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SCOTT BROS LTD

THORPE THEWLES APPLICATION FOR AN ENVIRONMENTAL PERMIT

ENVIRONMENTAL SETTING AND SITE DESIGN V2

NOVEMBER 2020

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DATE ISSUED:	**November 2020**
JOB NUMBER:	**ST18175**
REPORT NUMBER:	**001**
VERSION:	**V2.0**
STATUS:	**Final**

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CONTENTS

TABLES

DRAWINGS	TITLE
ST18175-001	Site Location
ST18175-002	Environmental Site Setting
ST18175-003	Historic Landfills
ST18175-004	Superficial Deposits
ST18175-005	Bedrock Deposits
ST18175-006	Potential Receptors Within 2km

1 INTRODUCTION

1.1 Report Context

1.1.1 Thorpe Thewles (the Site) is a historic landfill which is to be restored by Scott Bros Ltd and is currently utilised for rough grazing. Scott Bros Ltd (the Client) propose to emplace c. 16,425m^3 of soils over an area of c.27,000m^2 at an average thickness of 0.6m.

1.1.2 The Site is located on the outskirts of the village of Thorpe Thewles in Stockton-on-Tees at National Grid Reference (NGR) NZ 39731 23696. Thorpe Thewles is located approximately 6km north west of Stockton. The Site covers an area of approximately 27,000m^2. Access to the Site is from Durham Road, which bounds the eastern perimeter of the Site.

1.1.3 The following report has been prepared by Wardell Armstrong LLP (WA) to provide the Environmental Setting and Site Design to support the landfill permit application. The report describes the setting of the Site in terms of its geology, hydrogeology and hydrology and explains and justifies the design of the Site.

1.2 Site Details

1.2.1 The Site location and permit boundary are shown on Drawing No. ST18175-001 Access to the Site is from Durham Road, which bounds the eastern perimeter of the Site.

1.2.2 The reprofiling will be achieved through the import of a sufficient quantity of inert waste (subsoils) to ensure a consistent soil layer of 800mm above the historic inert landfill, beneath 200mm of topsoil using topsoil stripped and stored on Site where possible, and 2,400m^3 imported topsoil.

1.2.3 Condition 7 of the planning approval notice (17/2905/FUL) states that "*materials proposed to be imported onto the Site shall be clean, uncontaminated recycled soils with a reduced stone content".*

1.2.4 The Site is situated within a rural location, and security will be provided by post and wire fencing in order to exclude livestock from the Site. A gate will be provided at the Site entrance and will be locked whenever the Site is unmanned.

1.2.5 The general topography of the Site falls from 45m Above Ordnance Datum (AOD) in the north east, to 30m AOD in the south west. The current landform of the Site

comprises a number of depressions as a result of subsidence within the historic landfill.

1.2.6 The Site is predominantly surrounded by agricultural land. The closest residential receptors are listed in Table 1.1.

Table 1.1: Residential Receptors within 500m

Residential Receptor	Approximate Distance from Site Boundary
House on Durham Lane	50m
Houses on School Close	100m
Houses on St James Close	130m
Buildings on Hellhole Lane	140m
Village of Thorpe Thewles	Includes above properties and extends to approximately 500m south east of the Site boundary.

1.2.7 Thorpe Beck is classified by the EA as a main river and flows from west to east, approximately 165m south of the Site at its closest point (Drawing No. ST18175-002). Thorpe Beck falls within Billingham Beck from Bishopton Beck to Brierle surface water body (GB103025072360)[1] and is classified by the EA as Poor for ecological quality due to Biological Quality Elements (Invertebrates) and Good for chemical quality.

1.2.8 An unnamed drain runs alongside Hellhole lane to the north of the Site, before changing direction to flow south, along the western boundary of the Site towards Thorpe Beck. Further information pertaining to surface water features can be found in Section 3.4.

1.2.9 Whitton Bridge Site of Special Scientific Interest (SSSI) is located 1.6km south east from the Site (Drawing No. ST18175-002)[2]. There are no other SSSIs within 2km of the Site. There are a number of Woodlands and Ancient Woodlands classified as Priority Habitats within 2km of the Site – the closest Priority Habitat is located 455m east of the Site[2].

1.2.10 The MAGIC website indicates that lapwing, grey partridge and snipe may be present at or near to the Site[2]. These birds are priority species under the Biodiversity Action Plan. A conservation screening request undertaken for the preparation of the Waste

[1] Environment Agency (2020) Catchment Data Explorer: Billingham Beck from Bishopton Beck to Brierle [online] Accessed: June 2020 https://environment.data.gov.uk/catchment-planning/WaterBody/GB103025072360
[2] DEFRA (2020) Magic Map Application [online] Accessed: June 2020 https://magic.defra.gov.uk/MagicMap.aspx

Recovery Plan[3] identified the presence of protected species (water vole) within 250m of the Site.

1.2.11 There are no National Nature Reserves (NNR), Special Areas of Conservation (SAC) or Special Protection Areas within 2km of the Site. There is a Local Wildlife Site (LWS) which runs from Brierly Wood to the north east of the Site towards Thorpe Thewles along the Castle Eden Walkway, the LWS is located 450m east of the Site at its closest point[4]. There are a further two LWSs within 2km of the Site, one located 1.6km south west of the Site, and a second located 1.75km east.

1.2.12 There are three Grade II listed buildings within the village of Thorpe Thewles; St James Church, The Vane Arms Public House, and Hamilton Russel Arms. St Thomas A Becket's Church is a scheduled monument and is located 1.6km north of the Site[2].

1.2.13 The Site is located on a Secondary A Superficial Aquifer, and a Secondary B Bedrock Aquifer[2]. The Site is not located within a Source Protection Zone[2]. Further detail of the geology and hydrogeology is provided in Section 3.2.2 and Section 3.5.

[3] Scott Bros Ltd (2019) Waste Recovery Plan for Willow Dene Thorpe Thewles
[4] Stockton-on-Tees Borough Council (2019) Local Plan Policies Map Adopted 30 January 2019 [online] Accessed: July 2020 https://www.stockton.gov.uk/media/1585778/local-plan-policies-map-website.pdf

2 SOURCE CHARACTERISATION

2.1 Historical Development

2.1.1 The Site is a historic landfill, closed in the early 1970's. The Site was operated by Teesside Borough Council and records indicate that the waste deposited comprised of household and commercial wastes. The existing waste mass is covered by soils to a varying depth, from a minimum thickness of 100mm[5].

2.1.2 There is no known leachate containment or gas control system associated with the historic landfill, as was normal at the time of operation. The Site was completed prior to the licencing regime being implemented.

2.1.3 Following completion, the Site was subsequently utilised as agricultural land for grazing, however subsidence has caused numerous depressions across the Site and resulted in the land becoming unusable.

2.1.4 There are 16 historic landfills within 2km of the Site, including the historic landfill at the Site, details of these are summarised in Table 2.1 (Drawing No. ST18175-003).

Table 2.1: Summary of Historic Landfills within 2km of the Site

Site Name	Site Operator	Distance and Location from Site	Operational Dates	Waste Types Accepted
Refuse Tip off Durham Road	Teesside County Borough Council	At Site	1970 – 1973	Commercial and Household
Thorpe Thewles Landfill	Thorpe Thewles Landfill	0.5km east	Unknown	Unknown
Thorpe Thewles	Blakeston Hall Farm Company	0.7km north east	1979 – 1986	Inert, Industrial and Liquid Sludge
Blakeston Lodge	Blakeston Hall Farm Company	0.9km north east	1972 – Unknown	Commercial
Middlefield Farm	Mr Hall	1.0km east	1950 – 1975	Unknown
Blakeston Hall	Blakeston Hall Farm Company	1.2km east	1969 – 1989	Inert and Industrial
Land to the East of Whitton to Redmarshall Road	Cleveland County Council	1.3km south west	1982 – 1985	Inert and Industrial

[5] Scott Bros Ltd (2020) Thorpe Thewles – Deposit of waste for recovery for land improvement: Environmental Permit Application Thorpe Thewles Operational Techniques

Table 2.1: Summary of Historic Landfills within 2km of the Site				
Site Name	**Site Operator**	**Distance and Location from Site**	**Operational Dates**	**Waste Types Accepted**
Blakestone Lane	Blakeston Hall Farm Company	1.4km north east	1987 – 1988	Inert
Land to the West of Whitton to Redmarshall Road	Cleveland County Council	1.7km south west	1977 -1987	Inert
North of Thorpe Theules to Wolviston Road	Cleveland County Council	1.7km north east	1977 – 1978	Inert
Quarry	Stockton Rural District Council	1.7km south west	1970 – 1970	Unknown
Stillington Tip	Stockton on Tees Borough Council	1.8km west	Unknown	Unknown
Wynyard	Blakeston Hall Farm Company	1.9km north east	1977 -1978	Inert, Industrial and Household
Wynyard Road	Stockton Rural District Council	2.0km north east	1965 - 1972	Unknown
Stillington Tip	Metabrasive Limited	2.0 km west	1977 – 1991	Inert and Industrial
Stillington Industrial Estate	Stockton on Tees Borough Council	2.0km west	1992 – 1993	Inert

2.1.5 There are no recorded pollution incidents within 2km of the Site, however three Category 2 (Significant) pollution incidents have been recorded at or adjacent to Thorpe Beck upstream of the Site between 2006 and 2019.

2.2 Proposed Development

2.2.1 The primary purpose of the waste activity is to raise the level of the agricultural land by approximately 1m in some areas, in order to re-profile depressions in the land and ensure sufficient coverage of appropriate capping material above the in-situ landfill.

2.2.2 The existing waste mass is covered by soils to a varying depth, however a review has suggested that this is as low as 100mm in areas. Existing topsoil will be stripped and stockpiled for reuse following placement of the appropriate inert soils across the Site.

2.2.3 The Waste Recovery Plan and Operational Techniques set out a full list of materials and detailed materials acceptance criteria as well as the approximate amount of waste soils required.

2.2.4 The Site is approximately 2.7 hectares and the estimated net fill volume is 16,425m^3.

2.2.5 The operation of the Site will involve the following processes:

- Acceptance of inert waste (subsoil) suitable for use in land reclamation and capping.
- Placement and spreading of the suitable wastes to pre-agreed levels followed by limited compactions (only through tracked plant).

2.2.6 The Site will accept only clean inert materials, which by definition means that they will not undergo any significant physical, chemical or biological transformations and will not generate leachate.

2.2.7 The Environmental Permitting (England and Wales) Regulations 2016 replace the Groundwater Regulations 2009 and transpose the Groundwater Directive 1980, the Water Framework Directive 2000 and Groundwater Daughter Directive 2006. These directives require that inputs of pollutants to groundwater are either prevented or limited, to avoid or control groundwater pollution. A risk screening exercise must be undertaken to assess the level of risk assessment required for the Site.

2.2.8 As the materials accepted will be inert, and by definition not generate leachate, no leachate collection infrastructure will be required.

2.3 Installation Engineering

Groundwater Management Systems

2.3.1 The proposed activities include stripping the topsoil only prior to emplacement of the inert waste (subsoil). The in-situ historic waste is not proposed to be excavated. No waste will be removed and there will be no activities within the underlying geology. Groundwater management is not required.

Stability

2.3.2 The site has been assessed to be flat in the eastern half of the site dropping to a slope in the region of 1:12 for the western half of the site, which continues into the adjacent

field to the west. Based on these slope angles the site is considered low risk with regards to stability. There are no visible sings on site that instability has been an issue.

2.3.3 Due to the shallow gradients of the site it is not expected that the placements of an additional 600mm of soil material to follow the general profile of the existing slope would change the risk of instability. It is therefore not considered necessary to undertake further detailed slope stability assessments on this site.

2.3.4 Materials will be placed in accordance with the Specification for Highways works, Series 600. The works will be developed in a manner that ensures adequate run off and minimises ponding on slopes.

Basal Lining System

2.3.5 It is not proposed to install a geological barrier due to the inert soils being emplaced above the in-situ historic waste.

Leachate Generation and Management

2.3.6 Due to the Site only receiving inert waste (subsoil) there will be no leachate generation. Rainfall which moves through the Site will produce a waste leachate, however this will not alter the existing water balance for the Site. Therefore, a water balance is not required to be undertaken for the Site.

2.3.7 No formal leachate management is proposed as the material to be deposited is inert and by definition will not generate leachate, waste leachate derived from rainfall may contain low levels of contamination, however this will be in accordance with SR205 No 39: Use of Waste in A Deposit for Recovery Operation.

2.3.8 It is not proposed that any leachate monitoring is undertaken due to the very low risk posed by leachate from the deposited materials.

Landfill Gas Management and Monitoring Infrastructure

2.3.9 Strict pre-acceptance and acceptance procedures will be in place to control the inert materials deposited on Site. There can therefore be a high level of confidence that biodegradation of the material will be negligible. Due to the very low risk it is not intended that any landfill gas monitoring boreholes are installed.

Surface Water Management

2.3.10 During construction surface water will primarily be allowed to drain to ground. During periods of extended or significant rainfall, or in areas where clay based soils have been emplaced the operator will reduce the potential for runoff by replacing the topsoil on Site as soon as an area has been completed. If any significant runoff is noted temporary ditches may be constructed to slow water progress and reduce any runoff from the Site. Monitoring will be undertaken daily to identify any runoff from the Site and recorded within the site log/diary.

Post Closure Controls

2.3.11 As the Site will be infilled with inert materials no formal cap is required. The Landfill Directive only requires capping where there is a need to minimise leachate formation, i.e. at hazardous and non-hazardous landfills. The Site will be restored with topsoil and returned to agricultural use.

2.3.12 Due to the inert nature of the infill materials there will be minimal infrastructure to maintain in the aftercare period, the deposited material itself will pose a very low risk to the environment.

2.3.13 Surrender of the permit will largely be based on records demonstrating good characterisation of the material throughout the life of the Site, providing the necessary evidence that only clean inert materials have been deposited.

2.3.14 Once restoration is completed, the Site will be returned to agricultural use.

3 PATHWAY CHARACTERISATION

3.1 Climate

3.1.1 Long term monthly rainfall data has been obtained from the Meteorological Office for Hartburn Grange at NGR NZ 43846 19831 located approximately 5.5km south east of the Site for the 1981 – 2010 period[6]. Average precipitation for this period is included within Table 3.1.

Table 3.1: Monthly Average Rainfall at Hartburn Grange Meteorological Station for the Period 1981 - 2010

Month	Average Monthly Rainfall (mm)	Month	Average Monthly Rainfall (mm)
January	41.1	July	52.9
February	32.9	August	60.6
March	36.3	September	49.7
April	41.5	October	57.5
May	40.8	November	60.2
June	52.4	December	48.2

3.1.2 Within the UK wind is typically from the south west. No detailed wind information is available for the Site. There is a stable building approximately 100m north from the Site that would be a potential receptor for dust. To minimise the potential for dust generation during movement and storage of wastes the following measures will be implemented as deemed relevant;

- The wastes accepted will predominantly be clay based and not likely to cause dust issues whilst they retail the natural moisture content and all efforts will be made to utilise the wastes in the deposit activity and prevent the waste from drying out.
- The orientation of long stockpiles will be placed in the direction of the prevailing wind.
- During times of high winds the stockpiles will not be disturbed.
- The maximum height of each stockpile will be considered depending on the wastes/materials being stored.
- All operations will be carried out with regard to prevailing climatic conditions.
- Dust suppression of stockpiles may be carried out using a water bowser if deemed necessary.
- Gas is not expected to be generated from inert and uncontaminated soils.

[6] Meteorological Office (2020) UK Climate Averages Stockton-on-Tees [online] Accessed: June 2020 https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcxn3ykru

3.2 Soils

3.2.1 A Site Walkover undertaken by a WA Principal Soil Scientist in June 2020 identified that the topsoil in the east of the Site was between 0.15 and 0.27m deep and was dark brown in colour with rusty mottles, with a heavy clay loam texture and slightly stony, the stones were predominantly soft limestone. The subsoil within the east of the Site extended to between 0.22 and over 0.60m and was dark greyish brown with up to 2% dark reddish brown mottles and gey ped faces; it was slightly stony.

3.2.2 Within the western area of the Site no topsoil was identified, subsoil was present above the historic landfill at a depth of 0.40 to 0.80m. The subsoil had a clay texture and was predominantly slightly stony, however some areas had large stones present at the surface. There was the presence of some construction rubble at the boundary between the east and west parts of the Site, and a temporary haul road comprised of recycled aggregate lead from the eastern part of the field towards the west.

3.3 Geology

Made Ground

3.3.1 The Site is underlain by a historic landfill. This is shown on British Geological Survey (BGS) mapping as Made Ground[7]. No information is available relating to the depth or thickness of the historic landfill.

Superficial Deposits

3.3.2 According to BGS mapping[7] the Site is underlain by Glaciofluvial Deposits – Devensian Sand and Gravel (Drawing No. ST18175-004.According to BGS Borehole Logs NZ32SE14751/TP37- TP42[8] the Site was a Sand and Gravel Pit prior to landfilling. TP39 is located along the southern boundary of the Site and identifies waste to 1.3m below ground level (bgl) underlain by firm clay subsoil over loose medium grained sand with gravels to the base of the Trial Pit at 3.2m bgl. TP42 is located in the south eastern corner of the Site and did not encounter waste, alternating layers of coarse sand and gravel with black suspected coal was reported to 3.2m bgl, TP38 encountered medium

[7] British Geological Survey (2020) GeoIndex [online] Accessed: June 2020 http://mapapps2.bgs.ac.uk/geoindex/home.html

[8] British Geological Survey (2020) Borehole Scan Reference: NZ32SE14751/TP37 – 42 [online] Accessed: June 2020 http://scans.bgs.ac.uk/sobi_scans/boreholes/685826/images/16750397.html

grained sand with gravels to 3.0m bgl. The remaining three Trial Pits (TP37, TP41 and TP40) recorded waste to their base, between 3.0 and 3.5m bgl. These Trial Pits are located towards the south of the Site, therefore the depth of the historic landfill is unconfirmed, and although it is likely that a large majority of the superficial deposits were excavated during quarrying activities it is unknown whether any superficial deposits remain beneath the historic landfill.

3.3.3 The surrounding areas are predominantly underlain by Till to the north and west, and Till and Glaciofluvial Deposits to the east. Alluvium associated with the Thorpe Beck is present approximately 60m to the south of the Site.

Bedrock Geology

3.3.4 BGS Mapping[7] indicates that the Site is underlain by the Roxby Formation (Drawing No. ST18175-005 described as Mudstone and siltstone, reddish brown with subordinate sandstone, sulphates (gypsum, anhydrite) common towards base.

3.3.5 Approximately 600m to the south of the Site there is an area of Yoredale Group – limestone, argillaceous rocks and subordinate sandstone, interbedded. The Roxby Formation is bound to the west by the Seaham Formation and overlain to the south and east by the Sherwood Sandstone Group. The Seaham Formation and Roxby Formation are present to the north.

3.3.6 An inferred fault, with unknown displacement, runs from west to north east approximately 500m north of the Site.

3.4 Hydrology

Surface Water Features

3.4.1 Whitton Beck and Letch Beck converge 870m south west of the Site to form Thorpe Beck which flows east, 165m south of the Site at its closest point. Maudlin Gutter is located 575m west of the Site, and flows south to join Thorpe Beck. There is an unnamed drain 750m west of the Site which also flows south to join Thorpe Beck.

3.4.2 An unnamed drain runs west alongside Hellhole lane, 150m north of the Site, before flowing south, along the western Site boundary and sinking to groundwater 55m south east of the Site.

3.4.3 There is no flow data available for Thorpe Beck.

Surface Water Abstractions

3.4.4 The Environment Agency confirmed on 29th June 2020 that there are no licenced abstractions within 3km of the Site.

Surface Water Discharges

3.4.5 The EA responded to a data request on 29th June 2020 with details of surface water discharges within 3km of the Site. Information relating to these discharges is summarised in Table 3.2.

Table 3.2: Surface Water Discharges within 3km

Licence Number	Effluent Type	Receiving Waterbody	Discharge Volume (m^3/day)	NGR	Distance from Site
NE/25/04/1606/001	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ39950 23330	0.34km South
NE/254/E/0018/001	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ39810 23400	0.28km south
NE/254/0974/002	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ40070 23210	0.48km south east
NE/254/E/0016/001	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ38710 22700	1.30km south west
NE/254/D/0172/003	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ39800 21800	1.84km south
NE/25/04/1706/007	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	1605 (685 under dry weather)	NZ38480 22230	1.84km south west
NE/254/1427/001	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ39230 21640	2.05km south
NE/25/04/1766/001	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ37900 22500	2.06km south west
NE/254/0290/001	Sewage - not water company	Billingham Beck from Bishopton Beck to Brierle	3 (1 under dry weather)	NZ37850 22500	2.10km south west
NE/EPRAB3493DL/001	Sewage - not water company	Billingham Beck from Bishopton Beck to Brierle	1.5	NZ38114 21836	2.34km south west
NE/254/E/0020/001	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ39200 21100	2.59km south west

Table 3.2: Surface Water Discharges within 3km					
Licence Number	**Effluent Type**	**Receiving Waterbody**	**Discharge Volume (m^3/day)**	**NGR**	**Distance from Site**
NE/254/1844/003	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ37400 23600	2.15km west
NE/254/1825/003	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ37386 23328	2.23km west
NE/254/1872/003	Trade	Billingham Beck from Bishopton Beck to Brierle	18	NZ37390 23250	2.20km west
NE/25/04/1717/003	Trade	Billingham Beck from Bishopton Beck to Brierle	2	NZ37390 23220	2.21km west
NE/254/1834/002	Sewage - water company	Billingham Beck from Bishopton Beck to Brierle	NA	NZ37260 23350	2.33km west
NE/254/A/0648/001	Sewage - not water company	Billingham Beck from Bishopton Beck to Brierle	7.5	NZ37100 23800	2.47km west
NE/254/1904/001	Sewage - not water company	Billingham Beck from Bishopton Beck to Brierle	5	NZ38750 26180	2.62km north

Surface Water Quality

3.4.6 As discussed above, Thorpe Beck falls within Billingham Beck from Bishopton Beck to Brierle surface water body. The reasons for Billingham Beck from Bishopton Beck to Brierle not achieving good status have been determined by the EA as; poor soil management, poor livestock management, poor nutrient management, and sewage discharge (continuous and intermittent)[1].

3.4.7 A baseline surface water contamination assessment was undertaken by Arc Environmental Ltd in April 2019. Surface water samples were obtained within Thorpe Beck, and the Unnamed Drain adjacent to the Site. Three samples were obtained within each watercourse; one upstream, one adjacent, and one downstream of the Site.

3.4.8 The results obtained identified elevated concentrations of Boron, Copper and Polycyclic Aromatic Hydrocarbons (PAH's) within all three surface water samples in the Unnamed Drain. Concentrations identified were higher upstream of the Site and diminished over distance, indicating that the drain was impacted by these determinands upstream of the Site. No elevated Benzene, Toluene, Ethylbenzene and Xylene (BTEX) or Total Petroleum Hydrocarbons (TPH) impacted water was recorded.

3.4.9 The results obtained within Thorpe Beck also identified elevated concentrations of Boron, Copper and PAH's in all three samples. Elevated TPH's (EPH Aliphatic Band >C16-C35) were also recorded within all three samples. Concentrations were slightly higher upstream, and diminished over distance, indicating that Thorpe Beck was impacted by these determinands upstream of the Site. No elevated BTEX or other TPH bands were recorded.

Flood Risk

3.4.10 The Site is located within Flood Zone 1 according to the EA Flood Map for Planning, defined as having less than 1 in 1,000 annual probability of river or sea flooding. There is a small area in the north eastern corner of the Site mapped as being at risk from surface water flooding. Surface water flooding occurs when rainwater does not drain away through normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

3.4.11 According to the EA Long Term Flood Map the Site is not at risk of flooding from reservoirs[9].

3.4.12 The Stockton-on-Tees Borough Council Strategic Flood Risk Assessment (SFRA) map shows that the Site is located within an area with between 50% to 75% risk of flooding from groundwater.[10]

3.5 Hydrogeology

Aquifer Characteristics

3.5.1 The EA classifies the superficial deposits at the Site as a Secondary A Aquifer, defined as being permeable layers capable of supporting water supplies at a local, rather than strategic, scale, and in some cases forming an important source of baseflow to rivers.

3.5.2 The underlying Roxby Formation is classified as a Secondary B Aquifer, defined as predominantly lower permeability layers which may store and yield limited amounts

[9] Environment Agency (2020) Long Term Flood Risk Map [online] Accessed July 2020 https://flood-warning-information.service.gov.uk/long-term-flood-risk/map
[10] JBA Consulting & Stockton-on-Tees Borough Council (2017) Strategic Flood Risk Assessment Map 5 [online] Accessed July 2020 https://www.stockton.gov.uk/media/1585595/2017s5531_sbc_sfra_detailed_map_5.pdf

of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

Groundwater Elevation and Flow

3.5.3 No groundwater monitoring data is available for the Site or the surrounding area.

3.5.4 A review of BGS Borehole logs has identified six trial pits dug immediately to the South of the Site, within both the waste associated with the historic landfill and the superficial deposits. These trial pits were dug between 3m below ground level (bgl) and 3.4m bgl, no groundwater was encountered.

3.5.5 BGS Borehole NZ42SW27, located 800m east of the Site, indicates that groundwater was struck at 3.6m bgl within the superficial deposits.

3.5.6 Groundwater elevation and contour plans were requested from the Environment Agency on 1st June 2020. On 29th June 2020 the Environment Agency advised that they hold no records of historic or recent groundwater levels or contour plots for the Site or the surrounding area.

3.5.7 It is anticipated that groundwater flow within the superficial deposits is towards the unnamed drain to the west. Based on the surrounding topography groundwater flow within the bedrock likely discharges to Thorpe Beck.

Groundwater Abstractions

3.5.8 The Environment Agency confirmed on 29th June 2020 that there are no licenced abstractions within 3km of the Site.

Groundwater Discharges

3.5.9 There are three discharges to groundwater within 3km of the Site, details of which are included in Table 3.3.

Table 3.3: Groundwater discharges within 3km

Licence Number	Effluent Type	Receiving Waterbody	Discharge Volume (m^3/day)	NGR	Distance from Site
NE/254/0759/002	Sewage - not water company	Land	1.5	NZ39200 22600	1.13km south west

Table 3.3: Groundwater discharges within 3km					
Licence Number	**Effluent Type**	**Receiving Waterbody**	**Discharge Volume (m^3/day)**	**NGR**	**Distance from Site**
NE/253/1027/001	Sewage - not water company	Land	0.75	NZ38700 24800	1.41km north west
NE/EPRMP3822GY/002	Trade	Land	1.1	NZ37341 23553	2.23km west

Groundwater Quality

3.5.10 The Roxby Formation underlying the Site is part of the Skerne Magnesian Limestone groundwater body (ID: GB40301G704000)[11]. The Quantitative and Chemical Status element of the Skerne Magnesian Limestone is classified as Poor. The EA define the reasons for this waterbody not achieving Good status as Saline or other intrusion and Groundwater resource impacts.

3.5.11 The Site is located within a Nitrate Vulnerable Zone[2].

3.5.12 The Site is not located within a Source Protection Zone or a Drinking Water safeguard zone[2].

3.5.13 The Site is located on a historic landfill, therefore any potential contamination from the waste streams previously deposited at the Site must be considered with regards to their potential impact upon baseline conditions.

3.6 Landfill Gas

3.6.1 There are no historic gas monitoring boreholes around the Site. Although the Soil Gas and Vapour Survey identified concentrations of Carbon Dioxide and Methane associated with the historic landfill, all new materials to be accepted will be inert other than in the final 0.2m of clean topsoil and strict acceptance criteria will be in place. As a result there is no intention to install peripheral monitoring boreholes.

3.6.2 Waste acceptance procedures will ensure that all imported subsoils are inert and therefore will not generate gas. In addition, the maximum depth of waste will be approximately 1m and will not be over compacted, to allow plant growth. This being

[11] Environment Agency (2020) Catchment Data Explorer Skerne Magnesian Limestone [online] Accessed: June 2020 https://environment.data.gov.uk/catchment-planning/WaterBody/GB40301G704000

the case it is expected that aerobic conditions will predominate making the generation of landfill gas very unlikely.

3.6.3 The materials are intended to provide clean cover but will not form an airtight cap. As such, the risk of alterations to any existing pathways, for gas from the historic landfill are considered to be very low, especially given the age of the landfill. With no tipping in the last 45 years , it is expected that any landfill gas generation from the historic landfill will be in decline, if not fully complete.

4 RECEPTOR AND COMPLIANCE POINTS

4.1 Groundwater and Surface Water

4.1.1 Potential groundwater and surface water receptors will be considered within the Hydrogeological Risk Assessment (HRA) (Section 7).

4.2 Residential Receptors

4.2.1 The residential receptors closest to the Site are listed within Table 1.1 with the closest property 50m to the south of the Site.

4.2.2 Should landfill gas be released from the historic waste mass as a result of the removal of topsoil, there is potential for damage to vegetation within the agricultural fields around the Site.

4.2.3 Landfill gas typically comprises approximately 60% methane and 40% carbon dioxide. Both of these gasses are greenhouse gasses and may contribute to global warming. For this reason the air itself is a receptor and uncontrolled releases to the atmosphere should be minimised.

4.2.4 The waste to be deposited is inert waste (subsoils), with topsoil in the final 0.2m and thus the potential for landfill gas generation is negligible. Good Waste Acceptance Criteria will be in place to ensure that the materials deposited are in accordance with the permit, and records will be kept of materials accepted.

4.2.5 Carbon Dioxide and Methane concentrations associated with the historic landfill were found to exceed occupational health criteria during spike testing in 2019. The Preliminary Risk Assessment identified that should gas be identified the requirement for control measures including vents, trenches or other features would be assessed. The Waste Recovery Plan details that daily and ongoing checks for odour will be undertaken, with particular focus on the boundary of the Site. If odour is identified, and also identified at the boundary to the Site then works will stop and an assessment made by a competent person as to the way to proceed.

4.3 Amenity

4.3.1 As the material to be accepted is inert waste (subsoil) and clean topsoil there will be no litter or odour generated on Site. The only fugitive emission that may cause a

potential nuisance is dust. Control measures will be in place to prevent dust as set out in the Operating Techniques[5].

4.3.2 The compliance point will be the Site boundary and control measures will be put in place to ensure there is no significant dust beyond the Site boundary, including;

- The wastes accepted will be predominantly clay based, and thus not likely to cause dust issues whilst they retain the natural moisture content, therefore efforts will be made to prevent the wastes from drying out.
- The orientation of long stockpiles will be placed in the direction of the prevailing wind.
- During times of high winds stockpiles will not be disturbed.
- The maximum height of a stockpile will be considered, depending on the materials being stored, likely to be 4m.
- All operations will be undertaken with consideration of prevailing climatic conditions.
- Dust suppression of stockpiles may be carried out using a water bowser if deemed necessary
- A static wheel wash will be provided. This will be filled using the bowser.

4.4 Habitats

4.4.1 There are no SAC's, SPAs or Ramsar Sites within 2km of the Landfill. Whitton Bridge SSSI is located 1.6km south east from the Site. Various protected farmland birds are reported to be present within the area, including lapwing, grey partridge and snipe.

4.4.2 The Site will only accept clean inert waste (subsoils). Dust will be managed and controlled, as outlined in Section 4.3.2, so that it does not impact nearby receptors. The Site is not expected to impact the local bird population. As an inert Site it will not attract predators. It is considered that the impact on local habitats will be negligible.

4.4.3 Further detail is provided in the Habitats Risk Assessment which accompanies the application.

5 SITE CONDITION REPORT

5.1.1 There is no requirement to provide a site condition report for areas that will be subject to a permanent deposit of material. The purpose of a site report is to set out the condition of the land at permit issue so that at permit surrender it is possible to demonstrate that there has been no deterioration in the quality of the land. Clearly in the case of a permanent deposit of waste the land will not be restored to the same condition that was present at permit issue. Instead surrender of the permit will be based on records of the materials accepted and environmental monitoring carried out during the operation life of the site and post closure to demonstrate that the clean inert material that has been deposited is not impacting and will not impact the environment.

5.1.2 There is no fuel storage on Site. All plant and equipment will be refuelled by a diesel tanker coming onto Site. Such refuelling will be undertaken by a trained personnel who are fully aware of the spillage clean up requirements outlined within the accident management section of the Environmental Permit Application.

5.1.3 The only infrastructure on site will be a welfare unit and a wheelwash. These are considered to pose a very low risk of contaminating the land.

6 SUMMARY OF THE CONCEPTUAL SITE MODEL

6.1 Introduction

6.1.1 The findings of the desk study have been interpreted to form a Conceptual Site Model (CSM)which is discussed in the form of "Source, Pathway and Receptors" below.

6.2 Source

6.2.1 It is proposed to reprofile the land using inert waste (subsoils). The source will therefore be the inert soils deposited. Good material acceptance procedures will remove the risk at source.

6.2.2 The is also the possibility of outbreaks of perched landfill leachate from the historic waste mass following the removal of topsoil.

6.3 Pathways

6.3.1 Pathways for potential pollutants include any route from the inert soils to the receptors.

6.3.2 The main pathway will be through infiltration, and subsequently through the underlying historic waste mass into the superficial deposits.

6.3.3 Groundwater flow could occur through the soil zone as 'interflow', or through the superficial deposits at a depth greater than 3m bgl.

6.3.4 Due to the topography of the Site sediment laden runoff could occur towards the adjacent unnamed drain.

6.3.5 Outbreaks of perched landfill leachate from the historic waste mass could runoff into the surface watercourses. If leachate is identified the area will be isolated, a bund formed around it and leachate tankered from Site to a suitably permitted facility for treatment, this will prevent landfill leachate from reaching the surface watercourses.

6.3.6 No works will be undertaken within 20m of the nearest surface watercourse. Monitoring of site works will be undertaken on a daily basis to identify any runoff from the Site. Once the deposited soils have been capped using the existing topsoil, runoff will be from the existing topsoil rather than the deposited inert soils.

6.3.7 No landfill gas will be generated due to the inert nature of the soils and the strict material acceptance criteria in place.

6.3.8 Dust or litter can become airborne. No litter is anticipated due to the nature of the materials to be imported. Dust will be managed at the source using the dust control measures described in the operating techniques[5].

6.4 Receptors

6.4.1 Although the superficial deposits are overlain by the historic landfill, there is potential for infiltration to occur through the inert soils into and through the historic waste mass, therefore the superficial deposits may be a receptor.

6.4.2 The Roxby Formation is not considered to be at risk due to the low permeability of this unit.

6.4.3 The topography of the Site slopes towards the unnamed drain 20m west, therefore this surface watercourse is a potential receptor. In addition it is likely that both the unnamed drain and Thorpe Beck receive groundwater inflow, and thus both may be a receptor.

6.4.4 The nearest property is 50m south of the Site.

6.4.5 There are Biodiversity Action Plan (BAP) species and habitats in the vicinity of the Site and agricultural land may also be a receptor.

6.4.6 It is considered that the strict control of the source, via material acceptance procedures and compliance with the operational techniques identified will provide adequate protection to the receptors.

6.5 Source-Pathway-Receptor Linkages

6.5.1 During the operational phase when waste is being deposited at the Site, rainwater can infiltrate the waste and migrate vertically into the underlying in-situ waste mass. There is no information regarding engineered containment of the historic in-situ waste mass and thus it is assumed that this waste mass is in continuity with groundwater within the underlying superficial deposits (Secondary A aquifer). Groundwater within the superficial deposits has the potential to migrate towards surface water bodies such as the unnamed ditch to the west of the Site and enter surface water.

6.5.2 Additionally, during the soils tip at the Site there is potential for breakout of perched leachate within the underlying historic in-situ waste mass which could migrate overland and into the unnamed ditch the west of the Site. However whilst this is a potential SPR linkage the proposed operating techniques involving daily monitoring, bunding and tankering meaning that this potential SPR linkage is unlikely to be realised through good site management.

6.5.3 Post restoration, the stripped topsoil will be replaced on the imported waste materials and planting re-established. This will reduce the infiltration of rainfall into the waste soils and reduce rainfall runoff containing sediment.

Table 6.1: Source-Pathway-Receptor Summary for Thorpe Thewles

Phase	Sources	Pathway	Receptor
Operational Phase – deposition of inert waste (subsoil) as a recovery operation	Inert waste (subsoil)	Infiltration and vertical flow through historic waste mass	Groundwater within Superficial Deposits
		Groundwater flow through Superficial Deposits	Superficial Deposits, Unnamed Drain and Thorpe Beck
		Sediment laden rainfall runoff	Unnamed Drain
		Airborne	Residential properties to south east, BAP species and habitats and agricultural land
	Historic waste	Overland runoff of perched leachate outbreaks following topsoil removal	Unnamed Drain
		Release of landfill gas due to removal of topsoil	Air, residential properties and agricultural land
Post Restoration Phase	Inert waste	Infiltration through topsoil into deposited wate and through historic waste	Groundwater within Superficial Deposits
		Groundwater flow through Superficial Deposits	Superficial Deposits, Unnamed Drain and Thorpe Beck
		Rainfall runoff from replaced topsoil	Unnamed drain

7 HYDROGEOLOGICAL RISK ASSESSMENT

7.1 The Nature of the Hydrogeological Risk Assessment

7.1.1 The proposed scheme is a waste recovery scheme. Therefore, once the soil substitute materials are placed the materials will cease to be a waste and the Site will not be a landfill. The materials imported will be subject to compliance with the waste acceptance criteria outlined in the Operational Techniques[5]. The Operational Techniques highlight that waste soils will only be accepted provided the chemical, physical and biological characteristics are suitable for the intended use.

7.1.2 Due to the nature of the Site and the intended operations a simple risk screening is considered appropriate. The methodology employed for the HRA includes:

- Establishing a CSM using desk study information (Table 6.1);
- Identification of source, pathway and receptor linkages; and
- Risk screening to assess the risk presented to groundwater by the linkages identified.

7.2 The Proposed Assessment Scenarios

7.2.1 The proposed scheme is a waste recovery scheme, therefore once the imported soils have been placed the materials will cease to be waste and the Site will not be a landfill.

7.2.2 Given the inert nature of the material, the absence of any biodegradable materials and the strict pre-acceptance and acceptance procedures that will be in place for the Site the physical characteristics of the deposited material are envisaged to remain constant. It is unlikely that there will be any significant change in quality of any waste leachate generated through infiltration over the life of the Site.

7.2.3 The CSM identified potential linkages including infiltration through the imported soils and vertical migration through the historic waste mass into the underlying superficial deposits, groundwater flow within the superficial deposits towards the surface watercourses, and overland runoff of either sediment laden rainfall runoff or perched leachate outbreaks from the removal of topsoil (Table 6.1).

7.3 Proposed Priority Contaminants

7.3.1 Numerical modelling is not considered necessary, see Section 7.1.

7.3.2 Inert wastes are unlikely to produce leachate that presents a risk to groundwater quality, as inert waste does not undergo any significant physical, chemical or biological transformations.

7.3.3 The types of waste to be accepted and restrictions for the use of waste in deposit for recovery are outlined within the Application Table for List of Permitted Wastes[12]. As outlined within the Waste Recovery Plan[3] The soil chemical quality standards outlined in Table 7.1 will be utilised to assess chemical quality requirements in addition to assessment of the site from which the soils are arising.

Table 7.1: Soil quality acceptance criteria

Component	Proposed guideline total concentrations for soils	Source and comments
Arsenic	32	CLEA soil guideline value for residential end-use
Cadmium	10	CLEA soil guideline value for residential end-use
Chromium	130	Previous SGV for residential with plant uptake
Copper	200	Previous PAS 100 compost specification
Lead	450	Previous SGV for residential with or without plant uptake
Mercury	1	CLEA soil guideline value for residential end-use
Nickel	130	CLEA soil guideline value for residential end-use
Zinc	400	Previous PAS 100 compost specification
pH	6 – 10	Guideline values to avoid extreme acidic or alkaline conditions
Total Petroleum Hydrocarbons	400	20% below inert landfill limit value
PAHs (total) – unspeciated (must be non-hazardous)	50	20% below inert landfill limit value
All thresholds for metals stated in mg/kg dry weight		

7.4 Review of Technical Precautions

7.4.1 The inert soil wastes will be placed at average fill depth of 0.6m across the Site, and to approximately 1m in some areas of depressions in the current Site topography, above the historic waste mass. The existing topsoil will be stripped and stockpiled for reuse following placement of the appropriate inert soils across the Site. The proposed

[12] Scott Brothers (2019) Thorpe Thewles WE4813AA Application Table for List of Permitted Wastes Document Reference: WE4813AA-B4-1b

waste recovery scheme does not involve the excavation of any historic waste during this activity.

7.4.2 The Site will only accept inert wastes (subsoils). Due to the nature of the Site and the activity to provide a capping layer to formally landfilled waste the materials used will have a requirement to be low stone content, therefore the soils accepted will include selected subsoils with no particles or stones greater than 50mm and a moisture content less than 35%. As detailed within the Waste Recovery Plan pre-acceptance procedures will ensure than only compliant waste types are accepted. Additionally a trained operator will examine waste descriptions and make a visual inspection of waste loads at the Site. Operatives at the facility will also be made aware of the type of waste to allow additional visual inspection upon off-loading.

7.4.3 Monitoring on the Site is to be undertaken on a daily basis to identify any potential outbreaks of leachate from the historic waste mass. If leachate is identified, the area will be isolated, a bund formed around it, and leachate tankered to a suitably permitted facility for treatment.

7.4.4 The main risk to the environment would be through the deposit of non-conforming waste types. In order to minimise this risk, all incoming waste will be subject to strict waste acceptance. The Waste Recovery Plan, included as part of the application, details the strict procedures in place to ensure that only verified permitted waste types are accepted and deposited on-site.

7.4.5 Adherence to the strict waste acceptance procedures will ensure that the finished scheme will not result in environmental problems associated with pollution.

7.5 Numerical Modelling

Justification for Modelling Approach and Software

7.5.1 Numerical modelling not considered necessary, see Section 7.1.

Model Parameterisation

7.5.2 Numerical modelling not considered necessary, see Section 7.1.

Sensitivity Analysis

7.5.3 Numerical modelling not considered necessary, see Section 7.1.

Model Validation

7.5.4 Numerical modelling not considered necessary, see Section 7.1.

Accidents and their Consequences

7.5.5 Numerical modelling not considered necessary, see Section 7.1.

7.6 Emissions to Groundwater

Compliance Monitoring

7.6.1 In general, for the CLEA limits identified, the compliance point would be at the point at which the substance would enter the groundwater below the Site. However, risk screening has identified that the superficial and bedrock aquifer are at negligible risk of unacceptable inputs of contaminants to groundwater from the inert waste. Therefore groundwater monitoring is not proposed.

Surface Water Management

7.6.2 During construction surface water will primarily be allowed to drain to ground. During periods of extended or significant rainfall, or in areas where clay based soils have been emplaced the operator will reduce the potential for runoff by replacing the topsoil on Site as soon as an area has been completed. If any significant runoff is noted temporary ditches may be constructed to slow water progress and reduce any runoff from the Site. Monitoring will be undertaken daily to identify any run off from the Site and recorded within the site log/diary.

7.6.3 In addition to monitoring for runoff, daily monitoring will be undertaken to assess the presence of any outbreaks of leachate from the historic waste, should leachate be identified the area is to be isolated and a bund formed around it, prior to tankering from the Site to a suitably permitted facility for treatment.

7.6.4 Surface water sampling and screening has been undertaken prior to the commencement of works, and will be undertaken following the completion of works, and if deemed necessary during the works.

7.7 Hydrogeological Completion Criteria

7.7.1 The proposed scheme is a waste recovery scheme. Therefore, once the inert soil is deposited the materials will cease to be waste and the Site will not be a landfill.

7.7.2 Groundwater monitoring is not considered necessary and groundwater compliance limits have not been proposed. Surface water monitoring and assessment criteria are proposed in Section 8.

8 REQUISITE SURVEILLANCE

8.1 The Risk Based Monitoring Scheme

Leachate Monitoring

8.1.1 Given the CSM and the nature of the waste recovery scheme, and the low risk to identified groundwater receptors, no leachate monitoring is considered necessary.

Groundwater Monitoring

8.1.2 Given the CHSM and the nature of the waste recovery scheme, and the low risk identified to groundwater receptors, no groundwater monitoring is considered necessary.

Surface Water Monitoring

8.1.3 Surface water monitoring locations were determined during the baseline surface water contamination assessment. It is proposed to undertake monitoring at the same locations following completion of the works.

8.1.4 The objectives for the surface water monitoring will be to demonstrate that the emplacement of inert soils above the historic waste mass is not having an adverse impact on the identified surface water receptors i.e. the unnamed drain and Thorpe Brook. If significant runoff or outbreaks of perched leachate are identified during daily inspections further surface water sampling will be undertaken.

8.1.5 The proposed suite will include the parameters inspected during the baseline surface water contamination assessment.

9 CONCLUSIONS

9.1 Compliance with the Landfill Directive

9.1.1 The Landfill Directive does not apply to deposit for recovery operations and has not been considered for this report.

9.2 Compliance with the Groundwater Regulations, 2009

9.2.1 Only inert waste (subsoils) will be accepted under strict criteria for the waste recovery scheme. Quality verification checks of the materials will be undertaken at the Site prior to emplacement.

9.2.2 The imported materials will be emplaced above the historic landfill, and capped with the existing topsoil to provide a more substantial cap to the historic waste.

9.2.3 Appropriate risk assessment has been undertaken which has identified that hazardous substances and non-hazardous pollutants are unlikely to enter the groundwater as a result of the emplacement of the non-biodegradable inert materials.

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