



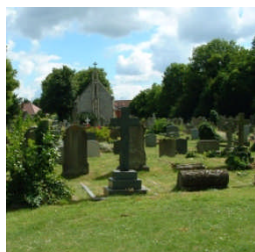
Cemetery Development Services

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A report to Leeds City Council on the Groundwater Risks and Drainage options for Whinmoor Proposed Cemetery

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D1.0



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Leeds City Council

A Summary Review on Groundwater and Drainage at the Proposed Whinmoor Cemetery Development off York Road

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1.0 Executive Summary

Following the previous site observations and detailed desk analysis undertaken, our conclusion is that the site in its current state poses a high risk to controlled waters as assessed under EA current guidelines, this is mainly due to the factors described in section 3 below that offset the high score.

However all risks taken into account, and mitigation of those risks identified (ensuring burials are at least 30 meters from the stream and that deep land drains are decommissioned), then we would consider the overall risk to the groundwater and surface water to be generally low and that the site would be suitable for burial with specific regard to the higher potential numbers (150 burials per annum).

The proposed drainage scheme formed from the extensive use of swales and miniature attenuation ponds is felt to be overtly engineered. A simpler more practical surface water intercept drainage scheme would provide cheaper and more effective drainage and water stress management and increase the quantity of burial plots.

This type of system with a simple attenuation pond and reed bed would ensure that any small risk of contaminants reaching surface waters will be minimised further.

The potential of groundwater pollution will also be minimal, the high Cation Exchange Capacity of the soil and with groundwater levels expected to be at least 1.5 to 2 meters below lowest depth of grave the risk of contamination is all but quashed.

2.0 Introduction

Cemetery Development Services carried out a series of desktop as well as site specific surveys of soil and water interactions within the proposed development site at Whinmoor Figure 1a and b below. During these investigations undertaken in October 2010, the site general area was surveyed in order to establish the degree of variation in the type and condition of the soil; its hydraulic properties and the potential risk to groundwater contamination and the appropriate drainage options required.

The proposed development areas outlined in pink and yellow were assessed on a centroid of a 500 meter area of influence, grid reference 437267, 437999. The north site area is calculated as being 11.9 hectares (29.3 acres). The south site is calculated to be 6.1 hectares (15 acres).



Figure 1a

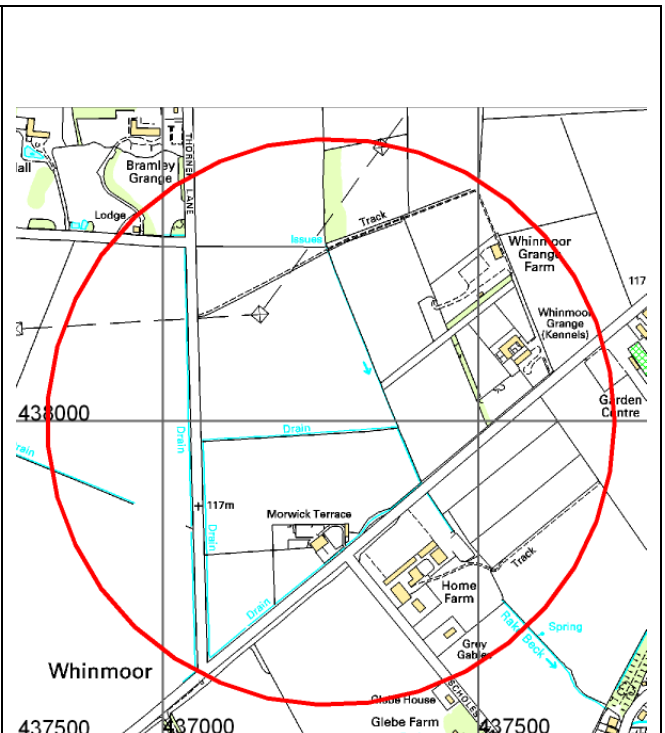


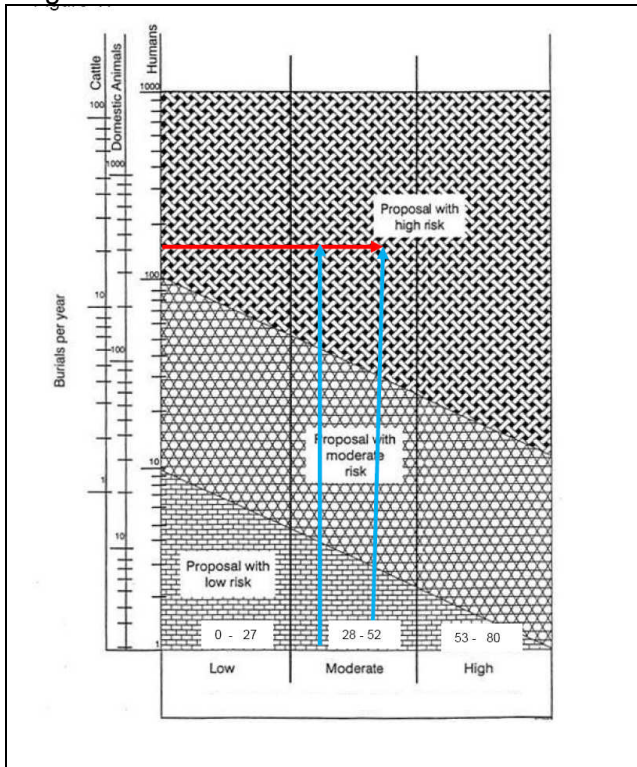
Figure 1b

A series of profile pits were dug over the majority of the site, with the exception of the area marked by the blue shading, no pits were dug within this area due to access issues. However with the consistency of the soil from investigations of the adjacent fields, and from evidence of desktop and geological data sources we don't anticipate that the soils' morphology within the area shaded yellow will be different to the rest of the site.

3.0 Groundwater Risk.

Using the assessment criterion as set out by the Environment Agency in its GP3 guideline notes and specifically to their technical document RD P223, the site was assessed as “High Risk” from the application of site specific data to the nomograph Figure 2 below.

Figure 2



However it is important to note that whilst the site is classified as “High Risk”, the weighting of the scores would not be considered necessarily detrimental or potentially damaging to ground and surface water stocks.

The high risk score data was heavily weighted by 3 main factors.

1. The significant occurrence of clay tile land drains within the site.
2. The proximity of surface water streams.
3. The high burial number estimated at 150 per annum.

At least two of the above criteria can be mitigated to reduce the risk. The existing drainage system can be decommissioned and the location of burials can be placed at least 30 metres from any water courses.

Scores criterion that would have been of greater concern, would include the locality of wells and potable water supplies, location within a Source Protection Zone, soils of a fractured morphology, Principal Aquifer designation and water tables within close proximity to the base of grave. Within the Whinmoor site, there were no wells or potable water supplies within the area, no fracture flow pathways to the Secondary A bedrock aquifer and no Source Protection Zones or water tables within 5 meters of the surface.

These factors alone make the site particularly suitable for burial and with the high clay content of the soil reduce the leachate risk significantly.

Clay has a very high Cation Exchange Capacity (CEC 45 meq/100gm) up to five times that of sand this ensures that certain chemicals and elements are buffered by the reactivity of the clay. Further, clay acts as a barrier and absorbent for pathogens including the CJD prion.

It is in our opinion that the site should be suitable as a cemetery as potential risk to protected surface and groundwater stocks are minimal and manageable.

4.0 Drainage.

Drainage in cemeteries is complex; whilst land drains are not permitted the use of deep drainage dewatering systems and the adoption of surface water catchment systems are permitted subject to design approval and licensing.

The site is frustrated by poor permeability which will cause seasonal water stress and in situations of prolonged or heavy rainfall perched water.

The use of an effective piped surface drainage system will reduce infiltration through graves and thus reduce leachate potential.

The site will require an effective drainage scheme that must take into account current EA flood risk development policies with the implementation of SUD's for preservation of water stocks and the protection of surface water from contamination and flooding.

The current proposed drainage design and plot layout reduces burial efficacy by nearly 40%, further the scheme is overly complex expensive to construct and be difficult to maintain.

Dr Hann FIAgrE. CEng. CEnv chief engineer to CDSL makes the following comments;

1. The drainage design proposed is over engineered; the use of so many swales (all be it small) is more than would be required to deal with the surface water problems.
2. The placement of some swales is questionable as they will not intercept the direction of flow efficiently.
3. Till soils are mostly of low hydraulic conductivity hence swales are not an efficient method of dealing with the soil water problems which are experienced here.
4. The classic method of coping with the soil/water problems experienced is to collect the flow lines into a series of lateral drains laid in a direction which intercepts the said flow lines. The laterals carry the water to a main drain which then outfalls into a ditch/river system possibly via an attenuation pond or reed bed. This site has the topography and outfall available to make good use of the system described. The installation of reed bed will further reduce any risk of potential pollution of surface waters.

4.1 Recommendations

It is recommended that a piped drainage scheme is installed, this would include;

1. A series of lateral French drains made up of a 0.5m deep trench approximately 200mm wide containing a 100mm corrugated plastic drain pipe backfilled with appropriate stone to within 250mm of the surface. The final backfill to the surface being selected root zone. The laterals to run west east at spacing's of between 25m and 30m (to meet the burial pattern).

2. A main to run down the eastern boundary to which the laterals are connected. This drain would have similar trench dimensions and fill with a 150mm corrugated plastic drain pipe.
3. The construction of a reed bed and attenuation pond would act as a final point of protection against any possible contaminants entering surface waters. The use of oil filtration traps might be considered of parking areas.
4. The exact layout and dimensions of the laterals and main drains would be finalised after further site and desk top investigation.

4.2 Advantages of the proposed change of system are considered below;

1. Reduced cost of construction
2. The space taken by the pipe system is minimal as it is installed in the walk way between graves. A substantial amount of burial space will be lost to the swale system reducing the number of potential burial sites (perhaps by as much as 40% on top of pathways and plantings)
3. The pipe system will be a more reliable approach as it has a positive flow path removing rain water quickly (less than 24 hours) from the site which therefore remains drier for longer, and reduces permeation into graves and thus reduces leaching.
4. The pipe drainage will be less disruptive to install and will take less construction time.

5.0 Conclusion

Following the previous site observations and detailed desk analysis undertaken, our conclusion is that the site in its current state poses a high risk to controlled waters as assessed under EA current guidelines, this is mainly due to the factors described in section 3 below that offset the high score.

However all risks taken into account, and mitigation of those risks identified (ensuring burials are at least 30 meters from the stream and that deep land drains are decommissioned), then we would consider the overall risk to the groundwater and surface water to be generally low and that the site would be suitable for burial with specific regard to the higher potential numbers (150 burials per annum).

The proposed drainage scheme formed from the extensive use of swales and miniature attenuation ponds is felt to be overtly engineered. A simpler more practical surface water intercept drainage scheme would provide cheaper and more effective drainage and water stress management and increase the quantity of burial plots.

6 Contact details

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Cemetery Development Services - Terms and Conditions

Cemetery Development Services (CDS)
Terms and Conditions for the Supply of Services

Interpretation

In these Conditions

AGREED FEE means the charges agreed between CDS and the Client in relation to the Specified Service

CLIENT means the person named on the Specification Sheet for whom CDS has agreed to provide the Specified Service in accordance with these Conditions

CONTRACT means the contract for the provision of the Specified Service

DOCUMENT includes, in addition to a document in writing, any map, plan, graph, drawing or photograph, any film, negative, tape or other device embodying visual images and any disc, tape or other device embodying any other data

INPUT MATERIAL means any Documents or other materials, and any data or other information provided by the Client relating to the Specified Service

OUTPUT MATERIAL means any Documents or other materials, and any data or other information provided by CDS relating to the Specified Service

SPECIFICATION SHEET means the sheet to which these Conditions are appended

SPECIFIED SERVICE means the service relating to geophysical surveys of land to be provided by CDS for the Client and referred to in the Specification Sheet

CDS means CDS (registered in England under number 05089827) or its subsidiary as stated on the Specification Sheet

The headings in these Conditions are for convenience only and shall not affect their interpretation.

Supply of the Specified Service

CDS shall provide the Specified Service to the Client subject to these Conditions. Any changes or additions to the Specified Service or these Conditions must be agreed in writing by CDS and the Client.

The Client shall allow CDS adequate access to its property at reasonable times and for so long as is necessary to enable CDS to provide the Specified Service in accordance with the Contract.

The Client shall at its own expense supply CDS with all necessary Documents or other materials, and all necessary data or other information relating to the Specified Service, within sufficient time to enable CDS to provide the Specified Service in accordance with the Contract. The Client shall ensure the accuracy of all Input Material.

CDS shall have no liability for any loss or damage, however caused, to the Input Material. All Output Material shall be at the sole risk of the Client from the time of delivery to or to the order of the Client.

The Specified Service shall be provided in accordance with the Specification Sheet subject to these Conditions.

Further details about the Specified Service, and advice or recommendations about its provision or utilisation, which are not given in CDS's brochure or other promotional literature, may be made available on written request.

CDS may correct any typographical or other errors or omissions in any brochure, promotional literature, quotation or other document relating to the provision of the Specified Service without any liability to the Client.

CDS may at any time without notifying the Client make any changes to the Specified Service which are necessary to comply with any applicable safety or other statutory requirements, or which do not materially affect the nature or quality of the Specified Service.

Charges

Subject to any special terms agreed, the Client shall pay the Agreed Fee and any additional sums which are agreed between CDS and the Client for the provision of the Specified Service or which, in CDS's sole discretion, are reasonably incurred as a result of the Client's instructions or lack of instructions, the inaccuracy of any Input Material or any other cause attributable to the Client.

All charges quoted to the Client for the provision of the Specified Service are exclusive of any Value Added Tax, for which the Client shall be additionally liable at the applicable rate from time to time.

CDS shall be entitled to invoice the Client on completion of the Specified Service.

The Agreed Fee and any additional sums payable shall be paid by the Client (together with any applicable Value Added Tax, and without any set-off or other deduction) within 30 days of the date of CDS's invoice.

If payment is not made on the due date, CDS shall be entitled, without limiting any other rights it may have, to charge interest on the outstanding amount (both before and after any judgment) at the rate of 4 % above the base rate from time to time of Barclays Bank plc from the due date until the outstanding amount is paid in full.

Rights in Input Material and Output Material

The property and any copyright or other intellectual property rights in:

any Input Material shall belong to the Client

any Output Material and any amendments or variations to the Input Material made by CDS shall, unless otherwise agreed in writing between the Client and CDS, belong to CDS, subject only to the right of the Client to use the Output Material for the purposes of utilising the Specified Service.

Any Input Material or other information provided by the Client which is so designated by the Client and any Output Material shall be kept confidential by CDS, and all Output Material or other information provided by CDS which is so designated by CDS shall be kept confidential by the Client; but the foregoing shall not apply to any Documents or other materials, data or other information which are public knowledge at the time when they are so provided by either party, and shall cease to apply if at any future time they become public knowledge through no fault of the other party.

The Client warrants that any Input Material and its use by CDS for the purpose of providing the Specified Service will not infringe the copyright or other rights of any third party, and the Client shall indemnify CDS against any loss, damages, costs, expenses or other claims arising from any such infringement.

Warranties and Liability

CDS warrants to the Client that the Specified Service will be provided using reasonable care and skill and, as far as reasonably possible, in accordance with the Specification and at the intervals and within the times referred to in the Specification Sheet. Where CDS

supplies in connection with the provision of the Specified Service any goods (including Output Material) supplied by a third party, CDS does not give any warranty, guarantee or other term as to their quality, fitness for purpose or otherwise, but shall, where possible, assign to the Client the benefit of any warranty, guarantee or indemnity given by the person supplying the goods to CDS.

CDS shall have no liability to the Client for any loss, damage, costs, expenses or other claims for compensation arising from any Input Material or instructions supplied by the Client which are incomplete, incorrect, inaccurate, illegible, out of sequence or in the wrong form, or arising from their late arrival or non-arrival, or any other fault of the Client. Except in respect of death or personal injury caused by CDS's negligence, or as expressly provided in these Conditions, CDS shall not be liable to the Client by reason of any representation (unless fraudulent), or any implied warranty, condition or other term, or any duty at common law, or under the express terms of the Contract, for any loss of profit or any indirect, special or consequential loss, damage, costs, expenses or other claims (whether caused by the negligence of CDS, its servants or agents or otherwise) which arise out of or in connection with the provision of the Specified Service or their use by the Client, and the entire liability of CDS under or in connection with the Contract shall not exceed the amount of CDS's charges for the provision of the Specified Service, except as expressly provided in these Conditions.

CDS shall not be liable to the Client or be deemed to be in breach of the Contract by reason of any delay in performing, or any failure to perform, any of CDS's obligations in relation to the Specified Service, if the delay or failure was due to any cause beyond CDS's reasonable control.

Termination

Either party may (without limiting any other remedy) at any time terminate the Contract by giving written notice to the other if the other commits any breach of these Conditions and (if capable of remedy) fails to remedy the breach within 30 days after being required by written notice to do so.

Insolvency of Client

This clause applies if:

the Client makes any voluntary arrangement with its creditors or (being an individual or firm) becomes bankrupt or (being a company) becomes subject to an administration order or goes into liquidation (otherwise than for the purposes of amalgamation or reconstruction); or

an encumbrancer takes possession, or a receiver is appointed, of any of the property or assets of the Client; or

the Client ceases, or threatens to cease, to carry on business; or

CDS reasonably apprehends that any of the events mentioned above is about to occur in relation to the Client and notifies the Client accordingly.

If this clause applies then, without prejudice to any other right or remedy available to CDS, CDS shall be entitled to cancel the Contract or suspend any further provision of services under the Contract without any liability to the Client, and if the Services have been provided but not paid for the price shall become immediately due and payable notwithstanding any previous agreement or arrangement to the contrary.

General

These Conditions (together with the terms, if any, set out in the Specification Sheet) constitute the entire agreement between the parties, supersede any previous agreement or understanding and may not be varied except in writing between the parties. All other terms and conditions, express or implied by statute or otherwise, are excluded to the fullest extent permitted by law.

Any notice required or permitted to be given by either party to the other under these Conditions shall be in writing addressed to the other party at its registered office or principal place of business or such other address as may at the relevant time have been notified pursuant to this provision to the party giving the notice.

No failure or delay by either party in exercising any of its rights under the Contract shall be deemed to be a waiver of that right, and no waiver by either party of any breach of the Contract by the other shall be considered as a waiver of any subsequent breach of the same or any other provision.

If any provision of these Conditions is held by any competent authority to be invalid or unenforceable in whole or in part, the validity of the other provisions of these Conditions and the remainder of the provision in question shall not be affected.

Any dispute arising under or in connection with these Conditions or the provision of the Specified Service shall be referred to arbitration by a single arbitrator appointed by agreement or (in default) nominated on the application of either party by the President for the time being of Institute of Arbitrators.

English law shall apply to the Contract, and the parties agree to submit to the non-exclusive jurisdiction of the English courts.