Great Billing Quarry

Environmental Permit Application

Hydrogeological Risk Assessment

Mick George Limited

October 2022

Prepared on Behalf of Tetra Tech Environment Planning Transport Limited.

Registered in England number: 03050297

tetratecheurope.com
Tetra Tech Manchester, Quay West at MediaCityUK, Trafford Wharf Road, Trafford Park, Manchester, United Kingdom, M17 1HH
Tetra Tech Environment Planning Transport Limited, Registered in England number 03050297
Registered Office: 3 Sovereign Square, Sovereign Street, Leeds, United Kingdom, LS1 4ER

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1.0 INTRODUCTION

1.1 REPORT CONTEXT

1.1.1 This report has been prepared by Tetra Tech on behalf of Mick George Limited (Mick George) to support an environmental permit application to gain a bespoke waste disposal permit at Great Billing Quarry (the site) in Northamptonshire.

1.1.2 This report presents the Hydrogeological Risk Assessment (HRA) for the proposed waste operation. The objectives of this document are to assess whether the proposed operations and end-use as an inert landfill, its engineered containment design and construction, monitoring network and management controls fulfil the requirements of the Groundwater Regulations 2009 and Landfill Directive 1999 and ensure that the site is in compliance with the requirements of the Environmental Permitting Regulations, 2016.

1.1.3 Details regarding other aspects of the proposed waste operation are provided in other supporting documents that have been prepared to support the Environmental Permit Application. This includes the Environmental Setting & Site Design (ESSD) report, Operating Techniques and Environmental Risk Assessment (ERA).

1.1.4 Due acknowledgement is made for specific background information used in this document which was obtained from Peter Brett Associates LLP report: Environmental Statement, September 2017 parts of which are repeated here for completeness.

1.2 SITE LOCATION

1.2.1 The application site is situated to the east of the Great Billing Water Recycling Centre (WRC) and is located approximately 3km east of Northampton on the south side of the dual carriageway A45. To the north west of the application site but separated from the site by the dual carriageway A45, is the settlement of Great Billing which is part of the larger Northampton urban area (nearest homes in Great Billing are approximately 400m). Also, to the north beyond the A45, is the village of Ecton (nearest homes at approximately 800m) and North east is the village of Earls Barton, over 1km from the site. The River Nene and ponds lie to the south, approximately 400m from site. Further south, beyond the River Nene, lies the village of Cogenhoe, whose closest properties are approximately 800m.

1.2.2 The northern boundary of the application site in the central parts reaches almost to the A45 just south of Ecton Lane where is crosses the A45. In other parts of the site the northern boundary is separated from the

A45 by open land including an area of mature trees and agricultural land. The southern boundary adjoins a restored former mineral workings, comprising water bodies, beyond which is the River Nene. The western boundary of the extraction area is partly formed by an overland drain. Barton Brook forms the eastern boundary of the site and flows south to join the Nene.

1.2.3 The site is centred at approximate National Grid Reference (NGR) SP 83190 62010. The site location and the environmental permit boundary is shown on Drawing Number MGL/B029956/PER/01.

1.2.4 There is a limited height change across the site ranging from approximately 48m above Ordnance Datum (AOD) on the southern boundary up to approximately 51m AOD along the northern boundary.

1.3 BRIEF SITE HISTORY

1.3.1 Based on the historic maps that are available on the Old-Maps website, the site has been used, at least in part, as an irrigation farm as far back as the late 19th Century. Use as an 'Irrigation Field' continues into the 20th century, with tanks shown on the mapping from the 1960s when the site was re-designated a 'Sewage Farm'.

1.3.2 The sewage irrigation use continued until recently, but is no longer actively used on site and much of the site is in arable use.

1.3.3 In July 2018, planning permission (reference 17/00053/MINFUL) was granted by Northamptonshire County Council (NCC) the extraction of sand and gravel, construction of concrete batching plant, processing plant, including ancillary weighbridge, office, workshop, recycling activities and access, plus the importation of inert material and restoration to agricultural and nature conservation.

1.3.4 Planning permission 17/00053/MINFUL was granted to Anglian Water Services Ltd who went out to open tender for contractors to operate the site. Mick George were successful in the tender and they are in the process of dealing with outstanding planning conditions that are required to be discharged.

1.3.5 Following mineral extraction, the site will be restored in accordance with the restoration plan (Drawing Number G13/20/01, Revision B) that was formally discharged by NCC in connection to Conditions 23 and 24 of planning permission 17/00053/MINFUL. The restoration of the site will include a combination of natural habitats in the southern part of the site including reedbeds, wet and neutral grasslands, hedgerows and waterbodies. Areas of arable land with additional boundary features will be included in the northern part of the site.

1.4 PROPOSED DEVELOPMENT

1.4.1 The proposal comprises the importation of inert waste for infilling of the quarry void that would be created following mineral extraction activities at the site and would comprise ten separate phases which are detailed in the phasing plans (Drawing Numbers 0047/PO/01 – 0047/PO/04).

1.4.2 The proposed development would be restored in accordance with the proposed restoration scheme (Drawing Number G13/20/01, Version B) that is approved by NCC.

1.5 LANDFILL DESIGN PHILOSOPHY

Basal Layer

1.5.1 Prior to the commencement of landfilling activities, a geological basal barrier will be constructed in compliance with the 'Landfill Operators: Environmental Permits' guidance (updated 17th February 2022), which specifies a minimum geological barrier of 1m thickness and shall have a hydraulic conductivity less than or equal to $1x10^{-7}$ m/s (See cross section on Drawing Number MGL/B029956/HYD/02 showing engineering details).

Side Sloping Lining

1.5.2 An engineered side wall liner is to be constructed along the sidewall of the quarry and is to have a thickness of 1m and a permeability of no greater than $1x10^{-7}$ m/s.

1.5.3 The proposed construction of the basal and side liner would be to the specification detailed in the Construction Quality Assurance (CQA) Plan that will be produced for the site. The method and testing of the material will be pre-agreed with the Environment Agency (EA) and subsequently demonstrated to ensure that the quality of installation is to the required standards (i.e. no greater than $1x10^{-7}$ m/s).

Capping

1.5.4 In accordance with the current requirements of the Landfill Directive, an engineered cap (clay or plastic) is not required. On completion of filling to final levels, the site will be capped with 1m of restoration soils.

Restoration

1.5.5 The final landform would comprise a complex of wetlands running east to west along the southern side of the site which would be achieved through water management, soil form and planting. Approximately half of the applications site would be restored to farmland, the southern area of which would be a grassland habitat and maintained to encourage biodiversity with new planting. The new planting would include mixed native species hedgerows with trees, and the improvement of existing hedgerows.

Aftercare

1.5.6 Aftercare will be carried out for a period of 5 years following the completion of restoration of any phase and will provide for the management of the soil resources to establish a sustainable after use.

1.5.7 An annual site meeting between Mick George and NCC will be undertaken to review the performance of

the aftercare scheme for that year and agree on a detailed programme for the following year.

1.5.8 Details regarding the site's aftercare are provided in the Closure and Aftercare Plan (Appendix I of the Environmental Permit Application).

1.6 REGULATORY CONTEXT, GROUNDWATER AND SURFACE WATER PROTECTION

Aquifer designation

1.6.1 With reference to the Multi Agency Geographic Information for the Countryside's (MAGIC) and the British Geological Survey's (BGS) website, the drift geology of the site consists of clay and silt (alluvium) which was formed up to two million years ago in the Quaternary Period. The aquifer designation for the drift deposits is Secondary A which is defined as 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

1.6.2 The proposed facility is not located in a Groundwater Source Protection Zone however does coincide with a drinking water safeguard zone (surface water) (MAGIC website).

Licensed and Unlicensed Abstractions

1.6.3 According to Peter Brett Associates LLP (2017) there are five licensed groundwater abstractions within a 1km of the site and primarily relate to process water used in aggregate extraction, general farming and domestic use, spray irrigation and mineral processing. A summary of these abstraction licences is provided below.

Table 1: Abstraction Licences within 1km of the Site

Licence Number	Operator	Location	Abstraction Type	Source	Distance from Site
5/32/05/*G/0042	Hanson Quarry Products Europe Ltd	Billing East Lagoon	Process water	Groundwater	205m, south west
5/32/05/*G/0042	Amey Roadstone Corporation Limited	Well at Cogenhoe	General use	Groundwater	880m, south west
5/32/05/*G/0071	Tarmac Ltd	Billing East Lagoon	Process water	Groundwater	440m, south west
5/32/05/*G/0030	E Ward & Son	Well 2, Lower End Farm	General Farming and Domestic	Groundwater	500m, north east
5/32/05/*G/0030	E Ward & Son	Well 1, Lower End Farm	General Farming and Domestic	Groundwater	665m, north east

1.6.4 The same report by Peter Brett Associates LLP (2017) indicates that there no licenced surface water abstractions within 2km of the site.

Water Table

1.6.5 The interpreted groundwater levels in Appendix B are on average 1m-3m (49mAOD-47mAOD) below the ground surface. The proposed maximum mineral extraction level in the void will be approx. 8.5m (around 41.5mAOD) therefore the working area will be fully saturated and to ensure safe conditions the site will be worked dry via a dewatering scheme. Hence, the installation is defined as being sub-water table. To facilitate the dewatering process, Mick George submitted applications for a surface water discharge permit and a water abstraction licence. Both applications were submitted to the Environment Agency in June 2022.

Hydrology

1.6.6 According to the Flood Map for Planning Service (FMPS) shows that the application site lies within the low probability flood area (Flood Zone 1), medium probability flood area (Flood Zone 2) and high probability flood area (Flood Zone 3). The application site is also shown as being potentially liable to flooding from several local reservoirs / water bodies.

1.6.7 Water bodies within the vicinity of the site include the River Nene which lies to the south of the application site and flows east roughly parallel to the southern boundary of the site. Billing Brook is located approximately 1.5km west of the site. The Ecton Brook flows south through the Ecton Brook Linear park along the western edge of Great Billing, towards the Great Billing WRC.

1.6.8 The Barton Brook flows south from Sywell Wood some 7.5 km to the north of the site. Its route takes it

beneath the A45 from where it flows along the eastern boundary of the site and into the Nene. The Brook is joined at Sywell Reservoir (approximately 2.7 km north of the site) by a tributary originating in the north-east of Sywell village.

Ecology

1.6.9 A 'Nature and Heritage Conservation Screen' (Reference EPR/KB3109GZ/A001) was requested from the Environment Agency. The screen determines the presence of any site of nature and heritage conservation, or protected species or habitats that may be impacted by the proposal. A copy of the results is appended in the Environmental Risk Assessment (Appendix D of the Environmental Risk Assessment).

1.6.10 The results of the screen identified the following:-

- Two Local Wildlife Sites (Ecton Backwater and Ecton Gravel Pits) within 200m of the site;
- The following protected species within 500m of the site:
  - Brown trout (*Salmo trutta*)
  - European eel (*Anguilla Anguilla*)
  - European eel *(Anguilla Anguilla*) migratory route
  - Bullhead (*Cottus gobio*)
  - Spined loach (*Cobitis taenia*)
  - Water Vole (*Arvicola amphibius*)

2.0 CONCEPTUAL HYDROGEOLOGICAL MODEL

2.0.1 The conceptual hydrogeological model for the site is based on the source-pathway-receptor linkages and relies on the geological and hydrogeological information gathered during site investigations.

2.0.2 A preliminary schematic conceptual hydrogeological model for the site (See cross sections in Drawing number MGL/B029956/HYD/02). This model will be updated as the site develops and more information becomes available.

2.0.3 It is proposed to excavate to the base of the Whitby Mudstone with 1 in 2.5 slopes.

Source: potentially-contaminating leachate that could be generated by rainfall infiltration through the emplaced inert material and any moisture inherent to the inert material itself.

Pathways: to include the landfill liner system (base and sides), an unsaturated zone within the *in situ* geology, and a saturated zone below the groundwater table in which dilution and degradation processes may occur.

Receptors: the groundwater system beneath the site is considered to be the primary receptor. To our knowledge there are no secondary receptors in the form of licensed surface water abstractions.

2.0.4 A detailed discussion of the three components of the conceptual model is given in the sections below.

3.0 CONCEPTUAL MODEL: SOURCE TERM

3.0.1 The requirements of the Landfill Directive for the disposal of inert waste material do not necessitate the installation of a leachate management or monitoring system. However, a leachate source term component will be incorporated into this risk assessment process.

3.0.2 Permitted wastes accepted at the site will be strictly inert as classified under the Landfill Directive (1999/31/EC) and Council Decision (2003/33/EC) of 19 December 2002 'Establishing criteria and procedures for the acceptance of waste landfills'.

3.0.3 Details regarding the proposed waste types including restrictions are provided in the Operating Techniques (Appendix B of the Environmental Permit Application).

3.0.4 A volume of 1,000,000m^3 of imported material (or 1,600,000 tonnes using a conversion factor of 1.6m^3/tonne) is required in order to restore the site following mineral extraction.

3.0.5 The proposed types of waste to be deposited into the landfill void are detailed in the Operating Techniques report (Appendix B of the environmental permit application).

3.0.6 However, a consideration is made for the potential of accepting waste that is not inert (e.g. potentially contaminated soil) or non-inert waste concealed within a load of waste that appears to be inert. Due to the inert nature of the material to be used to restore the quarry, it is considered highly unlikely that water coming into contact with the material at the site will generate high concentrations of pollutants. It is proposed to screen incoming waste under Council Decision (2003/33/EC) Inert waste acceptance criteria.

3.0.7 It is recognised that hazardous substances and non-hazardous pollutants are present in these criteria and could occur from rogue loads of non-inert waste. However, to mitigate this, the operator would restrict the source of waste materials allowed on to the site and all waste would be subject to stringent Waste Acceptance Procedures (as detailed in the Operating Techniques, Appendix B of the Environmental Permit Application). It is therefore considered that hazardous substances are not expected to be present and non-hazardous substances are expected to be low with respect to the background groundwater quality.

3.0.8 The likelihood of any (or both) of these types of actions is predicted to be very low as strict source characterisation procedures will be applied to the loads being imported and visual inspection of each load will be undertaken prior to and during disposal.

3.0.9 Any fuel tanks and oil drums used on the site and by sub-contractors will be stored in a containment bund

capable of containing 110% of the total quantity of fuel present at any one time.

3.0.10 All fuel spillages from moving plant or machinery will be remediated immediately in a safe and controlled manner by ensuring spills kits are kept on site and checked daily.

4.0 CONCEPTUAL MODEL: PATHWAYS

4.1 GEOLOGY

4.1.1 A total of 18 no. boreholes (BH1 to BH18) were installed around the site's perimeter in 2021 and their logs are shown in Appendix A. Additional boreholes(BHA to BHN) were installed within the site but no drilling logs were available at the time of writing this report. It is assumed that these remaining boreholes intersected the same geological units as those drilled in 2021. In addition to providing basic geological and hydrogeological information these boreholes indicated the depths of exploitable minerals. For the locations of all drilled monitoring boreholes (BH1 to BH18 in blue and BHA to BHN in red) see Drawing Number GtB.Q_mpp_1121.

4.1.2 According to the British Geological Survey's (BGS) 'Geology of Britain Viewer' and drilling information gathered, the geological sequence beneath the site is composed by approximately up to 0.7m of topsoil and subsequently clay and silt deposits of variable thickness, which are identified as alluvium overlying the Whitby Mudstone formation.

4.1.3 According to the results from the BGS' "Geology of Britain Viewer" there is no evidence of any mine activities (subsurface pathways) beneath the site.

4.2 HYDROGEOLOGY: AQUIFER DESIGNATION AND GROUNDWATER VULNERABILITY

4.2.1 The MAGIC website shows that the groundwater vulnerability for the site is Low – Medium.

4.2.2 As noted in Section 1.6, the aquifer designation for the drift deposits is Secondary A whereas the solid geology (Whitby Mudstone) is unproductive.

4.3 GROUNDWATER MONITORING BOREHOLES

Groundwater levels

4.3.1 The available groundwater data submitted by Mick George were plotted on the hydrograph of Appendix B (raw level data also in this appendix). The following comments apply to the plotted data:-

- The highest average water table levels are recorded in those boreholes located along the northern boundary of the proposed development i.e., BH2, BH3, BH4, etc. , whereas the lowest average levels

were generally measured in boreholes situated along the southern boundary of the site i.e., BH11, BH12, BH13, BH14. From these data the groundwater flow direction can be inferred to be broadly north west to south east towards the River Nene, and reflecting the general topographic gradient of the area;

- A groundwater contour map has been prepared and is presented as Drawing Number MGL/B029956/HYD/01.

4.3.2 The inferred groundwater flow direction has allowed for the identification of the up- and down-gradient boreholes. However, due to be high number of these monitoring points around the site's boundary only a limited representative number have been chosen to provide adequate coverage of potential pathways for contaminants movement, namely:-

- Up gradient: BH2, BH4, BH6, BH7, and BHB
- Down gradient: BH11, BH13, BH14, BH16 BH18 and BHN.

Baseline Groundwater Quality

4.3.3 Groundwater quality data were obtained from the boreholes forming the current monitoring network (Drawing GtB.Q_mpp_1121) between November 2021 and August 2022.

4.3.4 The groundwater quality results for the indicator substances ammoniacal nitrogen (Amm. N) and chloride are chosen to identify are potential contamination arising from inert landfills due to their high mobility. Sulphate is included as an additional substance since it has been identified as being a primary potential leachable component of inert waste along with chloride.

4.3.5 Various metals have also been included in the interpretation of the chemical characteristic of the groundwater .

4.3.6 The raw and plotted data to derive the time series chemographs are shown in Appendix C. Plotting of "less than" reported values has been possible by substituting the limit of detection value as reported by the laboratory thus representing a more conservative concentration.

4.3.7 It should be noted that potential outliers have not been removed at this stage due to the limited amount of monitoring data available. However, statistical analysis has been performed on the data set for the calculation of the Compliance Limits (CLs) in Section 6.2.

Up-gradient boreholes

- The Amm. N chemograph displays a peak in values in all five monitoring boreholes on the same visit i.e., March 2022. The remaining data points are in a harmonised linear pattern, with no discernible trends. Average concentrations are recorded between a maximum of 0.8mg/l in BH7 in spite of the anomalous value of 2.6mg/l and a minimum of 0.10mg/l, however the maximum value recorded could be skewed as a result of the noted peak.

- Chloride average concentrations are all below 200mg/l for these up-gradient boreholes although a distinctive value of 180mg/l was returned for Jan. 2022 sampling round in BHB although its trend thereafter is see as decreasing. The remaining trends are generally stable and linear which reflect the range in average concentrations of between 50mg/l and 157mg/l.

- Average sulphate values are within a relatively narrow range of between 191mg/l and 91mg/l. The plot of these concentrations displays a relatively stable and linear trend for all the monitoring locations with the exception of the reading taken in Nov. 2021 from BH7. This monitoring point shows a clear decrease in concentration thereafter and in the context of the pattern shown by the remaining readings is considered to be marginally anomalous.

- Common metal values up-gradient display similar patterns within the five monitoring boreholes, with cadmium, mercury and lead detected below the laboratory's limit in all the visits expect for mercury in April 2022 and for lead in Jan. 2022. Iron is consistently being found in the dissolved state and values are mostly below the limit of detection (Lod). The remaining metals have varying concentrations between being below the limits of detection or a narrow range of values.

Down gradient boreholes

- The Amm. N plot is also affected by a noted spurious (anomalous) behaviour of values found during May 2022 visits in all the six monitoring boreholes. For the remainder of the previous monitoring period trends are mostly linear and stable and fall within a very narrow range of values. Average concentrations vary between a minimum of 0.2mg/l and a maximum of 1.1mg/l, although this latter value is significantly affected by the noted peak in concentration recorded within BH16 in May 2022.

- Average chloride concentrations are also all below 200mg/l and fall within a range of 57mg/l and 126mg/l. The linear trends displayed in the chemograph by all the monitoring points reflect the narrow plotting series of these boreholes. The only pattern to be noted is for BH16, which is increasing up to 140mg/l in March 2022 and then stabilises in the last three visits.

- Average sulphate values are within a range of between a maximum of 336mg/l and a minimum of 77mg/l, inexplicably noticeably higher compared to those for the up-gradient boreholes. The plot of these concentrations displays a relatively stable and linear trend for all the monitoring locations with the exception of BH16, which shows an initial maximum of around 600mg/l with a noticeable decrease to less that 200mg/l in March 2022.

- Metal values down-gradient display somewhat contrasting patterns to those from the up-gradient boreholes . To note is the concentrations of cadmium which at times are above the LoDs during many of the sampling visits in contrast to the concentrations below the LoD in the up-gradient monitoring facilities. A response to concentrations above LoDs is seen for lead in the down-gradient boreholes in Jan. 2022 – at the same time as that shown in the up-gradient boreholes. Lastly mercury shows values above the LoD in Apr. 2022 at the same time as those recorded in the up-gradient boreholes. Again, the remaining metals have varying concentrations between being below the limits of detection or a narrow range of values, although is it interesting to note that manganese in the downgradient boreholes was consistently measured at values sometime one order of magnitude above those in the up-gradient boreholes.

4.3.8 As an overall comment, the groundwater quality between the up-gradient and down-gradient monitoring points is generally similar, as expected to be found within a hydrogeological environment that is undeveloped. The rapid concentration flux time noted for lead and mercury are an indicator that the aquifer system is highly responsive to any potential contamination arising from the landfill.

Long Term Hydrogeological Changes

4.3.9 Hydrogeological changes are expected within the Superficial Deposits as a result of the proposed extraction activities. These impacts are predicted as localised changes to recharge characteristics and flow directions; but would not affect resources within the underlaying Chalk Formation. The impact of the proposed activity on recharge and flow direction are assessed as being minor, but long term, due to the localised nature of the development.

4.3.10 Any impacts in terms of both magnitude and duration that future climatic changes could bring about on the groundwater regime are too difficult to predict given the localised nature of the development.

5.0 CONCEPTUAL MODEL: RECEPTORS

5.1 CURRENT LICENSED/EXEMPT GROUNDWATER OR SURFACE WATER ABSTRACTIONS

5.1.1 As noted in Section 1.6.3, there are five groundwater abstraction licences within 1km of the site. The licence (reference 5/32/05/*G/0042) is located approximately 205m north east of the site.

5.1.2 As noted in Section 1.6.4, the site does not lie within the source protection zone (SPZ) but does coincide with a drinking water safeguard zone.

5.1.3 Therefore, the underlying remaining geological unit(s) i.e. the remaining alluvial deposits, is considered to be the principal receptor for this assessment, following extraction of the superficial mineral units.

5.2 EXISTING NATURAL/INDUCED DISCHARGES (E.G. SPRINGS/WETLANDS)

5.2.1 Groundwater flow direction appears to be north west to south east, down the topographic dip of the strata towards the River Nene.

Surface Water

5.2.2 The site lies within the Nene Middle catchment and the river flows approximately 330m south of the site and therefore is considered to be a potential receptor. In addition, there are a number of lakes around the site which may be considered as potential receptors.

5.3 SITES OF ECOLOGICAL OR NATURE CONSERVATION SIGNIFICANCE

5.3.1 As noted in Section 1.6, there are two Local Wildlife Sites within the vicinity of the site. In addition, the River Nene and surrounding lakes some of the lakes that have been created from previous restoration works support European eel, Brown Trout, Bullhead Cottus, Spined Loach and Water Vole.

6.0 QUANTITATIVE HYDROGEOLOGICAL RISK ASSESSMENT

6.1 THE NATURE OF THE ASSESSMENT

6.1.1 The proposed environmental permit application will be submitted for the site in order to receive inert materials. Given the definition of the inert wastes to be imported, the total leachability, pollutant content and ecotoxicity of any leachate generated are considered to be insignificant and unlikely to endanger the quality of any receiving environment.

6.1.2 In line with current legislation, inert landfills could be subject to a quantitative risk assessment process if a reduction in the specification of the Landfill Directive, Annex 1 “geological barrier”, would be considered and the receiving environment has been identified as being particularly sensitive.

6.1.3 In the case of the proposed geological barrier its specification, as set out in the Operating Techniques, will not be reduced therefore the receiving environment i.e. the limited areal extent of the remaining alluvial deposits is not affected. However, due to the sensitive nature of the receiving environment a quantitative risk assessment will be undertaken in order to consider the risk due to an accidental acceptance of a rouge load of materials.

6.1.4 The inert nature of the materials imported into the site will ensure that any leachate generated (both in terms of quality and quantity) is expected to pose a negligible risk to the receiving environment therefore has considerably lowered the sensitivity of the first component of the Source-Pathway-Receptor linkage.

6.1.5 The likelihood of accidents that could result in a potential impact would be during the operational phase of the excavation and infilling activities, when plant and machinery are used in those tasks. Any fuel tanks and oil drums used on the site and by sub-contractors will be stored in a containment bund capable of containing 110% of the total quantity of fuel present at any one time.

6.1.6 All fuel spillages from moving plant or machinery will be remediated immediately in a safe and controlled manner by ensuring spills kits are kept on site and checked daily. However, the risk is considered low and closely related to efficient site management and conscientious equipment and plant operators who will ensure lowering/minimising risk through a robust implementation of site procedures which are detailed in the Operating Techniques document accompanying this application.

6.1.7 A risk screening exercise has also been carried out in order to identify key contaminants potentially generated within the leachate and associated with the Waste Acceptance Criteria (WAC) to be adopted, in accordance with EU Council Decision 2003/33/EC.

6.1.8 However, a quantitative assessment will be undertaken based on the secondary nature of the aquifer around and beneath the site and the possibility of a rogue load(s) being accepted on site presented as a sensitivity analysis calculation, on the assumption that some materials would not be subjected to testing, even though it has been stated that specific waste codes will be tested (see Section 6.1.15).

6.1.9 The current conditions around the site show that groundwater levels will be above the base of the development and as such would require the application of a hydraulic containment model in order to quantify the potential for the site to contaminate.

6.1.10 The application of the Agency's "Contaminant Fluxes from Hydraulic Containment Landfill Spreadsheet V1.0" as the modelling tool for contaminant transport evaluation, supported by the characterisation of the source term using data available either from literature or site obtained.

6.1.11 The developed models are presented in Appendix D, for the three chosen indicator substances (non-hazardous pollutants) i.e. Amm N, chloride and sulphate, as well as one hazardous substance – chromium due to its high mobility.

6.1.12 The emissions to groundwater, in accordance with the results from the hydraulic containment spreadsheet tool, show that all the chosen substances do not to pose a contamination risk from the proposed cell – no contaminant flux has been detected at the compliance point to cause pollution.

6.1.13 In order to simulate the highly unlikely importation of a series of rogue loads that could have an impact on the groundwater quality, a sensitivity analysis has been carried for the five chosen substances by increasing the concentration of the source term x 100 the current average concentrations found in the up-gradient groundwater.

6.1.14 Even at these excessive concentrations the sensitivity models show that no breakthrough of contaminants is detected at the down-gradient compliance point, therefore the proposed engineered design of the basal and side slope system meets with the requirements of Paragraph 6 of Schedule 22 to EPR 2016).

6.1.15 The proposed material to be imported will fully comply with the waste types listed in Tables 2 and 3 of the Operating Techniques (OT) report submitted as part of this application. In particular, Table 3 (page 5 of the OT) details those materials whose waste codes will be subjected to WAC testing.

6.2 COMPLIANCE LIMITS (CLS)

6.2.1 Although the site will accept inert materials, a set of Compliance Limits (CL) will still be required to form part of the Environmental Permit, since this is defined as a value set at the down gradient compliance points

BH11, BH13, BH14, BH16 BH18 and BHN, calculated to be a maximum concentration allowable at that point in order to protect the identified potential principal receptor i.e. groundwater. Four indicative substances had been chosen for this purpose: Amm N, chloride, lead and sulphate.

6.2.2 The proposed compliance limits in Table 2 are derived using the Agency's accepted protocol of the mean plus 3 times standard deviations using the average data from the up-gradient boreholes for non-hazardous substances Amm N, sulphate and chloride.

6.2.3 For hazardous substance lead the CLs are set at the corresponding minimum reporting value (MRV) as defined in UK Technical Advisory Group (UKTAG) – "Technical report on groundwater hazardous substances".

6.2.4 The anomalous situation of the down-gradient sulphate concentrations being higher than those up-gradient, is temporarily balanced by the derivation of CLs using average concentrations of the down-gradient boreholes plus one standard deviation.

Table 2: Compliance Limits

Substance	MRV (mg/l)	Selected CL (mg/l)
Lead	0.0002	0.0002
Chloride		123
Sulphate		405
Amm N		1.26

6.2.5 It is recommended these CLs be reviewed during the annual monitoring reporting process but also informally following each monitoring visit due to the specific environmental circumstances associated with the site once operational.

7.0 REVIEW OF TECHNICAL PRECAUTIONS

7.1 REVIEW OF TECHNICAL PRECAUTIONS

7.1.1 A series of necessary technical precautions have been identified as part of this risk assessment, which will be reviewed during the life of the permit.

Capping

7.1.2 On completion of infilling to final waste levels, the installation will not require a capping system but the final landform will be restored with soil materials recovered during the preparation phase of the site.

Lining Design

7.1.3 The base and side slopes will have an engineered containment system, which has been risk assessed on the basis of the proposed design and according to the waste stream to be imported.

7.1.4 Additional confidence in the robustness of these designs will be provided by the CQA supervision programme that will be implemented during the construction phases of each individual cell.

Leachate Head Control, Drainage and Extraction Systems

7.1.5 These operational controls will not be required as the installation is an inert landfill.

Groundwater Management

7.1.6 Given the difference in proposed basal level of the development and current average groundwater elevations it is expected to counteract groundwater inflows with a dewatering system. As a result the site is defined as being sub-water table. As mentioned in Section 1.6.5, Mick George have applied for a surface water discharge permit and a water abstraction licence to facilitate the dewatering process.

7.1.7 The operator will also ensure that any rainfall collected within the open void is managed as necessary. Site CQA supervision will also ensure that any potential heave encountered during construction works will be managed and that safe working conditions will be maintained.

Surface Water Management

7.1.8 A surface water management system has been proposed and will be installed around the perimeter of the site in the form of collection drains and any water generated will be conveyed into infiltration ponds located

down-gradient of these ditches.

8.0 REQUISITE SURVEILLANCE

8.1 THE RISK BASED MONITORING SCHEME

Groundwater Monitoring

8.1.1 Groundwater level and chemical data are to be collected from the groundwater monitoring points shown in Drawing GtB.Q_mpp_1121.

8.1.2 The parameters to be sampled and monitoring frequency to be included in the Environmental Permit are presented in Table 3 below. These requirements are considered adequate in providing an ongoing characterisation of the groundwater conditions.

Table 3: Groundwater Determinants and Sampling Frequency

Monthly	Quarterly	Annually
Levels	pH, Chloride, Alkalinity, Amm N, Sulphate, Sodium, Potassium, Iron, Manganese, Cadmium, Chromium, Copper, Calcium, Nickel, Lead, Zinc, Electrical conductivity, Magnesium, Selenium, and Mercury.	*To include quarterly suites plus Hazardous substances:*

Surface Water

8.1.3 Surface water run-off will be controlled and conveyed in accordance with the agreed Surface Water Management Plan. Also, as mentioned in Section 1.6.5, Mick George have submitted an application for a water discharge permit to facilitate dewatering at the site. As such, it's proposed that surface water monitoring will be undertaken in accordance with the conditions of the water discharge permit.

8.2 CONTINGENCY ACTION PLAN

8.2.1 An annual review of the proposed compliance limits should be carried out and any alterations in the compliance levels discussed and agreed with the EA.

8.2.2 Where the site monitoring programme identifies an increase in groundwater determinants that could lead to a breach, then a series of contingency actions will be required. Suggested contingency actions, which will need to be agreed with the EA, are presented in Table 5.

Table 5: Suggested Contingency Actions

Appropriate Contingency Action	Timescale
Advise Site Management	Immediately
Advise Operator's Environmental Manager	1 Day
Advise EA	1 Day
Confirm by repeat sampling and analysis	1 Month
Review existing monitoring information	1 Month
Review site management/operations, implement actions to prevent future failure of a compliance level	3 Months
Review assumptions in conceptual site model	3 Months
Review existing HRA Compliance Levels	6 Months
Consult EA about need for corrective action	6 Months

9.0 CONCLUSIONS

9.0.1 The proposed engineered containment for the inert landfill at the site (Great Billing Quarry) complies with the requirements of the Landfill Directive.

9.0.2 Surface water runoff is to be controlled within a proposed set of perimeter ditches around the landform and gravity released to infiltration ponds down-gradient of the development.

9.0.3 The proposed installation will comply with current engineering design, materials, specifications and CQA protocols applicable to current landfill containment best practices.

9.0.4 An independent CQA procedure will be carried out for all aspects of the basal and sidewall lining construction. This ensures that the liner meets the required engineering standards and thus complies with the Landfill Directive and will not have an impact on the groundwater system.

9.0.5 The hydraulic quantitative modelling has demonstrated that the proposed geological barrier will provide adequate containment of landfill 'leachate' to meet the requirements of Landfill Directive (1999/31/EC) and will provide sufficient attenuation to prevent a risk to the underlying strata and groundwater environment.

9.0.6 Compliance limits for groundwater have been derived and a robust monitoring network has been installed to ensure that the future performance of the site will be correctly managed.

9.0.7 The requirements of the Groundwater Regulations, 2016, have been satisfied by the inclusion of requisite surveillance of the groundwater quality to be carried out regularly as discussed in Section 8.

DRAWINGS

MGL/B029956/HYD/01 - Groundwater contours

MGL/B029956/HYD/02 – Conceptual Model for HRA

MGL/B029956/PER/01- Environmental Permit Boundary

0047/PO/1 – 0047/PO/4 (4 Drawings) – Phasing Plans

G13/20/01 (Version B) – Restoration Strategy Plan

GtB.Q_mpp_1121 – Monitoring Point Plan

APPENDICES

APPENDIX A – BOREHOLE LOGS

APPENDIX B – GROUNDWATER LEVEL DATA AND PLOT

APPENDIX C – GROUNDWATER QUALITY DATA AND PLOTS

APPENDIX D – HYDRAULIC CONTAINMENT MODELS