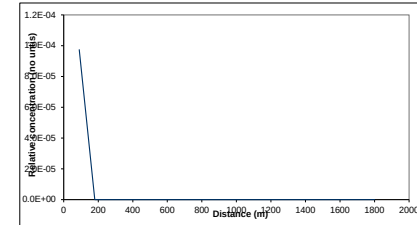
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Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations f_c distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)
90.0	9.7E-05
180.0	2.2E-08
270.0	6.4E-12
360.0	2.1E-15
450.0	7.0E-19
540.0	2.5E-22
630.0	9.1E-26
720.0	3.4E-29
810.0	1.3E-32
900.0	4.9E-36
990.0	1.9E-39
1080.0	7.4E-43
1170.0	2.9E-46
1260.0	1.1E-49
1350.0	4.5E-53
1440.0	1.8E-56
1530.0	7.2E-60
1620.0	2.9E-63
1710.0	1.2E-66
1800.0	4.7E-70

This sheet calculates the Tier3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Tier 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Remedial Targets

Remedial Target	LTC3	5.41E+68	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or	5.93E+69	mg/kg	This assumes Tier 1 Remedial Target is based on Target Concentration.
Distance to compliance point		1800	m	For comparison with measured soil concentration. This assumes Tier 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	9.26E-70	fraction	Ogata Banks
after		9.9E+99	days	

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Site being assessed: Reading Cemetery
Completed by: Julian
Date: #####
Version: x.xx