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Analytical Report Number : 22-83971

Project / Site name:	Begbroke	**Samples received on:**	13/09/2022
Your job number:	19114	**Samples instructed on/ Analysis started on:**	13/09/2022
Your order number:	PO19941	**Analysis completed by:**	22/09/2022
Report Issue Number:	1	**Report issued on:**	22/09/2022
Samples Analysed:	1 10:1 WAC Sample		

Signed: [redacted]

Dominika Warjan
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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Waste Acceptance Criteria Analytical Results

Report No:	22-83971						
					Client: HYDROCK		
Location	**Begbroke**						
Lab Reference (Sample Number)	2423919 / 2423920				**Landfill Waste Acceptance Criteria Limits**		
Sampling Date	05/09/2022				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	WS236						
Depth (m)	0.20						
Solid Waste Analysis							
TOC (%)**	4.1				3%	5%	6%
Loss on Ignition (%) **	6.6				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	< 0.007				1	--	--
Mineral Oil (mg/kg) EH_1D_CU_AL	510				500	--	--
Total PAH (WAC-17) (mg/kg)	3.40				100	--	--
pH (units)**	8.1				--	>6	--
Acid Neutralisation Capacity (mmol / kg)	4.5				--	To be evaluated	To be evaluated
Eluate Analysis	10:1			10:1	Limit values for compliance leaching test		
(BS EN 12457 - 2 preparation utilising end over end leaching procedure)	mg/l			mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
Arsenic *	0.0037			0.0357	0.5	2	25
Barium *	0.0099			0.0946	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	0.0006			0.0058	0.5	10	70
Copper *	0.021			0.20	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0022			0.0214	0.5	10	30
Nickel *	0.0042			0.040	0.4	10	40
Lead *	0.0066			0.063	0.5	10	50
Antimony *	< 0.0017			< 0.017	0.06	0.7	5
Selenium *	< 0.0040			< 0.040	0.1	0.5	7
Zinc *	0.0065			0.062	4	50	200
Chloride *	1.1			10	800	15000	25000
Fluoride	0.37			3.5	10	150	500
Sulphate *	1.8			17	1000	20000	50000
TDS*	66			630	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	19.3			184	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	0.80						
Dry Matter (%)	98						
Moisture (%)	2.0						

Results are expressed on a dry weight basis, after correction for moisture content where applicable.
*= UKAS accredited (liquid eluate analysis only)
Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation
** = MCERTS accredited

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

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* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2423919	WS236	None Supplied	0.2	Brown loam and sand with vegetation and clinker

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Project / Site name: Begbroke

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
BS EN 12457-2 (10:1) Leachate Prep	10:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-2.	L043-PL	W	NONE
Acid neutralisation capacity of soil	Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe.	In-house method based on Guidance an Sampling and Testing of Wastes to Meet Landfill Waste Acceptance""	L046-PL	W	NONE
Loss on ignition of soil @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace.	In house method.	L047-PL	D	MCERTS
Mineral Oil (Soil) C10 - C40	Determination of mineral oil fraction extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L076-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated WAC-17 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270. MCERTS accredited except Coronene.	L064-PL	D	MCERTS
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH at 20oC in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In house method.	L005-PL	W	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Total BTEX in soil (Poland)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073-PL	W	MCERTS
Metals in leachate by ICP-OES	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Chloride 10:1 WAC	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
Fluoride 10:1 WAC	Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L033B-PL	W	ISO 17025
Sulphate 10:1 WAC	Determination of sulphate in leachate by ICP-OES	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Total dissolved solids 10:1 WAC	Determination of total dissolved solids in water by EC probe using a factor of 0.6.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L031	W	ISO 17025

Analytical Report Number : 22-83971
Project / Site name: Begbroke

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Monohydric phenols 10:1 WAC	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Dissolved organic carbon 10:1 WAC	Determination of dissolved inorganic carbon in leachate by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Appendix H Preliminary Geotechnical Risk Register

Geotechnical Hazard Identification – Desk Study Stage

Potential geotechnical hazards have been assessed in accordance with the general requirements of ICE/DETR Document 'Managing Geotechnical Risk' and the HE documents CS 641 and CD 622. The following pages set out the identified geotechnical risks and hazards which are associated with the proposed development and establish the approach which is to be taken to manage the risks including the geotechnical input and analysis.

Table H.1 is a preliminary assessment of possible geotechnical hazards at the site at Desk Study stage. This information is used to assist with ground investigation design.

Table H.1: Possible geotechnical hazards

Hazard	Comment	Hazard status based on desk study	
		Could be present and / or affect site (i.e. Plausible)	Unlikely to be present and/or affect site
Uncontrolled Made Ground (variable strength and compressibility).	Associated with former landfill (off-site) and around localised buildings.	✔	-
Soft / loose compressible ground (low strength and high settlement potential).	Alluvium present around streams and in the east of the site.	✔	-
Shrink swell of the clay fraction of soils under the influence of vegetation.	Cohesive deposits present on site. Moderate to high potential for swell in these areas.	✔	-
Variable lateral and vertical changes in ground conditions.	Various geologies across site.	✔	-
High sulphates present in the soils.	Oxford Clay Formation is known to have high sulphate content.	✔	-
Adverse chemical ground conditions, (e.g. expansive slag).	Unlikely to affect the site.	-	✔
Obstructions.	Sewer mains present crossing the site along with overhead power line pylon/pole foundation bases and farm building foundations.	✔	-
Existing below ground structures to remain (i.e. sewer main).		✔	-
Shallow groundwater.	Potential for shallow groundwater levels in vicinity of the streams and within the Alluvium and River Terrace Deposits.	✔	-
Changing groundwater conditions.		✔	-

Hazard	Comment	Hazard status based on desk study	
		Could be present and / or affect site (i.e. Plausible)	Unlikely to be present and/or affect site
Risk from erosion.	Site is partially within Flooding Zone 2 and 3.	✔	-
Risk from flooding.		✔	-
Running sands and / or loose Made Ground, leading to difficulty with excavation and collapse of side walls.	Localised to River Terrace Deposits, Made Ground and Alluvium.	✔	-
Slope stability issues – general slopes.	Site slopes from the topographic high in the west towards the north, east and south. Level changes may be required on slopes.	✔	-
Slope stability issues – retaining walls.		✔	-
Earthworks – settlement (due to placement of fill on soft / loose ground).	Site levels may need to be altered to create development plateaus.	✔	-
Earthworks – poor bearing capacity of new fill.		✔	-
Earthworks – unsuitability of site won material to be reused as fill.		✔	-
Solution features in Chalk.	Unlikely to be present on site.	-	✔
Cavities in the Superficial Deposits due to solution features.		-	✔
Dissolution (associated with “wet rock head”).		-	✔
Brine extraction.		-	✔
Mining / quarrying / mineral extraction (including sand and gravel workings).	Unlikely to be present on site, however, shown in the surrounding areas and within the Sand Lane pits.	✔	-
Cambered ground with gulls possibly present.	Unlikely to be present on site.	-	✔
Relict Slip Surfaces.	Unlikely to affect the site.	-	✔
Solifluction.	Site slopes away from the topographic high in the west of the site towards the north, east and south.	✔	-
Problematic soils (silts and rewetting etc.).	Alluvium present on site.	✔	-

Geotechnical Hazard Identification – Following Ground Investigation

The preliminary Geotechnical Risk Register following Ground Investigation is set out in Table H.3 and assumes that no works are proposed in the Landfill area.

The probability and impact of a hazard have been judged on a qualitative scale as set out in Table H.2. The degree of risk (R) is determined by combining tan assessment of the probability (P) of the hazard occurring with an assessment of the impact (I) of the hazard and associated mitigation it will require if it occurs (R = P x I).

Table H.2: Qualitative assessment of hazards and risks

P = Probability			I = Impact			R = Risk Rating (P x I)	
1	Very unlikely (VU)		1	Very Low		1 – 4	None / negligible
2	Unlikely (U)		2	Low		5 – 9	Minor
3	Plausible(P)		3	Medium		10 – 14	Moderate
4	Likely (Lk)		4	High		15 – 19	Substantial
5	Very Likely (VLk)		5	Very High		20 - 25	Severe

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
Uncontrolled Made Ground (variable strength and compressibility).	There are small areas of Made Ground around site associated with farm buildings and trackways.	New Structures	Bearing capacity failure, settlement (total and differential).	1	4	4	Design foundations to found below Made Ground or on Made Ground which has been improved.
			Floor slab failure.	1	4	4	Design floor slabs as suspended.
		Roads and Pavements.	Settlement (total and differential) of roads and pavements.	1	2	2	Design roads and pavements using suitable geotechnical parameters and increase the sub-base and use geo-grids as appropriate.
		Services.	Settlement (differential), causing damage to services.	1	2	2	Anticipated settlements are not anticipated to be significant with regard to services. It is also advisable to steepen falls in drainage to prevent back fall and use rocker boxes and flexible couplings.
		Gardens / POS areas	Settlement (differential), in gardens.	1	2	2	It is unlikely that settlements will be significant with regard to gardens / POS areas.
		Construction staff, vehicles and plant operators.	Trafficking of the site in temporary conditions. Overturning of plant during construction.	1	3	3	Where soft spots encountered, over-excavation and replacement with suitable fill. Outline design of working platform to include geo-grid. Site inspection and watching brief by Contractor to review working platform frequently and regularly.

Cont……

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
Soft / loose ground (low strength and high settlement potential).	The shallow natural soils comprise River Terrace Deposits, Head Deposits, Alluvium, and the Solid Geology of the Oxford Clay Formation, Kellaways Sand Member, Kellaways Clay Member and the Cornbrash Limestone Formation.	New Structures	Foundation bearing capacity failure, settlement (total and differential).	4	4	16	Design foundations to found below any loose sand and gravel or soft clay, or improve the underlying geology is required.
			Floor slab failure.	4	4	16	Design floor slab as suspended.
		Roads and Pavements.	Settlement (total and differential), of roads and pavements.	4	3	12	Design roads and pavements using suitable geotechnical parameters and increase the sub-base and use geo-grids as appropriate. If anticipated settlements are significant, and cannot be mitigated by design, over-excavate and replace soft soils.
		Services.	Settlement (differential), causing damage to services.	3	3	9	Settlements are not anticipated to be significant. No additional design requirements envisaged.
		Gardens / POS areas	Settlement (differential), in gardens.	3	3	9	
		Construction staff, vehicles and plant operators.	Trafficking of the site in temporary conditions. Overturning of plant during construction.	4	3	12	Where soft spots encountered, over-excavate and replace with suitable fill. Design working platform to suit the ground conditions. Outline design of working platform to include geo-grid if necessary. Site inspection and watching brief by Contractor to review working platform frequently and regularly.
Shrinkage / swelling of the clay fraction of soils under the influence of vegetation.	The clays of the Oxford Clay Formation, Alluvium and Kellaways Clay are medium to high heave potential. Cohesive lenses within superficial deposits.	Foundations.	Shrinkage or heave of soils and associated damage to foundations.	4	3	12	Design foundations in accordance with relevant standards. Deepen foundations due to trees as appropriate.
		Floor slabs.	Floor slab failure.	4	4	16	Design floor slabs in accordance with relevant standards. Design floor slab as suspended with a void, unless the warranty provider is satisfied the soil is not desiccated, or slabs are constructed when soils are not seasonally desiccated (i.e. during winter and spring).

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
Variable lateral and vertical changes in ground conditions.	The Shallow soils vary laterally and vertically across the site and comprise River Terrace Deposits, Head Deposits, Alluvium, and the Solid Geology of the Oxford Clay Formation, Kellaways Sand Member, Kellaways Clay Member and the Cornbrash Limestone Formation. Structures may be founded in materials with different geotechnical parameters.	New Structures	Foundation bearing capacity failure, settlement (total and differential).	4	4	16	Design foundations to found below Made Ground or on Made Ground which has been improved. Design foundations to found below any loose relative density sand and gravel or soft clay, or improvement prior to founding.
			Floor slab failure.	4	4	16	Design floor slabs in accordance with relevant standards.
		Roads and Pavements.	Settlement (total and differential), of roads and pavements.	4	3	12	Design roads and pavements using suitable geotechnical parameters and increase the sub-base and use geo-grids as appropriate. If anticipated settlements are significant, and cannot be mitigated by design, over-excavate and replace unsuitable soils.
		Services.	Settlement (differential), causing damage to services.	3	3	9	Settlements are not anticipated to be significant with regard to services. No additional design requirements envisaged.
		Gardens / POS Areas	Settlement (differential), in gardens.	3	3	9	It is unlikely that settlements will be significant with respect to gardens/POS.
		Construction staff, vehicles and plant operators.	Trafficking of the site in temporary conditions. Overturning of plant during construction.	4	3	12	Where soft spots encountered, over-excavate and replace with suitable fill. Design working platform to suit the ground conditions. Outline design of working platform to include geo-grid if necessary. Site inspection and watching brief by Contractor to review working platform frequently and regularly.

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
Cont…							
Sulphates present in the soils.	The ground investigation has proven that there is the potential for expansive sulphate bearing soils to be present (DS-4) within the Oxford Clay	Attack of buried concrete.	Damage to concrete and reduction in strength.	3	4	12	Classify concrete in accordance with BRE SD1 and design concrete accordingly.
		Earthworks.	Sulphate heave following the use of hydraulic binders.	3	4	12	Supplementary sulphate testing in accordance with BRE guidelines to be undertaken as part of detailing investigation works. Before the use of hydraulic binders is approved, comprehensive testing and design will need to be completed by a Specialist Contractor to satisfy both themselves and the Engineer of the suitability of the soils for treatment, and confirm that the requisite end-performance of the material is achievable. The use of modification / stabilisation to be restricted to suitable materials following laboratory trials. In all instances where improvement by the inclusion of binders is considered, a mix design is required and as part of this design, samples should be checked for swelling, even where very low sulphate values are recorded.
Obstructions.	Obstructions were not noted during the investigation, however a number of services	Construction staff, vehicles and plant operators.	Risk of collapse of excavation as obstructions are pulled out.	3	3	9	Undertake Enablement Works and remove all obstructions. Allow for a breaker to be present during construction and remove obstructions where encountered during construction.

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
	are present beneath the site..	Roads and Pavements.	Hard spots in externals and roads / pavements.	3	2	6	
		Structures	Impact on foundations resulting in re-design	3	3	9	
Cont…							
Shallow groundwater.	Monitoring during the ground investigations has proven a shallow groundwater table in the north, east and south of the site (at a minimum of <1.0m bgl), with relatively fast inflows of water seen during the ground investigation.	Construction staff, vehicles and plant operators.	Difficulty with excavation. Limit state failure, excessive deformation, trafficking of site plant, inability to place and compact fill.	4	2	8	Contractor to appoint competent Temporary Works Designer to design temporary works, in accordance with BS 5975:2008+A1:2011. Temporary Works Designer to consider in their analysis the impact of, and requirements for, de-watering of excavations. Any water that collects at the base of excavations to be removed as soon as practicable.
		Slopes and Retaining.	Serviceability issues.	5	2	10	Contractor to appoint competent Temporary Works Designer to design temporary works, as required in accordance with BS 5975:2008+A1:2011. The shallow groundwater is to be taken into account during geotechnical design of the permanent works.
Changing groundwater conditions.	Monitoring during the ground investigation is ongoing. Groundwater levels likely to be seasonally variable.	Construction staff, vehicles and plant operators.	Difficulty with excavation. Limit state failure, excessive deformation, trafficking of site plant, inability to place and compact fill.	4	2	8	Contractor to appoint competent Temporary Works Designer to design temporary works as required, in accordance with BS 5975:2008+A1:2011. Temporary Works Designer to consider in their analysis the impact of a variable water table.

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
		Slopes and Retaining.	Serviceability issues.	5	2	10	Contractor to appoint competent Temporary Works Designer to design temporary works, as required in accordance with BS 5975:2008+A1:2011. Design drainage for retaining walls to account for fluctuating groundwater levels. The shallow groundwater is to be taken into account during geotechnical design of the permanent works.
Subject to risk from erosion.	A stream is present in the north and along the south of the site.	The entire development.	Damage to structures, gardens/POS roads and services.	4	4	16	Slopes to be designed at stable angle. Slopes to be designed with erosion matting to prevent scouring.
Cont…							
Subject to risk from flooding.	The site is within an area of flood risk near the stream in the north and in the east of the site	The entire development.	Damage to structures gardens/POS roads and services.	4	4	16	The site is partially located within a Flood Zone 2/3, and as such is at risk of flooding. The planning of the site needs to take into account the risk of flooding.
Running sands and / or loose granular soils, leading to difficulty with excavation and collapse of side walls.	The ground investigation has indicated that there is a potential for loose soils and Shallow Groundwater to be present at the site with collapse noted in trial pits.	Construction staff, vehicles and plant operators.	Ground failure, instability of plant and machinery.	5	4	20	As instability has been noted in all pits during excavation and exacerbated by groundwater ingress, foundation options should be reviewed to ensure minimal excavation (e.g. piles) where instability is noted at shallow depths. Contractor to appoint competent Temporary Works Designer to design temporary works, in accordance with BS 5975:2008+A1:2011. Temporary Works Design to include recommendations for inspection of excavations. No person entry to unsupported excavations.
			Risk of collapse of excavation.	5	3	13	
	The site is on sloping ground and the	New Structures	Serviceability issues.	4	4	16	Safe slope angles to be assessed during design.

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
Slope stability issues – General Slopes.	proposed development is likely to require slopes to be formed as part of the cut to fill.	Roads and Pavements.	Serviceability issues.	4	3	12	Engineered fill requirements to be defined at outline design stage. Drainage requirements to be assessed during design. Slopes to be constructed at a safe angle.
		Gardens/POS	Serviceability issues.	3	2	6	
Cont…							
Slope stability issues – retaining walls.	The site is on sloping ground and the proposed development may require retaining walls to be constructed.	New structures.	Serviceability issues.	4	4	16	Design of the retaining to be undertaken in accordance with EC7. Adequate drainage to be designed behind the structure, or for water seepage through the face of the wall. Lateral earth pressure parameters to be characterised during investigation and design. Engineered fill requirements to be defined at outline design stage.
		Pavement construction and long-term durability highways and external areas.	Serviceability issues.	3	3	9	
		Gardens / POS	Serviceability issues.	3	2	6	

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
		Construction staff, vehicles and plant operators.	Potential for future movements / collapse.	3	4	12	
Cont…							
Earthworks – Settlement (due to placement of fill on soft / loose ground	The ground conditions at the site include variable cohesive and granular deposits and locally recorded up to 4.0m as soft/loose.	New Structures	Foundation bearing capacity failure, settlement (total and differential).	4	4	16	Soft to loose ground, within structurally placed fill or improve ground using VSC
			Floor slab failure.	4	4	16	Design floor slabs in accordance with relevant standards.
		Roads and Pavements.	Settlement (total and differential), of roads and pavements.	3	3	9	Undertake ground improvement (pre-load and surcharge / rolling dynamic compaction / dynamic compaction / over-excavation and replacement) to reduce settlements.

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
							Design roads and pavements using suitable geotechnical parameters and increase the sub-base and use geo-grids as appropriate.
		Services.	Settlement (differential), causing damage to services.	2	3	6	Settlements are not anticipated to be significant with regard to services.
		Gardens / POS	Settlement (differential), in gardens.	3	3	9	Assess the use of geogrids as part of the design process. Undertake ground improvement (pre-load and surcharge / rolling dynamic compaction / dynamic compaction / over-excavation and replacement) to reduce settlements.
		Construction staff, vehicles and plant operators.	Trafficking of the site in temporary conditions. Overturning of plant during construction.	3	3	9	Where soft spots encountered, over-excavate and replace with suitable fill. Design working platform to suit the ground conditions. Outline design of working platform to include geo-grid if necessary. Site inspection and watching brief by Contractor to review working platform frequently and regularly.
Cont…							
Earthworks – poor bearing capacity and / or settlement of new fill.	There may be a requirement for cut to fill to create the development platform depending on final design	New structures	Foundation bearing capacity failure, settlement (total and differential).	4	4	16	Design foundations to found below soft to loose ground or within new engineered fill.
			Floor slab failure.	4	4	16	Design floor slabs in accordance with relevant standards.
		Roads and Pavements.	Settlement (total and differential).	3	3	9	Minimum engineering performance to be defined in an Earthworks Specification.

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
	This will require reuse of soils excavated from the site.	Services.	Settlement (differential), causing damage to services.	3	3	9	Earthworks to be designed in accordance with 1) Manual of Contract Documents for Highway Works (MCHW), Volume 1; 2) Specification for Highway Works (SHW) Series 600; 3) 6031:2009, Code of practice for earthworks; and 4) BS 8000-1, workmanship on building sites. Site testing to be undertaken to confirm the works are in accordance with the design. A suitable watching brief and independent verification.
		Gardens/POS	Settlement (differential), in gardens/POS	2	3	6	
		Construction staff, vehicles and plant operators.	Trafficking of the site in temporary conditions. Overturning of plant during construction.	3	3	9	
Earthworks – Unsuitability of site won material to be reused as fill.	There may be a requirement for cut to fill to create the development platform depending on final design This will require reuse of soils excavated from the site.	Earthworks control, inability to place and compact fill.	Service limit state failure, excessive and intolerable total and differential settlement.	4	3	12	The design is to describe the processes required to produce suitable fill for reuse. Contractor to design site control measures, plant, equipment and arrangement to comply with processing requirements. Site testing to be undertaken to confirm the works are in accordance with the design. A suitable watching brief and independent verification. Adequate investigation required of soil types and characterisation of the soils to be undertaken during investigation. Some fill may be unsuitable for use.
		Project Budgets - Insufficient fill to complete earthworks.	Additional Costs, due to importation of fill or having to modify designs.	3	2	6	
Cont…							
Problematic soils (silts and rewetting etc.).	Silts recorded in a number of locations	New Structures	Foundation bearing capacity failure, settlement (total and differential).	4	4	16	Design foundations to found below any problematic soils.
			Floor slab failure.	4	4	16	Design floor slabs in accordance with relevant standards.

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
		Roads and Pavements.	Settlement (total and differential), of roads and pavements.	4	3	12	Design roads and pavements using suitable geotechnical parameters and increase the sub-base and use geo-grids as appropriate. If anticipated settlements are significant, and cannot be mitigated by design, over-excavate and replace soft soils or undertake ground improvement.
		Services.	Settlement (differential), causing damage to services.	3	3	9	Ground levels are likely remaining at approximately current levels. Settlements are not anticipated to be significant. No additional design requirements envisaged.
		Gardens/POS	Settlement (differential), in gardens / POS	2	3	6	
		Construction staff, vehicles and plant operators.	Trafficking of the site in temporary conditions. Overturning of plant during construction.	3	3	9	Where soft spots encountered, over-excavate and replace with suitable fill. Design working platform to suit the ground conditions. Outline design of working platform to include geo-grid if necessary. Site inspection and watching brief by Contractor to review working platform frequently and regularly.
Cont....							
Unforeseen ground conditions - risk associated with limited data.	Ground investigation has been undertaken. However, additional information will be	All aspects of the development		3	4	12	Designers to be contacted if conditions encountered are different to those identified during investigation. Regular inspections of excavations and earthworks for evidence of stability.

Hazard	Comments	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
	obtained during construction. Ground conditions are only defined at exploratory hole locations.						Adequate investigation required to characterise the site and understand the potential risks.

Whilst the probability and impact of the hazard occurring can be reduced to a minimum by geotechnical design, the impact cannot be reduced below very low. The risk register will need to be up-dated, as necessary, to reflect design, additional information, data and experience as it is gained through the construction process.

Impacts of the design with regard to health and Safety considerations will need to be included by the designer at design stage.

Appendix I Plausible Source-Pathway-Receptor Contaminant Linkages

Summary of Potential Contaminant Linkages

Table I.2 lists the plausible contaminant linkages which have been identified. These are considered as potentially unacceptable risks in line with guidelines published in LCRM (2022) and additional risk assessment is required.

Source – Pathway – Receptor Linkages have been assessed in general accordance with guidance in CIRIA Report C552 (Rudland *et al* 2001) but modified to add a 'no linkage' category and to remove low/moderate risk (See Table I.1).

It should be noted that whilst the risk assessment process undertaken in this report may identify potential risks to site demolition and redevelopment workers, consideration of occupational health and safety issues is beyond the scope of this report and need to be considered separately in the Construction Phase Health and Safety Plan.

Table I.1: Consequence versus probability assessment.

		Consequence			
Probability		Severe	Medium	Mild	Minor
	High Likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Low risk	Very low risk
	Low Likelihood	Moderate risk	Low risk	Low risk	Very low risk
	Unlikely	Low risk	Very low risk	Very low risk	Very low risk
	No Linkage	No risk			

Table I.2: Exposure model – final source-pathway-receptor contaminant linkages

Sources	Possible Pathways	Receptors	Probability	Consequence	Risk Level	Comments	
Wider Site							
Asbestos fibres from insulation or asbestos-containing materials in the buildings.	Fugitive dust.	On Site	Likely	Severe	High	Asbestos may be present in existing farm buildings and sporadically on surface. Careful removal will be required from buildings during demolition. However, removal under controlled conditions should limit release of fibres to the air and the ground.	
		Neighbours.	Unlikely	Severe	Low		
Asbestos fibres within soils around Parkers Farm	Fugitive dust.	On Site	Low likelihood	Severe	Moderate		
Landfill Area							
Landfill Made Ground (metals, metalloids, and PAH).	Ingestion, inhalation or direct contact.	Site users.	Likely	Medium	Moderate	There is Landfill Made Ground below the entire site, and there are metals, metalloids, PAH at levels in excess of the GAC. No capping layer is currently present.	Contact with these materials is likely in gardens and areas of POS. Mitigation measures will be required to break the SPR linkage.
	Leaching through unsaturated zone.	Surface Waters	Low likelihood	Medium	Low		No significantly elevated concentrations of metals, metalloids and PAH in groundwater samples, when compared to the WQT.
	Root uptake	Landscape planting	Likely	Medium	Moderate		Mitigation measures will be required to break the SPR linkage.
	Direct contact	Water supply pipes	Likely	Medium	Moderate	Direct contact with buried water supply pipes is therefore likely	

Sources	Possible Pathways	Receptors	Probability	Consequence	Risk Level	Comments	
Landfill Made Ground below the site (Ammoniacal Nitrogen).	Leaching through unsaturated zone.	Surface Waters	Low likelihood	Medium	Low	The concentrations that have been observed in the landfill soils are, in Hydrock's experience' towards the lower end of typical concentrations in historical landfills. The closest surface receptor to the site appears to be an un-named brook some 230m to the south. Given the distance from the site and shallow unconsolidated nature of the superficial aquifers (River Terrace Gravels / Alluvium), any ammoniacal nitrogen from the landfill is expected to attenuate (via dispersion, dilution and degradation) before the surface water receptor is reached. Additional sampling shows decreased ammoniacal nitrogen outside of the landfill and indicates a low risk to controlled water. If necessary, a Detailed Quantitative Risk Assessment (DQRA) required.	
Asbestos free fibres within the Landfill Made Ground	Inhalation of fugitive dust.	Site users.	Likely	Severe	Very High	There is Landfill Made Ground below the entire site, and ACM and asbestos fibres have been proven to be present in the soil.	Contact with these materials is likely in gardens and areas of POS. Mitigation measures will be required to break the SPR linkage
		Neighbours.	Unlikely	Severe	Low		
Metals, metalloids and PAH within the Topsoil Made Ground	Ingestion, inhalation or direct contact.	Site users.	Likely to High likelihood	Medium	Moderate to High	Contact with these materials is possible/likely in gardens and areas of POS. GAC are exceeded by a significant amount. Mitigation will be required.	
	Direct contact	Water supply pipes.	Likely	Medium	Moderate	Direct contact with buried water supply pipes is likely and mitigation will be required.	

Sources	Possible Pathways	Receptors	Probability	Consequence	Risk Level	Comments
Ground gases (carbon dioxide) from organic materials in the Landfill Made Ground.	Migration, build up and explosion.	Site users.	Likely	Medium to Severe	Moderate to High	Ground gas monitoring has indicated concentrations of carbon dioxide above the detection limits of the analytical apparatus. Mitigation measures are required for carbon dioxide in accordance with CS2 conditions. Further monitoring required to assess risks on the wider site.
		Neighbours.				
		Buildings on site.				
		Buildings on adjacent sites.				
Radon	Migration	Site users.	Likely	Medium to Severe	Moderate to High	Mitigation measures required north of Rowel Brook if construction undertaken in this area.