Maxey Crossing Extension

Hydrogeological Risk Assessment

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1 Introduction

1.1 Background and Objectives

This report has been prepared by Ayesa (Byrne Looby Partners (UK) Limited) on behalf of Tarmac Trading Limited (Tarmac) to produce a Hydrogeological Risk Assessment in support of the restoration of the Maxey Crossing Extension (the Site) as required by the Planning Permission for the approved scheme.

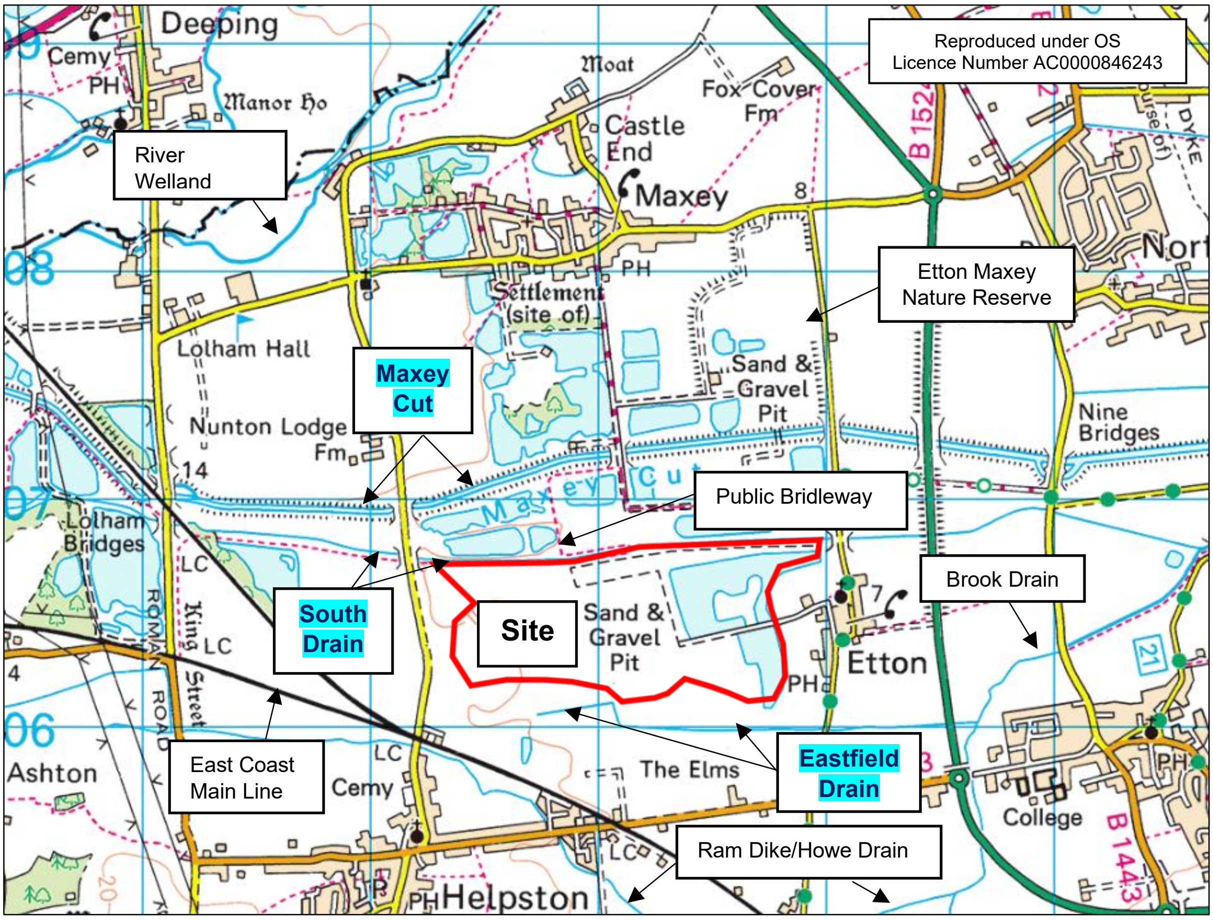
The restoration works will require the importation of soils and compatible material under a Deposit for Recovery Environmental Permit. Details of the recovery aspects of the scheme are presented in a Waste Recovery Plan (Report K6036-R01), and the wider site setting and engineering information provided in the Environmental Setting and Site Design (ESSD) report K6036-R03.

The scheme will restore an operational Sand and Gravel quarry by restoring the land to a combination of its original agricultural land use, lowland meadow and a series of ponds.

1.2 Site Location and Surrounding Features

The Site is located at Maxey Quarry, High Street, Maxey, Peterborough, PE6 9EA approximately 10km northwest of Peterborough City centre and 1km to the southeast of the village of Maxey. As the development is the third stage/phase extension of the original Maxey Quarry, the site is closer to the village of Etton, at a distance of approximately 250m to the east rather than the village of Maxey to the north (Figure 1).

Figure 1 Site Location and Surrounding Surface Water Features



The Maxey Crossing Extension is centred on National Grid Reference (NGR) TF 13426 06630 and situated in a predominantly rural area comprising agricultural land, isolated dwellings, woodland, and water bodies. The East Coast Main Railway Line runs in a north-west to south-east direction 0.2km away to the south-west. There are currently no public rights of way within the extension area, however a public footpath and bridleway exists to the north of the extension area.

The site is within an area of low-lying land which slopes from 10-11mAOD at the west to ~9mAOD to the east, and is on a slight rise above a fenland landscape which continues to the east to the Wash, which is typically in the 4 – 6mAOD elevation range. There are numerous land drainage channels in the area which range in size from major strategic channels such as the "Maxey Cut", located approximately 430m to the north (Figure 1). This feature flows from west to east to the River Welland 3.7km to the east, where there is a three channel confluence between the River Welland, the Maxey Cut and the Car Dyke (a northerly flowing artificial drainage channel) draining the lands between Peterborough and the site.

The Maxey Crossing Extension (the Site) is bounded between two surface water drainage channels. Somewhat counter-intuitively, the "South Drain" is at the northern boundary of the Site, and the "Eastfield Drain" is at the southern perimeter (Figure 1), which along with other tributary drainage channels also drain towards the River Welland / Maxey Cut channel as described above.

Although identified as land drainage channels, the South Drain and the Eastfield Drain are ephemeral and are frequently reported as dry.

The land to the south, east and west of the site is agricultural. However, to the north there are the earlier phases of the Maxey Quarry workings which have largely been restored as a series of groundwater fed lakes and ponds, wetland habitats along with agricultural land.

2 Proposed Development

2.1 Introduction

Planning Permission 10/00151/MINFUL was granted on 10th October 2012 for the Maxey Crossing Extension for the extraction of mineral as a southern extension to the original Maxey Pit. The southern extension area covers an area of 140ha (including buffer zones, operational areas and access areas), of which 87ha will be worked for the mineral resource.

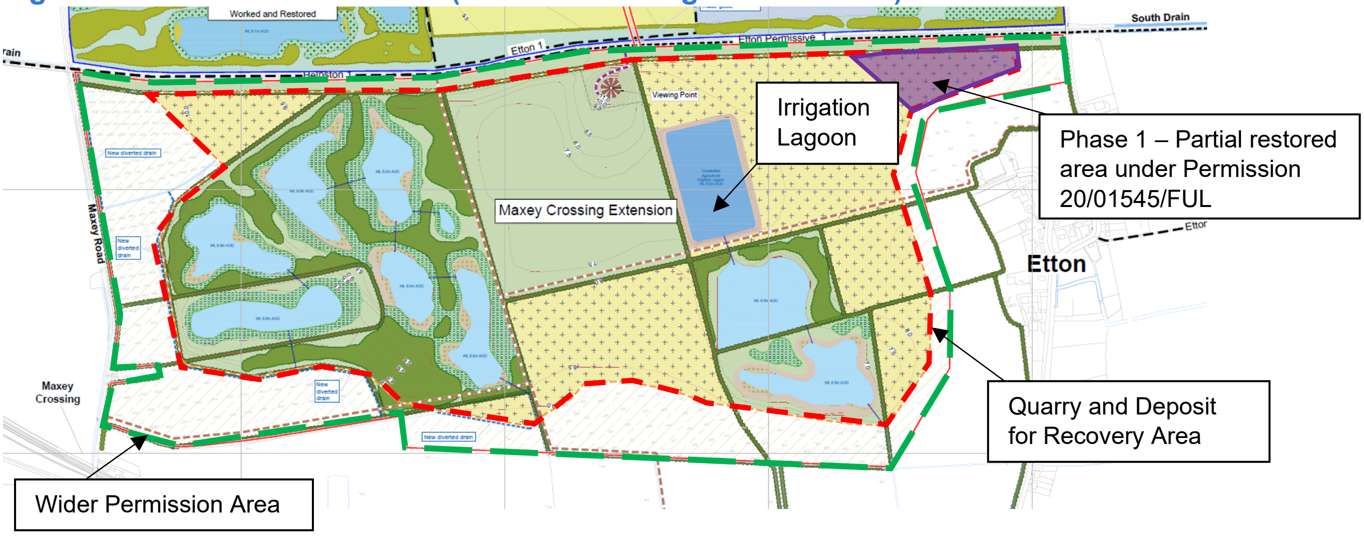
In accordance with Planning Permission 22/01203/MMFUL approved on 26th March 2024, there is a requirement to restore the quarry to a mixture of agriculture, lowland meadow, woodland planting, and low-level water-based nature conservation habitat including provision of a viewing area.

Planning Permission 22/01203/MMFUL revised the original scheme after it was identified that the original restoration scheme could not be achieved using solely site derived material due to the potential for basal heave in utilising "overdig" material i.e. extracted clay from beneath the superficial sand and gravels. In relation to this, Planning Permission was sought to allow the importation of inert materials to restore the site and changes were made to the final restoration scheme in order to minimise the amount of imported material required to achieve the scheme.

2.2 Scheme Overview

The quarry area and restoration scheme cover an area of 87ha. The restoration scheme for the site is illustrated on Drawing M031-00421-4A. The site is to be restored to a mixture of agriculture, lowland meadow, woodland planting and low-level water-based nature conservation habitat including provision of a viewing area using approximately ~1.3million cubic metres of inert material. The proposed Recovery Permit boundary and restored site layout is shown on Tarmac Drawing M032-00421-4 (Figure 2).

Figure 2 Scheme Overview (Extract from Dwg M032-00421-4)



The quarry is being worked and will be restored in a phased manner with the site split into six Phases (1 to 6). Phase 1 which occupies an area of 9.2ha has been excavated and partially restored using imported materials in accordance with Planning Permission 20/01545/FUL granted on 16th March 2021. The Phase 1 restoration material comprised of excavated material from a one-off construction project.

The remaining quarry area (Phases 2 to 6) covers an area of 77.8ha and largely exist as agricultural field parcels separated by a network of land drains. Mineral excavation had progressed into Phases 2 and 3 by Autumn 2023.

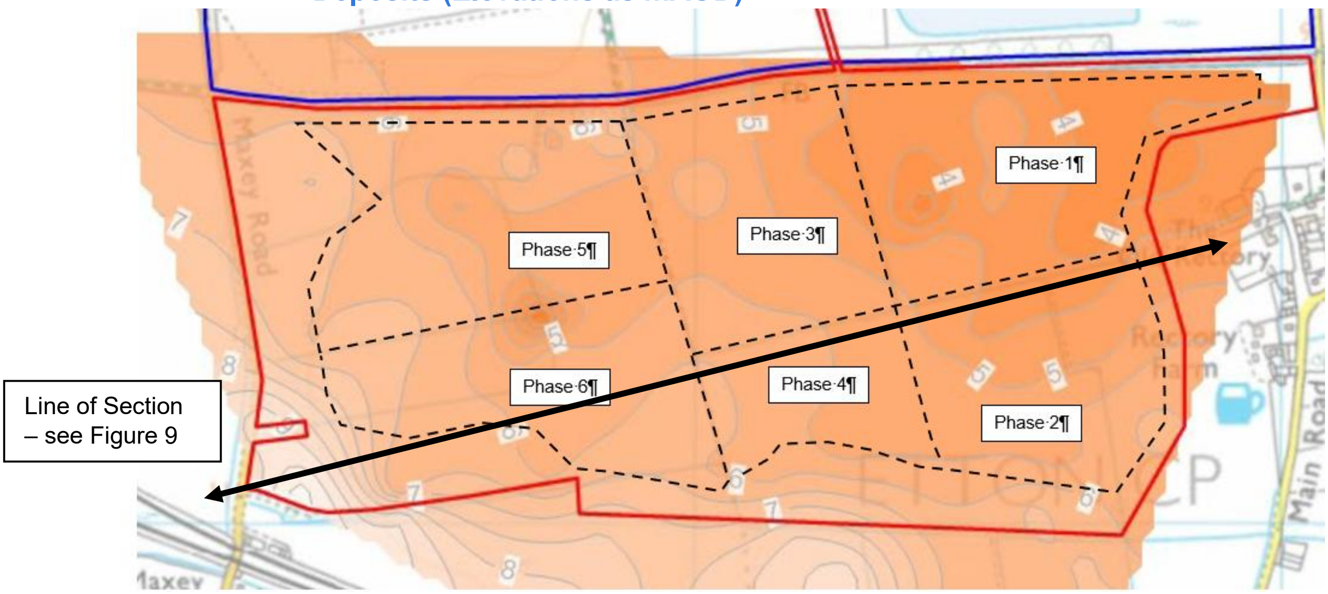
The western part of the quarry will be excavated to the base of the River Terrace Gravel deposits. However, some clay will also be won by over-digging into the underlying Kellaways Clay strata in the east in order to create an irrigation lagoon which will be located in the eastern section of the site. All other ponds will be created using imported materials and shaping the topography as illustrated in Tarmac Drawing M032-00421-4 (extract at Figure 2 above).

The phase dimensions, excavation depths and restoration heights are illustrated as Table 1, with the phase layout illustrated as Figure 3, which also illustrates the basal elevation of the Terrace Gravel Deposits, which falls from ~7mAOD in the west to ~4mAOD in the east.

Table 1 Proposed Phasing Development Summary

Phase	Position	Base of Excavation	Restoration Level	Waste Depth	Proposed restoration
		mAOD	mAOD	m	
1	Northeast	2.8 to 4.0	7.5 to 8.5	4.5 to 5.2	Restored to agricultural land. Water level in lagoon at ~6.5mAOD.
2	Southeast	4.0 to 6.0	7.0 to 8.0	2.0 to 4.0	Restored to wildlife lakes (with water level ~6.5mAOD), woodland and grassland.
3	North (central)	4.0 to 6.0	7.5 to 11.0	1.5 to 7.0	Restored to lowland meadow
4	South (central)	5.0 to 6.5	8.0 to 9.0	2.5 to 4.0	Restored to agriculture
5	Northwest	4.0 to 7.5	8.0 to 10.0	2.5 to 6.0	Restored to agriculture, wetland (water level ~8.0 to 8.5mAOD) and woodland
6	Southwest	3.5 to 7.5	8.0 to 10.0	2.5 to 6.5	Restored to wetland and woodland

Figure 3 Extract from BCL Hydro Figure 54 illustrating Base of River Terrace Deposits (Elevations as mAOD)



Quarry Restoration is to be undertaken under a Restoration Plan as set out in ByrneLooby Report K6036-R01.

This restoration Plan sets out the type of materials to be imported and the illustrates the depth of infill on scaled cross-sections Drawing K6036-01-00 (reproduced as Figure 4 - Figure 6

Figure 4 East - West Scale Cross-Section Extract from Drawing K6036-01-00

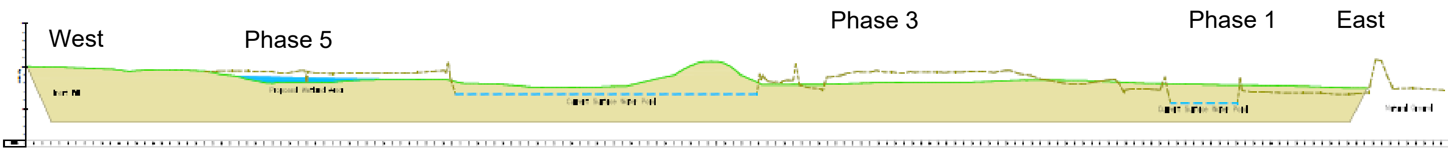


Figure 5 North – South Scale Cross-Section Extract from Drawing K6036-01-00

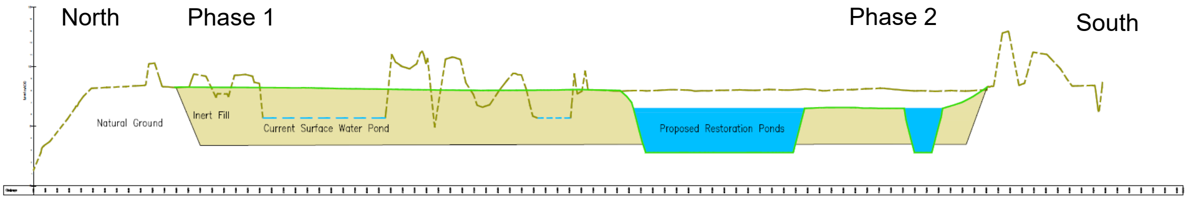
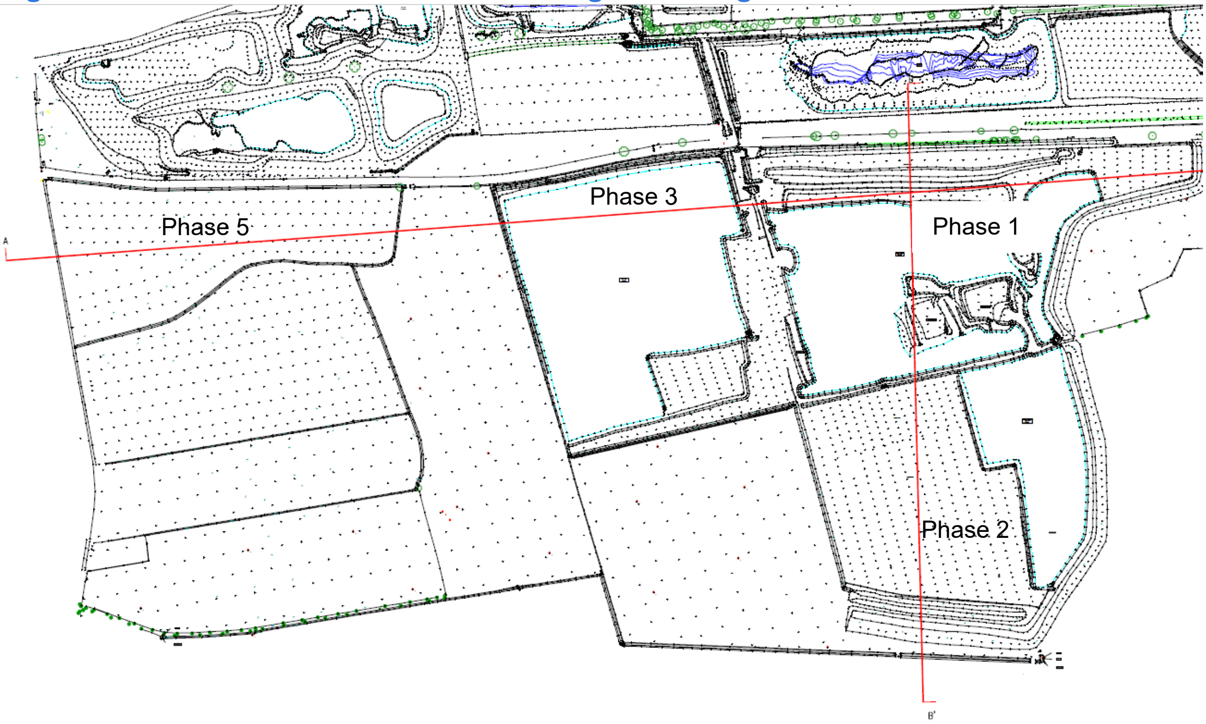


Figure 6 Section Line Locations for Figure 4 & Figure 5



The restored topography will form a sympathetic landscape with the pre-quarrying ground level and incorporate a series of wetland features for both ecological and flood attenuation purposes. The flood attenuation ponds will capture all incidental water onto the restored surface (except for the northeast corner, which will drain directly into the South Drain). The ponds will be interconnected at three stepped elevations; namely 8.5mAOD in the west, 8.0mAOD in the centre-west, and 6.5mAOD in the east.

The elevation of each set of ponds as illustrated on Tarmac Drawing M032-00421-4 is based on a requirement to drain into the Eastfield Drain which has an easterly falling profile from 9.25mAOD at the southwest of the site (MCD1) to 6.5mAOD at the southeast of the site.

2.3 Source and types of Waste Materials

The Planning Permission for the site restricts the types of infilling materials to inert materials only. This is further caveated to only those materials approved under the Waste Recovery Plan, which will primarily comprise largely of soils characterised as

- 17 05 04 "*Soils and stone other than 17 05 03*" and
- 20 02 02 "*Soil and stones*".

The full list of waste to be accepted has been taken from Standard Rules Permit SR2015 No. 39 and these are represented below as Table 2.

Table 2 Waste Types Approved under Site Recovery Plan

EWC	Description	
01	**Wastes resulting from exploration, mining, quarrying, and physical and chemical treatment of minerals**	
01 01	wastes from mineral excavation	
01 01 02	Wastes from mineral nonmetalliferous excavation. Limitation: - Restricted to waste overburden and interburden only.	AN
01 04	wastes from physical and chemical processing of non-metalliferous mineral	
01 04 08	Waste gravel and crushed rock.	MN
01 04 09	Waste sands and clays.	AN
10	**Waste from thermal processes**	
10 12	Wastes from manufacture of ceramic goods, bricks, tiles and construction products	
10 12 08	Waste ceramics, bricks, tiles and construction products (after thermal processing)	AN
17	**Construction and Demolition Waste**	
17 01	Concrete, bricks, tiles and ceramics	
17 01 01	Concrete	MN
17 01 02	Bricks	MN
17 01 03	Tiles and ceramics	MN
17 01 07	Mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06. Limitation : - Metal from reinforced concrete must have been removed.	MN
17 05	soil (including excavated soil from contaminated sites), stones and dredging spoil	
17 05 04	Soils and stone other than 17 05 03. Limitation: - Restricted to topsoil, peat, subsoil and stones only.	MN
19	**Waste from mechanical treatment of waste (sorting, crushing, compacting palletising not otherwise specified)**	
19 02 06	sludges from physico/chemical treatment other than those mentioned in 19 02 05 **Proposed addition – see Section 2.4**	**MN**
19 12	wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified	
19 12 09	Minerals (for example sand, stones) only. Limitation:- Restricted to wastes from treatment of waste aggregates that are otherwise naturally occurring minerals. Does not include fines from treatment of any non-hazardous waste or gypsum from recovered plasterboard.	MN
19 12 12	Other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11. Limitations: - Restricted to crushed bricks, tiles, concrete and ceramics only. Metal from reinforced concrete must be removed. Does not include fines from treatment of any non-hazardous waste or gypsum from recovered plasterboard.	MN
19 13	Wastes from soil and groundwater remediation	
19 13 02	solid wastes from soil remediation other than those mentioned in 19 13 01	MN
20	**Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions**	
20 02	Garden and park wastes (including cemetery waste)	
20 02 02	Soil and stones. Limitations: - Restricted to topsoil, peat, subsoil and stones only.	AN

AN – Absolute Non-hazardous entry MH – Mirror non-hazardous entry

19 02 06 is also proposed as discussed in Section 2.4

The green shaded cells within Table 2 are identified under Paragraph 2.1.1 of European Council Decision 2003/33/EC[1] as being acceptable to be received at inert landfills without testing, provided source characterisation demonstrates that the materials are suitable.

[1]Paragraph 2.1.1 of European Council Decision 2003/33/EC of 19th December 2002 as establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of Directive 1999/31/EC (of 26 April 1999 on the landfill of waste)

These materials have an inherently low pollution potential. They do not contain substances at concentrations that may present a risk to surface water or groundwater. After its deposit and subsequent profiling, the already low permeability of this material is further reduced. This further restricts the leachability of any potential soluble components and mobilisation of solids from its compacted surface.

2.4 Additions to the Waste Acceptance Codes

There is one further EWC code that is recommended to be added to the list of wastes, namely

- 19 02 06 sludges from physico/chemical treatment other than those mentioned in 19 02 05

In this case the waste stream intended is specifically filter cake from soil washing that is primarily intended to produce a recovered aggregate, and produces a separate silt and clay.

In this regard the material is consistent with that of the 19 12 12 coded wastes that are to be accepted under the caveats given in Table 2, and is an addition to that presented in the approved waste recovery plan. Market and industry surveys by the applicant (Tarmac) has identified this type of filter cake as an increasingly available waste stream and comes from a "wet" process consistent with that of a dry trommel separated aggregate.

The wet washing allows an improved efficiency for separating out sand grade particle sizes to leave the silt and clay. Such a waste stream is also consistent with the separation of interburden from aggregate gravels that are intended to remain on site.

There is a further advantage in that the wet wash allows for improved removal of readily soluble components, which are retained in the wash water whilst low density incidental plastics, wood and root fragments that contribute to the organic content of construction and demolition excavation derived soils.

In order for such a soil derived filter cake for this clay and silt material to be suitable for deposit in the Maxey Deposit for Recovery Scheme the following caveats are recommended the filter cake :

- is non-hazardous
- meets the requirements for Inert Waste Acceptance in accordance with the criteria specified in section 2.1 of the Annex to Council Decision 2003/33/EC
- any organic flocculants used are readily degradable, or where inorganic holistically meet the criteria in the first two bullet points

These are the same pre-operational conditions as recently being added to Environmental Permit KB3708TC (Brooksby) for the same applicant, which is in draft form.

3 Pathways and Receptors

3.1 Geology

The Site's geological setting is presented on British Geological Survey (BGS) 1:50 000 scale mapping Sheet 158 (Peterborough). The site is at the edge of the map, and wider westerly detail is presented on BGS Map Sheet 157 (Stamford), as well as the online mapping platform https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/.

Regionally, the site is located within an area with an extensive coverage of superficial deposits, comprising River Terrace Deposits (RTD's) on the grounds between ~5mAOD and ~10mAOD. Below 5mAOD, the superficial sediments comprise alluvium of both terrestrial and marine origin, as well as peat deposits.

The underlying bedrock is easterly dipping and comprises of a Jurassic sequence of strata. To the east of the site, the subcropping strata beneath the superficial deposits is largely Oxford Clay, with underlying strata subcropping to the west of the Oxford Clay subcrop. Further west, as the topography rises the bedrock outcrops directly (Figure 7 and Figure 8).

The regional bedrock geological sequence comprises:

- Oxford Clay
- Kellaways Formation
    - Kellaways Sand Member
    - Kellaways Clay Member
- Cornbrash Formation (Limestone)
- Blisworth Clay Formation
- Blisworth Limestone Formation
- Upper Estuarine Deposits

Specifically, at the site, the geological sequence comprises (Table 3 - Table 5) a sequence of:

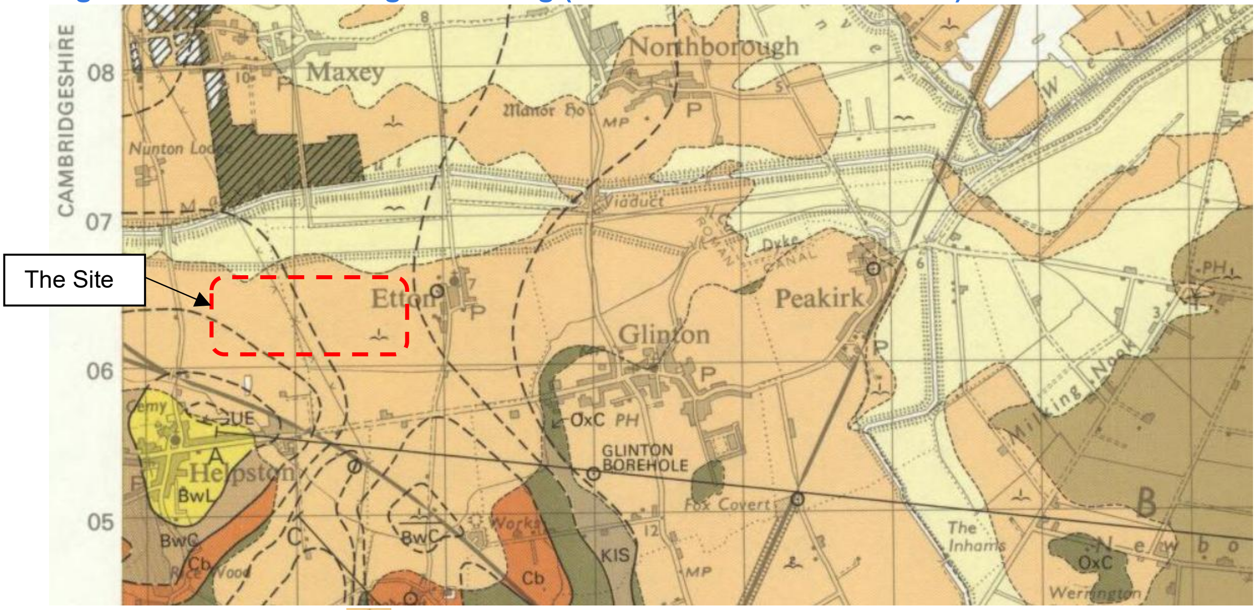
Superficial Deposits

- 1st Terrace Gravels

Bedrock (Sub-cropping due to the dip of the strata) based on BGS data

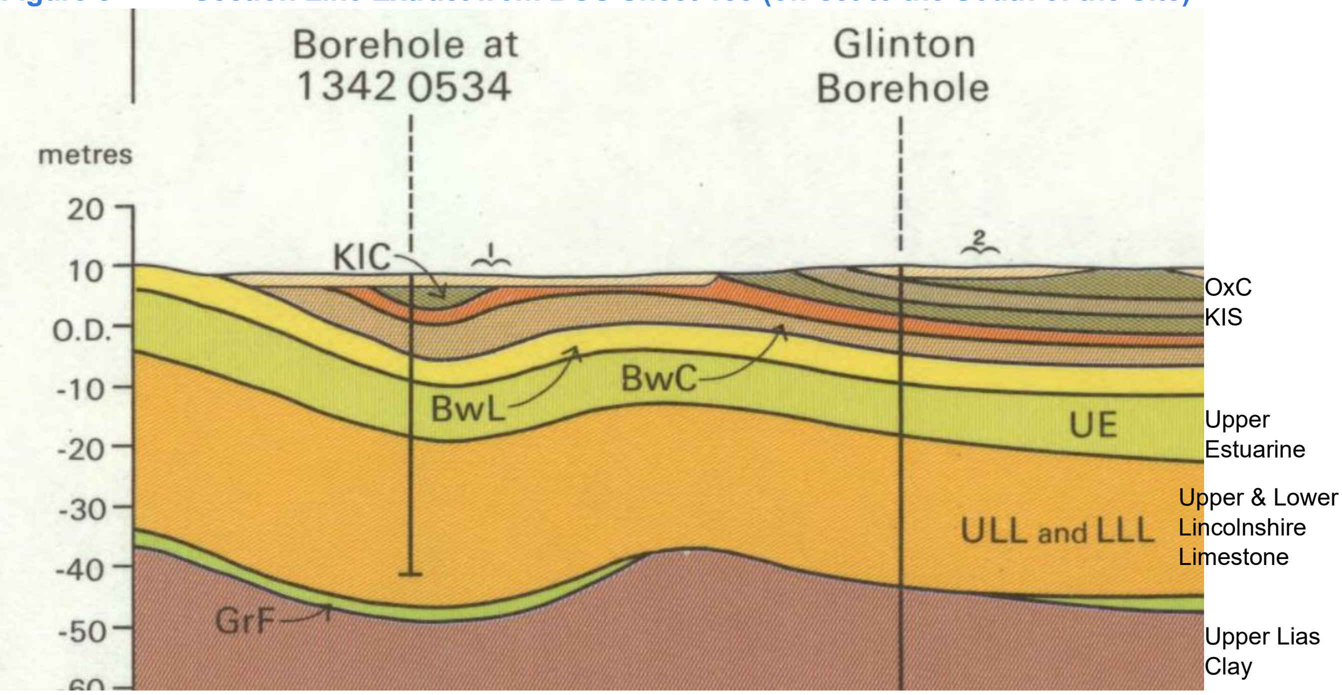
- Kellaways Sand (east of Phase 1 and 2)
- Kellaways Clay (beneath Phase 1, 2, 3 and 4)
- Cornbrash Limestone (beneath Phase 5 and most of Phase 6)
- Blisworth Clay (SW corner of Phase 6) / Blisworth Limestone (SW of site)
- Upper Estuarine Sequence (SW of site)
- Upper & Lower Lincolnshire Limestone

Figure 7 Site Geological Setting (Extract from BGS Sheet 158)



- Alluvium; – 1st Terrace Gravels OxC – Oxford Clay; KIS – Kellaways Sand;
KIC – Kellaways Clay; Cb – Cornbrash Limestone; BwC – Blisworth Clay; BwL – Blisworth Limestone

Figure 8 Section Line Extract from BGS Sheet 158 (off-set to the South of the Site)



The site is located to the west of the Kellaways Sand subcrop, and is underlain by the Kellaways Clay in the eastern and central section of the site. Regional scale mapping implies that the Cornbrash Limestone should subcrop in the western part of the site, whereas the BGS cross section (Figure 8) would also imply minor flexure / folding of the Jurassic strata (pre Oxfordian) and the presence of an “inlier” feature locally, centred at Helpston.

However, BCL's 2022 review of the site's geological exploration logs demonstrated that weathered or *in-situ* clay appears to overstep the zone that is mapped as Cornbrash Limestone, and that at subcrop there is a continuous clay layer beneath the base of the sand and gravel Terrace Deposits (*i.e.* the erosional surface through the inlier feature expressed on Figure 8 extends vertically and has removed fully the intervening Cornbrash down to the Blisworth Clay).

Table 3 Underlying Geological Strata

Location	PZ1	PZ3	PZ4	PZ9	PZ5	PZ10	PZ6	PZ8	PZ2
Paired	05/07	05/03	05/04	Paired		Paired		Paired	
	mAOD	mAOD	mAOD	mAOD	mAOD	mAOD	mAOD	mAOD	mAOD
Ground Level	10.42	9.37	8.84	9.21	9.50	8.72	8.65	8.76	8.76
Top of RTD	None Present	8.67	7.74	8.91	9.20	8.32	8.25	8.26	8.01
Top of Kellaway Clay		6.37	5.14	6.51	6.70	4.82	4.75	5.76	5.56
Top of Cornbrash		5.21	-2.86		3.40		2.35		-0.44
Top of Blisworth Clay	9.82	3.97	-4.66		1.60		0.75		-2.50
Top of Blisworth Limestone	5.32	-0.66					-3.05		-5.34
Top of Rutland Fm	0.52	-6.03							

Shaded cells – borehole terminated before unit encountered, monitoring locations are presented on drawing K6036-1004.

Table 4 Underlying Geological Strata (2023 Installations)

Location	BH22/01	BH22/02	BH22/03
Paired	Paired		
	mAOD	mAOD	mAOD
Ground Level	7.56	7.60	8.31
Top of RTD	7.16	7.60	7.71
Top of Kellaway Clay	3.66	3.20	4.81
Top of Cornbrash		-1.70	-1.39
Top of Blisworth Clay		-3.90	-2.99

Shaded cells – borehole terminated before unit encountered

Table 5 Bedrock Unit Thickness Encountered at Site

	Location	RTD	Kellaway Clay	Cornbrash Limestone	Blisworth Clay	Blisworth Limestone
		m	m	m	m	m
Southwest	PZ1	Not Present			4.50	4.80
South Centre	PZ3	2.30	1.16	1.24	4.63	5.37
Centre	PZ4	2.60	8.00	1.80		
North Centre (Paired)	PZ9	2.40	6.51			
	PZ5	2.50	3.30	1.80		
North Centre (Paired)	PZ10	3.50				
	PZ6	3.50	2.40	1.60	3.80	
Southeast Paired	PZ8	2.50				
	PZ2	2.45	6.00	2.06	2.84	
East	BH22/03	2.90	6.20	1.60		
Northeast (Paired)	BH22/01	*3.50				
	BH22/02	4.40	4.90	2.20		
Summary	Average	3.0	4.8	1.8	3.9	5.1
	Max	4.4	8.0	2.2	4.6	5.4
	Min	**2.3	1.2	1.2	2.8	4.8

Thickened soil/alluvial cover (to 0.4m depth) above Terrace Deposits for paired location
**minimum adjacent in zone adjacent to be quarried

The presence of a continual clay layer beneath the RTD's is confirmed from a review of 2005 / 2006 investigations and shallow investigation boreholes for reserve calculation purposes, The information is summarised in Table 6 for completeness relative to the site Phase areas.

Table 6 Top of Clay datum (2005 / 2006 SI) and confirmed thickness of proven clay

Phase Area	Location	Datum Level	Top Of Clay	Thickness	Comments
		mAOD	mAOD	m	
Phase 1	MQ06 / 08	8.60	4.50	1.90	CLAY, blue / grey stiff clay
	MQ06 / 09	8.45	4.10	1.65	CLAY, brown, stiff becoming blue
	MQ06 / 10	8.19	4.79	1.00	CLAY, brown then blue (stiff)
	MQ06 / 11	8.21	3.71	1.50	CLAY, brown firm, becoming blue
	MQ06 / 12	7.77	3.77	2.00	CLAY, stiff, becoming very stiff, blue grey
	MQ06 / 13	7.10	3.80	0.70	CLAY, soft brown into blue stiff
	MQ06 / 16	8.29	3.59	1.30	CLAY, firm blue grey, then very stiff
	MQ06 / 17	8.12	4.52	0.40	CLAY, blue grey, very stiff
	MQ06 / 18	8.27	3.62	0.85	CLAY, blue grey, very stiff (hard below 5m)
	MQ06 / 19	8.55	4.15	3.60	CLAY, brown firm, becoming blue, very stiff base
	MQ06 / 20	8.48	4.63	0.65	CLAY, sandy soft brown clay becoming stiff, blue
	MQ06 / 21	8.52	4.82	0.80	CLAY, pale bluish grey, becoming stiff, blue grey
	MQ06 / 22	8.85	4.15	0.80	CLAY, soft brown into blue stiff
	MQ06 / 24	9.27	5.27	0.50	CLAY, green, becoming blue grey, stiff
Phase 2	MQ06 / 32	8.57	5.12	0.30	CLAY, brown, stiff becoming blue
	MQ06 / 33	8.36	4.61	0.25	CLAY, blue grey, very stiff
	MQ06 / 36	8.57	5.32	0.25	CLAY, blue grey, very stiff
	MQ06 / 37	8.55	5.60	0.55	CLAY, blue grey, very stiff
	MQ06 / 39	8.23	6.18	0.95	CLAY, brown firm, becoming blue, very stiff base
Phase 3	MQ06 / 03	9.34	5.04	0.10	CLAY, blue grey, very stiff
	MQ06 / 05	9.36	5.86	1.00	CLAY, brown firm, becoming blue
	MQ06 / 06	8.45	4.10	1.65	CLAY, brown stiff, becoming blue, very stiff base
	MQ06 / 07	9.14	4.54	0.40	CLAY, blue grey, very stiff
	MQ06 / 23	8.90	5.40	0.50	CLAY, brown very stiff
	MQ06 / 25	9.26	5.76	2.50	CLAY, blue grey firm, stiff with depth
	MQ06 / 30	9.19	6.69	0.50	CLAY, blue grey, very stiff
Phase 4	MQ05 / 08	9.49	5.59	0.70	CLAY, stiff brown (occasional gravel) to blue stiff
	MQ06 / 29	9.46	5.76	0.30	CLAY, blue grey, very stiff
	MQ06 / 31	8.78	5.28	0.50	CLAY, blue grey, very stiff
	MQ06 / 35	8.81	5.11	0.30	CLAY, blue grey, very stiff
	MQ06 / 38	8.71	6.31	0.60	CLAY, blue grey, very stiff
	MQ06 / 53	8.80	8.00	0.70	CLAY, brown soft to firm then blue grey (stiff)
Phase 5	MQ05 / 08	9.49	5.59	0.70	CLAY, stiff brown (occasional gravel) to blue stiff
	MQ05 / 09	9.98	6.38	0.40	CLAY, brown firm gravely clay, to blue grey stiff
	MQ05 / 10	10.46	6.21	1.25	CLAY, brown firm sandy with fine gravel
	MQ05 / 11	10.13	6.88	0.75	CLAY, blue grey, very stiff
	MQ05 / 12	10.05	5.85	0.80	CLAY, blue grey, very stiff
	MQ05 / 13	9.47	5.27	0.80	CLAY, blue grey, very stiff
	MQ05 / 14	10.13	5.93	0.80	CLAY, blue grey, very stiff
	MQ05 / 15	10.34	6.34	0.50	CLAY, blue grey, very stiff
	MQ05 / 16	10.30	6.10	0.80	CLAY, blue grey, very stiff
	MQ05 / 17	10.48	6.48	0.50	CLAY, blue grey, very stiff
	MQ05 / 18	10.36	6.46	0.60	CLAY, blue grey, very stiff
	MQ06 / 01	9.59	5.29	1.70	CLAY, blue / grey stiff clay
	MQ06 / 02	9.16	5.26	1.10	CLAY, blue / grey soft then stiff clay
	MQ06 / 04	9.34	5.24	0.40	CLAY, brown firm, becoming blue, very stiff base
	MQ06 / 08	8.60	4.50	1.90	CLAY, blue grey, very stiff
	MQ06 / 27	9.57	5.37	0.30	CLAY, blue grey, very stiff
Phase 6	MQ06 / 28	9.41	5.91	1.00	CLAY, soft brown into blue stiff
	MQ06 / 55	9.44	6.64	0.20	CLAY, blue grey, very stiff
	MQ06 / 63	10.26	9.96	1.70	CLAY, orange, brown stiff, light grey from 1.0m
	MQ06 / 64	10.18	5.88	0.20	CLAY, blue grey, very stiff
	MQ06 / 65	9.50	5.65	0.65	CLAY, brown firm, becoming blue stiff
	MQ06 / 66	10.03	6.13	0.60	CLAY, brown stiff, becoming blue very stiff
	MQ06 / 67	9.70	5.80	0.10	CLAY, brown sift to firm
	MQ06 / 68	9.26	6.26	0.50	CLAY, soft brown into blue stiff

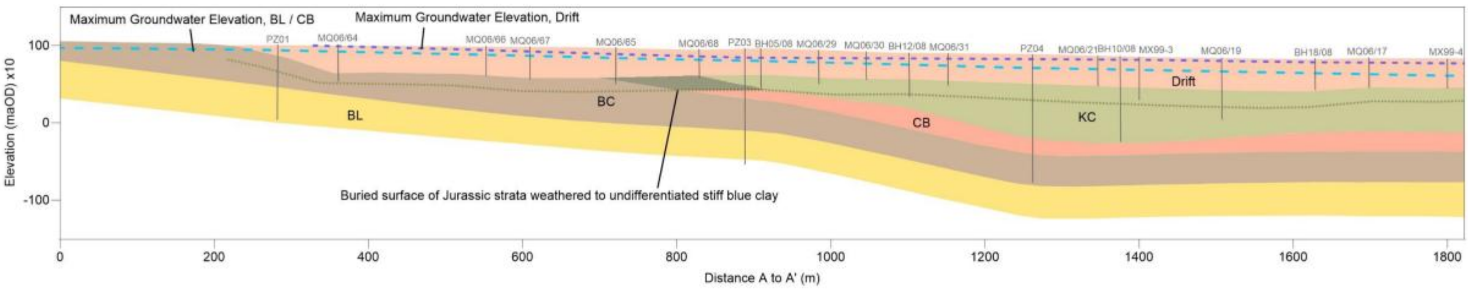
MQ05 and MQ06 series (2005 / 2006) investigation points, locations depicted on drawing BCL drawing "Drilling Locations" V4 (17/06/2022). Clay thicknesses are "minimum" as the logs terminated before proving full depth.

Both the 2005 / 2006 investigation[2] and subsequent 2022 review[3] indicate clay (mudstone) bedrock beneath the RTD's in advance of the limestone sequences (Cornbrash and older). The observation of "blue / grey" stiff clay in the majority of locations could imply that the overstep (potentially an eroded surface of the inlier feature) is marked by the beginning of the Oxford Clay as the Kellaways Clay is generally predominated by a "black" or "grey" colouration (a reflection of anoxic deposition and greater degree of organic material).

Notwithstanding the above, the demonstration of the wider stratigraphic sequence at locations such as PZ05, PZ03 and PZ01 (Table 3) in conjunction with a brown colouration to the horizon would imply that the Kellaways Clay is present which is weathered in the uppermost part (i.e. partially oxidized akin to the Oxford Clay in some locations throughout the UK, including Dogsthorpe to the southeast).

A simpler explanation is that the sequence at site is marked by a "non-sequential junction" which would confirm BGS's local interpretation of a diachronous upper surface to the Cornbrash and that deposition of the Kellaways Clay "*started earlier in the south of the district than in the north*"[4]. This would result in Blisworth Clay passing directly to younger Kellaways Clay above. As such, the clay disconnects the Cornbrash Formation subcrop beneath the RTD's and direct continuity with groundwater therein (as illustrated in Figure 9).

Figure 9 Interpretive Cross Section SW – NE (extract from BCL Hydro, Figure 15, 2022)



KC – Kellaways Clay; CB – Cornbrash Limestone; BC – Blisworth Clay; BL – Blisworth Limestone. Line of section is presented on Figure 3.

The bedrock sequence adjacent to, and beneath the RTD's can be summarised as:

- Kellaways Sand (east of Phase 1 and 2 – off site)
- Kellaways Clay (beneath Phase 1, 2 and weathered clay / Kellaways Clay beneath Phase 3, 4) that crosscuts and confines the Cornbrash Formation
- Blisworth Clay (beneath Phase 5, 6)
- Blisworth Limestone and older limestone sequences (off-site to the SW)

Clay thickness between the base of the RTD's and the Cornbrash Limestone are ~ 1.2m at PZ03 and 2.5m at MQ06/25 (Table 3), thickening to the east (Figure 9).

[2] Report on Exploration Drilling on Area to the South of the South Drain 2005/2006, Paul Brewer Geological Services (Location Plan and Logs – BCL Hydro)
[3] BCL Hydrological and Hydrogeological Impact Assessment 2022 (Interpretive cross section, Figure 15)
[4] Horton A. 1989. Geology of the Peterborough district. Mem. Br. Geol. Survey, Sheet 158, England and Wales

3.2 National Aquifer Designations and Source Protection Zones

The Terrace Deposits and alluvium have been designated as a Secondary A aquifer (Figure 10). It is noted that outside of the Terrace Deposits the superficial deposits are largely designated as unproductive strata.

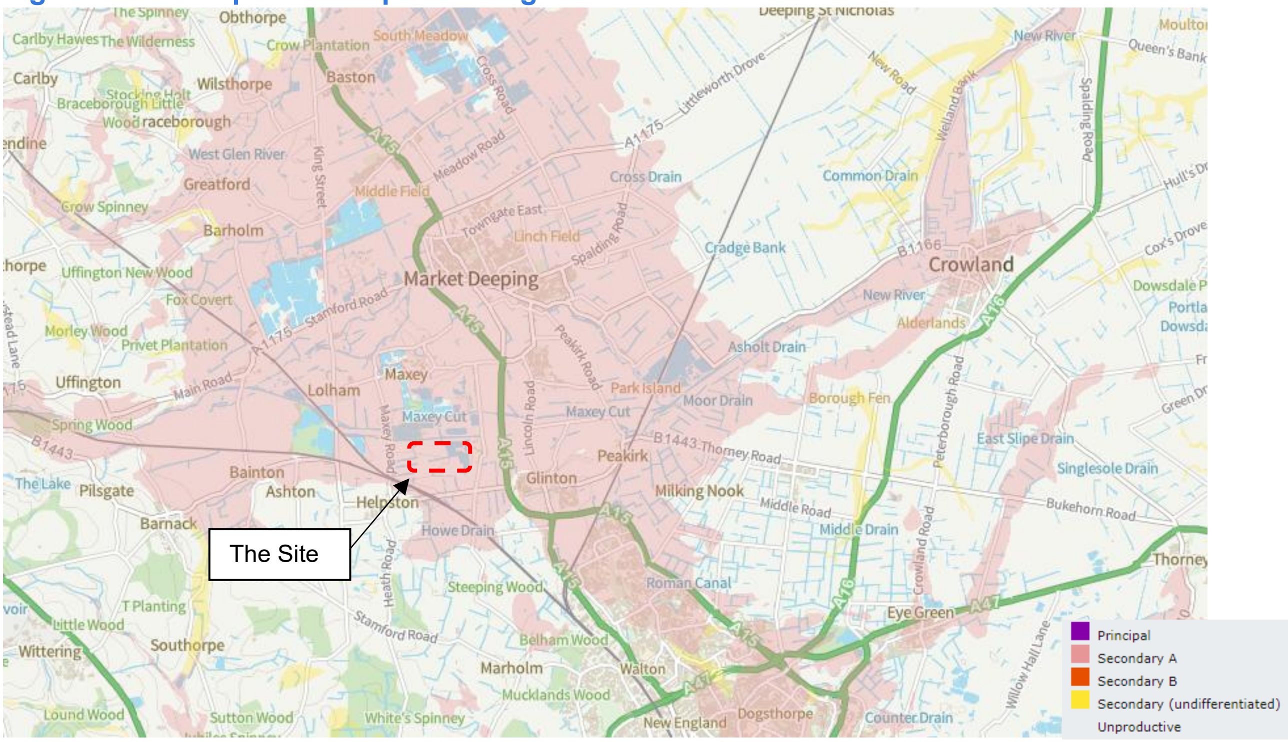
There are also numerous quarry dewatering and agricultural irrigation abstractions from the superficial deposits, as well as abstractions from the main river channels (*e.g*. Maxey Cut and the River Welland) for irrigation purposes in the vicinity and general area.

The majority of these are to enable quarry dewatering and the abstracted waters are returned to the inter-related superficial groundwater-surface water channel system.

During the operation of the quarry for mineral extraction and restoration under the proposed Recovery Permit scheme, dewatering will be required to access the mineral as well as place the imported inert material.

In the intermediate to longer term, the closest abstraction point to the site will be the proposed irrigation lagoon that will be constructed in the Phase 1 area (Figure 2).

Figure 10 Superficial Aquifer Designation



The bedrock aquifer status designations (Figure 11) coincides with the outcrop or the subcrop of the

- Kellaways Sand
- Cornbrash Formation (Limestone)
- Blisworth Limestone

Source Protection Zone (SPZ) designations (Figure 12) are however from the Lincolnshire Limestone, recharged from the west of the site. The Total Catchment (SPZ 3) recharge to these SPZs is from the west of the site; however although the site itself is within an SPZ 2 (outer SPZ), the SPZ is physically separated by confining layers of clay.

Figure 11 Bedrock Aquifer Status

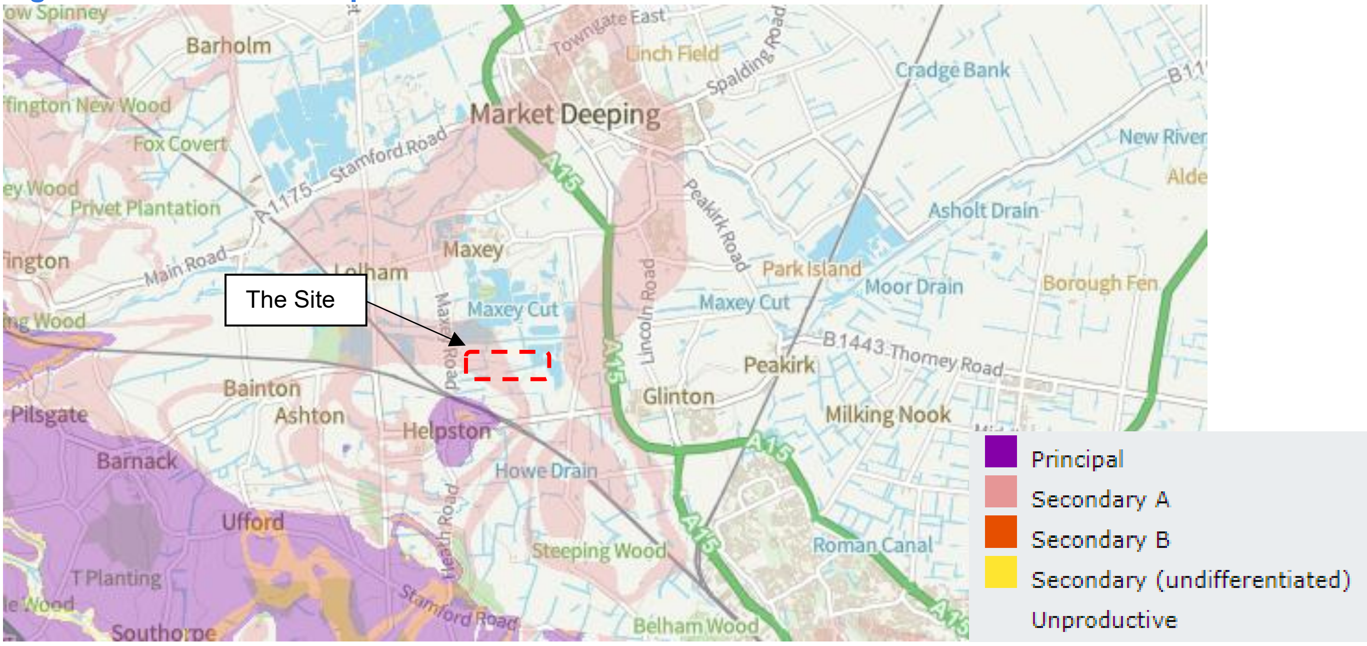
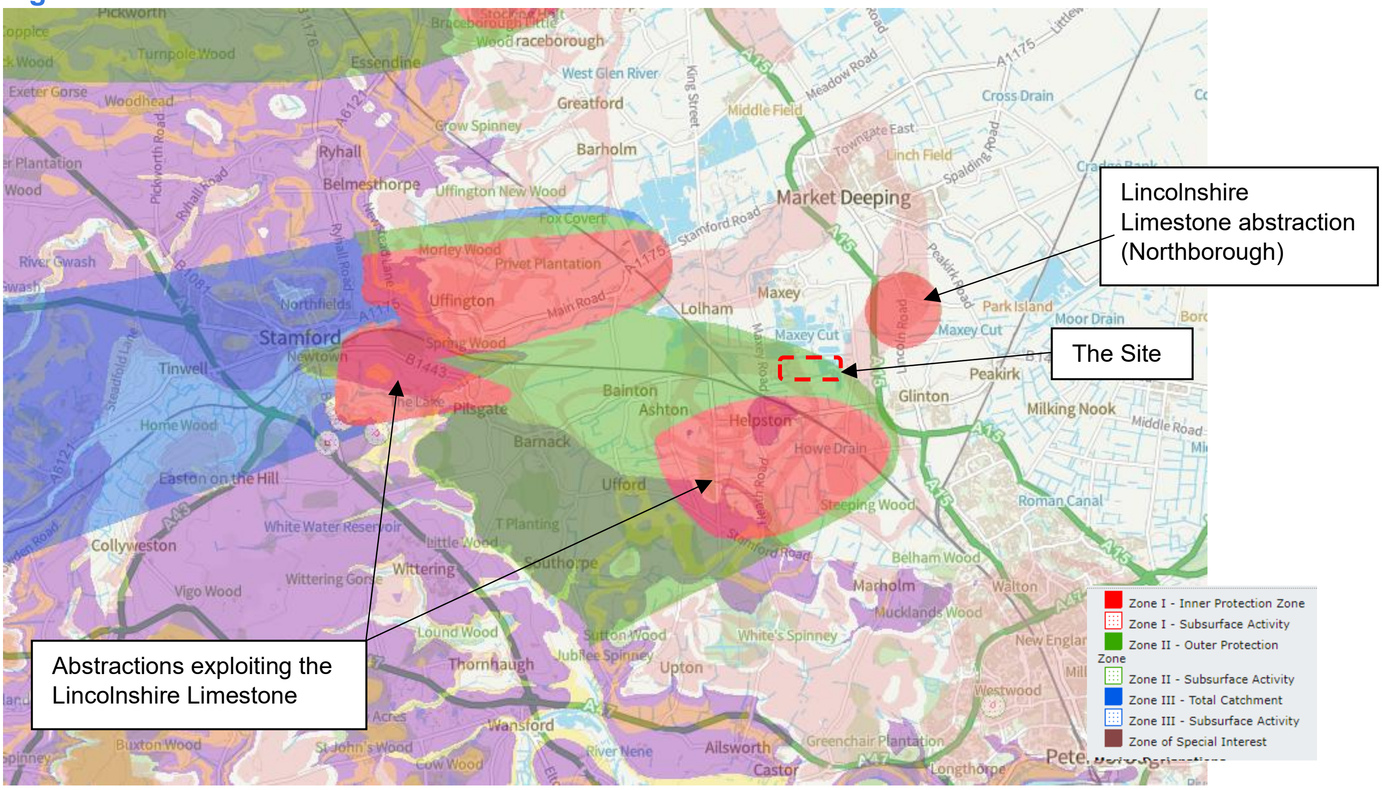


Figure 12 Source Protection Zones



Source Protection Zones for Public Water Supply Abstraction from the Lincolnshire Limestone at Northborough (confined), Etton (Confined) and Tallington Well fields

3.3 Hydrogeology

River Terrace Gravels are high permeability units that can transmit significant quantities of water, their resource value is therefore dependent on the saturated thickness of the unit, which at the site is limited. At the current point in time this is limited in part due to the ongoing quarrying activities. However, monitoring data is demonstrative of a minor saturated water surface above the *in-situ* clay.

The superficial deposits will be in direct hydraulic continuity with the surface water channels and the majority (if not all) of the quarry lakes/ponds that have been formed from historical mineral workings (e.g. as illustrated by Figure 1).

The hydraulic gradient in the superficial deposits is from west to east to discharge into the marine alluvial deposits (tidal flats) to the east of the site where the ground elevation is in the 2 – 4mAOD range (i.e. beyond Newborough) at the "North Levels".

The hydrogeology of the bedrock, is in contrast, dominated by low permeability strata. The Oxford Clay, Kellaways Clay and Blisworth Clay are all low permeability natural geological barriers, hence their designation as "unproductive strata".

This original designation was made based on the nomenclature of the strata (*i.e.* named as clay strata, with the assumed consistent properties).

This same approach has not been extrapolated to the Kellaways Sand, and Cornbrash Limestone, and are strata designated as Secondary Aquifers, along with the Blisworth Limestone which has been designated as a Principal Aquifers.

These designations are however flawed for both designation and risk assessment purposes as neither the size (thickness) or the permeability properties of the strata warrants such a designation.

Ayesa have been collating information from a number of landfill and recovery sites on the nature of the Kellaways, Cornbrash Formation and Blisworth Formations. In all cases, the thickness of the saturated units between the confining clay units and their inherent low hydraulic properties demonstrate that there is insufficient yield for the strata to have an aquifer designation.

The key designated "aquifer" unit at the Site is the Cornbrash Formation Limestone, which is present at a thickness of between 1.2m and 2.2m (consistent with BGS data)[4]. This is a typical thickness for the Cornbrash Limestone in the wider Peterborough area and the Marston Vale of Bedfordshire to the south. The Cornbrash is a dense shelly limestone, interbedded (bioclastic wackestone and packstone) with clay layers.

However, even in the southwest of England (*e.g.* Dorset), where the Cornbrash thickens to ~20m, the Formation is described[5] as "*The porosity of the Cornbrash limestone here is very low (around 1 percent) and permeability is negligible"*.

In conclusion, the entire Kellaways, Cornbrash and Blisworth Formations geological sequence should be considered as unproductive strata which is supported by the commentary associated with groundwater yield investigatory boreholes available on the BGS website[6].

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[5] West , I Petroleum Geology of the South of England accessible at https://wessexcoastgeology.soton.ac.uk/Oil-South-of-England.htm

[6] British Geological Survey. Borehole Locations accessed from http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Published data for the Kellaways Sand and Blisworth Limestone for the Jurassic minor aquifers section of The Physical Properties of Minor Aquifers in England and Wales, Technical Report WD/00/04 (Environment Agency R&D Publication 68, Table 6.2) which reports a typical intergranular permeability of 10^{-4}m/d, (equivalent to $1.2x10^{-9}$m/s).

Further validation has been gained by field hydraulic testing of the Cornbrash where hydraulic conductivities of $8.8x10^{-10}$m/s have been returned from field testing. Such a low hydraulic conductivity is unsurprising for a cemented limestone, with intervening clay and mudstone layers that are, in itself, confined between two clay / mudstone sequences.

The Kellaways Sand, Cornbrash Limestone and Blisworth Limestone have hydraulic properties which meet the classification of a Natural Geological Barrier for an inert Landfill site, *i.e.* $\leq 1x10^{-7}$m/s, and frequently equate to the hydraulic conductivity standard for an *in-situ* geological barrier and mineral liner standard for a non-hazardous landfill site, *i.e.* $\leq 1x10^{-9}$m/s.

As such, the entirety of the sequence beneath the proposed quarry restoration scheme constitutes the classification as an aquitard. Confirmation of the 'aquitard type' status and negligible flow / yield properties of the underlying strata can be gained from the increasing salinity of the strata as the sequence dips beneath the Oxford Clay and hence depth of confinement increases. The variance of salinity is due to natural mineralisation and both chloride and sulphate whereby increase to in excess of 1,000mg/l within the Peterborough region are reported.

However, this natural mineralisation of the confined groundwaters is limited at site due to the closer proximity to the recharge either at direct outcrop (at Helpston and to the west) or subcrop beneath the superficial Terrace Deposits (to the west).

3.4 Hydrology

The hydrological setting is dominated by artificial drainage channels, cut to a depth of 1 – 1.5m below the natural ground surface (Figure 1). The base of these channels is dependent on the topography which slopes towards the east. Consequently, the base of the drainage which follows the southern perimeter of the site (the Eastfield drain) falls from 9.25mAOD at the southwest to 5.76mAOD at the southeast of the site (Figure 13). Although the western section of the Eastfield Drain is hosted / contained by the Blisworth Clay, the 3m fall in topography results in rapid water movement which then infiltrates into ground prior to reaching the eastern extent of the site.

There is a similar fall in the elevation of the South Ditch which follows the northern edge of the site from ~9.5mAOD in the northwest to 6.4mAOD at SW1, at the northeast corner of the site (Figure 14). These drainage channels are recharged from, and their primary purposes is to receive surface run-off from agricultural fields, as well as to limit the height of winter groundwater seasonal water levels by forming a conduit that prevents land flooding.

The land drainage channels at the north and south of the site will therefore always be ephemeral, and this factor is exacerbated by groundwater management implemented to facilitate the quarrying and future deposit activities. In this regard water levels in the channels are generally low or dry, on the rare occasions there is water, it is less than 0.1m in depth.

Approximately 1.5km downstream of the site, the surface water drains discharge into the fenland drainage system, as a tributary the River Welland. All superficial groundwater will be captured by this drainage system as the topography falls to between 2.5 and 4mAOD.

Figure 13 Eastfield Drain Water Levels and Adjacent Groundwater Surface

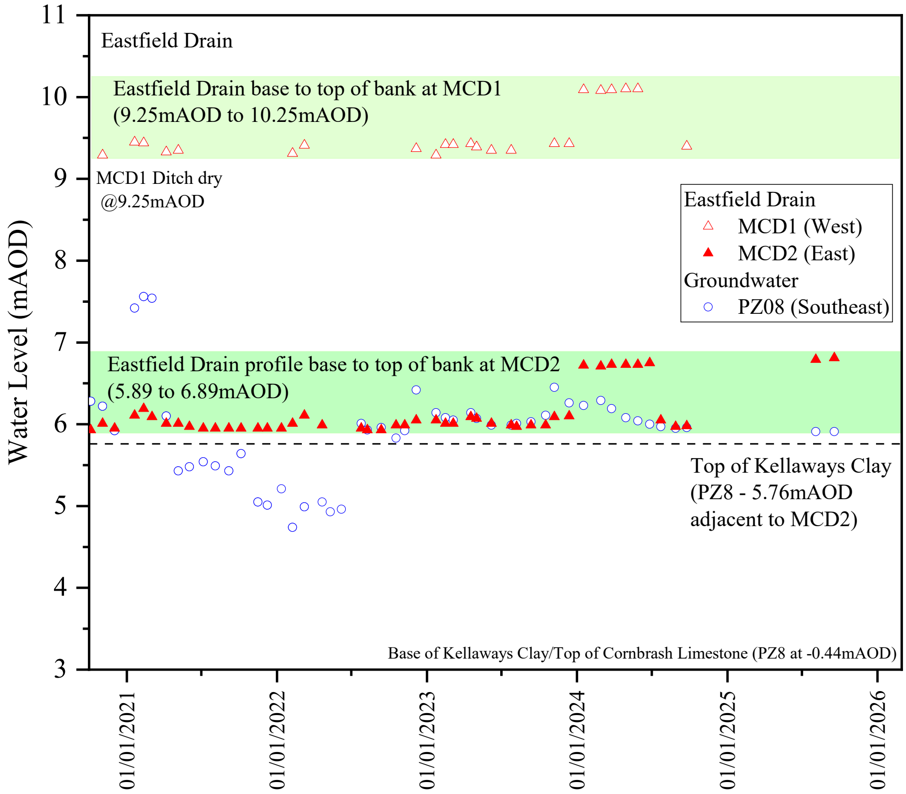
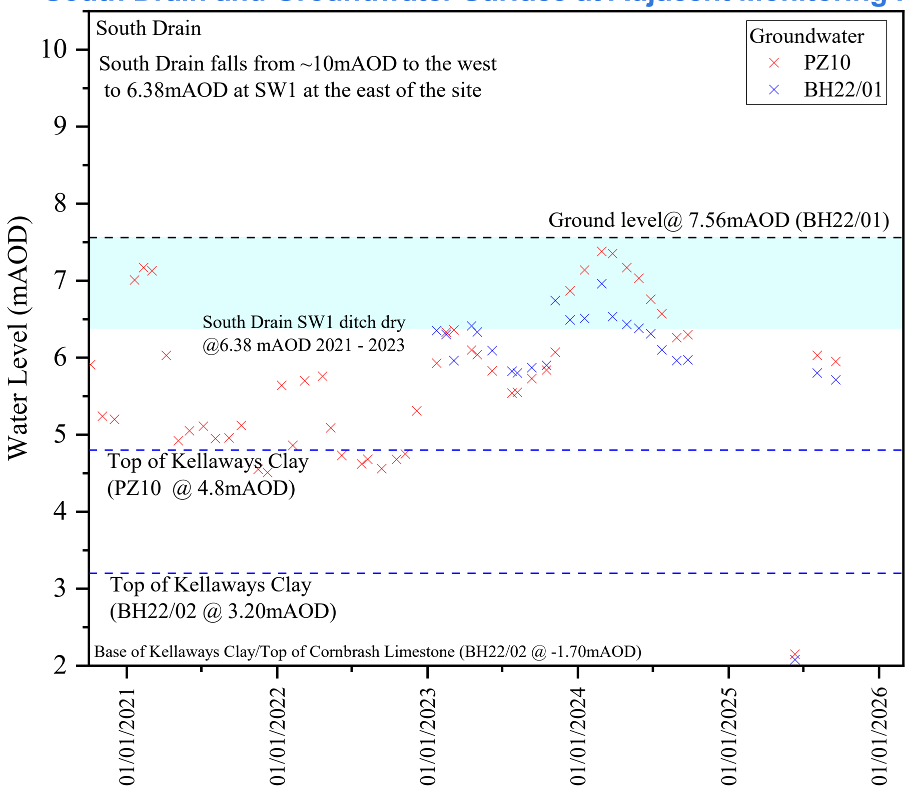


Figure 14 South Drain and Groundwater Surface at Adjacent Monitoring Points



3.5 Groundwater Surface and Inter-relationship with Surface Water

The groundwater surface in the superficial deposits is confined between a set of boundary conditions. The Eastfield and the South Drains form an upper limit to the groundwater elevation, and the topography of the surface of the Blisworth Clay in the west and the Kellaways Clay in the east form a lower boundary condition (Figure 16) for the superficial groundwater system.

This is an erosional surface caused by the ancient river system which deposited the River Terrace Deposits (RTD's), and slopes in an easterly to northeasterly direction, a direction which is generally consistent with the fall in topography consequently the superficial groundwater surface is at a higher elevation to the west than the east (*e.g.* Figure 15). The groundwater surface has then been further modified by dewatering to facilitate the quarry operations, hence there is a consistency in water elevations in the east of the site.

Monitoring data demonstrates that groundwater has in the footprint of the quarry been reduced to below the base of the superficial deposits in the west and is fluctuating between approximately 5.5mAOD and 6.5mAOD (Figure 15), i.e. the elevation of the base of the South Drain at the northeast corner of the site (Figure 14).

Monitoring point BH99/2 is located to the north of the South Drain, close to the location of the paired PZ05 & PZ09 locations and this likely represents the upgradient groundwater surface elevation which seasonally fluctuates between 8mAOD and 9mAOD. Albeit periodically the groundwater surface at this location may be influence by dewatering.

Long term monitoring indicates a superficial groundwater elevation in the centre of the site at BH05/04, which is located next to PZ04 was between 6.5m and 8mAOD.

Figure 15 River Terrace Deposit Groundwater Elevation

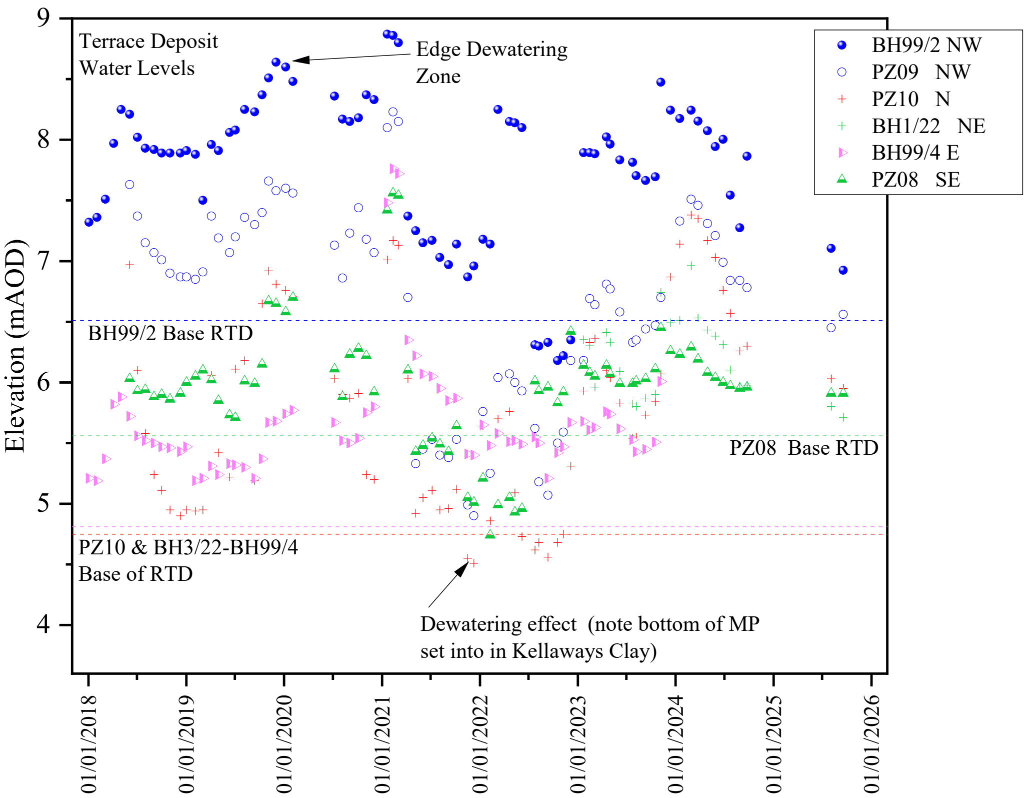


Figure 16 Base of Superficial RTD

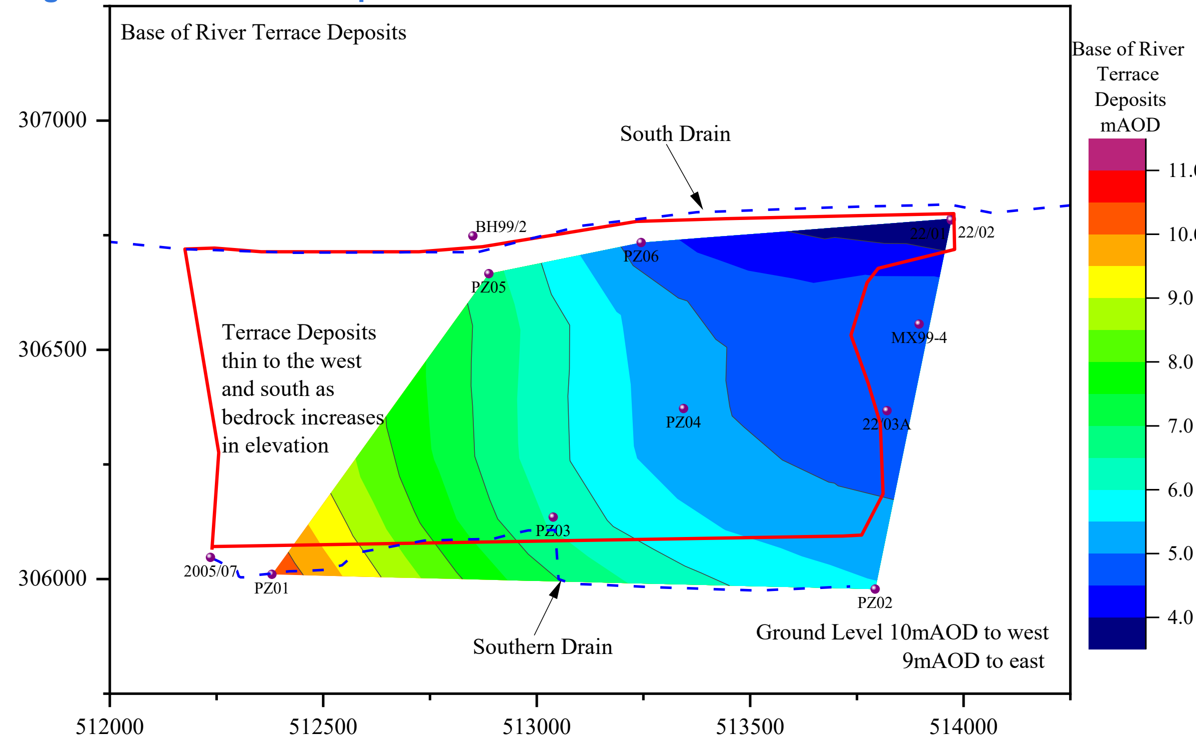
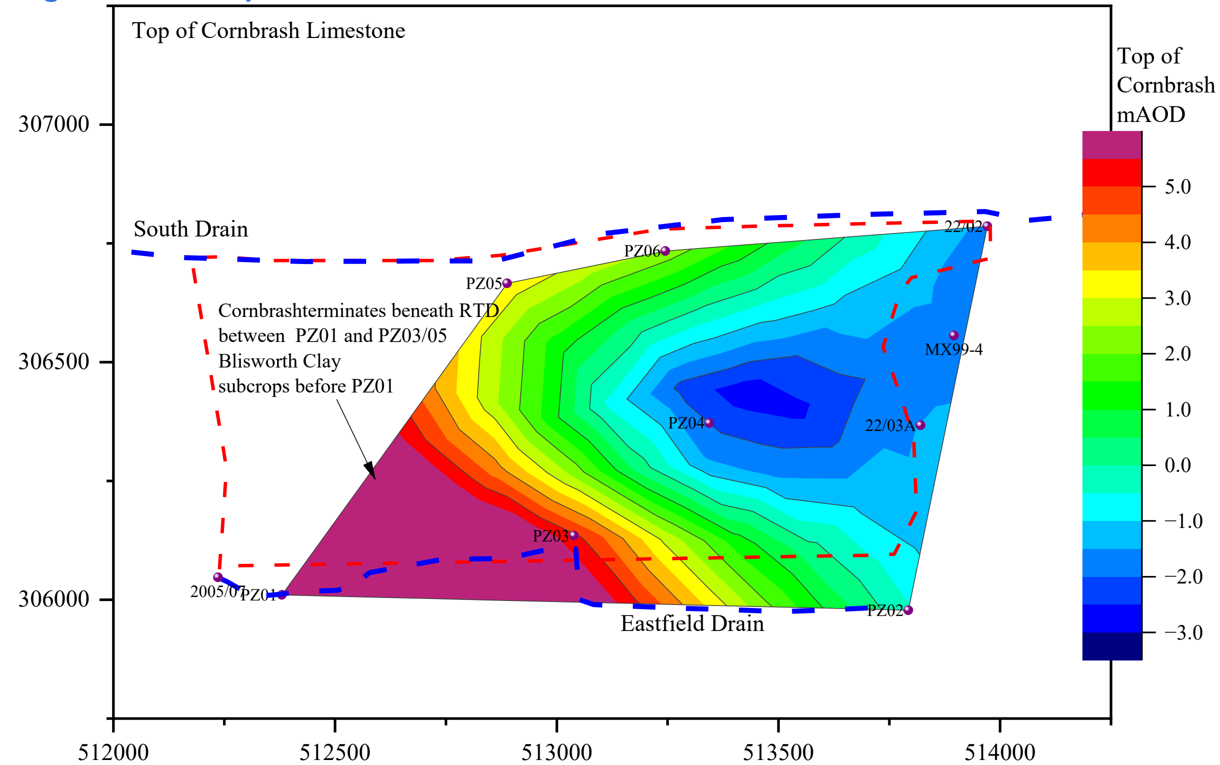


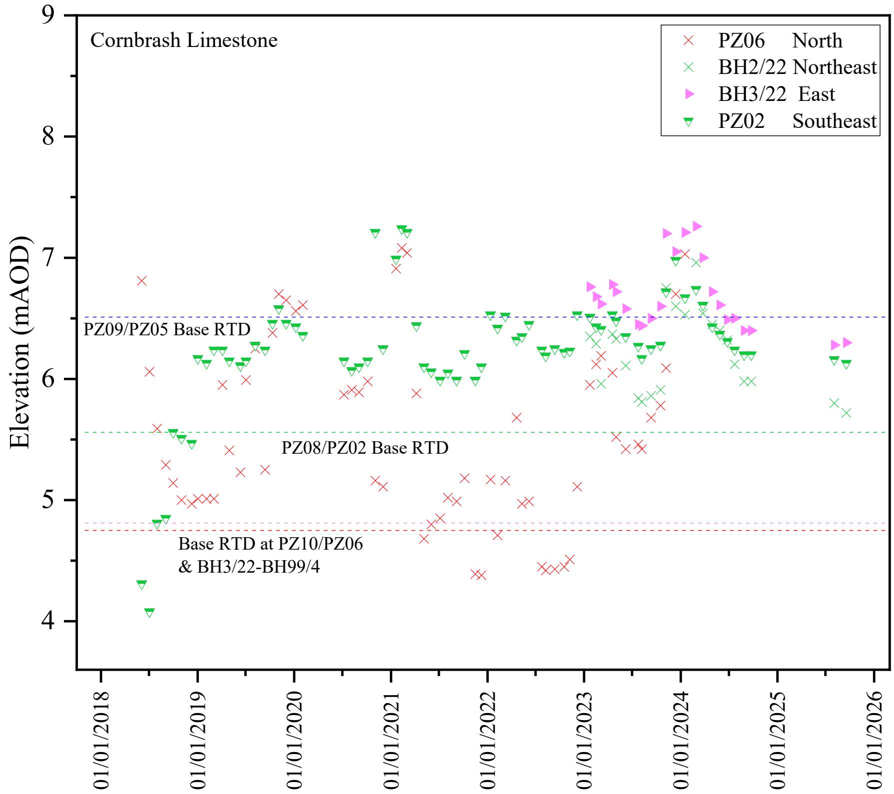
Figure 17 Top of Cornbrash



The base elevation of the RTD's falls towards the east / northeast (Figure 16), groundwater elevation monitoring in the Cornbrash Formation limestone indicates a piezometric surface generally consistent with that observed in the River Terrace Deposits (and reduction in basal elevation) and which is also concomitant to the upper surface of the strata (Figure 17). This groundwater is confined beneath the Kellaways Clay (Figure 18)at a minimum thickness of~1.2m – 2.5m of clay (Section 3.1). Progressing in an easterly direction, the depth of confinement becomes greater.

It is not considered that there is continuity between the superficial groundwater system and the Cornbrash Fm limestones within the site's footprint due to local confinement, this coincidence in flow direction is merely a response to the dip in the strata (which also dips in an easterly / northeasterly direction) or a wider area continuity with recharge to the Cornbrash from an off-site location to the west.

Figure 18 Cornbrash Limestone Groundwater Elevation



3.6 Water Quality

Groundwater and surface water quality monitoring has been undertaken since autumn 2018 on a monthly schedule until summer 2021, before reverting to a quarterly schedule. Water quality data is limited for the surface water systems as the ephemeral nature of the perimeter water courses / drainage channels limits the quantity of water that is available for sample collection.

The nature of the dewatering programme currently means that for the present time that all groundwaters must be considered as upgradient of the site. This will after completion of the restoration revert to a west to east gradient. Consequently, the downgradient monitoring points in the longer term can be identified as:

Downgradient (Superficial & Surface Water)

- SW1 (South Drain)
- BH01/22
- BH MX99-04
- PZ08
- MCD2 (Eastfield Drain)

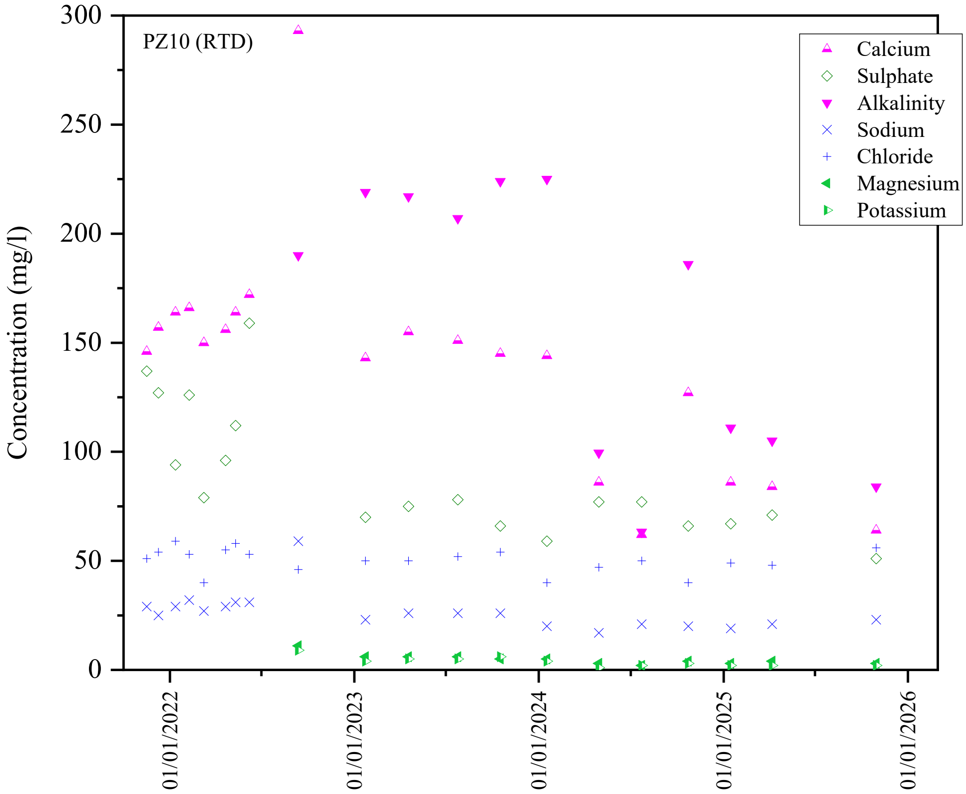
Downgradient Cornbrash

- BH02/22
- BH03/22
- PZ02

The longest complete dataset for matrix chemistry is available for the PZ10 location (northeast boundary Phase 4), which demonstrates that the groundwater is a calcium bicarbonate-based solution with secondary calcium sulphate and tertiary sodium chloride (*e.g.* Figure 19).

This type of groundwater geochemistry is typical for the region within unconfined and near surface groundwaters.

Figure 19 Superficial Groundwater Matrix Chemistry (PZ10)



Matrix Ions

There is no real distinction between the major ions for each of the strata where screened intervals allow such comparisons to be made, with sulphate consistently between 40mg/l and 160mg/l, with outliers at 176mg/l and 550mg/l reported up to 2024 (Figure 20). During 2024 and 2025, concentrations at BH1/22 have been consistently in the range between 151mg/l and 289mg/l (downgradient in the long term, adjacent to the South Drain and Phase 1). Chloride is lower at 15 – 60mg/l, increasing in the alluvium reported for the upgradient alluvium location BH05/07, located at the southwest corner of the site near the Maxey Road- railway bridge at 55 – 103mg/l (Figure 21).

A summary of the surface water and the groundwater matrix chemistry is presented as Table 7 and Table 8.

Figure 20 Groundwater Sulphate

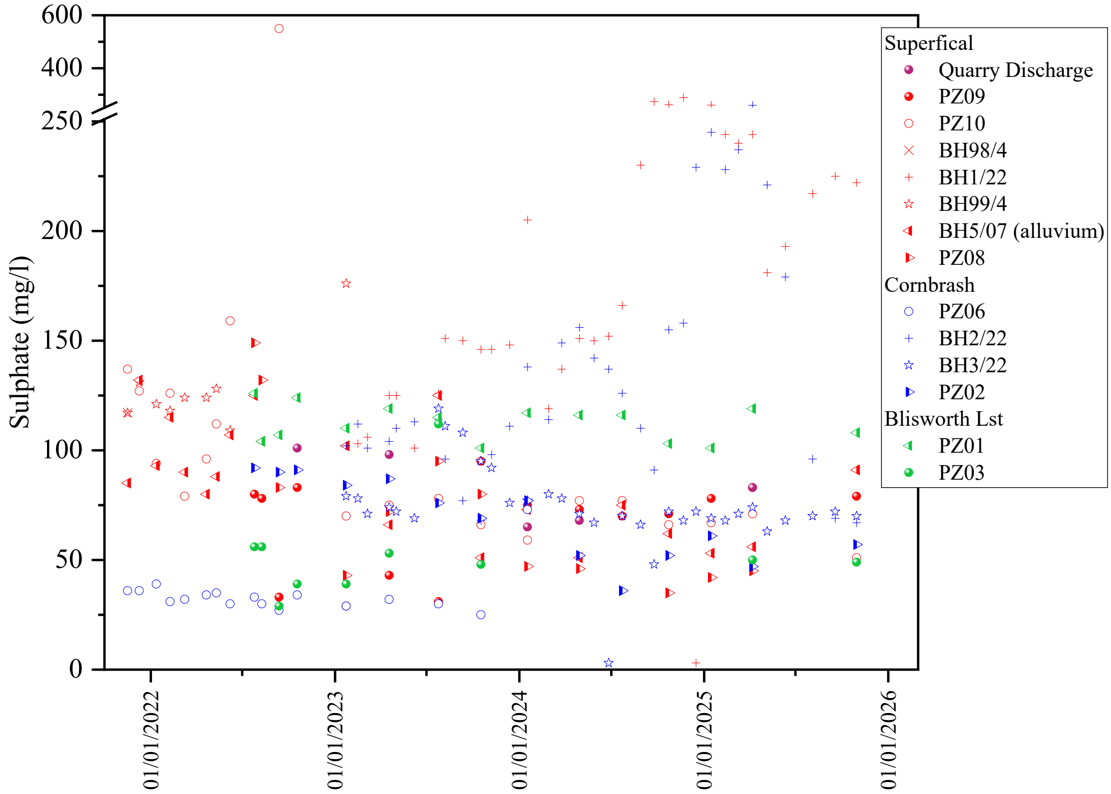


Figure 21 Groundwater Chloride

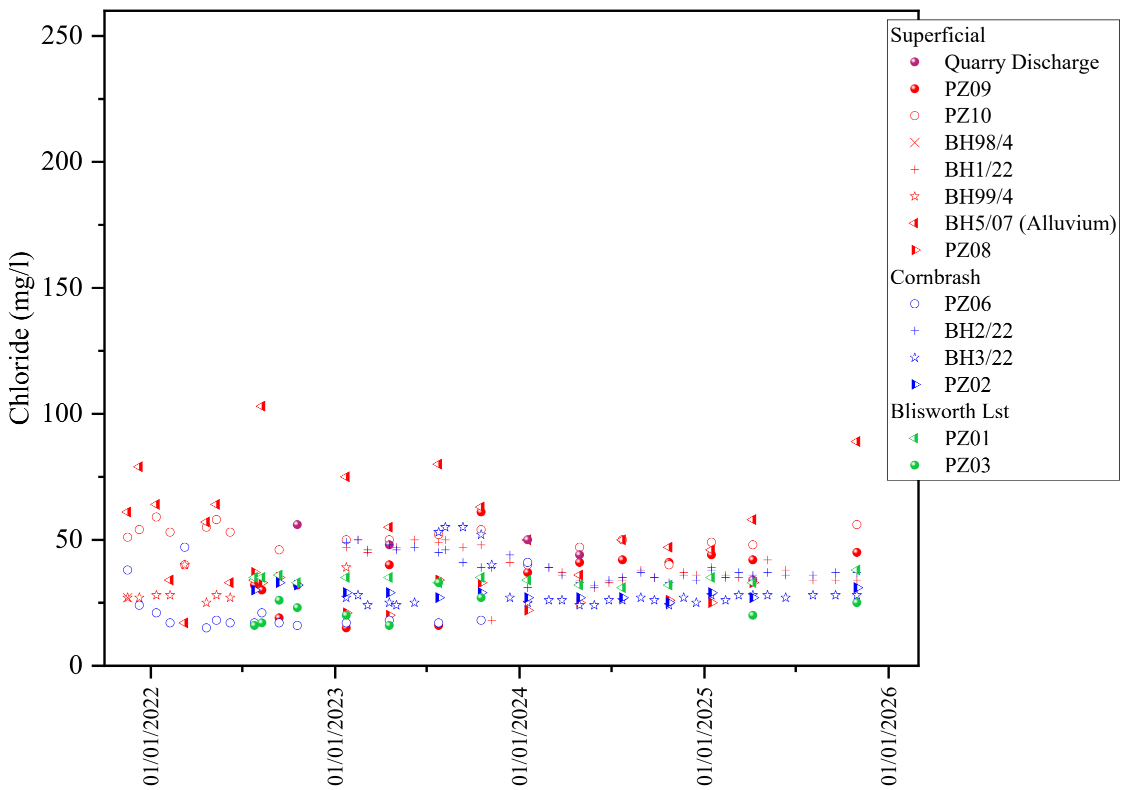


Table 7 Surface Water Matrix Chemistry

	Date	pH	EC	NH_4-N	TOC	Ca	Mg	Na	K	Cl	SO_4	Alk	TON
SW1	23/01/23	8.0	869	0.14	3	155	6	26	4	53	69	226	17
	18/04/23	8.8	798	0.01	4	156	6	24	4	48	68	241	15
Quarry Discharge	18/10/22	8.0	699	0.02	2	153	5	27	2	56	101	77	14
	18/04/23	7.8	631	0.11	3	103	5	22	3	48	98	92	13

Table 8 Groundwater Matrix Chemistry Summary (All Locations) 2019 - 2024

	pH	EC	NH_4-N	COD	BOD	TOC	DOC	Ca	Mg	Na	K	Cl	SO_4	Alk	TON
		µS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Max	9.0	1370	10.4	41	9	451	22	293	18	182	9	103	550	567	36
95th %ile	7.8	1026	4.5	25	4	33	3	210	17	168	8	62	139	393	17
Average	7.5	765	0.69	8	2	13	2	111	10	57	5	37	90	254	4
Median	7.5	772	0.05	5	1	2	2	118	10	42	5	33	91	247	0.8
10th %ile	7.3	575	0.01	5	1	1	1	41	5	22	3	17	32	184	0.2

There is an agricultural / farming influence to the groundwater as indicated by the ammoniacal-N concentration which increases above the median 0.05mg/l background into the 4 – 10.4mg/l range in both the superficial deposits and the two limestone units (Figure 22). Given that this influence includes the Blisworth Limestone, the source can be definitively identified as occurring from a hydrogeological upgradient location.

An agricultural source is also apparent in the nitrate data. Groundwater nitrate is almost exclusively derived from excess nitrate fertilisers. Nitrate (expressed as nitrogen or TON) can be described as in three concentration populations. A low range of up to 3mg/l in the majority of locations, a mid-range of 4 – 18mg/l in both superficial and Cornbrash locations, including the recent (2022) installed BH2/22, and an upper concentration in the 23 – 36mg/l range (Figure 23).

There is a seasonality to the higher range concentrations, and the data is therefore likely to be demonstrative of historical and future nitrate patterns. Consequently, this pattern will repeat in the long term as agriculture practices will continue to be undertaken after the site has been fully restored.

Metals

The redox sensitive metals indicate the groundwater is in part under manganese reducing conditions, whilst the heavy metal and metalloid data indicates environmentally insignificant metal concentrations except for zinc, which is probably a consequence of the dissolution of redox sensitive metal co-precipitates in the Cornbrash Limestone (Figure 24).

Table 9 Groundwater Heavy Metals and Metalloids 2019 - 2024

	Hg	Cd	As	Cr	Cu	Ni	Zn	Pb
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Max	<0.00003	0.0008	0.005	0.002	0.005	0.006	0.119	0.021
95th %ile		<0.0002	0.003	<0.001	<0.001	0.002	0.050	<0.001
Average			<0.001			<0.001	0.013	
Median							0.006	
10th %ile							<0.002	

Figure 22 Groundwater Ammoniacal-N

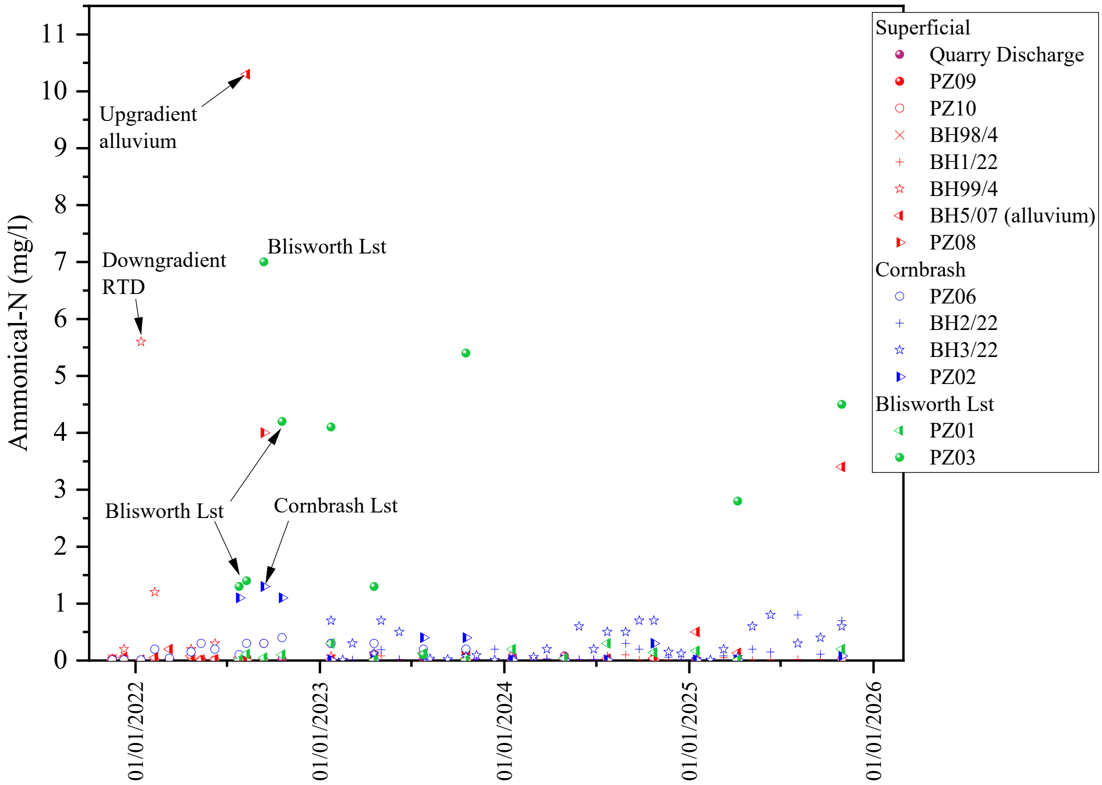


Figure 23 Groundwater Nitrate

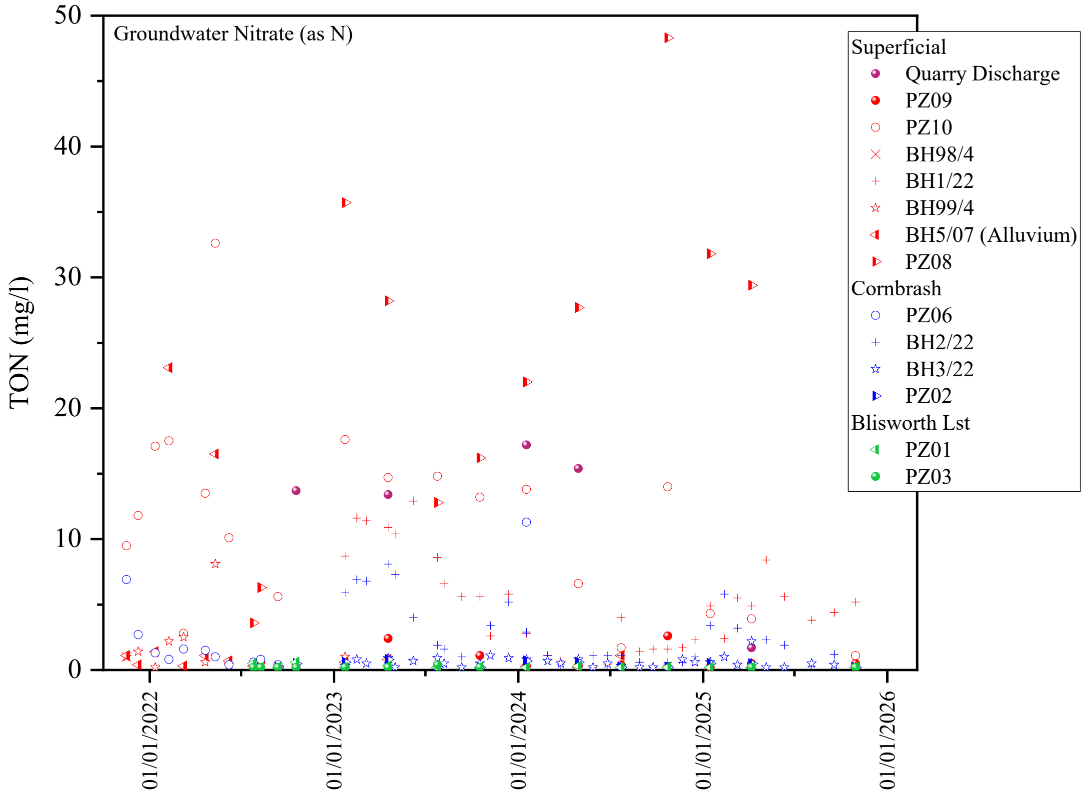
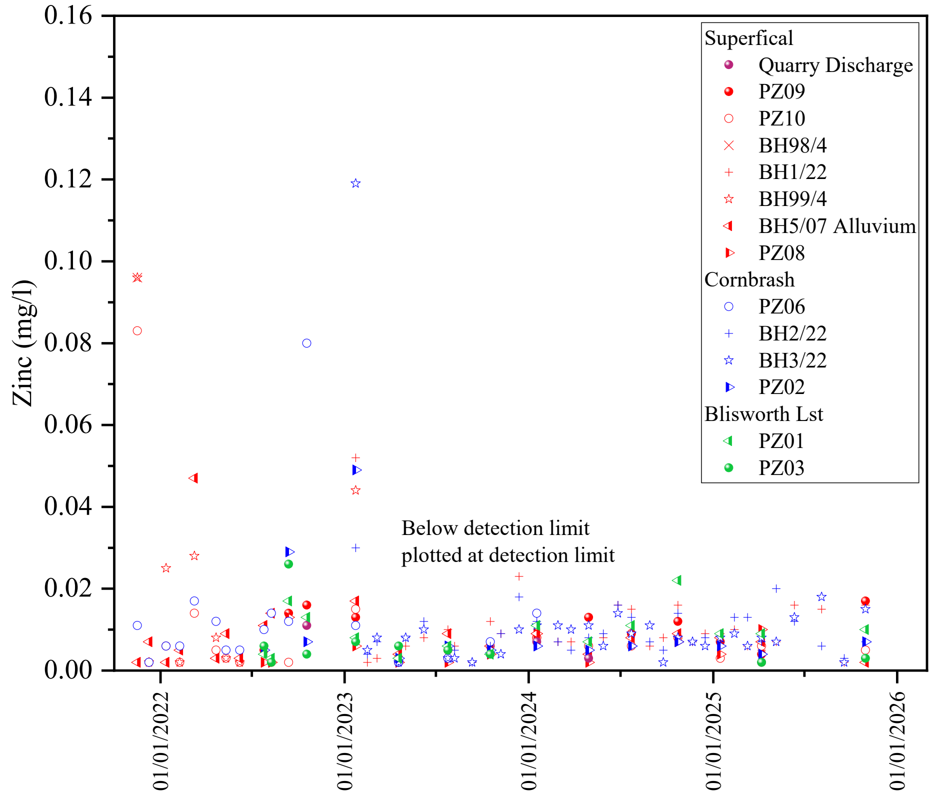


Figure 24 Groundwater Zinc



4 Conceptual Site Model

A simple relationship can be assessed for the proposed development where the:

- source is the inert restoration fill material
- the pathway is the cast back quarry overburden material (or any remaining *in-situ* unsaturated strata)
- the hydrogeological and hydrological receptors are

  a) the downgradient groundwater in the superficial sediments;

  b) surface water in the Eastfield and South Drains (to the south and north of the site respectively)

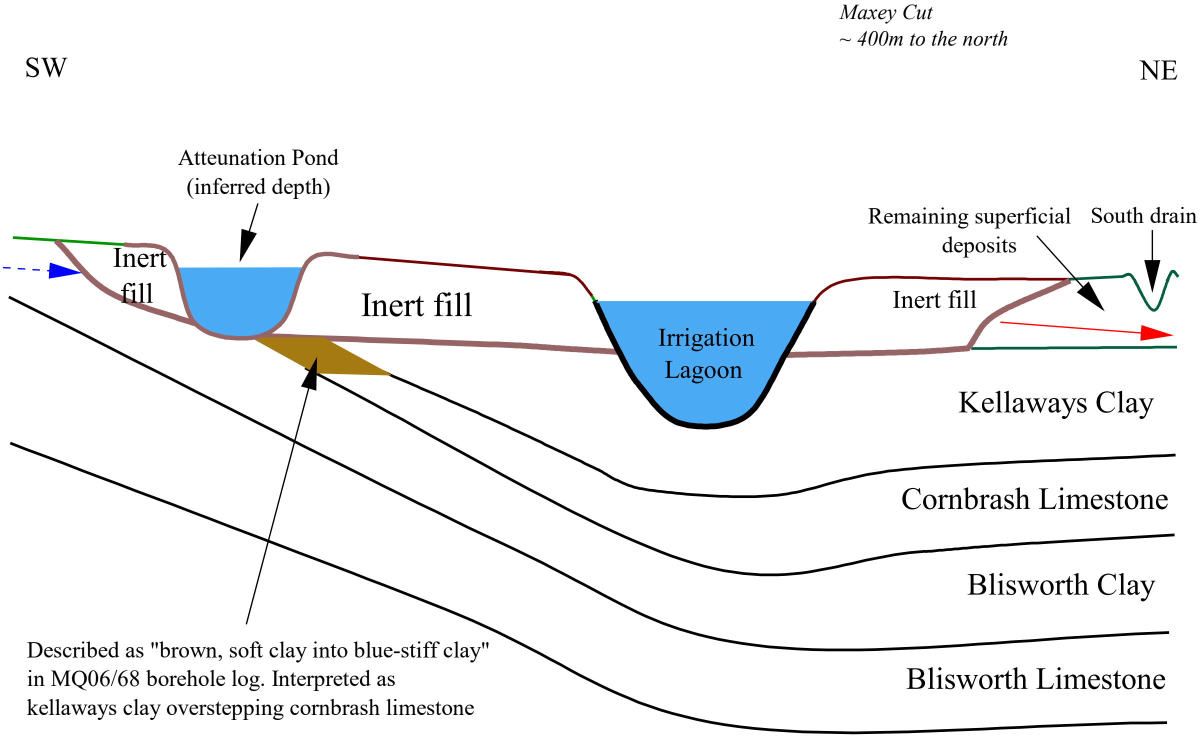
  c) surface water in the irrigation lagoon

The Cornbrash is screened out as a receptor of concern based on the thickness at site (consistent with BGS accounts at <2m locally)[4], hydraulics (k approximating to $1x10^{-9}$m/s and confinement beneath clay (1.2 – 2.5m at a hydraulic conductivity of ~$1x10^{-10}$m/s).

A generalised conceptualisation of the system after the imported materials have been deposited and the pond features created is illustrated as Figure 25.

This conceptualisation is premised on the replacement of otherwise permeable sand and gravels with a primarily clay and silt matrix (*i.e.* soil forming materials that are uneconomic to process into sand and gravels).

Figure 25 Southwest to Northwest Conceptual Cross-section



Incidental rainwater will fall onto the surface of the site and be diverted to a series of flow attenuation ponds. Given the nature of the types of fill, expected infiltration into the deposited materials will be limited. The majority, if not all water (i.e. that component not subject to evapotranspiration) is expected to be diverted via the interconnected field drains to be released into the adjacent Drains.

Groundwater flow in the superficial deposits will be in an easterly direction (post water management) following the surface of the underlying clay deposits (Figure 16) and local topography. The groundwater flux in the deposits is expected to be diverted around the deposited fill; these materials will essentially form a low-permeability "plug" at a hydraulic conductivity approximating to $5x10^{-10}$m/s. Although local disruption to the flow patterns may be expected, flow will be enhanced by the drainage channel which will be installed around the western edge of the site (replacing channels which will be removed as part of the works) with the diverted flow directed to the South Drain and the Eastfield Drain respectively. As such, any groundwater mounding (local increases in water table elevation upgradient of the infill are not considered as significant, dissipation of the groundwater will occur on account of the wider presence of permeable strata (RTD's and alluvium) and interconnectivity with drainage networks and flooded excavations / ponds.

In summary however, the natural flow patterns will be diverted around the imported fill with a limited, if any throughflow into the imported fill. The infill will adsorb water through capillary action albeit the presence of a "free flowing liquid" will not be realised and throughflow of water will be limited to negligible volumes (Section 5).

As noted above, vertical infiltration into the limestone is not considered as a risk pathway due to the strata properties and confinement by clay, in addition to the "low-permeability plug" that is to be emplaced above the clay

5 Risk Profile

5.1 Hydraulic Properties

There are three mechanisms for estimating the hydraulic flux through the inert fill. The first is that there is a general requirement for a geological barrier with properties equivalent to 1m thick and hydraulic conductivity of ≤1x10^{-7}m/s. The second mechanism is to calculate a hydraulic conductivity of the expected materials using particle size type distributions and the third is from site-based measurements accepting a similar fill.

The imported fill is intended as a replacement of sand and gravel, with soil forming materials. Any hardcore, gravel or sand type materials that can be recovered are unlikely to be imported, as this material has a commercial value and therefore it is the material that cannot be readily repurposed that will be diverted to the site. Consequently, it is expected that the site will be restored primarily with clay and silt dominated soil forming materials.

Hydraulic calculations demonstrate that as long as 10% of the infill material contains a medium silt or smaller grain size, a 1x10^{-7}m/s hydraulic conductivity criteria would be met (Table 10). This conclusion is also supported from permeability measurements of placed soils (Table 11).

Table 10 Hazen Formula Particle Size – Hydraulic Conductivity Relationship

Grain Size (Lower Size)	Particle Size 10% Passing		Hydraulic Conductivity
	d10		K
	micron	mm	m/s
Medium Gravel		8	0.100
Fine Gravel		4	0.025
V. Fine Gravel		2	0.006
V. Coarse Sand		1	0.002
Coarse Sand	500	0.5	3.9x10^{-4}
Medium Sand	250	0.25	9.8x10^{-5}
Fine Sand	125	0.125	2.5x10^{-5}
V. Fine Sand	63	0.063	6.2x10^{-6}
Coarse Silt	20	0.02	6.3x10^{-7}
Medium Silt	6.3	0.0063	6.2x10^{-8}
Fine Silt	2	0.002	6.3x10^{-9}
Clay	<2-0.06	<0.002 0.00006	5.7x10^{-12}

Hazens Formula

$$K = C_H . d_{10}^2$$

Where

K = Hydraulic Conductivity

d_{10} = Particle Size 10% Passing

C_H = Hazen Constant (0.00157)

Two examples from different operators illustrate this point (Table 11). For Site A, the non-hazardous landfill was designed to be capped and restored with 2m of a soil cover. The Site B data was taken from the upper 2m of the (inert) soil waste infill to the site.

In both cases, the hydraulic conductivity far exceeded the requirements for a geological barrier for both non-hazardous and hazardous sites. Tarmac have then repeated this exercise at three of their soil infill sites during March and April 2022 and returned confirmatory test data that a soil infill can expect to achieve a hydraulic conductivity in the order of 5x10^{-11} to 5x10^{-10}m/s.

Table 11 Placed Soil Hydraulic Conductivity Testing

Site A Placed Soil Restored Surface

Dry Density		Hydraulic Conductivity
Mg/m³		m/s
1.715		$2.5x10^{-10}$
1.623		$1.1x10^{-10}$
1.672		$7.8x10^{-11}$
1.750		$6.9x10^{-11}$
1.480		$2.6x10^{-10}$
1.735		$8.1x10^{-11}$
1.653		$1.1x10^{-10}$
1.711		$1.5x10^{-10}$
1.690		$4.3x10^{-11}$
1.693		$7.3x10^{-11}$
1.559		$3.9x10^{-10}$
1.628		$1.4x10^{-10}$
1.695		$4.9x10^{-10}$
1.930		$4.5x10^{-10}$
1.744		$8.5x10^{-11}$
1.673		$1.1x10^{-10}$

Site A and Site B Summarised in a Disposal Context

	Site A	Site B (near Surface)	Site B (Depth)
	m/s	m/s	m/s
Maximum	$5x10^{-10}$	$7.2x10^{-10}$	$5.1x10^{-10}$
Most Likely	$1x10^{-10}$	$4.4x10^{-10}$	$1.5x10^{-10}$
Minimum	$5x10^{-11}$	$1.6x10^{-10}$	$1.6x10^{-10}$

Site B Soil Infill Material Properties

In-situ	Laboratory Recompacted
m/s	m/s
$7.2x10^{-10}$	to $5.1x10^{-10}$
$1.6x10^{-10}$	to $1.0x10^{-10}$
$4.4x10^{-10}$	to $1.5x10^{-10}$

Tarmac Soil Infill Permeability Testing Summary (April 2022)

Alrewas	Swarkeston	Brooksby
m/s	m/s	m/s
$1.2x10^{-10}$	$1.1x10^{-10}$	$6.3x10^{-11}$
$1.9x10^{-10}$	$1.2x10^{-10}$	$4.9x10^{-11}$
$1.2x10^{-10}$	$2.9x10^{-10}$	$9.5x10^{-11}$

The data demonstrates that the placement of the clay soils with an informal compaction, *i.e.* deposited, spread and machine compacted without the benefit of third-party supervision or to a CQA plan that an impermeable layer is produced. The re-compaction testing carried out for Site B demonstrates that the compaction achieved using this methodology is consistent with that which could reasonably be expected from formal on-site compaction. This re-compaction data does demonstrate is that the likelihood that lower hydraulic conductivities will be achieved with depth throughout the vertical profile of the deposited mass.

These conclusions of an inherently low permeability fill material are also confirmed from test data from two of Tarmac's inert landfill site, whereby the artificial geological barrier created with a target hydraulic conductivity of $\leq 1x10^{-7}$m/s achieved a hydraulic conductivity of:

- $1.1x10^{-10}$m/s to $4.4x10^{-10}$m/s at the Spixworth Quarry site; and
- $3.8x10^{-11}$m/s to $8.0x10^{-11}$m/s at the Brooksby Quarry site

using a selection criteria of:

- no stones greater than 125mm;
- not oozing excess water; and
- is on visual assessment cohesive (i.e. "can be rolled into a sausage 3mm thick")

Consequently for a predominantly soil fill cell, the hydraulic properties are best described as a continuous geological barrier throughout the entire thickness of the imported fill ("a soil plug"). Even where larger materials are co-disposed with soils, the hydraulic characteristics are based on the lower permeability surround. For example gravely clay and Boulder Clays, contain large particle sized materials within the clay matrix, and retain low overall bulk permeability properties. A similar effect is expected for components of construction/demolition material (e.g. brick and concrete) entrained within the imported fill.

The bulk hydraulic properties of this material are, by cross-referencing with Table 10 and Table 11, equivalent to an infiltration rate in the order of 3 – 30mm/yr, with a potential that this is even lower at 0.3mm/yr (Table 12) for a silt / clay dominated restoration scheme.

Table 12 Infiltration Rate under Hydraulic Gradient i = 1 Compared to Hydraulic Conductivity

Hydraulic Conductivity	Infiltration Rate under Hydraulic Gradient i= 1
m/s	mm/yr
$1x10^{-7}$	3,154
$5x10^{-8}$	1,577
$1x10^{-8}$	315
$5x10^{-9}$	158
$2x10^{-9}$	63
$1x10^{-9}$	32
$5x10^{-10}$	16
$2x10^{-10}$	6
$1x10^{-10}$	3
$5x10^{-11}$	1.6
$2x10^{-11}$	0.6
$1x10^{-11}$	0.3

5.2 Seepage Rates

The hydraulic properties are such that the proposed fill will divert the groundwater flow around the site as outlined above. This can be demonstrated following Darcy's Equation for the cross-sectional area which faces the primary groundwater flow, i.e. from north to south with a northeast to southwest slant.

Darcys Equation $Q = KiA$

where

Q = Flow Rate
i = Hydraulic Gradient
A = Cross-sectional area

The superficial groundwater system is at approximately 8.6mAOD at and upgradient of the site and fall to 5.7mAOD at the downgradient surface water channel elevation. This water level fall occurs across at least a 925m pathway length and equates to a hydraulic gradient of up to 0.0031. The cross-sectional area from upgradient to downgradient is 570m, with the maximum vertical profile at 3.8m (above the *in-situ* clay, which equates to a cross-sectional area of 2,166m^2 perpendicular to the hydraulic gradient.

Seepage rates through this material are therefore dependent on the hydraulic conductivity of the placed material, which in all likelihood will achieve the criteria for an inert landfill geological barrier (i.e. $1x10^{-7}$m/s). Consequently, an upper estimate of the throughflow is likely to be in the order of 0.06m^3/day, with the potential to be as low as 0.0003 – 0.001 litres per day (a more realistic approximation) as illustrated by the sensitivity calculations shown in Table 13.

Volumetric throughflow from the imported fill and into the Terrace Deposits downgradient of the site are therefore expected to be in the order of <21m^3 per year, and potentially significantly less than 1m^3/year. As such there is no risk to the downgradient groundwater system or the surface water system that is in continuity with groundwater downgradient of the site.

Table 13 Illustrative Groundwater Seepage Rates through the Soil Fill

			High Rate			Low Rate
Upgradient Water Level		mAOD	8.6	8.6	8.6	8.6
Downgradient water Level		mAOD	5.7	5.7	5.7	5.7
Base Water Column (upgradient)		mAOD	4.8	4.8	4.8	4.8
Distance		m	925	925	925	925
Hydraulic Gradient	i	m/m	0.0031	0.0031	0.0031	0.0031
Hydraulic Conductivity	K	m/s	$1x10^{-7}$	$1x10^{-8}$	$1x10^{-9}$	$5x10^{-10}$
Seepage Face Width		m	570	570	570	570
Seepage Face Height		m	3.8	3.8	3.8	3.8
Seepage Face	A	m^2	2,166	2,166	2,166	2,166
Groundwater Flow Rate	Q	m^3/s	$6.8x10^{-7}$	$6.8x10^{-8}$	$6.8x10^{-9}$	$3.4x10^{-9}$
		m^3/d	0.059	0.006	0.001	0.0003
		m^3/yr	21.4	2.1	0.2	0.1

Even in the event that the flood attenuation lake features are “full height”, *i.e.* the water elevation managed to 8.5mAOD in the westernmost pond and 6.5mAOD in the easternmost pond this will have an insignificant change to the throughflow of water through the imported cohesive fill.

5.3 Design Standards - Requirement for Attenuation Layer

The inert materials to be emplaced are proposed as part of the recovery activity are tabulated in Section 2 Table 2. This list is also consistent with that detailed within Standard Rules Permit SR2015 No. 39 - the Use of Waste in a Deposit for Recovery Operations. The majority of the infill is likely to be coded as EWC 17 05 04 (Soil and Stone) which as noted, are identified under Paragraph 2.1.1 of European Council Decision 2003/33/EC[1] as being acceptable to be received at ‘inert landfills’ without testing, provided source characterisation demonstrates that the materials are suitable. These materials have an inherently low pollution potential and do not contain substances at concentrations that may present a risk to surface water or groundwater systems.

It is noted that the Maxey restoration is proposed under a Deposit for Recovery Environmental Permit (not a landfill operation); however it is pertinent that the aspect of artificial liner / attenuation layer must be addressed as the proposals much demonstrate “release of hazardous substances has been prevented and the pollution from non-hazardous substances has been limited” which is a requirement of EPR 2016, Schedule 22[7].

An attenuation layer is intended to meet the requirements of an artificial geological barrier for inert wastes, which requires a level of protection equivalent to:

- 1m in thickness at a
- $\leq 1x10^{-7}$m/s hydraulic conductivity

[7] The Environmental Permitting (England and Wales) Regulations 2016, No. 1154

The *in-situ* underlying bedrock (*i.e.* Cornbrash and surrounding clay / mudstone sequence) readily meets this requirement, with typical permeabilities' 3 to 4 orders of magnitude lower than $1x10^{-7}$m/s; however, it is not expected that the surrounding sand and gravel "sidewall" geology can meet this criterion. Consequently, a lateral attenuation layer is required (the restoration scheme does not require an underlying attenuation layer).

There are four options to construct this attenuation layer, by using

1) excavated Kellaways Clay from the base of the quarry;
2) clay and/or silt rich cohesive interburden/overburden materials segregated from the mineral being quarried and processed (if available);
3) importing specifically quarried (*i.e.* non waste) cohesive material, as typically used for non-hazardous landfills; or
4) the use of selected clean waste cohesive materials imported into the site.

Although the lateral attenuation layer will be constructed as far as practicable using site derived materials, there is a reasonable possibility that insufficient site derived materials will be available. An overdig into the Kellaways Clay to obtain clay for an attenuation layer is possible but unlikely, particularly where sequences are present but thinner in the central and western areas. Therefore, imported soil forming material may be required to complete the lining works.

Infilling / restoration will be undertaken "dry", post cessation of water management:

- the lower sidewall will be below the recovered groundwater elevation
- the upper sidewall will be above the recovered groundwater elevation

Continuity with water in the wider site area / proposed wetland / ponds will occur in advance of downgradient flow to the east of Phase 1 / Phase 2 (Figure 2).

5.4 Risk Screening Framework

The inert WAC criteria is the framework which controls the acceptance for all materials imported to the site under the proposed Recovery Permit. This framework also sets an upper tier concentration threshold for leachable constituents for imported cohesive materials that are to be used as an attenuation layer, albeit that, the WAC threshold limits for disposal as inert waste may be overly conservative for the attenuation layer, and lower concentrations may be required under a risk-based framework.

Notwithstanding the above, the purpose of an attenuation layer is not to be a polluting source itself, and be a protective layer that prevents leachate from the primarily soil fill imported from causing harm to the receiving waters. For some hazardous substances (e.g. arsenic and lead) this is problematic as they are a natural component of geological materials and soils derived from them.

Section 2.1.2.1 of the Council Decision sets leaching limit values for waste acceptance at landfills for inert waste and gives limits for a "first release, the "Co value" and then a 2:1 and a 10:1 Liquid to Solid (L/S) ratio (as set out for key substances in Table 14).

This 10:1 L/S leachable component for inert waste is understandably lower than the total concentration that would be present in even from a natural low metal UK setting soil, or the Maximum Allowable Concentration (MAC) for a sewage sludge amended soil. It should be noted that the sewage sludge amended soil MAC is independent of whether there is a Landfill

Directive compliant geological barrier, and is higher than the 40th percentile total UK soil concentrations, and can be higher than the 80th percentile UK soil concentration (Table 15).

Table 14 Inert WAC Leaching Test Limits as per Section 2.1.2.1 of the Council Decision

	Leachable Content			Uk Soil Total Content (Lower Range)		Sewage Sludge[8] in Soil
Component	C_o (percolation test)	L/S = 2l/kg	L/S = 10l/kg	10th %ile	40th %ile	MAC
	mg/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	0.06	0.1	0.5	8.6	13	50
Lead	0.15	0.2	0.5	32	44	300
Chromium	0.1	0.2	0.5	33	61	400
Nickel	0.12	0.2	0.4	7	18	50
Copper	0.6	0.9	2	9	16	80
Zinc	1.2	2	4	35	67	200
Cadmium	0.02	0.03	0.04	0.2	0.6	3
Mercury	0.002	0.003	0.01			1
Molybdenum	0.2	0.3	0.5	0.6	1	4
Antimony	0.1	0.02	0.06	0.3	0.6	
Selenium	0.04	0.06	0.1	0.2	0.4	3
Barium	4	7	20	132	259	
Fluoride	2.5	4	10			500
Chloride	460	550	800	74	100	
Sulphate	1,500	560	1,000	1,857	2,526	
TDS	-	2,500	4,000			
DOC	160	240	500			

Table 15 BGS UK Soil Observatory Database accessible at http://mapapps2.bgs.ac.uk/ukso/home.html

Substance		Min	10th	20th	30th	40th	50th	60th	70th	80th	90th	Max
Matrix / Major components												
Silicon	%	0.2	15.5	22.9	25.3	27.1	28.6	30.0	31.7	33.7	36.6	46.7
Aluminium	%	2.0	3.4	4.3	4.9	5.4	5.8	6.3	6.7	7.2	8.0	11.7
Iron	%	<1.1	1.1	1.6	2.1	2.5	2.8	3.1	3.5	3.9	4.5	23.7
Calcium	%	0.01	0.1	0.2	0.3	0.3	0.4	0.5	0.7	1.1	2.0	36.4
Potassium	%	<0.6	0.6	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.9	4.2
Magnesium	%	0.12	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8	1.1	5.0
Sodium	%	0.07	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.6	7.4
Sulphur (as SO_4)*	%	0.09	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.6	6.6
Manganese	%	<0.01	0.01	0.03	0.04	0.1	0.1	0.1	0.1	0.1	0.2	4.8
Minor Matrix Components												
Barium	mg/kg	7	132	191	227	259	288	313	342	381	434	17,800
Strontium	mg/kg	4	35	46	53	59	65	71	81	94	121	1,370
Common Heavy Metals & Metalloids												
Lead	mg/kg	13	32	37	40	44	49	55	64	83	133	10,000
Zinc	mg/kg	5	35	49	58	67	76	85	95	109	137	3,360
Chromium	mg/kg	5	33	46	55	61	67	73	79	85	96	1,140
Nickel	mg/kg	0.3	7	11	15	18	21	24	28	33	39	469
Copper	mg/kg	0.8	9	12	14	16	19	21	24	28	38	1,320
Arsenic	mg/kg	<8	8.6	10.4	12	13	15	17	19	23	30	820
Selenium	mg/kg	<0.2	0.2	0.3	0.4	0.4	0.5	1	1	1	1	16
Cadmium	mg/kg	0.1	0.2	0.3	0.3	0.3	0.3	0.4	0.5	0.6	1	48

* Excludes natural gypsum deposits

8 https://www.gov.uk/government/publications/sewage-sludge-in-agriculture-code-of-practice/sewage-sludge-in-agriculture-code-of-practice-for-england-wales-and-northern-ireland accessed 02/12/25

A review of the percentile statistics from the BGS compiled "UK Soil Survey database" demonstrates there are locally very high concentrations of the primary heavy metals and metalloids, which are either a function of contamination, or natural mineralised areas. However, of significance is that there is a narrow concentration range for up to the 70th percentile concentration of both substances, with:

- Most Likely (median) concentrations for lead and arsenic are 49mg/kg and 15mg/kg
- Low (20th percentile) concentration of lead and arsenic are 37mg/kg and 10.4mg/kg

Arsenic and lead are segregated from the table as more significant as they are classified as hazardous substances under current JAGTAG determinations.

All naturally occurring soils can therefore never comply with a constraint of being "free of lead and arsenic". Nevertheless, it is the "soluble lead and arsenic" content which is therefore the limiting factor (like all substances) yet there is no direct translation of a solid "acceptance concentration" with a leachable concentration, or an actual leachate concentration, and as such, collected "leachate data" from similar schemes (landfill and deposit for recovery) can be utilised for such source term appraisals and risk screening purposes.

Source Term Screening

Ayesa / ByrneLooby has been collating leachate chemistry from similar waste types from both inert and non-hazardous landfill sites. The leachate chemistry for most non-hazardous biological waste landfills is dominated by biological process and the degradation of organic matter, hence there is a large landfill gas production rate and the co-formation of ammonium, as the solubilised form of organic nitrogen. Soil fill has a separate geochemistry, it is not a biochemically derived solution as the bulk organic content is excluded prior to receipt at the site and deposit.

The silicate minerals in soils, ceramics and glass have low to negligible solubility characteristics and as sodium, potassium and chloride salts are rapidly dissolved and lost prior to being incorporated within wastes, then there is typically only one remaining potential solubility limiting mineral phase, mainly gypsum.

Gypsum has a solubility limit which equates to approximately 1,500mg/l sulphate and 700mg/l calcium under oxidising to anoxic conditions. It is only when significant anaerobic conditions develop that sulphate is reduced to sulphide to precipitate primarily as iron sulphide, whilst calcium is precipitated as calcium carbonate. Consequently, neither calcium nor sulphate are present within biological waste methanogenic leachates, they are however present as the primary ions in soil fill low organic waste leachates.

Monitoring of soil fill wastes leachates demonstrates that they have a very consistent chemical signature.

Biodegradable waste leachate is a sodium-chloride-bicarbonate solution containing elevated ammonium, potassium and organic substances; whereas soil fill leachates are a calcium sulphate solution, containing low ammonium, potassium, sodium, chloride and organic substances.

As a geochemically derived liquor, calcium and sulphate are limited by the solubility of gypsum, whilst in organic based waste masses, neither are significantly present as the calcium is precipitated as calcium carbonate under the enriched carbonate atmosphere (produced by the landfill gas) and sulphate is chemically and biologically reduced under the biologically induced methanogenic conditions.

Other substances are also low, albeit that occasional outliers have been observed, as well as short duration (weeks to months) releases of salts with low contents of heavy metals. Metals will themselves be removed from the source materials as a recoverable product, whilst contaminated source sites are to be avoided unless sufficient efforts have been made to demonstrate that the source material is not contaminated.

An expected pore solution chemistry is summarised as Table 16 as the primary constituents which could be present in the imported soils and materials. The background monitoring data (Table 16) demonstrates that there are consistencies between the type of leachate that could be generated and that already demonstrated to be present within the groundwater and surface water.

Some ammonium is inevitable in soils, particularly in agricultural areas where there is an expectation of manure spreading or the addition of ammonium nitrate fertilisers. Nevertheless, it is considered appropriate to consider these substances and their effects on the water system.

Table 16 Conservative Expectations for Soil Fill Leachate (based on non-hazardous and hazardous SNRHW based Soil Forming Material, Including Transfer Station Residues)

	Landfilled Soil, SNRHW & Soil Trommel Fines Leachate			Background (Groundwater) 2019 - 2024			
Determinand	**Min**	**Most Likely**	**Maximum**	**Median**	**85th %ile**	**95th %ile**	**Max**
	mg/l	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**
Ammoniacal-N	1	10	45	0.05	0.94	4.5	10.4
Chloride	50	350	500	33	53	62	103
Sulphate	950	1,500	1,900	91	125	139	550
	µg/l	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**
Chromium	1	3	6	<1	<1	<1	2
Nickel	10	20	100	<1	<1	2	6
Arsenic	3	5	16	<1	<1	<1	<1
Lead	<1	<1	3	<1	<1	<1	<1
BTEX			<5	<1	<1	<1	1.3

Akin to BTEX substances, lead is not prevalent in such source terms, a 7-10 year database from 7 sites indicates that leached lead was reported below the limit of detection for 89% of the samples analysed (580 samples).

The leachate chemistry presented as Table 16 is considered as a conservative representation of the type of porewater which could be present within a Recovery site type once infilled. This type of inventory will include a higher content of active material and therefore is considered as conservative.

Of the salts that could be present, sulphate is enriched compared to that of the background groundwater. Chloride is locally consistent with a conservative inventory; however, it could be enriched compared to the downstream. Similarly, ammonium could reasonably be expected to be enriched compared to the steady-state background water quality, as evidenced by the occasional 4mg/l and the 11mg/l ammoniacal-N identified in the groundwater.

Nickel as a surrogate for metals is not normally present in Anglian – Lincolnshire waters, is however present locally within the groundwater and is reported at 2 – 6µg/l on occasion in the groundwater. Median concentrations are generally similar between all three source types, albeit the imported fill is expected to be slightly enriched overall compared to that of the site's water systems.

This potential for harm and change to water quality is primarily limited by the small quantities of water which are expected to percolate through the imported materials that could seep to the receiving groundwater system (section 5.5 below).

Organic solvents, paints and fuel spillages, the primary source of hydrocarbons, and other priority substances will be excluded during initial pre-acceptance waste acceptance checks and therefore not transported to the site. Consequently, the risk of these substances is low to negligible. A greater risk pathway would be in the use and application of agricultural herbicides or insecticides at and adjacent to the site following completion and the return of the land to production.

5.5 Risk Assessment

A simple conceptual site model (CSM) can be constructed for the site, based on the relationship Source → Pathway → Receptor

Where the:

Source:

- Source is the Inert materials used to fill the void

Pathways:

- The Pathway is the basal clay and sidewall engineering and the geological pathway towards a water resource; and

Receptor:

- The Receptor is the adjacent water resource, which is being assessed in terms of:

1) For Hazardous Substances – groundwater at the down-gradient boundary of the landfill, (including dilution)[9,10]

2) For Non-Hazardous Substances – groundwater at the down-gradient boundary of the landfill (pragmatically positioned peripheral monitoring boreholes)

Site Sensitivity
There are no public water supply abstractions, and all nearby uses are for industrial processes, and any baseflow contributions to surface water ecosystems are at a distance of at least 3.7km downgradient of the infill.

It is clear from the conceptual model and the very limited (if any) pollution potential of the proposed inert infill that the hazards are low and the environmental setting is sufficiently insensitive to negate the possibility of significant impacts. Notwithstanding the above, in accordance with good environmental practices and due consideration of the water quality in the receiving superficial strata, a "qualitative" assessment is provided for completeness.

The underlying (confined) groundwater system is screened out of further assessment.

Assessment Scenarios / Lifecycle Phases
These lifecycle phases are summarised as a conceptualisation framework as:

[9] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/602593/Groundwater-discernibility.pdf

[10] https://www.gov.uk/government/publications/groundwater-protection-technical-guidance/groundwater-protection-technical-guidance#discernibility

1. Quarry dewatered (with an unsaturated zone), lined with an attenuation layer at 1m, $1x10^{-7}$m/s and infilled
    a. Waste infill, placed and compacted through depositional process (recoverable aggregates and large stones / boulders are likely to be removed at source or screened prior to waste placement) such that machine and natural compaction achieves a bulk hydraulic conductivity in the order of $1x10^{-10}$m/s.
    b. Waste infill is to be placed dry
    c. Infill mass is considered analogous as a low permeability “plug” equivalent in entirety to the placement of a geological barrier.
2. Cessation of quarry dewatering and completion of infilling
    a. Waste infilling / deposition completed to a surface elevation
    b. Groundwater rebound in superficial strata (period of hydraulic containment).
    c. Waste becomes progressively saturated to a level coincident with groundwater, leachate /porewater is generated.
    d. Seepage of porewater to groundwater at the edge of the infill / AGB in a down gradient direction
3. Restoration
    a. An unsaturated zone within the upper section of waste mass develops
    b. Completion of surface water scheme, inclusion of irrigation pond.
4. Aftercare period
    a. Continued stabilisation of the infilled materials.
    b. Monitoring and periodic review to be undertaken as per Environmental Permit requirements.

The lifecycle phases therefore include an “operational phase” (Stages 1 and 2 above), “post closure phase” (Stage 3 above) and “long-term closure phase” (Stage 4 above). Additionally, it is noted that the potential source, pathway and receptor terms can all be defined with sufficient certainty so as to be confidently represented by conservative inputs, models and assumptions, e.g. a single homogenous source of inert soils / construction / demolition wastes with conceptually understood flow characteristics and directions.

Choice of Priority Substances and Qualitative Screening

Inert materials are low activity wastes which do not contain significant quantities of degradable or soluble constituents. Neither are active industrial chemicals allowed.

As a starting point, screening of similar infills schemes as outlined previously identifies a limited number of potential contaminants at low concentrations but may be present above DWS. For assessment purposes, arsenic, nickel, chloride, sulphate, ammoniacal-N and lead have been identified during the preliminary screening for further consideration. Within this list, components such as ammoniacal-N have been included because of its perceived “risk” as it is a marker compound generally used within landfill assessment, lead has been included for completeness however in such infill schemes (from an aggregated database of 580 samples) is reported below detection limit at 89% of all analyses. Although included in the inventory at Table 16, chromium at a maximum concentration of 0.006mg/l is below the 0.05mg/l DWS and hence not considered further.

BTEX substances are invariably absent from such infill schemes (Table 16) and are screened out of the assessment. Previous site investigations have noted the presence of bitumen coated materials / or hydrocarbon odours at MQ06/09 (Phase 1) subsequently removed by processing / excavation and at 3 locations to the southwest at MQ06/49, MQ06/59 (off-site) and MQ06/64 (boundary of Phase 6). These locations are towards the location of the East Coast railway line (BCL drawing “Drilling Locations” V4 (17/06/2022).

Tier 1 assessment

The risk profile of the site will be determined by the quantity of throughflow of moisture through the inert fill and the leaching potential of the infilled material (lifecycle Phase 2d to 4). The risk presented by the soil fill can be described as how the baseflow contributions from the recovery activity could potentially change the groundwater baseflow into the downgradient groundwater system.

In this case it is the baseflow characteristics towards the River Welland approximately 3.8km downgradient of the site. At Maxey due to the nature of the surrounding topography and connectivity throughout the wider downgradient saturated superficial sediments, there is no expected change to the overall baseflow. Water resources and availability will therefore be determined by post operational agricultural irrigation waters. Any loss of water from mineral workings will be returned to the water system, and during any dewatering period, the quantity of water that could potentially percolate through the cohesive fill be reduced as the reduction in groundwater elevation will minimise the potential seepage face.

In this regard, there is expected to be only a minor influence on the surface water drainage channels, as any “leachate influenced” waters are expected to be stratified and below the drainage channels until the waters enter the River Welland.

At Maxey, a background groundwater flux around the site can be calculated from the same calculations as that through the site (Table 13), except that the water quantity will be based on the greater hydraulic conductivity for the sand and gravel deposits, which is expected to be in the order of 1×10^{-4}m/s (Table 17).

Table 17 Groundwater Flow through Superficial Deposits

			Towards Higher Permeability Range	Mid Range	Lower Permeability Range
Upgradient Water Level		mAOD	8.6	8.6	8.6
Downgradient water Level		mAOD	5.7	5.7	5.7
Base Water Column (upgradient)		mAOD	4.8	4.8	4.8
Distance		m	925	925	925
Hydraulic Gradient	i	m/m	0.0031	0.0031	0.0031
Hydraulic Conductivity	K	m/s	5×10^{-4}	1×10^{-4}	5×10^{-5}
Seepage Face Width		m	570	570	570
Seepage Face Height		m	3.8	3.8	3.8
Seepage Face	A	m^2	2,166	2,166	2,166
Groundwater Flow Rate	Q	m^3/s	3.4×10^{-3}	6.8×10^{-4}	3.4×10^{-4}
		m^3/d	293	59	29
		m^3/yr	107,076	21,415	10,708

A groundwater flow rate of $59m^3$/day equates to a 10,000 fold dilution factor after mixing with $0.006m^3$/day, and assumes an imported fill and geological barrier / attenuation layers are constructed to 1×10^{-8}m/s. This would reduce to a 1,000 fold dilution factor in the extremely unlikely event that the imported fill and barrier layers were at a hydraulic conductivity of 1×10^{-7}m/s. A more realistic scenario is that the attenuation layer (once placed and compacted) would achieve a permeability of 1x10^{-9}m/s, hence seepages are insignificant and resultant dilution is 100,000 fold.

Mixing calculations assuming no liner attenuation, at conservative parameterisation for substances typically considered in risk assessment (i.e. ammoniacal-N based on the general perception of water quality impact, selected salts, and metals including a hazardous substance) demonstrate that there is not expected to be a discernible change in the groundwater quality immediate downgradient of at an imported fill / barrier hydraulic conductivity of 1x10^{-8}m/s (Table 18) or at 1x10^{-7}m/s (Table 19).

Table 18 Predicted Groundwater Concentration after Mixing with Diverted Flow and imported fill at 1x10^{-8}m/s

			NH_4-N	Cl	SO_4	Ni	As	Pd
Leachate	Quality	mg/l	10	350	1500	0.02	0.005	0.001
	Volume	m^3/d	0.006	0.006	0.006	0.006	0.006	0.006
Groundwater	Quality	mg/l	0.05	33	91	0.002	<0.001	<0.001
	Volume	m^3/d	59	59	59	59	59	59
Mixing	Predicted Concentration	mg/l	0.05	33	91	2.0x10^{-6}	5.1x10^{-7}	1.0x10^{-7}
	DWS		0.39	250	250	0.02	0.01	0.01

Table 19 Predicted Groundwater Concentration after Mixing with Diverted Flow and imported fill at 1x10^{-7}m/s

			NH_4-N	Cl	SO_4	Ni	As	Pb
Leachate	Quality	mg/l	10	350	1500	0.02	0.005	0.001
	Volume	m^3/d	0.059	0.059	0.059	0.059	0.059	0.059
Groundwater	Quality	mg/l	0.05	33	91	0.002	<0.001	<0.001
	Volume	m^3/d	59	59	59	59	59	59
Mixing	Predicted Concentration	mg/l	0.06	33	93	2.0x10^{-5}	5.0x10^{-6}	1.0x10^{-6}
	DWS		0.39	250	250	0.02	0.01	0.01

Appropriate EAL's for the Maxey Crossing Extension site based on all available data (up to December 2025) are 6.7mg/l, 124mg/l, 348mg/l and 0.02mg/l for ammoniacal-N, chloride, sulphate and nickel respectively. To account for further groundwater cyclicity (influenced by seasonal precipitation, evapotranspiration, and human activities like pumping) particularly for recently installed infrastructure, maximum concentrations +20% have been applied. Appropriate EAL's for arsenic and lead at downgradient monitoring locations are considered as being a change to the background concentration which is in the <1 – 3µg/l concentration range.

Given the negligible Predicted Environmental Concentration change in the groundwater relative to EAL's and DWS, it is considered that the site's compliance monitoring programme could only demonstrate the fluctuation in the background water system.

5.6 Additional Specific Considerations- Sensitivity Analysis / Rogue Load Assessment

The volume of infill for the proposed scheme has been pre-defined at between 2.1 – 4 million cubic metres to be accepted over a 13 to 14 year period. The final quantity of imported material will depend on how much quarry overburden and site derived non-commercially viable material is present. Within such a large quantity of imported soils, soil forming materials and aggregates used to restore the quarry void it is considered possible for there to be some non-compliant material deposited within the imported fill.

Such a non-complaint load, if holistically significant for a specific load, is called a “rogue load”.

“*A rogue load assessment evaluates the risk posed by the accidental or deliberate import of waste material that does not meet a site's permitted waste acceptance criteria*”, however in reality how this is quantified for risk assessment purposes is purely subjective.

In terms of what a rogue load is, it has to be incorporated into the fill in a format that is not readily visually identifiable at the point of deposition from a vehicle and then pushed out by dozer into relatively thin layers as the landform is being created. It is assumed that visibly non-complaint materials will be quarantined and removed from the site or rejected prior to deposit in the operating area.

A single rogue load would be insignificant within such a large quantity of imported fill, as holistically the entirety of the fill would meet the acceptance criteria on chemical grounds, as the majority of imported material would be below the acceptance criteria. Notwithstanding this, for the purposes of this assessment a highly conservative sensitivity analysis has been performed that considers a rogue incorporation of “1% of bulk volume”, which equates to up to ~ 40,000m^3 (above WAC threshold limits) that becomes entrained into the bulk infill as either an interlayer mixture or localised hotspot(s).

In a practical sense, any received “rogue load” will be deposited and “encapsulated or “contained” within the majority low permeability soil plug (*i.e.* imported infill mass) of “non-rogue load material” and as such, the rogue load itself will be entombed within a low-permeability soil mass of bulk hydraulic conductivity that approximates to 1×10^{-10}m/s. ‘Free flowing liquid’ within the infill is not a credible mechanism for dispersion towards the perimeter of the waste mass / liner as attenuation and degradation processes will predominate for those substances of relevance (i.e. metals, organics). The infill is also underlain by a low permeability basal *in-situ* clay natural geological barrier which will prevent vertical seepage to groundwater.

As noted above, assessment is subjective yet needs to consider “realistic scenarios” to be meaningful, key aspects of consideration are:

- Volumetric considerations
- Appropriate concentrations
- Location considerations

all of which can be subject to critique.

As such, and relevant to Maxey, a rogue load implies “accidental incorporation” at concentrations above acceptance thresholds for minor overall volumes rather than deliberate import. Hence undertaking an assessment whereby all concentrations are increased to “maximum” levels are not realistic whereby acceptance is controlled by operator procedures.

Even at “higher concentrations” (i.e. localised hotspots), the resultant overall pollution load will only marginally increase as there will be a tendency for concentrations to remain relatively close to the overall median or average value of the infill. Hence it is likely that a “rogue load” volume of 1% will be averaged within only the surrounding 10% of the bulk infill, with the remaining 89% of the bulk fill unaffected by a rogue load hot spot.

To illustrate this point, Ayesa have collated an aggregated dataset of 579 samples of inert, SNRHW and residual waste/trommel fines containing landfills

For example, leachate nickel median and average concentrations are at 0.011mg/l and 0.017mg/l respectively. If 10% The incorporation of an additional 10% of samples (at an overly conservative rogue load volume) at 0.03mg/l (the 85th%ile for the aggregated database), the median and average concentrations do not alter significantly to 0.012mg/l and 0.018mg/l respectively. This remains considerably below the maximum previously observed concentration of 0.1mg/l, Table 16.

A more extreme approach is to consider if the rogue load contained 0.3mg/l nickel, then for 1% of the waste mass, the blended maximum concentration would increase from 0.1mg/l to 0.102mg/l, *i.e*. a negligible increase and within the precision of the risk assessed framework as illustrated in Table 18 and Table 19.

A similar "rogue" increase in arsenic can also be considered, given a median and average arsenic concentrations at 0.0051 and 0.0079mg/l (based on a 594 sample dataset), a 10% of imported fill "rogue load" component based on the 85th percentile concentration of this dataset at 0.013mg/l, *i.e*. over double the average and median concentrations would increase the holistic average concentration to a median concentration from 0.0051mg/l to 0.0060mg/l, and the mean average from 0.0079mg/l to 0.0084mg/l. These concentrations are within the maximum 0.116mg/l concentration that has been reported.

Taking a similar approach as for nickel, even if statistics are based on the 0.116mg/l "maximum" concentration, then if 1% of the infill mixture is at 0.3mg/l arsenic, the holistic concentration with increase from 0.116mg/l to 0.1178mg/l

These calculations are demonstrative that a rogue load contribution is unlikely to meaningfully change the nature of the leachate that could be produced. Notably, however, the peak concentrations identified in the dataset are not sustained and the likelihood is that they are either erroneous data reporting or of such a small, localised distribution they have no potential to cause harm for the duration of time they are present.

Confirmation that rogue loads are very unlikely to cause harm is provided from the leaching potential of the two hazardous substances lead and arsenic from a database compiled by Ayesa of hazardous soils collected from the more industrialised northwest and northeast of the country as discussed in Section 5.7 which demonstrates that hazardous soil leachable lead and arsenic contents are very low and can readily meet inert WAC limits.

Consequently it is considered that in the event that rogue loads were incorporated into the infill scheme that the resultant downgradient Predicted Environmental Concentration from the site would be a negligible change in concentration compared to that as presented in Table 18 and Table 19

5.7 Attenuation Layer Materials

The restoration scheme comprises a quarry infill directly into an *in-situ* natural geological barrier. However, an artificial geological barrier will be required for the sidewalls where there is not *in-situ* clay present and the sidewall abuts permeable strata in the River Terrace Deposits.

When initially placed, the restoration materials, and artificial geological barrier will be placed dry, however, upon the cessation of dewatering, groundwater will recover, and will seasonally increase to the elevation of the land drainage channels that surround the site. A large component of the sidewall geological barrier will therefore become saturated over time, and groundwater could ingress into this artificial geological barrier / sidewall lining attenuation layer.

The permeability properties of such a layer that is at least 0.5m thick and can meet a hydraulic level of protection equivalent to 1m thick at $1x10^{-7}$m/s.

Further details on the design and construction of this layer are as described in Section 5.3 of this report. The preference is to use available site derived and greenfield materials. However, there is the possibility that other sources of the material will be necessary. These will preferentially be taken from selected materials whereby the artificial geological barrier / attenuation layer is not a polluting source itself and is a protective layer that prevents any leachate from the primarily soil fill imported under a recovery permit from causing harm to the receiving waters.

The requirement for such a layer and that agreed with the Environment Agency for similar hydrogeological settings and the same approach is proposed for the Maxey Deposit for Recovery scheme.

Non-hazardous substances have been addressed within the seepage assessment above, and those conclusions remain valid for imported wastes if utilised to construct the 1m thick ($1 x 10^{-7}$m/s) attenuation layer.

In regard to hazardous substances, and in this case specifically arsenic and lead, imported materials will contain naturally occurring concentrations of these substances (Table 15), therefore a “zero” concentration does not exist either in the surrounding ground, or in materials that are to be imported. The approach taken elsewhere in the applicants other Deposit for Recovery schemes is to reduce the leachable lead and arsenic content of materials selected for the attenuation layer to 50% of the acceptance criteria for inert landfills as shown in Table 14, which summarises the concentration limits from Section 2.1.1 of the annex to Council Decision 2003/33/EC.

Such a database is required to give an understanding of the leaching behaviour of hazardous substances in geological materials as there is no direct background geological material data to compare with proposed acceptance criteria. However, there is groundwater data which demonstrates both arsenic and lead are low and are routinely reported as being <3µg/l, <1µg/l and <0.2µg/l for lead, with the detection limits provided by the laboratories, and primarily set at <1µg/l. It is this data that sets the “background” system, and hence the framework for setting attenuation layer properties /acceptance criteria.

With regards to arsenic and lead, given the region that the soils will be sourced from the only source of elevated lead could be from is historical lead pipes or lead roofing tiles. Neither can reasonably be expected to be present from a greenfield source, but could theoretically be present if from a demolition source, albeit that as a valuable commodity, lead tiling and above ground level pipework is expected to have been recovered at source.

Arsenic is not a routinely found commodity, and its presence in soil is usually mineralogical, as a co-precipitate in iron minerals, and not readily present as an industrial contaminant. It is however clear that a Percolation Test value of 60µg/l (as set out in the Council Decision as shown in Table 14) does not comply with the prevention of arsenic entering groundwater. This percolation test can be considered as analogous of the upper limit for porewater within an inert fill.

In this regard the approach considered appropriate is the same approach for hazardous substance releases from landfill, where the compliance point is an edge of site monitoring point, with emissions below the Minimum Reporting value. There is a similar requirement for lead.

Ayesa's compiled database of leaching test data for hazardous soils is demonstrative that the majority of soils readily meet the arsenic and lead leaching characteristics, namely being at less than 50% of the leaching limit for deposit of soil forming materials within an inert landfill for both lead (Figure 26) and arsenic (Figure 27).

50% of the lead and arsenic acceptance criteria of 0.5mg/kg equates to a leachable content of 0.25mg/kg. In this regard the dataset demonstrates that the majority of lead data is demonstratable below 0.25mg/kg. Where this cannot be demonstrated it is because the limit of detection employed by the analysing laboratory returns a leachable content of <0.3mg/kg.

There is a similar response for leachable arsenic where the majority of data demonstrates leachable concentrations below 0.25mg/kg, with a secondary component reported as <0.3mg/kg, *i.e*. the soil very likely met a 0.25mgkg threshold, with only two samples exceeding the 0.3mg/kg detection limit. This, however, is a demonstration that the potential for elevated arsenic is very low, and given that this dataset is skewed with respect to source materials being hazardous soils derived from the more industrially influenced northwest and northeast of the country, then the likelihood of there being the potential for a direct discharge to groundwater is very low to negligible.

Figure 26 Hazardous Soil Lead Leaching Test Summary (Data Compilation)

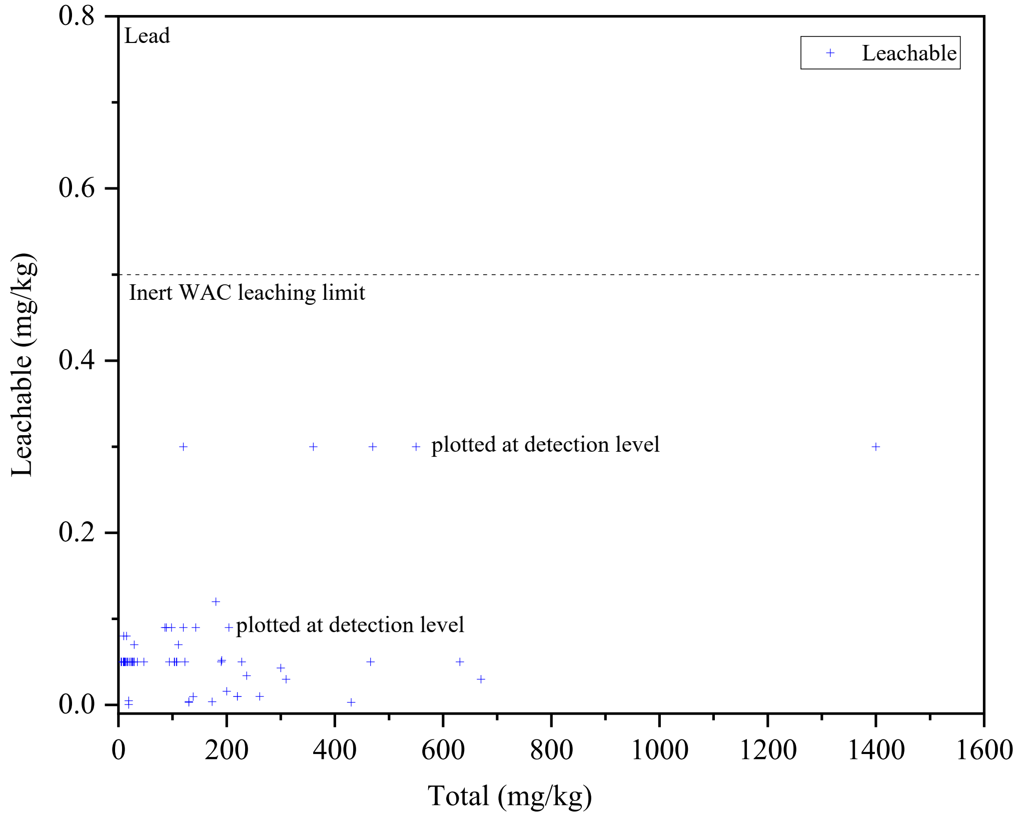
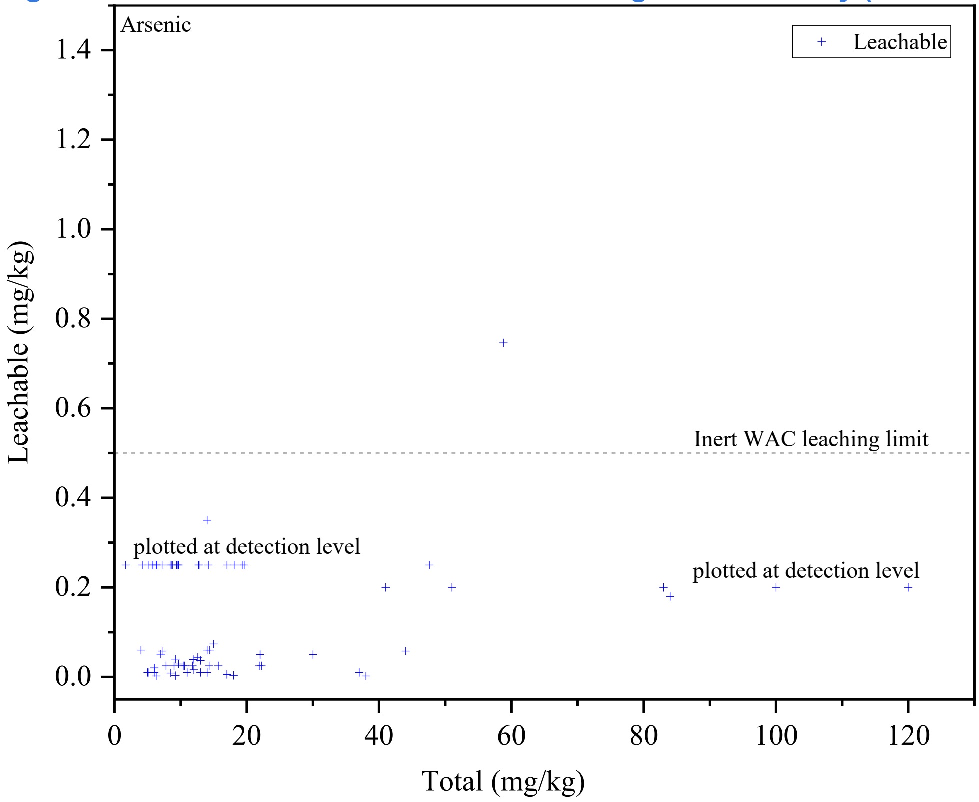


Figure 27 Hazardous Soil Arsenic Leaching Test Summary (Data Compilation)



This dataset is there a significant line of evidence that groundwater will not be compromised or cause pollution by leaching from the attenuation layer materials, subject to reasonable source control, namely:

- there is a reasonable likelihood that there can be high levels of hazardous substances leaching from any soil

Notwithstanding the above, care should be taken when selecting materials for the attenuation layer, and the following acceptance criteria is therefore recommended:

1) all imported attenuation layer material classified as "waste" should be preferentially sourced from sites where there is no suspicion of contamination, *e.g.* greenfield sites.
2) Where applied acceptance criteria for hazardous substances, lead and arsenic should be:
   - <0.3mg/kg leachable content at 10:1 L/S ratio (*i.e.* data obtained that is not reported at detection limit is less than 50% of inert WAC)
3) All other non-hazardous substances should meet their respective Inert "WAC" criteria

Assessment Summary

Under the basis of the conservative assessment undertaken, there are no requirements to further restrict waste acceptance criteria for the bulk infill materials proposed. It is not considered necessary to undertake a further Tier 3 assessment.

6 Technical Precautions

The quarry void is to be recovered to meadow and lake habitat in the west and centre of the site, with agriculture in the east. The site will be encapsulated by natural ground left *in-situ* to an elevation above groundwater heights.

The primary technical precaution is only to import clean, inactive materials suitable for an inert landfill site, as such technical precautions are to be proportional to that of an inert landfill.

The site is underlain by low permeability strata, which comprises a combination of Jurassic Clays and a cemented Limestone horizon, which is generally known as a having negligible aquifer potential and should be considered as an additional geological barrier. Nevertheless, the sides of the site are to comprise of silt and clay-based materials capable of being compacted to a hydraulic conductivity of $\leq 1x10^{-7}$m/s. However, it is expected that natural compaction due to the mass of overlying soil forming material will result in a lower hydraulic conductivity and the entirety of the infill will act as a geological barrier.

The site is to be dewatered during quarrying, a practice that will continue during restoration. Therefore, materials placement will be undertaken “dry”. Groundwater recharge will be allowed to recover following the cessation of materials placement to a natural elevation of 8 - 9mAOD on the upgradient side of the site (to the west), and 5 - 6mAOD to the east.

It is expected that the site will form a hydraulic barrier to groundwater flow, which will be diverted around the north of the site, by a new drain into the South Drain and the Eastfield Drain. These two channels are artificial land drainage channels and are part of the wider historical land -water management scheme in this part of the country. The drainage channels are ephemeral and only expected to contain water during winter or after storm events.

During operations the baseflow contribution will be maintained by the artificial recharge from pumping of dewatering waters. This diverted baseflow contribution will continue after the hydraulic block caused by the replacement of high permeability sands and gravels with a lower permeability silt and clay fill.

Groundwater abstractions to the north, south and east of the site will be unaffected by the creation of the new landscape. The Public Water Supply source protection zones are not in hydraulic continuity with the site and are physically separated by at least three separate low permeability clay units.

The lower 3 – 5m of the recovered fill profile will be below the recovered groundwater level. This infilled ground will gradually become saturated; however, saturation times are likely to be extended due to the hydraulic characteristics of soil forming materials. It is these low permeability properties, in combination with the limited leachability of the imported fill which will prevent off-site pollution.

The inherent low permeability properties of the imported fill will also provide a hydraulic barrier between the surface water ponds proposed and external waters below the “decant elevation”. The irrigation lake itself will be formally lined in order to prevent water loss through basal and sidewall seepages, as well as place a formal barrier between the imported waste soils and irrigation waters. The irrigation lake is to be installed into the Kellaways Clay which provides both additional depth as well as an engineered material. Notwithstanding this, the majority of the imported fill, is also expected to be capable of achieving the same function (*i.e.* the creation of an artificial geological barrier/liner).

The ponds and lakes are to be recharged naturally and are intended to function as a flood attenuation ponds a necessary precaution for the changed landscape from one where incidental rainfall is expected to infiltrate into the Terrace Deposits, to an impermeable landscape, where surface run-off waters will be diverted to the drainage channels that the site is aligned between.

Risk assessment has demonstrated that seepage rates are low and there is no expectation that the imported fill proposed could cause a discernible change to the downgradient water quality. Imported wastes if required for an attenuation layer and for the bulk infill purposes for restoration are considered both chemically and physically suitable for their intended purpose.

7 Monitoring

A groundwater and surface water monitoring programme has been implemented at the site, which has enabled background water quality and elevations to be established. The primary groundwater body being monitored will be removed as part of the quarrying works and be replaced by "unproductive strata". However, monitoring should be undertaken in downgradient locations, and the discharges from the site to surface water. This will include the interconnected irrigation lagoon, and the discharge point for the flow attenuation surface water ponds.

Monitoring is to be undertaken at the following locations, to the suite identified in Table 20

Downgradient (Superficial & Surface Water)	**Downgradient Cornbrash**
• SW1 (South Drain) • BH01/22 • BH(MX) 99-04 • PZ08 • MCD2 (Eastfield Drain) • Discharges to Eastfield Drain • Irrigation Lagoon	• BH02/22 • BH03/23 • PZ02

Table 20 Monitoring Schedule

Location	Parameter	Frequency
Groundwater **S & G** BH01/22 BH(MX) 99-04 PZ08 **Cornbrash** BH02/22 BH02/23 PZ02	Base of monitoring point (mAOD)	Annual
	Water Level (mAOD), pH, EC Ammoniacal-N, TON Chloride, Sulphate TOC, TPH Potassium Nickel, Copper, Zinc, Chromium	Quarterly
Groundwater Dewatering discharge Irrigation Lagoon Discharges to Eastfield Drain Eastfield Drain (MCD2) South Drain (SW1) (only if flowing)	Water Level (mAOD), pH, EC Ammoniacal-N, TON Chloride, Sulphate TOC, TPH Potassium Nickel, Copper, Zinc, Chromium	Quarterly
Dewatering Waters	Suspended Solids	Quarterly

Table 21 Groundwater Compliance Limits

Location	Parameter	Limit
S & G BH01/22 BH(MX) 99-04 PZ08 **Cornbrash** BH02/22 BH03/22 PZ02	Chloride Sulphate Nickel Chromium	250mg/l 250mg/l 0.02mg/l 0.05mg/l

An ammoniacal-N limit is not proposed as it is considered that this substance will not be a suitable ‘indicator substance’ as set out within the Environment Agency’s guidance. Due to the background conditions at the site and the expected low concentrations within the source term, it is unlikely that a discernible impact could be identified at any nearby receptors. This is demonstrated in Table 18 and Table 19 above.

8 Summary and Conclusions

The Maxey Quarry southern extension is an operational quarry, which exploits River Terrace Deposits (RTD’s). These deposits are partially saturated and are to be restored to a combination of agricultural land, meadows, and pond features under a Recovery Permit.

The Recovery Plan conditions required by the Environment Agency limit the importation of non-inert materials. Such materials are primarily cohesive in nature, albeit larger sized fractions will be present (*e.g.* bricks and concrete). The primary characteristics of such a fil is low to negligible hydraulic potential and low leaching potential.

The imported fill is to be placed on top of *in-situ* clay deposits. However, the base and sides of the site will either be an *in-situ* clay or a reworked cohesive material capable of achieving a hydraulic conductivity of $\leq 1x10^{-7}$m/s. Such a layer will also be placed at the base where there may be a suspicion that there is less than 0.5m of *in-situ* clay remaining after quarry has been completed in each section of the site.

The low permeability properties induced by a clay and silt-based infill in combination with natural (under the mass of soil) and placed compaction. Consequently, the majority of the natural baseflow will be diverted around the imported fill and therefore not come into contact with the imported material, consequently the potential for pollution is low.

The qualitative Tier 1 assessment herein has demonstrated that significant dilution is afforded based on the soils infill properties and potential seepages to the adjacent River Terrace Deposits. The proposed scheme is considered to therefore comply with requirements of Schedule 10 and Schedule 22 of the Environmental Permitting (England and Wales) Regulations 2016.

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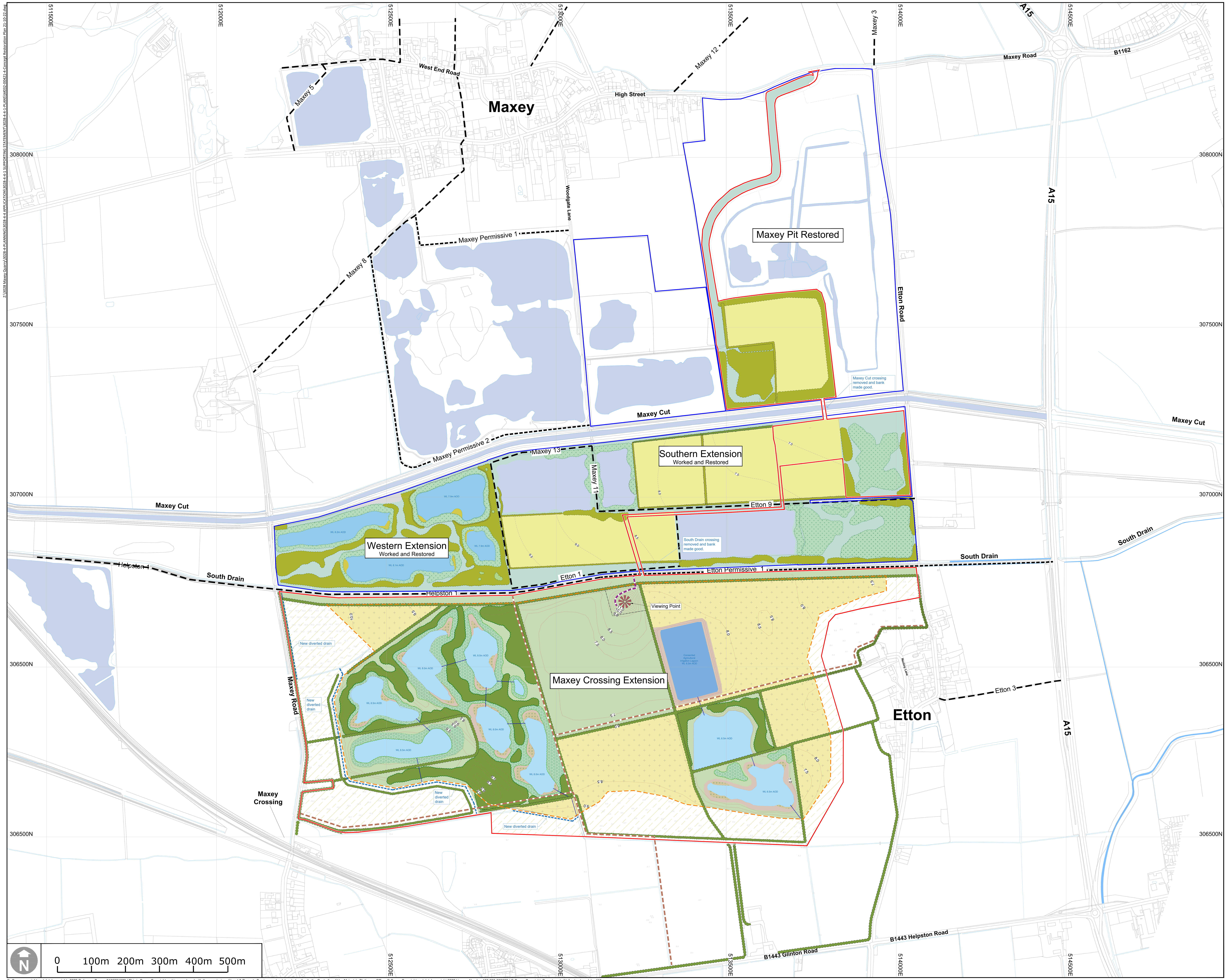
Drawings



Legend

- Consented Maxey Crossing Extension Site
- Other land under Tarmac control
- Extents of proposed importation area
- Existing spot level
- Etton 3 — Existing right of way and reference
- 8.0 — Consented restoration surface contour (at 0.5m intervals)
- 7.5 — Proposed restoration surface contour (at 0.5m intervals)
- Consented land restored to agriculture
- Consented wet woodland
- Consented dry woodland
- Consented hedgerow
- Consented tall grasses/ fenland
- Consented emergant vegetation
- Consented fishing lake
- Consented wildlife lake
- Consented agricultural irrigation lagoon
- Consented footpath
- Retained farmland progressively returned to agriculture
- Proposed land restored to agriculture
- Proposed land restored to lowland meadow
- Proposed wet woodland
- Proposed dry mixed decidous woodland
- Proposed hedgerow
- Proposed wet grassland
- Proposed reedbed
- Proposed diverted drain
- Proposed pipe
- Proposed wildlife lake
- Proposed viewpoint
- Proposed permissive footpath link to Viewpoint

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TARMAC
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Site Name: M032 - Maxey

Drawing Name: Concept Restoration Plan

Drawn By:	Scale @ A1:
DJA	1:5,000
Date:	**Drawing Number:**
21/10/2022	M032-00421-4A

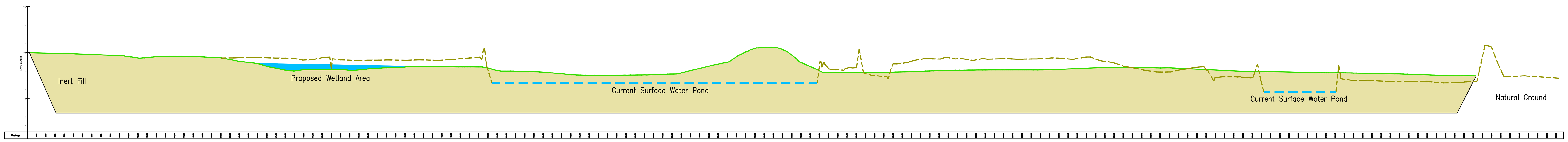
A1

GENERAL NOTES

Key

- Proposed Restoration Level
- Current Site Topography
- Current Surface Water Feature

A–A' SECTION
SCALE: H 1:500,V 1:50.



B–B' SECTION
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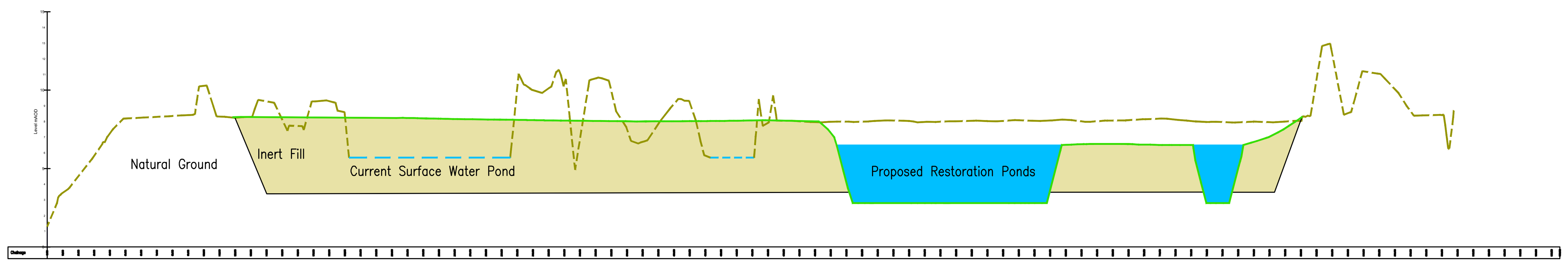

Rev	Date	Description	By	Chk	App
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BYRNELOOBY AN ayesa COMPANY

CLIENT
Tarmac Trading Limited

PROJECT
Maxey Waste Recovery

DRAWING TITLE
Site Cross Sections

STATUS
FINAL

Date: 06/2023	Scale: On Drawing	Drawn: AS	Chk: KW	App: KW

Project No:	Drg. No:	Rev:
K6063	K6063-01	00