ENVIROARM LTD

Group of Companies

ENVIRONMENTASL SETTING AND SITE DESIGN FOR WOODCOTE WOOD QUARRY LANDFILL SITE

REF: ESSD/WWQ/NRS/1.00/2023

Carried out for: **NRS Woodcote Aggregates Ltd**

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ENVIRONMENTAL SETTING AND SITE DESIGN

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Detail		Site location in relation to surrounding features			
Dwg No	**ESSD2**	**Scale**	10,000	**Title**	Environmental Site Setting
Detail		Installation boundary			
		Residential areas			
		Schools			
		Recreational areas			
		Waterways			
		Water bodies			
		Agricultural areas			
		Urban sites			
		Flood risk map overlay			
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		Topography 500m outside site			
Dwg No	**ESSD3**	**Scale**	25000	**Title**	Cultural and Natural Heritage
Detail		Natural heritage SSSIs, AONBs, National Parks cSACs, cSPAs, Ramsar sites Ancient Monuments			
Dwg No	**ESSD4**	**Scale**	2500	**Title**	Site Layout and Waste Deposition
Detail		Site Infra Structure			
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Dwg No	**ESSD6**	**Scale**	2500	**Title**	**Site Phasing**
Detail		Phases 1, 2 and 3			
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Detail		Regional geology (taken from BGS Geological Map)			
		Any appropriate regional cross sections			
Dwg No	**ESSD9**	**Scale**	12500	**Title**	**Regional Hydrogeology**
Detail		Aquifer classification			
		SPZs			
		Licensed and private abstractions from ground and surface water			
		Regional groundwater contours (for each ground water body)			
		Groundwater vulnerability			
		Off-site groundwater monitoring points (e.g. relevant EA Observation Wells etc)			
Dwg No	**ESSD10**	**Scale**	2500	**Title**	**Local Hydrogeology and Hydrology**
Detail		Groundwater monitoring points (constructional logs within an Appendix ESSD 7)			
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		Inter-relationship between; site (base and sides), leachate levels, groundwater levels and relevant surface water features			
Dwg No	**ESSD11**	Scale 2500		Title	**Conceptual Model**
Detail		Geology and Hydrogeology of Site			
Dwg No	**ESSD12**	**Scale**	**Title**		**Source, Pathway, Receptors**
		Met station location (if on site)			
		Receptors			
		Surface water Groundwater Amenity			
		Pathways			
		Air- include wind rose Surface water and surface water monitoring points Groundwater Drains- pipes etc Migration through surrounding strata			

APPENDICES

1.0 INTRODUCTION

1.1 Report Context

Enviroarm Limited were instructed by NRS, the operators of Woodcote Wood Quarry to prepare an environmental permit application for inert waste landfilling to allow for restoration of the site by way of inert landfill, infilled in designated phases within the environmental permit boundary.

The site will also operate a treatment area accepting construction and demolition wastes, soils etc., and for treatment by crushing and screening and wet washing of soils and construction and demolition waste.

This report provides a summary to the geological and hydrogeological setting of the site, the wider environmental setting and considers the operational impacts and installation design by inert landfill and the assessment demonstrates compliance the Environmental Permitting (England and Wales) Regulations 2016. Additional assessments include a Site Stability Assessment, Hydrogeological Risk Assessment, Landfill Gas Risk Assessment, and Amenity and Nuisance Assessment.

The site is off the A41 in Weston Heath, Sheriffhales, Shropshire, 5km south of Newport town centre and 4.2km north of the A5. The centre of the site is at National Grid reference SJ 77036 14780 and the site entrance is SJ 77388 14944 see Figure 1 and Drawing ESID 1.

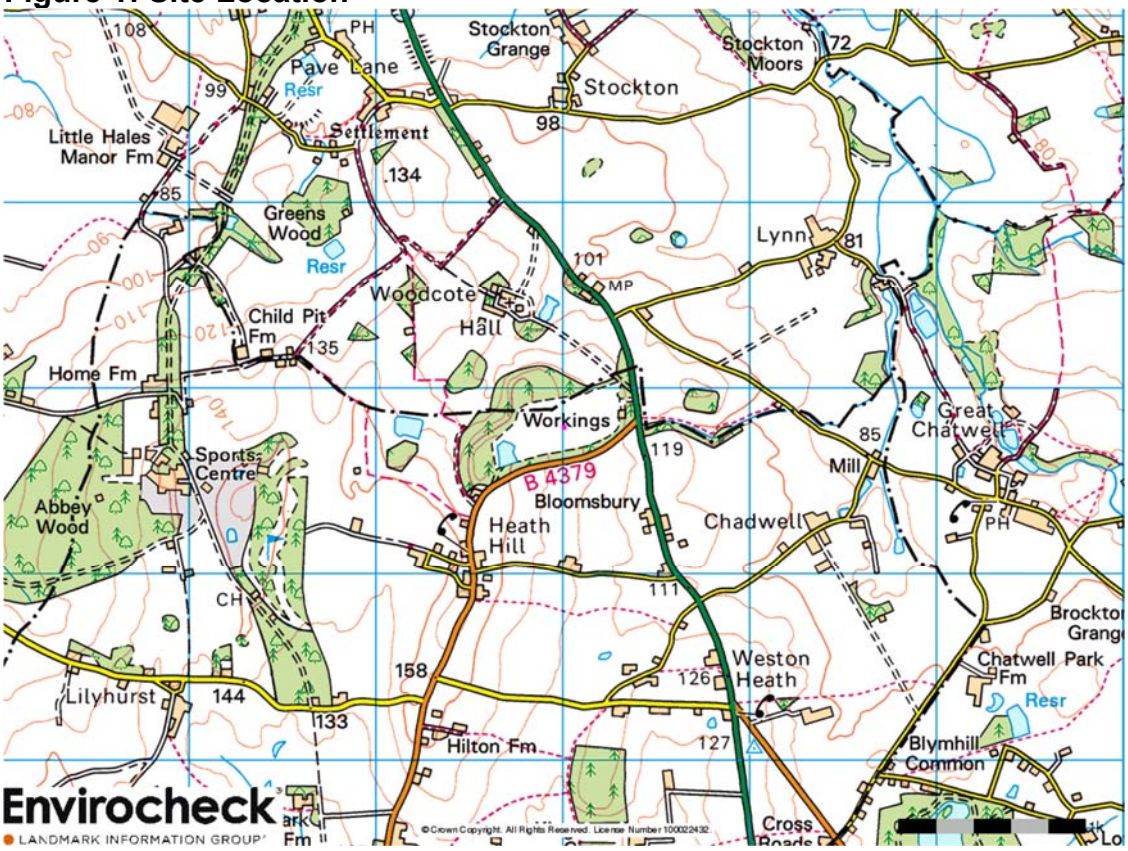
The Site comprises 22.4 hectares of agricultural land, which includes a woodland area. The site is a quarry.

The site is to be infilled specifically with inert waste which complies with the Landfill Tax (Qualifying Material) Order or is to be WRAP compliant and therefore outside the scope of the permit and will take 10 years to infill.

The site will accept up to accept 350,000 tonnes per year of waste for recycling equating to an average of 6,730 tonnes per week and storage of up to 10,000 tonnes.

The landfill site can take up to 900,000 tonnes per year of inert waste into the landfill.

Figure 1: Site Location



The site falls within the control of Shropshire County Council for mineral and waste planning permission and compliance.

This report presents a review of the Environmental Setting and Installation Design in relationship to the surrounding environment.

This report covers all Phases of the site from the advance works to the proposed landfill area and treatment centre through to final restoration and requirements for post closure monitoring.

A conceptual model is presented with potential contaminant migration pathways identified. The conceptual model has been developed on site specific data and local data obtained from the British Geological Survey, The Metrological Office, The Environment Agency, The Coal Authority, MAFF and data obtained from on-site testing, including; soils, groundwater, air and noise. A risk analysis for impacts on identified receptors has been developed at the Dorrington Quarry Landfill Site based on the factual findings.

1.2 Installation Details

The site is off the A41 in Weston Heath, Sheriffhales, Shropshire, 5km south of Newport town centre and 4.2km north of the A5. The centre of the site is at National Grid reference SJ 77036 14780 and the site entrance is SJ 77388 14944 see Figure 1 and Drawing ESID 1.

The Installation Boundary has included all of the area for the inert landfill and waste treatment facility, leading through lockable gates, along a fully concreted road to the site reception area which comprises a concrete reception area and turning area, site offices, weighbridge and wheel wash area, bunded fuel tank area and concreted treatment area before leading to the landfill area. The area covered under the current operations are coloured in yellow on ESSD 2 and the boundary is marked in green.

The permit application boundary is covered under all of the planning permissions listed above in Section 1.1.

Figure 2: Aerial view of site

The entire quarry perimeter is fenced with three strand barbed post and wire fence. The outer limit of the quarry has a hedgerow and tree planting. The site security fencing is considered adequate under the provisions of the Mines and Quarries Regulations 1999 in the location. The site has a substantial access to the site fitted with lockable gates. The site is within the entire ownership of NRS.

The gates at the site entrance are locked outside operating hours, and the site has offices and a weighbridge, inert treatment facility comprising a washing plant, mobile crusher and mobile screen.

All of the receptors have been identified on Drawing ESSD 2 and have been summarised on the Table ESSD 1, and this has identified the receptors, there elevation and distance from the landfill boundary, within a 500metre radius of the site.

A request was also made to Natural England, the Environment Agency and Shropshire County Council to identify all habitat sites etc. located within a specified radius of the centre of the site.

Table ESSD 1: Receptor List identified on ESSD 2.

Type of Receptor	Receptor Name	Location to site	Elevation m AOD
Domestic Dwelling Receptor	**DR1**	Coach House Cottages and Woodcote Hall, set in woodlands with trees from the site as well protecting it and fields used for agriculture	124m AOD
Domestic Dwelling Receptor	**DR2**	Brandon House, A41. There are trees and the landfill site and fields used for agriculture	104m AOD
Domestic Dwelling Receptor	**DR3**	Chadwell Lane. There are trees around the site and fields used for agriculture	108m AOD
Domestic Dwelling Receptor	**DR4**	Bloomsbury is lower down than the site and the site has trees towards this area and there are fields used for agriculture	114m AOD
Domestic Dwelling Receptor	**DR5**	Cherry Tree Farm and Broad Oak are at the Same height as the landfill has trees towards this area and there are fields used for agriculture	130m AOD
Domestic Dwelling Receptor	**DR6**	Ridge Hose is nearest the landfill to the south west at 145m and has trees between it and the landfill	150m AOD

Domestic Dwelling Receptor	**DR7**	Heath Ridge has trees between it and the landfill and fields used for agriculture	150m AOD
Industrial/ Commercial Receptor	**IR1**	Bloomsbury Garage 464m away from site with tree line at edge of site	114m AOD
Surface Water Receptor	**SW1**	Small Pond by Coach House	112m AOD
Surface Water Receptor	**SW2**	Small ponds by Coach House	110m AOD
Surface Water Receptor	**SW3**	Bolams Brook which leads into Lynn Brook	104m AOD
Surface Water Receptor	**SW4**	Small pond at Bloomsbury	112m AOD
Surface Water Receptor	**SW5**	Pond near Cherry Tree Farm	114m AOD
Surface Water Receptor	**SW6**	Pond at Barbers Gorse	122m AOD
Roads and highways	**HA1**	A41 which runs north and south of the site	104m AOD to the north of the site 120m AOD to the south
Roads and highways	**HA2**	Lynn Road	110m AOD
Roads and highways	**HA3**	Chadwell Lane	110m AOD
Roads and highways	**HA4**	B4379	112m AOD
Roads and highways	**HA5**	Heath Hill Lane	100m AOD
Roads and highways	**HA6**	Nutty Hill Farm Lane	100m AOD

The site is within Source Protection Zone III, on a Principle Aquifer. The indicative flood plain map shows the site to have Zone 3 risk from flooding.

The site has no recorded RAMSAR, SAC or SPA designations and there are no recorded monuments near to the site.

2.0 SOURCE TERM CHARACTERISATION

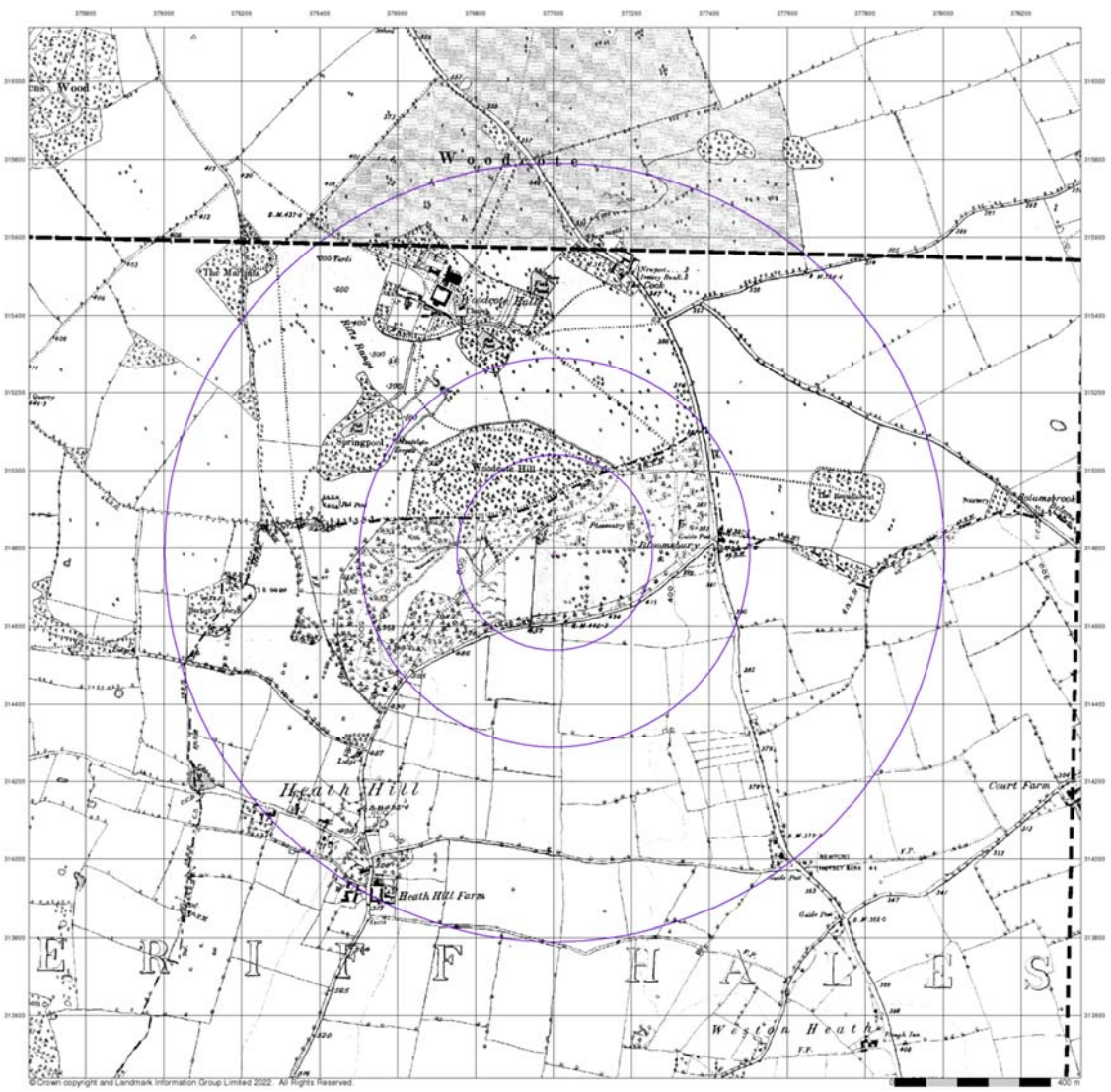
2.1 The Development of the Installation

All details refer to the appropriate tables, drawings or appendices attached to the report.

2.1.1 Historical Development

The site was woodland from 1887 amd became a quarry after a planning permission was granted in 2017.The OS maps for the site our presented at Appendix ESSD1.

Figure 2: Site in 1887 to 1889



Quarry development started in 2018 and is shown on Figures 3 to 5.

Figure 3: Quarrying in 2018

Figure 4: Quarrying in 2020

Figure 5: Quarrying in 2021

2.1.2 Proposed Development

This includes details relating to the following.

- The proposed waste types for the landfill area be inert sub soils which are Tax Qualifying Exempt Materials and inert recycling.

- A non-hazardous waste treatment facility will be operated to process construction and demolition wastes, soils and to recovery secondary aggregates, which will also involve the use of crushers and screens and use of a barrel wash plant. The detailed layout is presented at Drawing ESSD13.

- A skip will be located on site for load rejection.

- The site will have 3 operational phases in the base to complete the landfill final landform. The time taken for all mineral extraction, lining, infilling and restoration is 13 years.

- The site has valid planning permission.

- The final landform is to be fields with trees

- The site permit boundary requires an engineered geological barrier for all of the landfilling.

- No groundwater pumping occurs near to the site and the nearest licensed abstraction is Severn Trent Water at Hilton Bank, south west of the site, JM Bubb & Son north east of the site,1699 metres away and W Maddocks Ltd 1491 metres away of Chadwell Court Farm. .

- The site is within a Source Protection Zone 3 and the site will be designed and operated on the principles of hydraulic containment.

- The proposed final landform is to get the land back tofields as per the original levels prior to any quarrying. and restored areas and is presented at Drawing ESSD 5

2.2 Installation Engineering

2.2.1 Groundwater Management System

Groundwater management is not required for landfilling operations or in the inert recycling area.

2.2.2 Basal Lining System

It is proposed to use inert soils brought to site to form the geological barrier which will be rolled..

The Construction Quality Assurance Plan is presented at Appendix ESSD 2 detailing the method of construction and the standards and testing frequency.

The cells construction shall consist of a basal and side wall seal constructed above the prepared formation level from suitable low permeability material placed and compacted in layers. The thickness of mineral lining shall be a minimum of 1.0m.

The lining material shall be free of unsuitable material and a summary of the design specification is required to meet the following requirements:

i) Permeability ≤1 x10^{-7} m/s BS: 1377: 1990: Part 6: Method 6
ii) Plasticity Index <65% BS: 1377: 1990: Part 2: Methods 4.3 and 5.3
iii) Plasticity Index >10% BS: 1377: 1990: Part 2: Methods 4.3 and 5.3
iv) Clay Content (0.002mm) >8% BS: 1377: 1990: Part 2
v) Percentage Fines >20% BS: 1377: 1990: Part 2
vi) Maximum particle size >187mm* BS: 1377: 1990: Part 2
vii) Percentage Gravel(>5mm) ,≥30% BS: 1377: 1990: Part 2
viii)Liquid Limit <90% BS: 1377: 1990: Part 2: Methods 4.3 and 5.3
ix) Shear Strength >50kN/m^2 BS: 1377: 1990: Part 9

2.2.3 Side Slope Lining System

The Construction Quality Assurance Plan is presented at Appendix ESSD 2 detailing the method of construction and the standards and testing frequency.

The cell construction shall consist of a side wall seal constructed above the prepared formation level from suitable low permeability material placed and compacted in layers. The thickness of mineral lining shall be a minimum of 1.0m.

The lining material shall be free of unsuitable material and a summary of the design specification is required to meet the following requirements:

i) Permeability ≤1 x10^{-7} m/s BS: 1377: 1990: Part 6: Method 6
ii) Plasticity Index <65% BS: 1377: 1990: Part 2: Methods 4.3 and 5.3
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viii)Liquid Limit <90% BS: 1377: 1990: Part 2: Methods 4.3 and 5.3
ix) Shear Strength >50kN/m^2 BS: 1377: 1990: Part 9

The side slope stability has been assessed as part of the Stability Risk Assessment for the permit application presented at Appendix C supporting the application.

2.2.3 Leachate Drainage System

A leachate drainage system is not required at an inert landfill site.

2.2.4 Capping System

An engineered capping system is not required at an inert landfill site.

2.2.5 Restoration and Aftercare

Sub soils and topsoils or soil substitutes will be placed directly above the finished inert landfilling and placed in accordance with the requirements set out in Planning Permissions for the site.

Soil placement and restoration is a requirement set out in Planning Permissions and is to be placed to the satisfaction of the Mineral Planning Authority, Shropshire County Council and the Environment Agency.

The final restoration of the site is to grassland and tree planting, see Drawing ESSD 5.

2.3 Leachate Management and Monitoring Infrastructure

2.3.1 Leachate Generation

Leachate monitoring is a not a requirement at inert landfill sites. The site is designed as with an engineered barrier and unsaturated zone beneath the site.

2.3.2 Leachate Management

The Hydrogeological Risk Assessment has demonstrated that the site is unlikely to generate significant leachate that will have no detrimental impact on groundwater quality.

2.4 Landfill Gas Management and Monitoring Infrastructure

2.4.1 Landfill Gas Generation

The likelihood of gas production based on the Landfill Gas Risk Assessment is very low and it is recommended that internal gas monitoring points are constructed by retro drilling once each phase is completed.

There is no requirement for gas extraction due to the low organic fraction nature of the inert waste and therefore there will be little gas production and not enough gas for gas engines or flaring.

2.4.2 Landfill Gas Management

There is no proposed collection and extraction of landfill gas due to the inert nature of the waste and based on the Landfill Gas Risk Assessment.

There is no requirement for treatment and disposal of the landfill gas including the utilisation plant.

No gas will be flared or utilised on site. No landfill gas will emitted via sidewalls or the cap.

2.4.3 Landfill Gas Monitoring Infrastructure

Gas monitoring boreholes have been constructed around the outside of the landfill site and the locations are shown on Drawing ESSD 7. Gas monitoring will be carried out on a quartely basis at each of the external gas monitoring points using an infra-red gas analyser.

External gas monitoring is from the eight combined groundwater and gas boreholes.

Internal gas monitoring points are presented on Drawing ESSD 7.

Sampling will be undertaken by staff appropriately trained in environmental monitoring procedures, and who are familiar with the equipment and its limitations. The Company warrants that the personnel engaged in monitoring activities are trained to undertake the task. These will comprise the companies own technical personnel, the site manager or nominated deputy, following appropriate training by technical personnel. All monitoring staff undergo a period of job training and in addition external courses are used to supplement internal training. Results will be validated by the sampling personnel detailed above.

Gas monitoring boreholes and gas monitoring points are summarised in Table ESSD 2 and 3 below:

Table ESSD 2: The nature and location of perimeter gas monitoring points

Phase 1	**GV 1- GV2**	Monitoring Point in waste	Design detail on ESSD 7
Phase 2	**GV3- GV6**	Monitoring Point in waste	Design detail on ESSD 7
Phase 3	**GV7-GV11**	Monitoring Point in waste	Design detail on ESSD 7
Perimeter	**BH 1-8**	Monitoring Borehole outside waste. Combined gas and groundwater	Design detail on ESSD 7

2.4.4 Gas Monitoring

The gas monitoring frequency and determined range has been developed based on the landfill gas risk assessment and is summarised below in Table ESSD 3.

Table ESSD 3: Monitoring frequencies for landfill gas

Determinands	Monitoring Frequencies	Units and Accuracies
Methane (CH_4)	Quarterly	%v/v ±0.5%
Carbon Dioxide (CO_2)	Quarterly	%v/v ±0.5%
Oxygen (O_2)	Quarterly	%v/v ±0.5%
Atmospheric Pressure	Quarterly	±1 mb
Differential pressure	Quarterly	±0.1 mb
Meteorological Data	Quarterly	-

2.4.5 Making and submission of records

Records will be kept on site of determinands analysed, date of sampling, sampler, results, units.

A copy of the results of sampling and analysis will be forwarded to the Agency within 1 month of being carried out.

2.5 Surface Water Management System

Surface water is not required at Woodcote Wood.

2.6 Groundwater Management and Monitoring

It is essential to monitor groundwater adjacent to the site for quality to assess the integrity of the performance of the site and to ensure that there is no impact on groundwater.

2.6.1 Groundwater Level and Quality Monitoring

Boreholes are located both up and down hydraulic gradient. Borehole locations are presented on Drawing ESSD 10. The nature and location of the groundwater monitoring boreholes is set out on Table ESSD 5.

Table ESSD 5: Groundwater Monitoring Borehole Locations

Perimeter	**BH 1**	Perimeter Down Hydraulic Gradient	Level and Quality
Perimeter	**BH7**	Perimeter Middle Hydraulic Gradient	Level and Quality
Perimeter	**BH 8**	Perimeter Down Hydraulic Gradient	Level and Quality
Perimeter	**BH 2**	Side of site Hydraulic Gradient	Level
Perimeter	**BH 6**	Side of site Hydraulic Gradient	Level
Perimeter	**BH 3**	Perimeter Up Hydraulic Gradient	Level
Perimeter	**BH 4**	Perimeter Up Hydraulic Gradient	Level and Quality
Perimeter	**BH 5**	Perimeter Up Hydraulic Gradient	Level and Quality

It is recommended that the compliance limits are reviewed on an annual basis or as appropriate. If, for example, the trigger levels are exceeded on three consecutive times, then this should be highlighted and discussed within any annual review of monitoring data. Such an occurrence may be the result of contaminant breakthrough or a change in the up-gradient groundwater quality.

The groundwater sampling regime is set out in Table ESSD 6 and is based on the Environment Agency Regulatory Position Statement-Landfill monitoring and reporting standards.

Table ESSD 6: Groundwater Monitoring Parameters

Parameter	**Landfilling Phase**		**Closure/ Aftercare**
	Quarterly	**Annually**	**Annually**
Water Level	•	•	•
pH	•	•	•
Electrical conductivity 20ºC	•	•	•
Ammoniacal nitrogen	•	•	•
Chloride	•	•	•
Sulphate	•	•	•
Alkalinity	•	•	•
Sodium	•	•	•
Potassium	•	•	•
Calcium	•	•	•
Magnesium	•	•	•
Iron	•	•	•
Cadmium	•	•	•
Copper	•	•	•
Chromium	•	•	•
Lead	•	•	•
Nickel	•	•	•
Zinc	•	•	•
Mercury	•	•	
Hazardous Substance Scan		Annual for first six years	Six Yearly

Sampling will be undertaken by staff appropriately trained in environmental monitoring procedures, and who are familiar with the equipment and its limitations. The Company warrants that the personnel engaged in monitoring activities are trained to undertake the task. These will comprise the companies own technical personnel, the site manager or nominated deputy, following appropriate training by technical personnel. All monitoring staff undergo a period of job training and in addition external courses are used to supplement internal training. Results will be validated by the sampling personnel detailed above.

2.6.2 Submission of Data

All data from the groundwater monitoring will be stored on the in house electronic database. This database will enable reports to be issued detailing trigger breaches and standard quarterly and annual reports plus laboratory reports.

Reports will be provided in a standard PDF format to the Environment Agency.

2.7 Post Closure Controls

Groundwater and Leachate

Completion relating to hydrogeological risks will have been achieved when there is no unacceptable risk of pollution from the landfill, i.e. when the site can comply with the requirements of the Groundwater Regulations without the need for any active site management and during the three year post closure monitoring the results show the groundwater quality remains at or below the trigger levels.

The modelling has assumed 3 years of management after site completion.

Groundwater monitoring will continue for the period based on an annual sampling rounds from the four boreholes and the downstream surface water monitoring point.

Landfill Gas

Landfill gas utilisation and flaring is not considered necessary at the site long term based on the Landfill Gas Risk Assessment and again only requires monitoring for the three years post closure monitoring.

The nature of the waste should only allow for a nominal amount of settlement and the pre and post settlement levels are set as one and the same. Any low spots that form will be made good with importation of additional soils.

Gas monitoring will be carried out on a monthly basis for at least three years post closure.

Stability and Settlement

The final surcharged and post-settlement restoration levels are shown in Drawing ESSD 5 which is one and the same due to the inactive nature of the waste. A surcharge to accommodate settlement will therefore not be required.

The remainder of the post closure based on the risk assessments is for monitoring to ensure that the waste mass remains stable and that the leachate head does not increase above the design limit and therefore that no leachate removal is required.

Annual site surveys will be carried out using fixed settlement locations to measure settlement of the site once the site is completed.

Mining Subsidence

Likelihood of mining related subsidence is not considered an issue and was reviewed as part of the Stability Risk Assessment.

Restoration, Aftercare and Completion Phase

The site will be restored in accordance with the planning permission and maintained under a five year aftercare program under the Town and Country Planning Act 1991.The grassland and tree planting areas after the five years are completely self- sustaining without requirement for any further aftercare provision.

Monitoring

Features to be monitored for the purpose of closure include
Landfill Gas
Settlement Rate-Annual
Stability Observations
Groundwater Level
Groundwater Quality

3.0 PATHWAY AND RECEPTOR TERM CHARACTERISATION

3.1 Climate

The climate of the Midlands region is varied, ranging from cool and wet in the north-east Staffordshire and the Welsh Borders to warm and dry in Warwickshire and east Worcestershire, often reflecting changes in topography.

The nearest weather station to the site is at Shawbury, some 18km NNEof the site.

The average rainfall (as per the period 1971 to 2005) is around 650mm per year, the drier months generally being Spring, Appendix ESSD 4

Wind roses from the Meteorological Office at Shawbury are shown in Appendix ESSD 6. They indicate winds predominately from the south-west, which are particularly strong in winter. The long-term average potential evapotranspiration, obtained from the Met Office data presented at Appendix ESSD 6 indicates evapotranspiration at 516mm per annum and a total rainfall of 695 leaving a total annual rainfall of 179mm per annum.

3.2 Geology

Regional Superficial Geology

Regional superficial geology is predominantly till located in the low-lying topographical areas. Glaciofluvial deposits (sand and gravel) and alluvium (clay, silt, sand and gravel) are also present and are associated with water courses. There are no superficial deposits overlying the Woodcote Wood site. Aqualate Mere however, is thought to be formed in a glacial kettle hole, being a depression in the sand and gravel scoured out by the retreating glaciers which has then filled with freshwater. According to the BGS mapping, Aqualate Mere is underlain by the following superficial deposits:

- Peat- underlays the majority of the Aquaate Mere but is mainly found in the central area, underlying the lake.
- Glaciofluvial Deposits, Devensian- Sand and Gravel are found to the northeast and south of the central peat deposits;
- Till, Devensian- Diamicton (clay, gravel, and sand with poorly sorted clasts and boulders) is found to the north of Aqualate Mere and a small area is found to the west of the central peat deposits; and
- Alluvium- Clay Silt and Sand and Gravel are found in a small area in the western extent of Aqualate Mere, where watercourses are present.

Regional Bedrock Geology

Both the Woodcote Wood Quarry and Aqualate Mere are situated on the western fringe of the north-south orientated Stafford Basin; with younger

geological Units to the east and older Units to the west. The Woodcate Wood Quarry is entirely underlain by the Kidderminster Formation, comprised of pebble conglomerates and sandstone. Aqualate Mere is underlain by sandstone of the Wildmoor Sandstone Formation. There are two minor faults present in a northeast-southwest orientation between the Woodcote Wood quarry and Aqualate Mere.

Most of the strata are red as a result of the diagenetic alternation of iron oxide (haematite) of detrital ferromagnesian silicates and iron bearing clay minerals and is summarised on British Geological Maps presented at Drawing HRA 1.

Sherwood Sandstone Group

The site lies within this group. The Sherwood Sandstone Group was formally introduced for the formations that comprise the arenaceous lower part of the Triassic succession throughout Britain. This sequence was subdivided into three formations renamed recently (Warrington et al 1980), which are the basis for this report. An additional formation, the Quartzite Breccia, which locally underlies the Kidderminster formation and is therefore included as follows:

SUBDIVISIONS OF THE SHERWOOD SANDSTONE

Hull 1869	Warrington 1980
Lower Keuper Sandstone	Helsby Formation/Bromsgrove Sandstone
Upper Mottled Sandstone	Wildmoor Sandstone
Bunter Pebble Beds	Chester Formation/ Kidderminster Formation
	Quartzite Breccia

Deposition of the Sherwood Sandstone Group was controlled by palaeogeographical changes initiated during the Permian. A series of troughs and ridges were formed, orientated roughly north-south in response to east west tensional stresses in the region of the North Atlantic. One such trough was the Worcester Basin.

Chester Formation originally called the Kidderminster Formation

This name was introduced (Warrington et al, 1980) for beds formerly termed Bunter Pebble Beds. In the district relevant to the site, the sequence of fluvial sandstones and conglomerates crops out in the north west, where it attains a thickness of some 175m; it is present at depth in the south west and north east, but is absent in the south east where Ordovician and Silurian rocks prevail. In the location of the site the sequence comprises a basal conglomerate overlain by a mainly sandstone sequence. The Kidderminster formation comprises a sequence of upward fining rhythms, each with an erosional base. The rhythms commence with a hard conglomerate, overlain by sandstone, which is succeeded by mudstone, they are rarely complete and the mudstone is often

absent. The average grain size of the sediments decreases upwards through the formation.

The basal conglomerate of the sequence is composed of pebbles and cobbles in a weakly cemented matrix of coarse, micaceous sand. Most of the stones are derived locally from the Lickey Quartzite.

The main part of the Kidderminster Formation is dominated by massive red-brown to yellow-brown sandstones with a weak calcareous cement. The sand grains vary from coarse to fine in grade and are largely subangular. They are largely cross-bedded. No fossils have been found in the Kidderminster Formation within the district.

Wildmoor Sandstone

The name Wildmoor Sandstone was introduced for beds formerly termed Upper Mottled Sandstone. This formation consists predominantly of sandstone and provides the well-known moulding sands quarried around Wildmoor. The Wildmoor Sandstone is dominated by remarkably uniform, very weakly cemented, fine grained, silty, micaceous sandstone. The formation includes upward fining rhythms which commence with a medium too coarse grained or pebbly sandstone and pass upwards through cross-bedded, fine grained sandstones into plainer bedded fine-grained sandstones and mudstones. The Wildmoor Sandstone rests conformably upon the Chester Formation from which it is distinguished by its fine grain and foxy red colouration.

LOCAL GEOLOGY

The Woodcote Wood Quarry is located in sands of the Chester Formation. The quarry consists of a uniform, brownish red sandstone. The sandstone is medium too coarse grained, micaceous and feldspathic.

The strata dips easterly. The local strata dips at approximately 7°.

The local bedrock geology is also presented at Figure 2. The bedrock geological map is presented at Drawing HRA 1.

Figure 2: Bedrock Geology

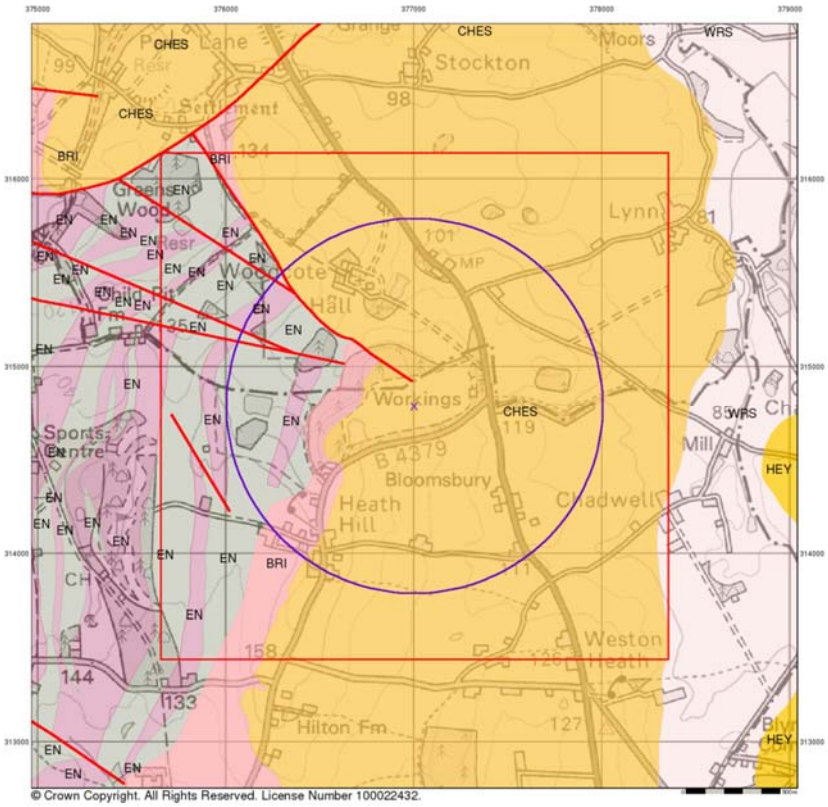
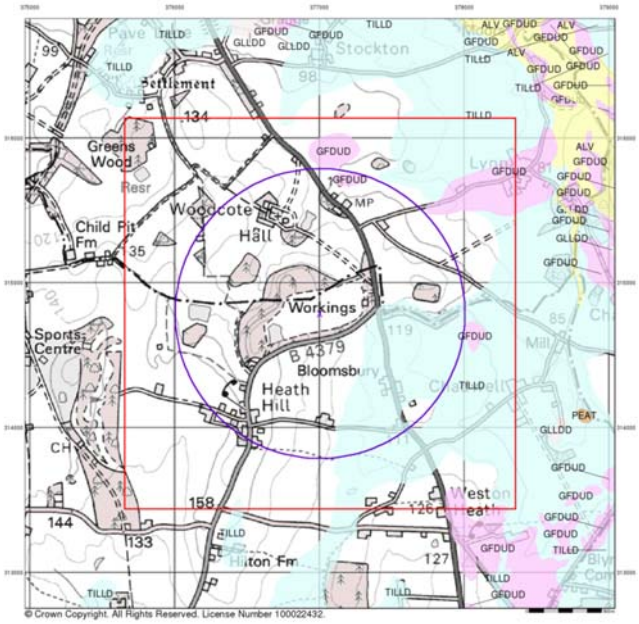


Figure 2 shows the site to consist of Chester Formation sand and graavel.

The site has no superficial covering. The superficial geological map is presented at Figure 3.

Figure 3: Superficial Geology



The Superficial Geological Plan is presented at Drawing HRA 1. A conceptual geological cross-sectional plan is presented as Drawing HRA3.

1.2.2 Man-made Subsurface Pathways

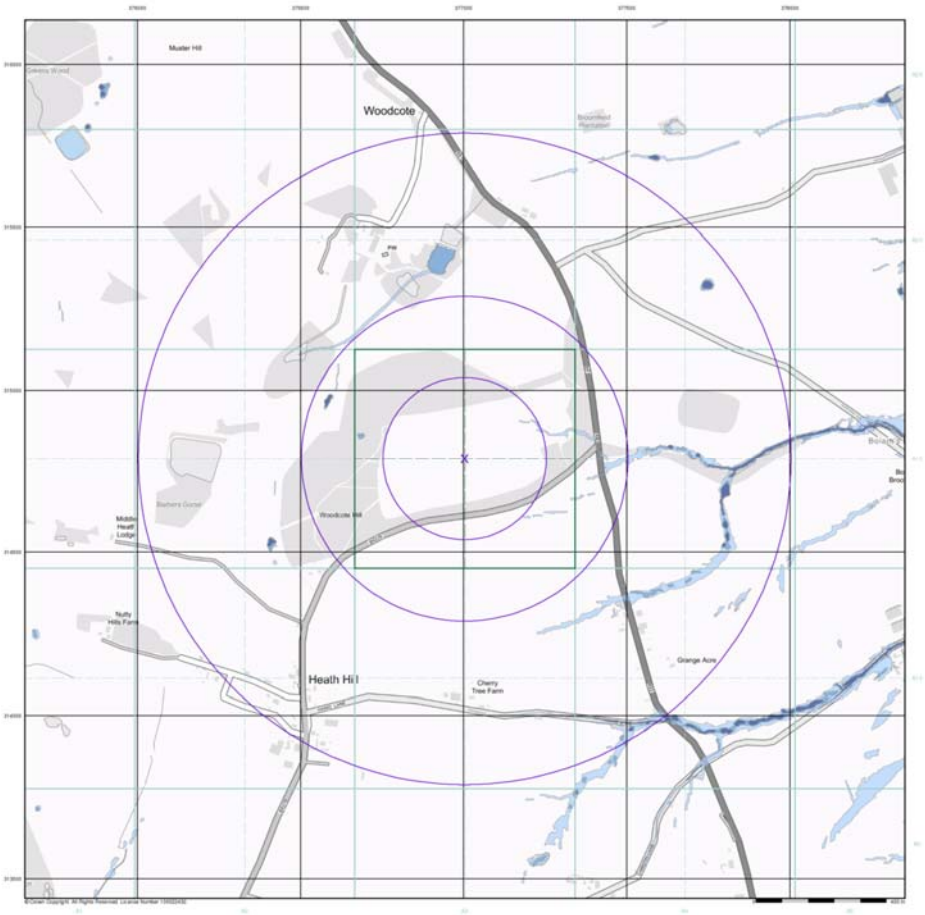
The following man made subsurface pathways have been identified;

- No field drains exist in any of the fields around the site.
- Mine workings do not occur in the area of the site with no underground saline of coal workings present.
- No services run through the proposed extraction area and landfill area.

1.2.3 Hydrology

The site is not within a Flood Zone. The local indicative flood map is presented as Figure 4 and shown in detail on Drawing HRA2.

Figure 4: Indicative Flood Zone Map



HYDROGEOLOGY

1.2.4 Regional Hydrogeology

The Permo-Triassic Sandstone is a high yielding aquifer and is regionally important for groundwater supply within the Shropshire Area. Recharge of the bedrock aquifers occurs mainly in the up-gradient areas of outcrop, inducing flow down-gradient to the surrounding rivers. To the east, recharge is severely limited by the presence of overlying low permeability superficial deposited (Till). Underlying bedrock aquifers can also be recharged by inter-aquifer flows from the surrounding aquifers and by stream bed leakage from surface waters such as during high flow or flood conditions.

Based on regional geology and hydrogeology, regional groundwater flows are likely to be to the east with recharge occurring where there is exposed Chester Formation sandstone and Wildmoor Sandstone Formation sandstone. Groundwater flow thereafter towards and underneath the till covered Mercia Mudstone in the east, unless captured by a public water abstraction.

Between Aqualate Mere and the Woodcote Wood site there are many groundwater Source Protection Zones (SPZ) and associated public water abstractions. The Woodcote Wood quarry and the west of Aqualate Mere are located within a SPZ 3: Total; Catchment. The purpose of the SPZ 3 is to define the total catchment area for a public supply abstraction. All groundwater recharge within this area is presumed to discharge to the associated water abstraction. There are also known to be many licensed and private groundwater abstractions in the area and creates uncertainty around the groundwater flow directions on the regional scale. Groundwater elevations are similar either side of the fault at Pave Lane suggesting a hydraulic connection across the fault.

Regional Groundwater Catchment

The Woodcote Wood quarry and Aqualate Mere both lie within the Shropshire Middle Severn-Permo Triassic Sandstone East groundwater catchment. However, due to the high clay content in the Till and Glaciofluvial deposits underlying the Aqualate Mere and acting as an impermeable barrier to vertical groundwater movement from the underlying bedrock aquifer, if there is a groundwater input into Aqualate Mere it is likely to be locally derived from permeable layers of sand and gravel within the glaciofluvial and alluvium deposits. Groundwater flow and direction in the superficial deposits surrounding Aqualate Mere tends to reflect local topography and be towards Aqualate Mere lake.

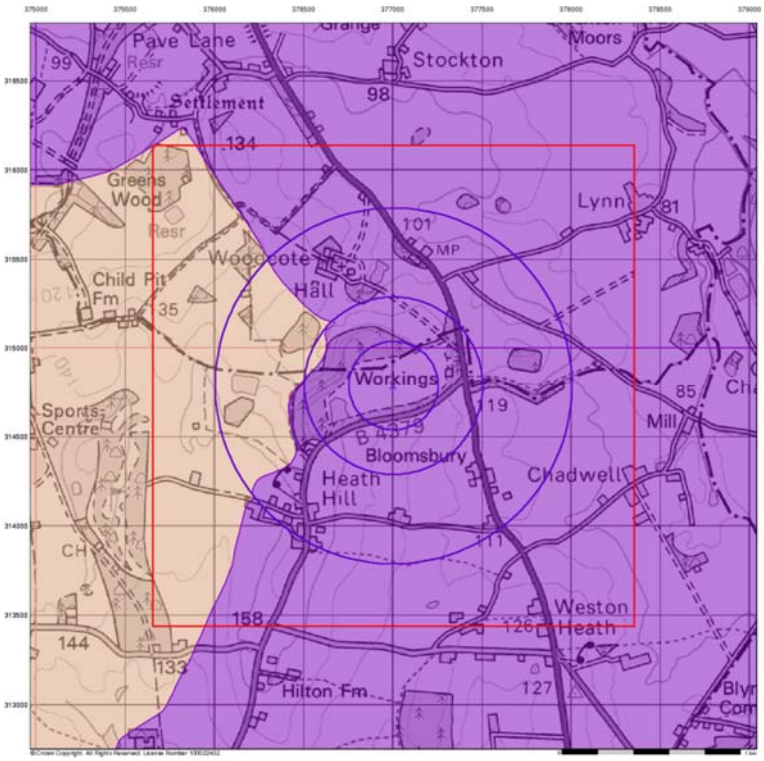
From 1st April 2010 new aquifer designations replace the old system of classifying aquifers as Major, Minor and Non-Aquifer. This new system is in line with our Groundwater Protection Policy (GP3) and the Water Framework Directive (WFD) and is based on British Geological Survey mapping.

The site is located on a bedrock Principal aquifer with rock deposits having high intergranular permeability and providing a high level of water storage. They may support water supply and or river base flow on a strategic scale. Areas of secondary A aquifer (supporting water supplies (locally) are located up hydraulic gradient north-east of the site and a Secondary B aquifer (predominantly lower permeability with limited storage and flow is located to the south west as the Mercia Mudstone Group.

The site is located within a Total Protection Zone (Zone 3). The nearest outer SPZ (SPZII) is located circa. 1000m to the south of the permit boundary and the public abstraction borehole is 1681metres from the site as shown in Figure 6.

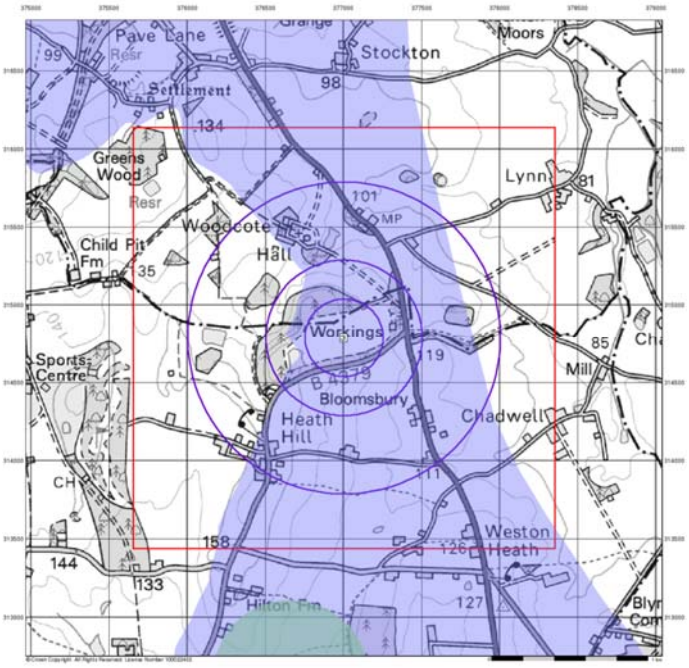
Figure 5 shows the bedrock geology aquifer designation for the site. The dark purple area represents the Sherwood Sandstone major aquifer with the brown areas being secondary aquifer of the Mercia Mudstone Group.

Figure 5: Aquifer designation map for Solid Geology



The regional supplies come from the Sherwood Sandstone in the Trias. The water resources are administered by Severn Trent Water. In the Trias, the Chester Formation, and all sub-units form a single aquifer, although it may contain aquicludes.

Figure 6: Source Protection Zones



1.2.5 Groundwater Flow

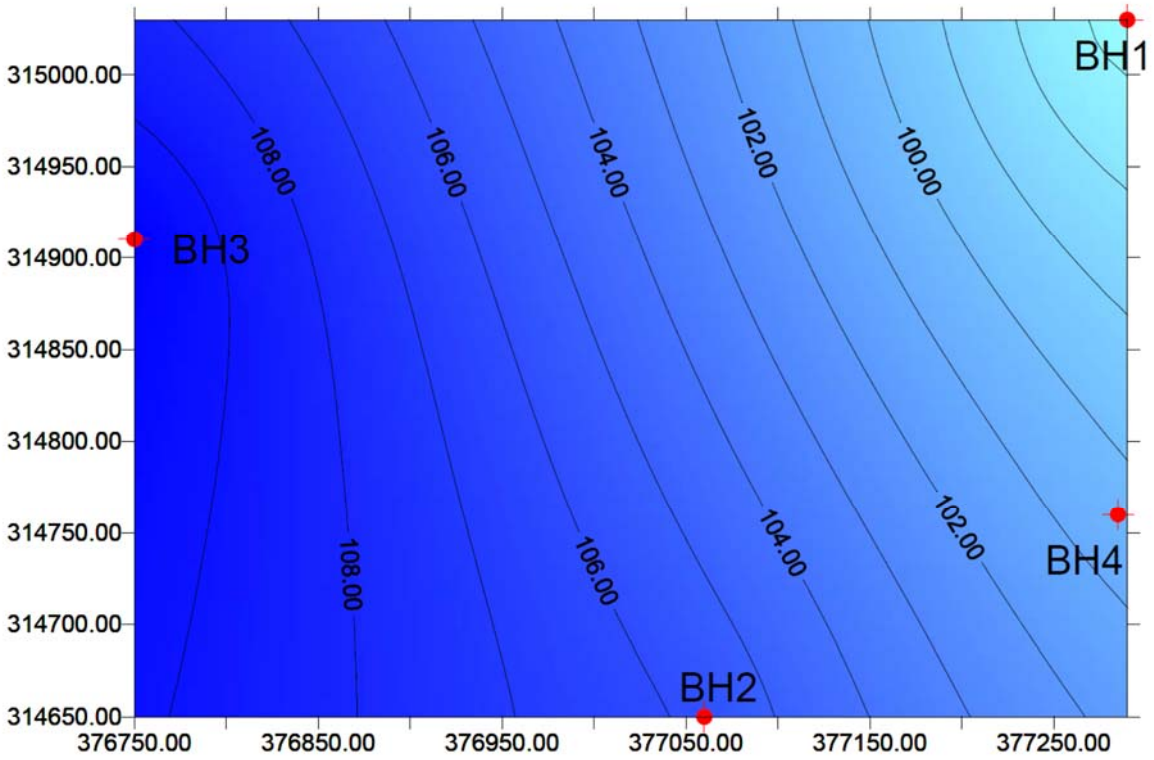
Groundwater levels have been monitored around Woodcote Wood Quarry and the hydrograph and results are presented at Appendix HRA 5. The borehole logs are presented at Appendix HRA 4.

The groundwater flow is eastwards and is presented at Figure 7 and the groundwater flows are presented at Drawing HRA 2 and has a hydraulic gradient between 0.0235m/m.

The unsaturated zone permeability range for use in LANDSIM modelling has been set at as follows: Lower 2.46 x 10^{-5}m/s. Average 1.95 x 10^{-5}m/s Upper limit of 1.007 x 10^{-4}m/s.

Porosity is averaged at 28.3% for the Chester Formation.

Figure 7: Groundwater contour model (average values)



Groundwater Quality

In accordance with the requirements for compliance levels as defined in Paragraph 4(c) of Annex III of the Landfill Directive, control and compliance limits have been established for all non-hazardous substances, with compliance limits set for hazardous substances.

The compliance limits are set at the average results plus three times the standard deviation. It is noted that a further six data sets will be used to finalise the Compliance Limits prior to issue of the permit.

Compliance limits will be reviewed on a regular basis in accordance with the requirements of the permit and routine reporting.

Table ESSD8: Compliance Limits for Groundwater

BH1	Cd	Cu	Hg	Zn	Napthalene	Toluene	Chloride	Ammonia
	0.00006	0.034	0.00001	0.018	0.01	0.1	73.4	0.06
	0.00006	0.014	0.00001	0.04	0.1	0.1	72.1	0.06
	0.00006	0.076	0.00005	0.145	0.2	0.13	30.3	
	0.00006	0.036	0.00004	0.05	0.05	0.1	29.3	0.06
	0.00006	0.044	0.0001	0.126	0.1		31.1	0.06
	0.00006	0.047	0.0001	0.03			31.0	0.06
Mean	0.00006	0.0418	0.00006	0.068	0.092	0.1075	44.53	0.06
Std	0	0.02	0.00004	0.053	0.071	0.015	21.86	0
3 Std	0	0.06	0.00012	0.159	0.213	0.045	65.58	0
Compliance Level	**0.00006**	**0.1018**	**0.000184**	**0.227**	**0.305**	**0.1525**	**110.11**	**0.06**

The groundwater quality results and the compliance limit calculations are presented at Appendix ESSD 9.

3.6 Off-site Landfill Gas Monitoring

Natural background gas concentrations have been carried out over a period of time from the outside groundwater monitoring boreholes to establish a baseline concentration. The boreholes have shown presence of carbon dioxide at very low levels.

Carbon dioxide has been recorded in all of the boreholes. The current data sets will be supplemented during the permit process to obtain trigger levels in accordance with the Industry Code of Practice.

Off-site gas monitoring details are presented at Appendix ESSD 10.

3.7 Receptors and Compliance Points

This section details the specific receptors identified and compliance points that have been set in the various risk assessments.

Groundwater

For Hazardous Substances, the receptor/compliance point will need to be the point at which the substance will enter the groundwater below or adjacent to the site. This can be monitored from Boreholes 1 and 3 which are down hydraulic gradient. Compliance limits have been set and are summarised in Table ESSD 8.

For Non-Hazardous Polluting Substances, the primary receptor/compliance point will normally be the downstream boundary of the site at Boreholes 1 and 3. Compliance limits have been set and are presented at Table ESSD 8.

Landfill Gas

The site will accept inert waste which produces extremely low concentrations of methane and low concentrations of carbon dioxide. The global impact is therefore considered as negligible from the waste mass.

Key receptors have been identified and gas monitoring boreholes have been located near to identified receptors based on level of risk.

Amenity (Nuisance and Health Issues).

Due to the site accepting only inert waste for landfill and the crushing screening and washing operations dust monitoring is not considered a requirement for the site.

Noise pollution primary controls are for the screening bunds have been constructed near to identified residential development and the site benefits from a detailed Noise Management Plan developed under the Noise Impact Assessment.

Habitats (where required)

An ecological screening was not requested from the Environment Agency. The site is not designated a Local Wildlife Site, devoid of trees and grass except for the boundary which is to remain unchanged and is not within a RAMSAR, SAC or SPA.

4.0 SITE REPORT

The Environmental Permit Regulations require that a permit application must be accompanied by a (Baseline) Site Condition Report, which describes the condition of the whole site, not just the landfill. Operators are required in particular to "*identify any substances in, on, or under land which may constitute a pollution risk*"

This Site Report gives a factual "baseline" account of the land.

4.1 Introduction and Background Information

The site is off the A41 in Weston Heath, Sheriffhales, Shropshire, 5km south of Newport town centre and 4.2km north of the A5. The centre of the site is at National Grid reference SJ 77036 14780 and the site entrance is SJ 77388 14944 see Figure 1 and Drawing ESID 1.

The Site comprises 22.4 hectares of agricultural land, which includes a woodland area. The site is a quarry.

Site details
This includes details relating to the following.

- The proposed waste types for the landfill area be inert sub soils which are Tax Qualifying Exempt Materials and inert recycling.

- A non-hazardous waste treatment facility will be operated to process construction and demolition wastes, soils and to recovery secondary aggregates, which will also involve the use of crushers and screens and use of a barrel wash plant. The detailed layout is presented at Drawing ESSD13.

- A skip will be located on site for load rejection.

- The site will have 3 operational phases in the base to complete the landfill final landform. The time taken for all mineral extraction, lining, infilling and restoration is 13 years.

- The site has valid planning permission.

- The final landform is to be fields with trees

- The site permit boundary requires an engineered geological barrier for all of the landfilling.

- No groundwater pumping occurs near to the site and the nearest licensed abstraction is Severn Trent Water at Hilton Bank, south west of the site,

JM Bubb & Son north east of the site,1699 metres away and W Maddocks Ltd 1491 metres away of Chadwell Court Farm. .

- The site is within a Source Protection Zone 3 and the site will be designed and operated on the principles of hydraulic containment.

- The proposed final landform is to get the land back tofields as per the original levels prior to any quarrying. and restored areas and is presented at Drawing ESSD 5

Any former land-uses that may give rise to potential sources of non-landfill related contamination

Based on the site investigations and historical research there are former landfill operation located at the site.

It is therefore reasonable to conclude that the site does not have influence from around the perimeter of the site, currently and historically.

Sources of Information

i. The Environment Agency;
ii. The British Geological Survey records and publications;
iii. The Ordnance Survey.
iv. Solihull MBC
v. DEFRA Magic Site
vi. National Air Quality Standards
vii. Natural England
viii Envirocheck

Geology and hydrogeology

The Woodcote Wood Quarry Landfill is located in the Chester Formation deposits.

Groundwater monitoring of levels is taking place around the site.

The Environment Agency has confirmed that the site is not within source protection area.

Archive search and land-use chronology

The site has been used as quarry for sand extraction since the 1970,s.

The area of the treatment facility was quarried for sand and gravel and backfilled and has been the subject of an inert treatment facility for a considerable time.

Relevant information relating to potential contaminants

Groundwater datasets suggest that former landfilling has not impacted on groundwater quality.

Any history of incidents

There are no records of pollution incidents relating to this facility from the Envirocheck search.

4.2 Objectives of this Assessment

Context within EP regime

Monitoring records for the site have been assessed together with site investigations to define the initial site conditions and to allow for baselines to be set and for action and trigger levels to be set for groundwater, leachate, landfill gas and particulate matter.

Description of general approach

The Environment Agency Template has been used for the “Conceptual Model, Environmental Setting and Site Design” section of the Environmental Permit application for the landfill has been used. It has been designed to describe the conceptual model and setting for the site.

The conceptual model has provided an understanding of the installation in its environmental setting and consideration of the design and operation of the site at the time of the application. This report addresses the source terms of the risk (i.e. waste), all pathways and receptors and has been used as a basis for commencing the risk assessments.

The final conceptual model report has been prepared on the basis of the findings of the component risk assessments (e.g. hydrogeology, stability, landfill gas, nuisance and amenity) required under this EP Application.

Different types of contaminants to be considered

The site will accept non-hazardous waste for treatment principally as demolition and construction materials in the inert recycling area and inert waste will be landfilled at the site. The Groundwater Regulations will therefore apply to this site.

The site area requires the construction of an engineered artificial geological barrier using clay type materials to the base and sides to achieve a minimum target permeability of 1 x 10^{-7}m/s.

4.3 Site Investigation (Data Collection) Details

Description of site investigation and related work activities.

Specific site investigations have been carried out with regard to the local hydrogeology of the site. As part of these site investigations, boreholes have been drilled and borehole logs produced at each stage.

Description of laboratory analysis

This includes permeability of the soil, groundwater quality, groundwater levels, site levels, gas concentrations outside the site.

4.4 Summary of Site Investigation and Analysis Findings

On-site observations

Physical observations of the base and sides of the quarry site have been observed during walk over surveys.

Site survey

Detailed groundwater level monitoring has taken place to establish the groundwater levels and full detailed surveys have been carried out of the site to provide detailed topographic information.

Monitoring data

This includes, groundwater level monitoring, groundwater quality testing, permeability testing of the site, noise monitoring, landfill gas monitoring.

4.5 Data Interpretation

Proposal of baseline conditions for the site.

Control and trigger levels for the groundwater are set in the HRA, LFGRA and SRA. Background gas monitoring and groundwater monitoring has been carried out.

4.6 Conclusions

The Woodcote Wood Quarry landfill site to be operated as a non-hazardous treatment facility and an inert landfill site, with the inert wastes deposited into separate engineered cells, within each Phase. The site is to have an engineered Geological Barrier constructed under an approved CQA regime.

The site will also operate as a non-hazardous waste treatment facility processing demolition materials to produce secondary recycled aggregates by

way of crushing, screening and washing. The site is to be operated under a Permit issued under the Environmental Permitting Regulations 2016.