

Shipley Lakeside Development

Reclamation Strategy

Waystone Developments Ltd

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SHLK-AEC-XX-XX-DR-GE-0003 Site Geological Plan

SHLK-AEC-XX-XX-DR-GE-0004 Ground Investigation Exploratory Hole Location Plan

SHLK-AEC-XX-XX-DR-GE-0013 Historical Mining Constraints

SHLK-AEC-XX-XX-DR-CE-00601 Earthworks Layout

SHLK-AEC-XX-XX-DR-GE-0030 Proposed Groundwater and Gas Monitoring Wells

SHLK-AEC-XX-XX-DR-GE-0031 Proposed Location of Rod and Plate Settlement Monitoring

SHLK-AEC-XX-XX-DR-GE-0032 Reclamation Earthworks Typical Section

SHLK-AEC-XX-XX-DR-GE-0033 Outline Drawing of Shipley Lake Dredging for Plot C

Glossary

- **'N' Value:** The number of blows required to achieve a penetration of 300mm
- **AA:** Averaging Areas
- **AAC:** Absolute Area Coverage
- **ACEC:** Aggressive Chemical Environment for Concrete
- **aOD:** above Ordnance Datum
- **bgl:** below ground level
- **BOD:** Biological Oxygen Demand
- **BRE:** Building Research Establishment
- **BTEX:** Benzene, Toluene, Ethylbenzene and Xylene.
- **CBR:** California Bearing Ratio
- **CIEH:** Chartered Institute of Environmental Health
- **CIRIA:** Construction Industry Research and Information Association
- **CL:** Clay Low (Clay soil, low plasticity)
- **CL:AIRE:** Contaminated Land: Application in Real Environments
- **CLEA:** Contaminated Land Exposure Assessment
- **CLR:** Contaminated Land Report
- **COD:** Chemical Oxygen Demand
- **CSM:** Conceptual Site Model
- **Cu:** Shear Strength
- **dB:** decibels
- **DEFRA:** Department for Environment, Food & Rural Affairs
- **DQRA:** Detailed Quality Risk Assessment
- **DWS:** Drinking Water Standard
- **EA:** Environment Agency
- **EAC:** Effective Area Coverage
- **EPH:** Extractable Petroleum Hydrocarbon
- **EP:** Environmental Permit
- **EQS:** Environmental Quality Standard
- **FW:** Freshwater
- **GAC:** Generic Assessment Criteria
- **GA:** Golder Associates
- **GI:** Ground Investigation
- **GSV:** Gas Screening Value
- **GW:** Groundwater
- **$L_{eq,\ 1hour}$:** Equivalent Noise Level over 1 hour period
- **LI:** Liquidity Index (%)
- **LL:** Liquid Limit
- **LPA:** Local Planning Authority
- **LQM:** Land Quality Management
- **Made Ground:** All materials above the natural superficial deposits (NSD)
- **MC:** Moisture Content
- **MCERTS:** Monitoring Certification Scheme
- **MDD:** Maximum Dry Density
- **MH:** M-soil High (Silt soil of High Plasticity)

- **MI:** M-soil Intermediate (Silt soil of Intermediate Plasticity)
- **MPM:** Management Plan for Materials
- **Natural Superficial Deposits:** superficial deposits consisting of quaternary glacial drift deposits, lacustrine clay deposits and Warp deposits.
- **NHBC:** National House-Building Council
- **NMC:** Natural Moisture Content
- **NWWTP area:** Northern Wastewater Treatment Plant area, as referred to in site investigation reports by Golder Associates and Scott Wilson - URS
- **OMC:** Optimum Moisture Content
- **PAH:** Polycyclic Aromatic Hydrocarbon
- **PCL:** Plausible Contaminant Linkage
- **PI:** Plasticity Index
- **PL:** Plastic Limit
- **PM:** Particulate Matter
- **PM_{10}:** Particulate Matter up to 10µm in size
- **PSD:** Particle Size Density
- **RCL:** Relevant Contaminant Linkages
- **RETEST:** Remediation Technologies Selection Tool
- **ROA:** Remediation Options Appraisal
- **RTM:** Remedial Target Methodology
- **RTV:** Remedial Target Value
- **SGV:** Soil Guideline Values
- **SCA:** Soil Conditioning Areas
- **SOM:** Soil Organic Matter
- **SPT:** Standard Penetration Test
- **SPZ:** Source Protection Zones
- **SRT:** Sand Replacement Test
- **SSAC:** Site Specific Assessment Criteria
- **SuDS:** Sustainable urban Drainage Systems
- **TOC:** Total Organic Carbon
- **TPH:** Total Petroleum Hydrocarbons
- **TRL:** Transport Research Laboratory
- **UKWIR:** UK Water Industry Research
- **WRAS:** Water Regulation Advisory Scheme Guidance Note 9-04-03 “Laying Pipes in Contaminated Land”

1. Introduction

1.1 Purpose of the Strategy

AECOM have been commissioned by Waystone Development Ltd (Waystone) to prepare a Reclamation Strategy for the Shipley Lakeside Development site. This Reclamation Strategy is based on available published data and the intrusive field studies/investigations that have been undertaken by AECOM across the site. The document will be updated once data from a supplementary ground investigation has been completed and interpreted.

AECOM has also been commissioned to prepare a Specification and Bill of Quantities for the supplementary ground investigation works to be undertaken. The data from the supplementary ground investigation will be used to inform and update the reclamation strategy.

The following documents have been used in the preparation of this Draft report:

- URS (December 2012), Shipley Lakeside Development, Phase I Assessment Report Issue 2 Final;
- URS (January 2013), Shipley Lakeside, Environmental Statement – Hydrology and Hydrogeology Report;
- URS (January 2014), Shipley Lakeside, Flood Risk Assessment;
- AECOM (March 2017), Shipley Lakeside Development, Phase II Geo-Environmental and Geotechnical Assessment; and
- AECOM (November 2019) Delineation of Supplementary Foundation Design Zone over Opencast Highwall at Shipley Lakeside.

1.2 Proposed Development

It is intended to develop the site for mixed residential and commercial end-use. The masterplan for the development is shown on the Waystone Drawing SL-DPP-MP-02 Rev D, Waystone Developments Limited (Appendix B). The earthworks layout plan related to the master plan is SHLK –AEC – XX-XX-DR-CE-00601 P4. The development will comprise the following:

- Residential houses;
- Business park including offices and industrial space;
- Retail development;
- Training, leisure and education facilities; and
- Healthcare, pub, restaurant, hotel and conference suite.

The development masterplan shows that Plot C (Hotel and Restaurant / Conference) is proposed to be located in of the eastern part of the Shipley Lake, indicating this area of the lake will be reclaimed during the earthworks for the construction of the development platform for Plot C.

1.3 Site Location and Description

The site is located approximately 10 miles to the north west of Nottingham and is positioned between the town of Heanor to the North West and then both Cotmanhay and Ilkeston to the south east. The site is centred on national grid co-ordinate SK444494, 344163 and is shown on the Drawing SHLK-AEC-XX-XX-DR-GE-0001. The site boundary is presented on SHLK-AEC-XX-XX-DR-GE-0002.

The site which is currently derelict is a bowl shape with site levels falling from the western, northern and eastern sides of the sites towards the lake at its centre. The lake is contained by a dam present at the southern extremity of the site. The site was noted to contain good vegetation cover in all areas except where there are hardstanding and floor slabs, foundations and bricks remaining from the former buildings and structures of the American Adventure Park.

Evidence of the former use of the site as an open cast coal mine was noticeable in the north western area of the site in the type of soil at the surface. The soil was clayey, very hard and was rutted but also contained a good cover of vegetation. No visual or olfactory evidence of contamination or pollution were noted in any areas of the site that were accessed during the site walkover.

The site is within an area of adopted Green belt but benefits from a special planning policy regarding development (EN3 Amber Valley Local Plan, 2006).

2. Site Setting and History

This section summarises the site setting and history of the Shipley Lakeside site and is taken from the URS (2012) Shipley Lakeside Development Phase I Report Issue 2 – Final (47061551/GEO/01).

2.1.1 Geology

This section summarises the geology of the site based on the information contained in the Envirocheck Report (41021474_1_1), published geological map Sheet SK44SW (1:10,560), Sheet No 125 for Derby Solid and Drift Edition (1972) and 'Geology of the Country North of Derby' a geological memoir for 1:50,000 geological sheet 125 by Frost, D V. London: HMSO, 1968. The geological plan for the site is shown on Drawing SHLK-AEC-XX-XX-DR-GE-0003. The geology and ground conditions encountered during the site investigation are discussed in Section 4.

2.1.1.1 Made Ground

As discussed in the Phase I Report, the historical mapping presented in the Envirocheck Report (41021474_1_1), BGS geological maps and information from the CA indicate the presence of Made Ground across the site.

The 1938 (1:10,560), 1955 (1:10,000) and 1966 (1:10,000) historical maps show increasing coverage of the northern part of the site in Colliery Spoil, which culminated in the partial infilling of the Shipley Lake (formerly called the Fish Pond). Made Ground is likely to have been deposited along the far northern site boundary as part of the construction and subsequent demolition of buildings associated with Shipley and Woodside Collieries, but also the former Heanor Branch Line, which linked the Collieries to the railway network. There is historical evidence of a Gas Works and a Brick Yard immediately to the south of the site from approximately the 1880s to the early 1930s. The majority of the site has been mined for shallow coal by opencast techniques and this has resulted in significant thicknesses of Made Ground such as colliery spoil and reworked natural materials (overburden).

The American Adventure theme park was closed in 2007. The main buildings and rides associated with the Theme Park have been removed. However, the foundations and floor / base slabs still remain at the site, with some associated building rubble. It is understood that Waystone Developments Limited plan to break out these materials during the earthworks stage of the proposed development and to process the materials for re-use as hard-core during the construction of roads and paths.

The details and composition of the Made Ground encountered during the investigation at the site are presented in Section 4 of this Report.

2.1.1.2 Superficial Deposits

The BGS Solid and Drift Map for Derby, (Sheet 125) 1:50,000, indicates that a tract of Alluvium (Clay, Silt, Sand and Gravel) runs from the northern end of Shipley lake in a north western direction. However, no superficial deposits are noted to be present in the remainder of the site.

The site has been extensively opencast mined for coal in the 1970s and the Alluvium is highly likely to have been removed during the mining operations and re-placed following the completion of the opencast operations. Limited Alluvium materials were encountered during the GI and the details are discussed in Section 4 of this report.

2.1.1.3 Bedrock

The BGS Solid and Drift Map for Derby (Sheet 125) 1:50,000 indicates that the underlying solid geology is comprised of Pennine Middle Coal Measures Formation (Mudstone, Siltstone and Sandstone). The site lies towards the southern edge of a shallow synclinal or bowl-shaped structure whereby the coal measures strata dip gently towards the centre of the bowl located approximately 50 – 100m north of the site. A coal crop is shown within the site boundary which relates to the Dunsil Coal seam. The Dunsil Coal seam strikes centrally in a broadly southeast to northwest direction, along the western edge of the syncline, before turning back south along the site boundary. The Top Hard Coombe and Mainsmut Coal seams are shown to outcrop concentrically towards the centre of the synclinal bowl structure. Other coal seams present beneath the site are discussed in section 8.

The BGS Open Geoscience (2012) website (1:50,000) confirmed these findings. To the east and west of the site, adjacent to site boundary, there are further areas of outcrop of the strata of the Pennine Middle Coal Measures Formation. The BGS Open Geoscience (2012) website (1:50,000) lists these deposits as being principally composed of Sandstone.

The BGS Solid and Drift Map for Derby (Sheet 125) 1:50,000 scale does not show any faults running across the site. The closest known fault is located approximately 200m to the north of the site, running north from the former

Heanor Branch Line in proximity to Hogg's Pond. A fault is located approximately 600m to the west of the site, on the western side of Shipley Hall. Another fault is located to the south of Lodge Farm, approximately 750m south of site. The BGS memoir indicates that a swarm of normal faults striking southeast – northwest disrupt the regional dip of the strata, with a subsidiary set of normal faults striking east – west and ENE-WSW.

2.1.2 Mining

The site is known to have a significant coal mining history. The Shipley Colliery and the Woodside Colliery are both located within the site boundary. Open cast coal mining was undertaken across the whole site in the 1970s, with the possible exception of a strip of land along the northern boundary to the site. There has been extensive open cast coal mining in the wider Shipley Country Park site. A mine water pumping station is located at the site of the former Woodside Colliery and associated treatment / settlement ponds are located approximately 500m to the south east of the site. There are 12 mine entries within the site or within 20m of the site boundary. The locations of the mineshafts are shown on Drawing SHLK-AEC-XX-XX-GE-0013.

A Non-Residential Coal Authority Mining Report was obtained from the Coal Authority (CA) as part of the Coal Mining Risk Assessment in Shipley Lake Phase I Assessment Report (URS 2012). The CA Mining Records Office in Mansfield was also visited to review the available plans and records relevant to the site. The information obtained includes plans showing the details of the seams worked and a Coal Inspector's report on the Shipley Lake Opencast. The historical mining constraints at the site are discussed in detail in Section 5.7 of this Report.

2.1.3 Hydrogeology

The Superficial Deposit of Alluvium identified on the BGS Sheet 125 Derby, in the northern area of the site is classed as Secondary A aquifer, (Minor aquifer on the Environment Agency Groundwater Vulnerability Maps). The Environment Agency (EA) defines these aquifers as "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers". However, these materials are likely to have been impacted by the open cast mining activities that were undertaken during the 1970s and the superficial deposits may have been re-used as topsoil elsewhere within the site.

The underlying bedrock of the Pennine Middle Coal Measures is classified by the Environment Agency as a Secondary A aquifer. The groundwater level in the underlying mining voids in the bedrock aquifer is controlled by the mine water pumping station adjacent to the northern boundary of the site. The pumping station is located in the former No. 2 shaft of the former Shipley Woodside Colliery which closed in 1966. The mine water is pumped and treated at the surface to prevent its breakout and pollution of surface waters, notably the Nut Brook.

There are no Source Protection Zones (Total Catchment – Zone 3) within 5km of the site.

2.1.4 Hydrology

The key hydrological feature on site is Shipley Lake, which the proposed development is centred around. To the northwest of the site there is a pair of ponds, with the closest named Coppice Lake, 135m from the site, then Osborne's Pond, 530m from the site. Observation of the mapping shown on the Environment Agency's website, and contained within the Envirocheck report, indicates that these ponds may be in continuity via a feeder stream which runs from Coppice Lake to Shipley Lake.

A further small pond is shown 120m north of the site in proximity to the local school and adjacent housing estate. This pond is known as Hogg's pond, and does not appear to be in continuity with Shipley Lake via above ground watercourse(s)

Shipley Lake outflows into a small pond immediately to the south of its dam. This pond is understood to be part of the Derbyshire Wildlife Trust Woodside site. Streams then flow from this pond towards the west and the east. To the west are the Mapperley Pond and Mapperley Reservoir. The eastern stream flows past the location of the treatment area for the mine water pumped from the pumping station near the development area. The locations of these ponds are shown on the Envirocheck site sensitivity plan.

The Environment Agency (EA) Catchment Data Explorer (CDE) website (accessed 26th July 2016) indicates that the site is located within the Nut Brook Catchment (tributary of Erewash). The chemical classification of the water body in the Catchment area has a "Good" status achieving the Water Framework Directive (WFD) 2015 objective. The ecological classification of the water body in the catchment area was "Moderate" in 2015. According to the CDE website the cause of the adverse ecological impact was "unknown" and was "technically infeasible" to achieve the 2015 WFD objective. A new target has been set for the ecological quality to be "Good" by 2027.

Further detail on surface water and groundwater sensitivity including details of any surface water abstractions within the area can be found by referring to the Hydrology and Hydrogeology Assessment report. Risks from flooding are discussed in the Flood Risk Assessment report and drainage issues are presented in the Drainage Strategy Report.

2.1.5 Historical Land Use

A review of the available historical maps for the area in question has yielded the following information and potential contaminative uses within the boundaries of the site:

- In the 1880s the site contains Railway lines and sidings along the northern site boundary. Shipley Colliery (Woodside Pit), with 3 named shafts, is present in the north eastern corner of the site. A mineral railway crosses the site. Fish Pond lake is present in the centre of the site. By the 1890s the site is used for the deposition of colliery spoil. By the 1920s Woodside Colliery has expanded within the northern area of the site.
- In the 1930s a significant area of the site is covered by colliery spoil which continues to expand until the 1960s. Although not shown on any of the maps it is known that the site underwent coal mining by open cast methods during the 1970s. Maps from the early 1980s do not show any evidence of the former Collieries, except for the presence of Woodside Pumping Station. Fish Pond Lake has been remodelled and is now known as Shipley Lake.
- In the 1990s structures associated with the American Adventure Theme Park are present on the OS maps.

The following describe the potential contaminative uses of the adjacent areas to the site:

- From the 1880s until the 1920s the main potential contaminative uses adjacent to the site were a Gas Works, Brick Yard, railway sidings and Shipley Colliery. An omnibus depot was present near the main site entrance off Hassock Lane North.
- From the 1950s to the 1980s opencast coal mining was present in the vicinity of the proposed development site. In the 1980s a Factory and School are present in the former location of Shipley Colliery. A series of lagoons are present ca. 500m to the south east of the site which are understood to be used for the treatment of mine water abstracted from the Woodside Pumping Station.

3. Summary of Previous Ground Investigations

The following Ground Investigation has been undertaken across the site:

- AECOM (2016) Shipley Lakeside Development Phase II Geo-Environmental and Geotechnical Assessment for Waystone Developments Limited (60469159)

A summary of this investigation is provided in the following sections:

3.1 Shipley Lakeside Development Phase II Geo-Environmental and Geotechnical Assessment (2016)

Ian Farmer Associates (IFA) carried out intrusive investigation works between 9th May 2016 and 14th June 2016 under the instruction and full-time supervision of an AECOM engineer. The scope and detail of the site works were based upon the guidance set out in BS 10175:2001 and BS 5930:1999 and BSEN 1997-2:2007. AECOM developed the ground investigation specification for the site in February 2016. The ground investigation works comprised cable percussion boreholes, rotary coring, and trial pitting.

The exploratory hole and sample locations are detailed on Drawing SHLK-AEC-XX-XX-DR-GE-0004.

3.2 Purpose and Scope of Works

The investigation comprised a combined geotechnical and geo-environmental assessment. The purpose of the investigation was to evaluate the extent, nature and geotechnical properties of the underlying ground conditions.

The summary of the scope of the site investigation works is as follows:

- Thirty-nine (39) cable percussion boreholes;
- Ten (10) boreholes extended by rotary coring;
- Groundwater level / monitoring and ground gas monitoring standpipes;
- Fifty-six (56) trial pits;
- Geotechnical in-situ and laboratory testing; and
- Geo-environmental laboratory testing.

The location of exploratory holes and the surface sampling points were surveyed and levelled at the end of the fieldwork.

3.3 Geotechnical and Chemical Testing

3.3.1 Geotechnical Testing

In-situ and laboratory testing were undertaken. In-situ testing comprised standard penetration tests in boreholes in granular and cohesive soils and hand shear vane tests were undertaken in cohesive soils in Trial Pits where possible.

The following geotechnical laboratory tests were undertaken:

- Two hundred and twenty (220) Moisture Content;
- One hundred and ninety-four (194) Atterberg Limits (Plasticity Indices);
- One hundred and thirty-eighty (138) Particle Size Distribution (PSD) by wet sieving;
- Fifty-six (56) PSD by sedimentation;
- One hundred and thirty (130) Particle Density;
- Twenty-one (21) Compaction test;
- Twenty-one (21) California Bearing Ratio;
- Fourteen (14) Consolidation (Oedometer) test;

- Thirteen (13) Uniaxial Compressive Strength (UCS);
- Nine (9) Undrained Shear Strength;
- Eight (8) Point Load Strength; and
- Eighty-one (81) BRE SD1 (Brownfield) Suite.

Some of the undisturbed soil samples initially scheduled for consolidation testing fell apart during extrusion and were rescheduled for moisture content, PSD and bulk density tests. Likewise, some rock samples initially scheduled for the UCS tests were fractured during preparation, these were either replaced with another suitable sample or rescheduled for Point Load test.

3.3.2 Chemical Testing and Monitoring

Contamination samples were taken at a number of locations across the site and from a range of encountered strata. The range of testing undertaken on soil, leachate and groundwater samples is detailed here.

Soil samples were tested as follows:

- One hundred and sixty-one (161) Metals Soil Suite, which included the following determinands: Arsenic, Boron Cadmium, Copper, Chromium (hexavalent), Chromium (total), Iron, Lead, Mercury, Nickel, Selenium and Zinc;
- One hundred and fifty-eight (158) Soil Suite, which included the following determinands: Cyanide (total), Cyanide (free), Thiocyanate, pH Value, Ammoniacal Nitrogen, Soil Organic Matter, Phenols (total HPLC);
- Seventy-five (75) Asbestos Screen and Identification tests;
- Sixty-six (66) tests for Total Petroleum Hydrocarbon (TPH);
- Sixty-five (65) tests for Polycyclic Aromatic Hydrocarbons (PAHs);
- Fifty-four (54) tests for Volatile Organic Compounds (VOCs);
- Fifty-two (52) tests for Semi-Volatile Organic Compounds (SVOCs);
- Fifty-four (54) Calorific Value tests; and
- Fifty-four (54) Cairney Potential Combustibility tests (Screening Test).

Soil leachate samples were tested as follows:

- Forty-three (43) Soil Leachate Suite tests, which included the following determinands: Arsenic, Boron, Cadmium, Copper, Chromium (hexavalent), Chromium (total), Iron, Lead, Mercury, Nickel, Selenium, Zinc, Ammoniacal Nitrogen, Cyanide (total), Cyanide (free), pH, Phenols (total HPLC) and Total Organic Content;
- Twenty-two (22) tests for Total Petroleum Hydrocarbon (TPH);
- Twenty-three (23) tests for Polycyclic Aromatic Hydrocarbons (PAHs);
- Twenty-seven (27) tests for Volatile Organic Compounds (VOCs); and
- Twenty-two (22) tests for Semi-Volatile Organic Compounds (SVOCs).

Following the completion of the site works, three (3) rounds of groundwater sampling and testing were carried out from the standpipes installed in twenty-three (23) boreholes. The locations of the groundwater standpipes are detailed on Drawing SHLK-AEC-XX-XX-DR-GE-0005 of the Phase II Report. Each borehole installation was purged until at least three (3) well volumes of water had been removed.

Groundwater samples for chemical analysis were then taken from the installations into appropriate containers and sent to the laboratory for analysis. The details of the groundwater testing Suite are listed below:

- Fifty-six (56) Water Suite tests, which included the following determinands: Aluminium, Arsenic, Cadmium, Calcium, Boron, Copper, Chromium, Chromium (Hexavalent), Lead, Mercury, Magnesium, Nickel, Selenium, Iron, Zinc, Ammoniacal Nitrogen, Sulphate, Cyanide, pH, Suspended Solids Total Hardness, Phenols (by HPLC).

Three (3) rounds of surface water sampling were undertaking after the completion of the site work. The locations of the surface water sampling locations are shown on Drawing SHLK-AEC-XX-XX-DR-GE-0005. The surface water samples were tested for the same Suite as the groundwater samples.

Thirty-five (35) standpipes (nominal 50mm diameter) were installed within selected boreholes to monitor soil gas emissions and groundwater levels. The standpipes were monitored on seven occasions between 8th July 2016 and 13th October 2016. Monitoring is still ongoing at the site as at the time of writing this report. Details of the standpipe installations are presented on the borehole records within the Contractor's Factual Report (Appendix B of the Phase II Report). The locations of the monitoring standpipes are detailed on Drawing SHLK-AEC-XX-XX-DR-GE-0006.

Standing water levels were monitored using an electrical dip-meter and composition of the ground gas as well as the flow rates were monitored using a GA2000 gas analyser. The gas monitoring recorded the following parameters:

- Concentrations of Methane, Carbon Dioxide, Oxygen, Hydrogen Sulphide and Carbon Monoxide;
- Gas Flow Rate; and
- Atmospheric Pressure and Relative Pressure.

4. Encountered Ground Conditions

4.1 Ground Profile

The records of the boreholes and trial pits report a consistent sequence of strata across the site but with significant variations in the thickness of strata. The materials identified at the site mainly comprise Made Ground, underlain by the Pennine Middle Coal Measures Formation of Mudstone, Siltstone and Sandstone. Alluvium deposits of clay were encountered to be overlying the Coal Measures in a small number of locations. Intermittent bands of Coal were also encountered within the Coal Measures.

The detailed descriptions of the strata encountered across the site are presented in the Phase II Report and are summarised in Table 4.1.

Table 4.1. Summary of Encountered Strata across Site

Strata	Top of Strata (m bgl)		Depth to Base (m bgl)		Thickness (m)	
	Min	Max	Min	Max	Min	Max
Made Ground	0.00	0.00	0.40	>38.70	0.40	>38.70
Alluvium (Clay)	0.40	37.00	1.40	37.14	0.14	3.15
Coal Measures (Mudstone, Siltstone and Sandstone)	1.20	37.14	2.29	53.00	>0.10	>17.00
Coal Bands	21.70	52.00	22.50	52.90	0.09	1.10

The Made Ground encountered at the site was primarily Colliery Spoil and reworked overburden materials placed as opencast backfill and comprising soft to firm Clay with varying proportions of clay, silt, sand and occasionally cobbles. Alluvium deposits were recorded in six (6) locations mainly in the eastern area of the site. The base and thickness of the Alluvium deposits were proven in all locations where they were encountered, except for CP16068. Where the base of the Alluvium deposits was proven, it was found to be overlying the Coal Measures. Pennine coal Measures at the site were identified to be composed primarily of Mudstone, Siltstone, and Sandstone and also reported as interlaminated variations of these strata. The Pennine Coal Measures rockhead was proven in twenty-two locations and was reported at a minimum depth of 1.2m bgl outside of the opencast backfill footprint, and up to a maximum depth of 37.14m bgl within the opencast backfill footprint. Geological rockhead levels ranged accordingly from 77m aOD to 43m aOD. Bands of coal were encountered in four of the ten rotary boreholes.

4.2 Physical Evidence of Potential Contamination

Physical indicators of potential contamination were identified during the course of the investigation and are recorded within the borehole and trial pit logs. The indicators which include visual and olfactory evidence were identified within the Made Ground at depths ranging from ground level to 5m bgl. A summary of the physical evidence of potential contamination identified on site is presented in Table 4.2.

Table 4.2. Physical Evidence of Potential Contamination

Location	Depth (m bgl)		Strata	Physical Evidence
	Top	Base		
CP16073	0.0	1.0	Made Ground	Rare roots with natural decay odour
CPR16081	1.75	2.85	Made Ground	Brick with rotten egg odour
CPR16084	5.0	5.0	Made Ground	Slight hydrocarbon odour
TP16035	1.7	4.6	Made Ground	Brick and coal with strong hydrocarbon odour

4.3 Groundwater Strikes and Groundwater Monitoring Levels

Groundwater strikes were encountered in a total of thirty-two (32) exploratory locations (seventeen boreholes and fifteen trial pits), primarily within the Made Ground and occasionally within Coal Measures (Siltstone). The details of the strikes at each location is presented in the Phase II Report.

Twelve (12) rounds of groundwater level monitoring have been undertaken at the site during the period between July 2016 and July 2017. A statistical summary of the monitoring results is presented in Table 4.3.

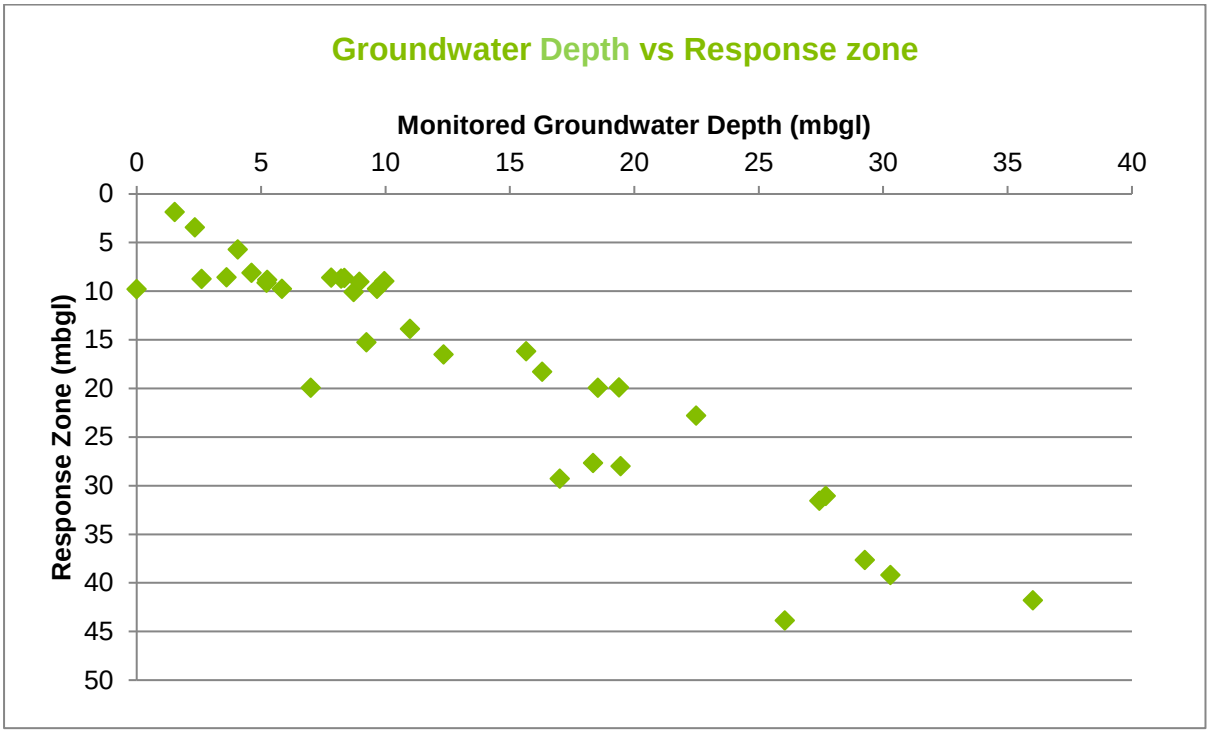
Table 4.3 Summary of Groundwater Level Monitoring

Exploratory Hole	Surface Level (m aOD)	Standing Groundwater Level (m aOD)			Strata Screened
		Minimum	Maximum	Mean	
CP16048	84.50	Dry	Dry	Dry	Made Ground
CP16052	72.05	64.58	62.00	63.54	Made Ground
CP16053	86.58	67.42	66.60	67.09	Made Ground
CP16054	78.16	75.23	73.81	74.36	Made Ground / Coal Measures
CP16056	73.05	69.87	64.25	68.01	Made Ground
CP16057	78.20	74.94	50.66	56.49	Made Ground
CP16058	71.06	61.56	60.66	61.07	Made Ground
CP16059	71.38	70.36	66.68	68.38	Made Ground
CP16060	90.19	86.29	81.21	82.43	Made Ground
CP16061	77.13	75.68	69.77	71.12	Made Ground
CP16062 (D)	75.96	56.66	55.63	55.97	Coal Measures
CP16062 (S)	75.96	64.36	62.59	63.77	Made Ground
CP16063	74.85	67.87	66.69	67.25	Made Ground
CP16064	89.52	85.08	84.02	84.75	Made Ground
CP16065	73.08	72.80	71.24	71.71	Coal Measures
CP16065A	73.19	72.09	67.62	69.61	Coal Measures
CP16067	73.09	65.29	56.79	59.13	Made Ground / Coal Measures
CP16069	82.97	78.08	76.58	77.24	Made Ground
CP16070	84.01	79.47	72.11	73.45	Made Ground
CP16071	91.45	82.59	81.78	82.00	Made Ground
CP16072	71.23	63.68	62.46	62.84	Made Ground
CP16073	76.20	68.12	67.68	67.96	Made Ground
CP16076A	78.74	76.74	76.15	76.43	Coal Measures
CP16077	71.57	62.62	62.62	62.62	Made Ground
CP16080	92.62	67.12	65.72	66.49	Coal Measures
CP16082	71.34	56.09	50.50	51.26	Coal Measures
CP16083B	81.49	61.49	51.64	53.89	Made Ground
CP16084	86.40	52.40	48.88	49.83	Coal Measures
CP16085	74.17	59.17	55.96	56.68	Coal Measures
CP16086	72.03	54.63	44.38	52.63	Coal Measures
CP16086A	71.55	62.55	61.95	62.23	Made Ground
CP16087 (D)	91.38	77.78	54.31	60.37	Coal Measures
CP16087 (S)	91.38	87.50	59.85	77.98	Made Ground
CP16088	78.67	52.55	50.43	50.76	Coal Measures
CP16089	79.63	55.06	44.13	48.13	Coal Measures

The plotted contours of combined monitored groundwater levels in the Made Ground and the Coal Measures did not indicate a clear groundwater flow direction. However, the plot of the groundwater strike depth versus response zone depth (presented in the Phase II Report and presented in Figure4.1 below) indicates a clear

proportional increase in groundwater strike depth with an increase in the response zone depth. This suggests a downward hydraulic gradient, driven by infiltration and by deeper drainage of old mine-workings in the underlying coal measures.

Figure 4.1 Plot of Groundwater Depth versus Response Zone Depth



4.4 Soil Contamination

The conservative Tier 1 screening and statistical assessments of the soil test results indicate that the risks to human health from organic and inorganic contamination in the soil are not significant in the context of the proposed end-uses of the site.

Asbestos (Amosite) was identified as loose fibres in two samples at depth in areas of the former American Adventure Park structures. As the asbestos fibres identified were present in trace levels, it is considered Control of Asbestos Regulations (CAR) 2012 do not apply in accordance with CL:AIRE (2016) Industry Guidance.

The Phase II report concluded that Made Ground materials at the site are not combustible based on the results of the Cairney Combustibility Potential Screening tests.

4.5 Ground Gas Conditions

The ground gas risk assessment undertaken as part of the ground investigation classified the site as a Characteristic Situation CS2, CS3 (Plot A only) and an NHBC Traffic Light classification of Amber 2, based on calculated GSVs and elevated levels of carbon dioxide recorded at the site. As a result, appropriate gas protection measures will be required dependent on the type of building within the development. There is also a potential risk of asphyxiation in confined spaces due to the presence of elevated carbon dioxide and depleted oxygen concentrations recorded.

Methane, carbon monoxide and hydrogen sulphide were also recorded but did not exceed concentrations considered to be a potential risk to human health.

4.6 Groundwater Conditions

The groundwater level monitoring has indicated that the presence of perched groundwater within the Made Ground, and the plot of the groundwater strike against depth suggests a downward hydraulic gradient potentially driven by infiltration. The Tier 1 Screening assessment and the DQRA undertaken as part of the ground investigation indicate that there is potential low risk to the Shipley Lake from metals and inorganic contaminants in the groundwater within the Made Ground.

4.7 Surface Water Conditions

The monitoring across the site suggests that the underlying groundwater may be in continuity with the Shipley Lake, although given the downward hydraulic gradient the lake most probably loses some of its volume slowly into the underlying opencast backfill. In addition, the contaminants present in marginally elevated concentrations (in comparison with the EQS) at the Lake were present in the underlying groundwater; this indicates possible migration from the lake to the groundwater or conversely from the groundwater to the Lake. However, all the determinands recorded in marginally elevated concentrations at the Shipley Lake (SW02) were also present in elevated and higher concentrations at the upstream location (SW01), except for Chromium (III). This suggests the exceedances of EQS relate to an indigenous mineral source in the Coal Measures strata.

4.8 High Wall Ground Investigation 2018

Following the recommendations of the Phase II report and Technical Note for the site, a supplementary ground investigation has been proposed. The main objectives of the investigation are to investigate the presence of an opencast highwall in the northern and south-eastern areas of the site; and to confirm the highwall position, geometry and extent inferred from Coal Authority abandonment plans and previous assessments.

4.9 Current Geotechnical condition

Due to the presence of a backfilled former opencast site and up to nearly 40m of the backfilled Made Ground in some areas dating from the 1970s, the potential exists for ongoing, albeit residual, consolidation and creep settlement to occur in the backfill. Based on the Oedometer test results presented in the Phase II Report, the materials exhibit “very low” to “medium” compressibility following the application of a 50kPa load in addition to the existing overburden pressure. The estimated potential settlements for each plot at the site are detailed in the Phose II report.

4.10 Material Earthworks Classification

A classification of the materials on site has been undertaken against Table 6/2 Grading Requirements for Acceptable Earthworks Materials (SHW Series 600). The assessment is provided in Table 4.4.

Table 4.4 Material Classification following the Specification for Highway Works series 600

Material	Class	General material description
Made Ground (opencast backfill)	Class 1B	Uniformly graded granular material
Made Ground (opencast backfill)	Class 2C	Stony cohesive material
Made Ground (opencast backfill)	Class 2A/2B	Wet cohesive and dry cohesive material

Based on the geotechnical testing undertaken on the main earthworks materials at the site, namely the Made Ground (opencast backfill), cohesive and granular, the materials are considered to possess geotechnical properties that would render them suitable for the formation of development platforms. The majority (54%) of the materials are classed as Class 2C in accordance with the Highways Agency Specification for Highway Works Series 600 document. The proportion of the materials classed as Class 2A/2B materials is 40% and as Class 1B materials is 6%.

It should be noted that Colliery Spoil material exhibiting geo-chemical and geotechnical properties outside of criteria detailed in this reclamation strategy do not render material “un-suitable” per se as marginal material can be subject to improvement and/or remedial treatment to render it suitable for use in the development earthworks.

4.11 Ground Aggressivity

A BRE sulphate assessment was undertaken at the site during the 2015 Phase II Ground Investigation to determine the presence of aggressive ground conditions. The aggressivity classification of the soil at the site, based on the results received in accordance with guidance provided by BRE Special Digest 1: ‘Concrete in Aggressive Ground’ (SD1: 2005 Third Edition) is detailed in Table 5

Table 4.5 Summary of Ground Aggressivity Classification

Material Classification	Design Sulphate Class[1]	Aggressive Chemical Environment for Concrete	Comments
Made Ground	DS – 3	AC – 3	Potentially Pyritic[2]
Alluvium (Clay)	DS – 1	AC – 1	Non – Pyritic[3]
Pennine Coal Measures	DS – 2	AC – 2	Non – Pyritic[4,5]

[1] Maximum Design Sulphate Class from assessment of groundwater, total potential sulphate and water soluble sulphate datasets.

[2] Potential for Pyrite identified in 10 out of 61 samples.

[3] Potential for Pyrite identified in 0 out of 2 samples.

[4] Potential for Pyrite identified in 0 out of 10 samples.

Although the Coal Measures are known to contain variable but sometimes significant pyrite contents, the tests undertaken on 10 samples from the formation did not indicate the presence of pyrite. An extract from the BRE SD1:2005 document states that "*Construction activities (e.g. excavation and backfilling) that substantially disturb the ground may allow pyrite in initially unweathered geological strata to have access to air, water and bacteria. The result may be a relatively rapid oxidation of all or part of the pyrite*". Therefore, the previous opencast operations at the site may have contributed to the reduction in pyrite content in the Coal Measures.

4.12 Coal Mining

4.12.1 Mine Entries

Twelve (12) mine entries are identified in the Coal Authority Mining Report, within the site or within 20 metres of the site boundary. The locations and treatment details of the mine entries at the site are presented in the Phase II Ground Investigation report. The mine entries within the site boundary without any documented treatment details are 444344-02, 444344-03 and 444344-04 located in the north-western tip of the site. There are no developments proposed for this area as shown on the Waystone Indicative Site Masterplan SL-DPP-MP-02 Rev D (Appendix B). Other mine entries within the site boundary have been filled or removed by opencast operations at the site. Therefore, it is considered that the risk to the proposed development from historical mine entries is low. However, if the masterplan is changed and development is proposed for the north western corner of the site then the risk assessment should be revisited.

4.12.2 Underground Mining

Information from the Coal Authority indicates deep coal mining has been undertaken beneath the site. The underground works were carried out by the Shipley Deepfield and Woodside Collieries. The seams worked were below the Top Hard and Dunsil seams. The seams worked and their approximate levels are: the Waterloo (15m aOD), Deep Soft (-102m aOD), Deep Hard (-132m aOD), First Piper (-142m aOD), Low Main, (-175m aOD) and Kilburn (-350m aOD) seams. The shallowest of these seams is the Bottom Second Waterloo located in the southeast area of the site at approximately 15m aOD (circa 71m bgl), which is approximately 38m below the geological rockhead level encountered during the ground investigation. Therefore, it is considered that the risk to the proposed development from the historical deep mining is low.

The majority of the shallow workings were exposed during the opencast operations, as the dragline extended as deep as the Top Hard seam (circa 35m bgl) in most areas of the site. The Coal Authority Interactive map (assessed on 11/11/2016) also indicates that there are no 'Probable Shallow Coal Mine Workings' within the opencast boundaries (shown on Drawing SHLK-AEC-XX-DR-GE-0013). Therefore, the risks from shallow workings within the opencast footprint are considered to be low. However, not all areas of the site were mined by open cast methods, as a result there remains a residual risk posed by shallow workings in the areas of the proposed development located outside of the opencast footprint. Coal seams were encountered outside the opencast footprint from circa 22m below the existing ground level.

During the ground investigation, voids and zones of core losses were encountered in the rotary boreholes. The existence of significant thickness of voids or core losses in the Coal Measures formation could indicate the presence of abandoned shallow coal workings. However, core loss could also indicate a weak rock that has been disturbed by the drilling operations. The summary of the voids and core losses encountered during the rotary coring is presented in the Phase II Ground Investigation Report.

4.12.3 Surface Opencast Mining

Following the completion of the opencast operations, the pit was backfilled with the overburden materials which mainly comprised Clay and Mudstone. There is no indication of any systematic engineered compaction of the backfilled materials have been implemented at the time of the restoration of the opencast mine. The risks associated with the historical opencast mining activities at the site include settlement of the backfill materials due to self-weight of the backfill, inundation-induced settlement of the backfill resulting from groundwater recovery, and consolidation settlement of the backfill under applied structural loads. Differential settlement is also an issue of concern due to variations in the thickness of the backfill, and abrupt thickness changes located for instance over perimeter and buried highwalls, variability in geotechnical properties of the backfill and any non-uniform distribution of loading.

With respect to the buried highwalls, a confirmatory investigation has been undertaken to probe the extent of the highwalls, as indicated along the opencast boundary (Drawing SHLK-AEC-XX-XX-DR-GE-0013). The finding of the investigation is detailed in the AECOM (2019) Shipley Lakeside Development Opencast Highwall Ground Investigation Report. The report presents the delineation of a supplementary foundation design zone in the vicinity of the highwalls should be delineated in accordance to the guidance provided in the BRE document “Building on fill: geotechnical aspects” (Watts and Charles, 2015). The supplementary foundation design zone is considered as the area of ground where building development with shallow strip foundations is not recommended because of the presence of uncompacted fill of varying thickness which presents the risk of excessive differential settlement. However, non-sensitive structures or developments able to tolerate differential settlement whilst remaining serviceable, and or structures founded upon deep foundations such as piles taken into and below rockhead, may be located within the zone. The purpose of the supplementary foundation design is to mitigate the potential differential settlement of the backfill over the highwall and consequent tilt impacts on buildings.

5. Reclamation Strategy Summary

5.1 Objectives of the Reclamation Strategy

The objectives of this Reclamation Strategy to provide for mixed residential and commercial developments with landscaping and amenity use at the site are as follows:

- to ensure that the site is geo-environmentally and geotechnically suitable for the proposed mixed residential and commercial end uses;
- to ensure that any on-site contamination is mitigated or remediated such that potential risks to human health, development infrastructure and the environment are minimised to a standard suitable for use of the site for residential and commercial development, including confirmation of a ground gas risk level and associated mitigation no more onerous than NHBC Amber 2 for residential development and no more onerous than CS3 (CIRIA C665) for commercial and other non-residential development;
- to ensure that the development platform is geotechnically suitable for the construction of foundations and pavements associated with the proposed development, including;
  - suitability for shallow reinforced concrete strip, pad or raft foundations for low rise residential houses and other low rise structures which are relatively lightly loaded and which do not require onerous limits on total and differential settlement
  - suitability as a formation for commercial and retail developments which may be founded on, for example, reinforced concrete strip, pad or raft foundations, piled foundations and / or combinations of these types depending on loading intensity and settlement criteria; and which may also involve further structure – specific ground stiffening measures catering for particular loadings and tolerances.
  - Suitability as a formation for pavements for roads and hard standings.
- to monitor settlement during and after placement of fill, until the settlement relating to earthworks has reached residual proportion.
- to ensure that the reclamation activities are undertaken in such a way as to prevent potential pollution of the environment; and
- to promote the use of site-won materials at the site as much as possible, minimising offsite disposal and the import of materials.

The strategy is primarily to be governed by the requirement for suitable foundations to the development.

5.1.1 Soil Contamination: confirmatory testing

The Phase II Geo-environmental and Geotechnical Assessment recorded that all potential organic contaminants were recorded at concentrations below their laboratory limit of detection or their corresponding generic assessment criteria (GAC) for residential with plant growth or for commercial /industrial end uses. Three metal determinands recorded individual samples elevated in comparison to their corresponding GAC values. The three metals were arsenic (As), iron (Fe) and lead (Pb). However, the UCL95 values for the three metals were all below their corresponding GAC values for a residential with garden end-use.

Therefore, there is no evidence to support the need to undertake remediation of soil materials at the site. Confirmatory testing will be carried out during the earthworks to provide evidence that only suitable materials have been used in to construct the development platform.

No testing has been undertaken of materials at and below the bed of the Shipley Lake. Any such materials removed from the lake shall be stored and placed in an agreed location. The materials will be allowed to dewater and sampled to allow chemical testing to determine whether the materials can be re-used within the works. Where the materials are chemically acceptable dredged materials may require improvement through stabilisation to allow handling and use as engineered fill in the works.

5.1.2 Groundwater

The objective of the works will be to minimise the risk of future contaminant migration to the groundwater and thereby the Shipley Lake. To achieve this objective the remediation works are intended:

- to compact fill to reduce pore space;
- to provide temporary works capture, treatment and discharge of any perched water encountered during the works so to minimise the risk of adverse impact upon receiving surface waters;
- to modify or stabilise geotechnically marginal materials;
- to provide for leachate testing of materials on excavation and placement during the works;
- to provide for groundwater monitoring before, during and following completion of the reclamation works; and,
- to assess results of leachate and groundwater chemical testing against Tier 1 Risk Assessment values.

5.1.3 Ground Gas

The objective of the reclamation works will be to ensure that the risk ranking of the residential areas of the site is no higher than Amber 2 in regards to the NHBC traffic light system and for commercial areas and non-residential properties in Plot A to be no higher than CS2 in regards to CIRIA C665 and BS8485:2015. To achieve this objective the reclamation works are intended:

- to stabilise Made Ground or Natural Ground materials where required to improve compaction properties;
- to compact earthworks materials to reduce pore space;
- to provide for gas monitoring before, during and following completion of the reclamation works; and
- to create a residential development platform where ground gas conditions are appropriate to Amber 2 (NHBC Traffic Light System) (see section 8) for residential properties, no worse than Characteristic Situation 2 (BS 8485:2015) for the commercial areas and non-residential properties in Plot A of the development.

5.1.4 Unanticipated Contamination

In the event that contamination is encountered at any time when carrying out the reclamation works that was not previously identified, an investigation and a risk assessment will be undertaken and where remediation is considered necessary a remediation scheme will be prepared and agreed with the relevant authorities.

Where unanticipated areas of contamination are identified then the process set out here will be followed:

- excavation of materials;
- sampling for, and undertaking chemical analysis;
- assessment of chemical data; and,
- sentencing for remediation, as necessary.

The location, depth and extent of any such unanticipated contamination encountered will be recorded, including the results of chemical testing, the volumes sentenced for treatment by remediation, the validation data showing compliance with the relevant RTVs and the location of the area of use of the remediated material within the development platform, or the details of off-site disposal of the impacted materials.

5.2 Summary of Works

The Reclamation Strategy is based upon excavation, testing, sentencing, remediation (as necessary) and engineered use of site-won materials, and physical modification or stabilisation of wet soils to allow compaction, and a cut-to-fill operation to provide the development platform. The objective of the works is to ensure that the ground gas risk ranking is no greater than Amber 2 (NHBC Traffic Light System) for residential plots or Characteristic Situation 2 (BS 8485:2015) for commercial plots and non-residential properties in Plot A (see section 9).

The following summarises the general reclamation works:

- Demolition, processing (crushing and screening) and re-cycling of concrete, brick and masonry from floor slabs, ducts, channels, and other remnant structures including any remnant above ground structures;
- Initial clearance of any vegetation and/or topsoil;
- Removal and stockpiling of any topsoil for later placement;
- In areas scheduled to be cut below existing ground levels down to finished platform level:

  - over- excavate to1m below the finished level where there is at least 3m of cut;
  - over-excavate to 2m below the finished level where there is at least 2m of cut;
  - over-excavate to 3m below the finished level in areas where there is at least 1m of cut.
  - proof roll the sub-formation with a heavy vibrating roller prior to filling back to finished level; and re – compact the material in thin layers back up to finished level; classify, test, stockpile and sentence the materials for the appropriate end use or to a remediation process before re-use. The objective is to provide a depth of engineered fill of at least 3m below finished level, by means of a combination of the pre-load effect from the cut material and the over-excavation and re-compaction.

- In areas scheduled for receiving engineered fill above existing levels:
  - Over-excavate the existing ground to a minimum 2m below existing ground level where the proposed depth of fill is less than 1m;
  - over-excavate the existing ground to a minimum 1m below existing ground level, where the proposed depth of fill is less than 2m;
  - proof roll the sub-formation with a heavy vibrating roller prior to filling back to original ground level; classify, test, stockpile and sentence the materials for the appropriate end use or to a remediation process before re-use; continue filling with engineered fill to the finished platform level. Where the proposed depth of engineered fill is 3m or greater, proof roll the existing ground level with a heavy vibrating roller prior to filling. The objective is to provide a depth of engineered fill of at least 3m below finished level.
- In each of the cases above, inspect the existing ground level from underside of topsoil, and the excavated sub-formation, for evidence of visual or olfactory evidence of contamination and/or geotechnically unsuitable material (U1); sample, test and validate the conditions at the sub - formation; over-excavate as necessary if there is evidence of significant contamination and classify, test, stockpile and sentence as above.
- Placement of materials to formation level with engineered fill compacted to target density.

Soils used for fill should reach at least firm consistency with a minimum undrained strength Cu of 50 kN/m^2 if cohesive and/or be engineered to a relative density of at least medium dense if granular.

The depths of over-excavation outlined above are shown on drawing SHLK-AEC-XX-XX-DR-GE-0032.

5.3 Performance of Earthworks

The proposed performance criteria are summarised as follows.

Materials placed as compacted fill should comply with the properties of primarily Class 2C and/or Class 2A/2B based upon the site investigation data.

It is intended that the density for compacted material should be a specified minimum of 95% of the maximum dry density (4.5 kg test); and should be a specified maximum of 5% air voids where the particle density has been measured.

Extraneous non-mineral materials such as fragments of plastic, wood and textile fragments and the like should be removed from the material before compaction as far as practicable. Durable materials including brick, concrete and masonry may be retained within the fill provided their largest particle dimension is no greater than two-thirds of the layer thickness being compacted and, in any case no greater than 200 mm. Particles larger than 200 mm will be segregated, crushed and used in the fill.

Plate bearing tests should be performed on the inspected and validated engineered fill finished level, finished level -1.0m and finished level -2.0m (where over-excavation extends to depths greater than 1m) using the 600mm diameter plate. The performance should be considered acceptable where settlement under a sustained load equivalent to 100 kN/m² is less than 15 mm.

Hand shear vane tests shall be undertaken at formation level and at the bases of excavations in cohesive materials. The specified minimum hand vane strength in cohesive materials shall be 50 kN/m^2.

5.4 Role of Engineer

The earthworks (including sampling, testing and compaction) will be supervised by a suitably qualified Engineer and the results will be recorded in the Validation Report.

Duties of the Engineer will comprise the following.

- Setting up the validation testing database, using GIS or MS Access and a grid reference system based upon the site survey.
- Supervision of site personnel in taking samples of imported and exported earthworks materials and scheduling tests in accordance with the specification.
- Inspection of formation, bases of areas of over-dig and bases of excavations to remove unacceptable materials, and recording of the geotechnical conditions at these levels.
- Liaising with the geotechnical and chemical testing laboratories to ensure prompt receipt of information.
- Receiving and inputting test results onto the database.
- Supervision of boreholes for installation of groundwater and gas monitoring standpipes.
- Taking readings from standpipes for gas emission and flow rate, and water level, and purging and sampling of standpipes for groundwater sampling.
- Ordering and supervising ground treatment validation tests in accordance with the specification.
- Preparing the validation (land quality) report.

The Engineer will be suitably qualified and experienced in site supervision of geotechnical and environmental reclamation. The Engineer will be qualified to degree and postgraduate Master of Science degree level in civil, geo-environmental and/or geotechnical engineering.

5.5 Approvals

Approval, via a planning application, will be required for the Reclamation Strategy from the Local Planning Authority (with the Environment Agency and the Local Authority EHO/CLO anticipated to be consulted by the LPA), and the Local Highways Authority before the works are undertaken. The NHBC will also be given the opportunity to confirm their acceptance that the proposed scope and detail of the reclamation works are acceptable to them.

6. Investigations in Areas of Abandoned Mine Shafts

6.1 General Requirements

Twelve mineshafts are present within or within 20m of the site boundary (nine of these within the site boundary). According to the Coal Authority, there are no treatment details for three of the mine shafts within the site boundary. These shafts are located in the north-western tip of the site, and their Coal Authority coordinates are estimated to be 444316N, 344731E; 444348N, 344689E; and 444355N, 344678E. These shaft positions will be not be probed as no development is proposed in the area; instead confirmatory probing will be undertaken across the footprints of the Plot F Development Plot closest to the shafts coordinates. However, where earthworks materials are required from this area and/or it is required to modify the current topography of the area, then the locations of the mineshafts will require investigation.

6.2 Location of Shafts

6.2.1 General

Shafts or areas adjacent to shafts proposed for exploration and treatment will be confirmed by the Engineer.

Other shafts/wells may be located during the course of the works. Any features which are not shown in the contract documents but which are discovered during exploratory works, or by any other means, shall be treated in the manner directed by the Engineer.

Before commencement of exploratory works, the approximate anticipated position of the shaft shall be marked in a manner approved by the Engineer. The Contractor shall maintain such markers until the exploratory work related to that location is complete and the Engineer has confirmed the form of shaft treatment required. He shall also take such measures as are necessary to enable markers to be replaced should they be disturbed for any reason and to replace them if exploratory holes indicate the shaft location to be in a location other than that originally anticipated.

The Contractor shall then install and maintain reference markers such that the recorded shaft position, as agreed with the Engineer, can be located at any time until the ground treatment works in or adjacent to that location are completed to the satisfaction of the Engineer.

Exploratory works will comprise probe drilling in designated zones within the development plot to confirm the absence of the recorded shaft.

6.2.2 Probe Drilling

Probe Drilling shall be carried out as directed by the Engineer, to ascertain the presence / absence and if proved to be present the precise location of the shaft.

Drill holes shall be formed by rotary percussive methods employing suitable techniques. Each drill hole will be drilled to determine the presence or otherwise of any anomaly such as fill material. It is anticipated that probe drilling will consist of a 1.5 m grid of drill holes of 75mm nominal diameter. The drill holes are to be carried out on a grid pattern across the footprint of the designated development plots. Where an anomaly is located by a drill hole, the drilling will continue as directed by the Engineer to prove the extent of the anomaly.

On completion of exploratory drilling, the Contractor shall fill the probe holes with a grout mix consisting of one part cement to five parts PFA, to the level of the surrounding ground at the time of grouting. The minimum amount of water shall be added to the dry grout mix to render a workable consistency with a maximum water to solid ratio of 0.4 by weight.

6.3 Grouting of Shafts Where Proved

6.3.1 Drilling Procedure

Initially, one drill hole shall be located centrally over each shaft requiring treatment for the purposes of delivering grout into the shaft. This shall be the grout hole. Depending upon the results obtained from the initial pressure grouting operations, a further grout hole or grout holes may be required. Grout holes shall be vertical throughout their entire length.

Grout holes shall be drilled by rotary methods employing an air or foam flush medium. The name and specification of any foam flush to be used shall be submitted to the Engineer in the Contractor's method statement. Foam flush shall be bio-degradable and acceptable to the Environment Agency.

Each minimum 75mm diameter grout hole shall be drilled with continuous casing until solid strata is reached at the base of the shaft. Drilling shall not proceed without the casing being at the base of the hole. Drilling shall then continue into the solid strata for a distance of at least 5 metres, or as directed by the Engineer.

If a cavity is located within the shaft, the Engineer may require the Contractor to carry out the following operations.

Continue drilling to a depth of at least 5 metres, or as directed by the Engineer, after solid strata are reached at the base of the shaft.

Pressure grout shaft from the base of the shaft to the lower limit of the cavity.

Re-drill the drill hole to a minimum diameter of 100mm to the upper limit of the cavity.

6.3.2 Grouting Procedure

The first stage of the grouting operation is to tremie grout to the base of the drill hole via tremie tubes of a 25mm minimum internal diameter. A tremie tube shall be lowered to the base of the drill hole and the casing shall be filled with grout until it overflows at the surface. The tremie tube may be raised gradually as the placement of grout proceeds but shall at no time be withdrawn above the top level of grout.

Pressure grouting of the shaft shall proceed via the casing, which shall be drilled into solid strata at the base of the drill hole. A triple outlet T-connection pipe shall be attached to the top of the casing via a coupling of approved design. The connection pipe shall be of such design that a free outlet is available to check the flow of grout and a pressure gauge calibrated up to 10 bar (1000 kN/m2) permanently attached at the inlet location. The grouting pressure shall be generally 0.1 bar (10 kN/m2) per metre depth up to a maximum pressure of 2 bar (200 kN/m2) or as directed by the Engineer.

Grouting shall continue until the pressure stipulated by the Engineer has been recorded at the pressure meter situated at ground level at which time the pressure shall be locked-in and maintained for a period of 5 minutes without a fall in pressure in excess of 10% being recorded. When the stipulated pressure has been maintained and further grouting at that level is not possible without generating greater pressure, the Contractor shall withdraw the drill string 3 metres, or as otherwise directed by the Engineer, then further grouting shall then proceed. Further withdrawal of the drill string shall not be carried out at this or any subsequent stage or level until the stipulated pressure has been recorded and maintained at that stage or level.

This procedure shall continue until the shaft has been pressure grouted to the surface, or near surface, to the satisfaction of the Engineer.

Should it become apparent that the drill string has become blocked, the drill string shall be removed, and the blockage cleared.

6.3.3 Grout Mix

The grout mix shall have a composition by weight of not less than 1 part Ordinary Portland Cement to 10 parts PFA. The Contractor may be required to include sand/gravel to the grout mix in proportions as specified by the Engineer. The minimum amount of water shall be added to the dry grout mix to render it a workable consistency with a water to solid ratio of 0.4 by weight.

Grout shall be mixed in approved plant and shall be continuously agitated, until injected into the drill holes by a double acting long stoke reciprocating or other approved pump. Grout shall not be continuously mixed and pumped from the same tank. Grouting pumps shall be capable of delivering grout at pressures up to 10 bar.

Grouting / injection shall incorporate calibrated weight-batching or other means approved by the Engineer to determine the weight of grout constituents, sand and gravel injected into each drill hole.

6.3.4 Recovery of Equipment

The Contractor shall recover from each drill hole all metal rods, connections and casings used during drilling and grouting, unless otherwise agreed with the Engineer.

6.3.5 Materials

Cement, PFA, sand and gravel shall comply with the following requirements.

- Cement shall be Ordinary Portland cement complying with BS EN 197-1.
- Sand shall comply with BS EN 12620 and it shall be of a size and grading approved by the Engineer.
- Pulverised fuel ash shall comply with BS 3892, Zone B, 1.5% sulphate.
- Gravel shall be 10 mm nominal size aggregate to BS EN 1262 to a grading approved by the Engineer.
- Demonstration of compliance with these requirements will be in the form of suppliers' certification at frequencies shown in Table 1/5 of the Specification.
- Cement shall be stored on a raised platform or in a silo and shall be protected by a waterproof covering.
- PFA, sand and gravel shall be kept free from contact with deleterious matter and shall be stored in stock piles or silos, adequately separated from each other and covered so as to prevent any air-borne dust resulting from the materials.

6.3.6 Grout Testing

Grout testing shall be as directed by the Engineer.

6.4 Daily Records

The Contractor shall keep a Daily Drilling Record for each drill hole, in a form approved by the Engineer, while work proceeds at the drill hole. Daily Drilling Records shall contain the following information:

- job title and location;
- drill hole and shaft reference number ;
- date;
- Contractor's name;
- plant in use, crew members and hours worked;
- method of boring or drilling, flushing medium and type of drill bit;
- type, diameter and depth of casing used;
- diameter and depth of hole at the beginning and end of each working day or shift;
- loss of any flushing medium during drilling;
- standing time, with reason, or time lost overcoming obstructions;
- details of underground services located;
- details of any settlement or ground heave;
- daily and cumulative length drilled;
- depth to each major change of stratum;
- description, with identification, of the stratum and whether it is intact or broken when possible;
- depths at which groundwater is encountered (if apparent);
- depths at which any samples are taken;
- details of any voids or suspected workings;
- details of any emissions of gas, water, etc and mitigation measures adopted to prevent the uncontrolled discharge of gas or water;
- depth of completed hole.

The Contractor shall keep separately a Daily Grouting Record for each drill hole. Daily Grouting Record shall contain the following information:

- job title and location;

- drill hole and shaft reference number;
- date;
- plant in use, crew members and hours worked;
- Contractor's name, plant in use, crew members and hours worked;
- details of type of injection and grout-line dimensions (eg tremie injection through 25mm diameter line);
- type of grout mix and dry weight of each material injected;
- grout pressures recorded, with the corresponding depths;
- details of casing or other equipment abandoned within the shaft.

The Daily Records signed by the Contractor's agent shall be submitted each day to the Engineer for his agreement. The Contractor shall provide one copy of the agreed Record for the Engineer's retention and keep a further copy available for inspection on site.

6.5 Capping of Shafts Where Proved

Shaft caps will be constructed where specified by the Engineer

Where required, excavations shall be formed to permit the construction of a shaft cap. Earthworks shall be carried out in accordance with MCHW Specification Clause 604, taking into account the thickness and nature of the unconsolidated deposits and the anticipated extent of the excavation.

The excavation shall be carried out so as to remove all fill material, shaft walling and shaft filling, including any other structure, brickwork, concrete, timber, superficial deposits, water, slurry or other material, such that a reinforced concrete cap may be constructed over the shaft at rockhead or at any other reasonably practicable level given the site's constraints.

The position and size of the cap will depend upon the size of the shaft as proved by the excavation and the nature and thickness of the superficial deposits overlying the rock strata. The dimensions and position of the cap will be confirmed by the Engineer after excavation and will in any event be not less than twice the shaft diameter at cap level.

If it is proved to be impractical to excavate to rock strata due to the presence of an excessive thickness of superficial deposits, the Engineer may specify that a reinforced cap be constructed at a level above rock strata. Alternatively the Engineer may instruct that a cap is formed by grout injection into the colliery spoil overburden subject to a review of the probing records.

An in situ concrete cap shall be left undisturbed for a period of at least five days before backfilling of the excavation, unless otherwise directed by the Engineer.

Backfilling of excavations shall be in accordance with MCHW Specification Clause 611.

6.5.1 Survey of Mine Shafts

Upon completion of works associated with the treatment of mine shafts, the contractor shall record the coordinates of the shaft centre for any proven and treated shafts.

7. Earthworks

7.1 General Requirements

The earthworks required to form the development platform will be carried out generally in accordance with Series 600 of the current Specification for Highway Works as published by the Highways Agency (unless indicated otherwise by the specification or as directed by the engineer). The Highway's Series 600 Earthworks Specification and Guidance notes should be used as reference for Tables 6/1 and 1/5. The earthworks cut / fill plan is shown on Drawing SHLK-AEC-XX-XX-DR-GE-034.

All materials will be subject to geotechnical and geochemical acceptability testing during the progress of bulk excavations. Earthworks will be controlled by means of geotechnical and geochemical point of excavation testing during excavations, and at point of placement.

All testing data, including geotechnical, chemical and compaction testing data, shall be made available to the engineer within 24hrs of its availability for review and comment.

The made ground shall be excavated to the pre-determined depths outlined in 5.2 above. The natural superficial deposits comprising alluvium and river terrace sands and gravels, where outcropping at the surface and not overlain by made ground, may be excavated to a pre-determined cut off depth if inspection shows the presence of significant contamination and/or if the deposit is geotechnically unacceptable due to high moisture content and/or high organic content and / or low shear strength and / or low relative density. The natural superficial deposits shall be separated from the made ground at the point of excavation and stockpiled separately.

Following topsoil and subsoil stripping, where present, bulk and selective excavations of materials will be either:

- inspected, tested, classified and sentenced for use direct from point of excavation to point of placement; or
- hauled to a designated Materials Processing and Stockpiling Area (MPSA) (part of Plot D and/or Plot E1/E2) before sampling, testing, use, remedial treatment (geotechnical or geochemical) or (in a very limited volume) off-site disposal as required.

The stockpiles within the MPSA will be constructed in such a way to ensure that the material is geotechnically stable such that placed material is not liable to subsidence or landslip.

On completion of the development platform a sacrificial layer 100 to 200mm thick may be placed across the development platform surface to minimise wetting of the surface and to protect the development platform surface.

7.2 Requirements for the Geotechnical Acceptability and Testing of Earthworks Materials

It is intended that all earthworks materials will be classified for acceptability in terms of their geotechnical properties and their geochemical properties as detailed in section 3. All specified geotechnical tests will be undertaken to the proposed frequencies referred to in Table 1/5a and to satisfy any requirements for the classification of materials in accordance with Series 600 earthworks specifications. Classification of material will be based upon both geotechnical and geochemical criteria.

The type and frequency of testing detailed in Table 1/5a, has been determined on the basis of past AECOM experience of earthwork schemes in a variety of conditions. The frequency is considered to be sufficient to ensure that the characteristics and acceptability of the fill materials are confirmed with a reasonable degree of confidence relative to the proposed volume of fill to be placed. The frequency of testing should not be considered exhaustive; additional testing may be necessary where materials are shown to be marginal, or where localised pockets of unsuitable material are encountered.

The parameters required for establishing geotechnical acceptability, for compacted material to be used in the development, are set out in Table 1/5a. The geotechnical acceptability criteria are set out in Appendix A.

Accurate records will be kept of materials encountered, general locations (i.e. grid cells and depth) and approximate volumes throughout the excavation phase of works operations.

All earthworks materials will be classified in accordance with the Specification for Highways Works Table 6/1 as detailed in Appendix A.

Where required unacceptable material will be processed by mechanical, chemical or other means to render the material acceptable for use in the works as per the requirements of Table 6/1 or sent for disposal off-site.

Earthworks materials classification will be carried out at point of excavation for site won materials and at the point of placement for any imported and site-won materials. Accurate records will be kept of materials encountered, locations and approximate volumes throughout the excavation phase of earthworks operations.

Any sampling locations required for classification purposes will need to be established in advance of works commencing. The rate of testing required will be sufficient to ensure the correct classification of materials, taking specific account of the variability of materials properties.

Potentially geotechnically marginally unsuitable materials, such as may occur through moisture content higher than the range specified for compaction, may be rendered suitable through modification, stabilisation, blending with suitable material, and/or by placing the material in discrete layers (300mm maximum) towards the base of the filled area where the overlying compacted fill is greater than 3.5m thick. All such materials stabilised and / or blended would require testing to ensure compliance with the earthworks specification, in particular the end-product compaction criteria.

Extraneous non-mineral materials will be removed from the material before compaction as far as is practicable. Durable materials including brick, concrete and masonry may be retained within the fill provided their largest particle dimension is no greater than two-thirds of the layer thickness being compacted and in any case no greater than 200 mm. Particles larger than 200 mm will be segregated, crushed and used in the fill.

Table 1/5a. Geotechnical Testing to be Carried Out

Clause	Work, Goods or Material		Test	Frequency of Testing	Test Certification	Comments
Series 600						
601, 631 to 637 & 640	Acceptable material		For site won aggregate, see sub-clauses 601.12 and 601.18 Cross-reference should be made to any requirements in Appendix 6/1			
	Class	General Description				
	1	General granular fill	Grading / uniformity coefficient	Twice per week	Required	
			MC (N)	1 per 2,000m^3		
			OMC, Max DD and particle density (N)	1 per 2,500m^3		
		1C only	Los Angeles coefficient (N)	Weekly		
	2	General cohesive fill	Grading	1 per 2,500m^3	Required	
			MC (N)	1 per field hand shear vane determination (see below)		
			/PL/LL (N)	1 per 2,500 m^3 (with a minimum of 5 tests per source)		
			OMC, max DD and particle density (N)	1 per 2,500m^3		
			Field undrained shear strength of remoulded material (N)	1 per 2,500m^3 (minimum of 5 determinations [sets of 3no readings] per source		[Field Hand Shear Vane] See Notes 8 & 9 to Table 6/1

Clause	Work, Goods or Material		Test	Frequency of Testing	Test Certification	Comments
			Laboratory undrained shear strength of remoulded material (N)	1 per 2,500m^3 (with a minimum of 5 tests per source)		[Laboratory multistage Triaxial] See Note 9 to Table 6/1
	4	Fill to Landscape Areas	Grading	Daily	Required	
			MCN (V)	Daily		
	5	Topsoil	Grading	Daily	Required	
	6 (except 6F4, 6F5)	Selected granular fill	Grading/ uniformity coefficient	1 per 1,000m^3	Required	
			PL/LL (N)	Daily		
			Los Angeles coefficient (N)	Weekly (on-site source); Monthly (imported)		
			OMC/MC (N)	1 per week per source	Required	
			Bitumen content	Weekly		
			Class A (asphalt) content	Weekly		
612	Compaction of fills				Required	See Note 12 to Table 6/1
		Method compaction	Field dry density (N)	Frequency as required in compaction trial.		
-	All Classifications of Material		BRE/TRL Sulphate Analysis Suite	1 per 2,000m^3	Required	See Note k)

Table 7.1. Point of Placement Geotechnical Testing

Work, Goods or Material	Test	Frequency of Testing
Point of Placement Geotechnical Tests on CLASS 1 and CLASS 2 Materials		
Compacted Fill (including Blended and/or modified and / or stabilised Fill)	Nuclear Density Gauge Tests to BS1377 (1990) part 9 (including confirmatory laboratory mc for each NDG test).	5no. tests per 1000m^3
Compacted Fill (including Blended and /or modified and / or stabilised Fill)	Sand Replacement Density tests	1no. test per 10 no. Nuclear Density Gauge tests
Compacted Fill (including Blended and /or stabilised Fill)	Particle Density test	1no. test per Sand Replacement test
Compacted Fill (including Blended and / or modified and /or stabilised Fill)	Grading MC (N) PL/LL (N) OMC, max DD and particle density (N)	1 no. test per 1,000 m^2 @ Formation Level and Formation Level -1m (see note h)

Work, Goods or Material	Test	Frequency of Testing
Development Platform	Plate bearing tests on a 30m grid positions varies with successive layers. All tests to be conducted using 600mm diameter plate, at a test load equivalent to 100kN/m^2	1 test per 900m^2 @ Finished Level, Finished Level -1.0m and, where over-excavation extends to depths greater than 1m, Finished Level -2.0m
Road Corridors	CBR testing	Allow for 45 number of CBR tests @ Formation Level along anticipated road corridors across development
Fill Areas subject to prior excavation and compaction below existing level; and / or fill areas placed onto existing ground level without prior excavation	Rod - & - plate settlement monitoring with base plate set at base of excavated sub-formation, or at existing ground level where no prior excavation is required.	Allow for 19no. R&Ps and 36no. surface settlement markers (proposed locations shown on Drawing SHLK-AEC-XX-XX-DR-GE-0031. To be monitored commencing with base readings and continuing weekly for minimum 3months then monthly until 6 months after reaching formation level

Notes applying to the Table 1/5a

a. Unless otherwise stated in Table 1/5a, all sampling and testing shall be by the Contractor.

b. Tests comparable to those specified in this Appendix will be necessary for any equivalent work, goods or materials proposed by the Contractor.

c. (N) indicates that a UKAS accredited laboratory sampling and test report or certificate is required.

d. Unless otherwise shown in this Appendix tests for work, goods or materials as scheduled under any one Clause are required for all such work, goods or materials in the Works.

e. Cube strength tests are not required for concrete complying with Clause 2602.

f. Unless otherwise shown in this Appendix test certificates for work, goods or materials as scheduled under any one Clause are required for all such work, goods or materials in the Works.

g. Testing specified in this Appendix is to be undertaken on all earthworks materials.

h. Testing to be carried out by the Contractor shall be undertaken in accordance with the Specification for Highways Works, 600 Series and the following.

i. All geotechnical testing to be carried out by a NAMAS accredited laboratory. All chemical analysis shall be UKAS and MCERTS accredited unless agreed with the Engineer.

j. All sampling shall be carried out in accordance with the `Specification for Ground Investigation' (Publication No 3 in the site investigation in construction series) published by Thomas Telford Ltd, 1993. Reporting shall be in digital form in addition to paper records as specified in Appendix III of the aforementioned documents.

k. Sulphate testing suite to be performed according to BRE Special Digest 1 (SD1:2005) as well as to any TRL report recommendations for brownfield land that may contain pyrite.

l. Inclusion of Sand Replacement Tests and Particle Density tests within general earthworks monitoring to allow for likely high variability of colliery shale properties.

m. Inclusion of geotechnical testing of all hard material encountered and crushed to ensure materials suitability for future inclusion in works or duty of care for off-site sale.

n. Data to be used to assess desiccation and heave potential of cohesive materials placed as fill

7.3 Excavations

All excavations shall be undertaken in such a manner that will not cause any risks of instability and risk to construction workers, adjacent buildings, water courses or services.

Ground materials will be excavated to the pre–determined depths set out in Section 5.2. The excavation is required to confirm the absence of potentially volatile contaminants beneath the formation level, and / or to provide the minimum required thickness of engineered fill set out in Section 5.2. The over-dug material will be re-used and recompacted if it meets the geotechnical and geochemical acceptability criteria. The base of the over-excavation shall be validated by hand shear vane testing, the minimum acceptable strength being 60 kN/m$^{2.}$

7.4 Compaction Requirements

All materials to be used in the construction of the development platform must be classified in accordance with Table 6/1 of the Highways Agency Series 600 Earthworks Specification.

Compaction shall be carried out to an end product. The methodology required to achieve the end product for the various earthworks materials is to be confirmed through compaction testing and compaction trials, as detailed in section 6.5.1. The method determined from trials shall be chosen in order to achieve the specified end product of a maximum 5% air voids / minimum 95% MDD, based on a 4.5 kg compaction test, for any materials used across the site. Note that the particle densities of samples used to check compliance must be measured, rather than assumed. On the proposed road corridors across the development CBR testing shall be undertaken at the rate noted in Table 6-2. The compliance criterion shall be 5% CBR.

7.4.1 Compaction Trials

Placement of the bulk earthwork fill materials shall be continuously monitored via assessment of in-situ and laboratory compaction testing data to demonstrate that the choice of plant and method of working achieve the required state of compaction as set out above.

Where any Class of material in the fill contains material having different maximum dry densities and optimum moisture contents, the Class shall be further sub-divided, by extending the identification system, in order to monitor the compacted density.

Where engineered fill is unable to attain the required compaction specification, but the Engineer is satisfied that the method of reinstatement is in accordance with these specifications, then the lateral extent of poorly compacted fill will be determined and recorded.

All earthworks are to be placed in accordance with the outcome of compaction testing and on-going compaction monitoring and shall be a maximum of 5% air voids and shall be a minimum of 95% MDD (4.5kg test).

The Laboratory sub-contractor shall liaise closely with the Engineer during the compaction works on site to confirm and agree a) bulk materials classifications and b) methods for compaction including type of plant to be used, number of passes required and optimum thickness for reinstatement activities. Compaction assessment data shall be made available to the Engineer prior to any filling operations. Methods of compaction must be agreed in writing with the Engineer prior to the undertaking of any re-compaction works.

For each new ‘type’ of fill within each class to be placed the following shall be provided:

- values of the material properties required for assessment of acceptability and
- classification in accordance with Table 6/1 of the HA Specification;
- the values of maximum dry density and the optimum moisture content obtained in
- accordance with BS 1377 Part 4 Method 3.6;
- a graph of dry density plotted against moisture content from which each of the values
- of maximum dry density and optimum moisture content were determined, and on
- which the zero, five and ten per cent air voids lines are also plotted; and
- values of percentage air voids shall be calculated in accordance with BS 1377.

Values of particle density to be used in derivation shall be the average of a minimum of three tests on samples representative of the material undertaken in accordance with BS 1377 Part 2 Method 8.2.

During the compaction works of any one combination of plant type, number of passes layer thickness and material type in situ density tests shall be conducted of a type consistent with the size of material and thickness of the layer and shall take samples at each location for moisture content testing in accordance with BS 1377 Part 2.

The approval by the Engineer to any part of the completed earthworks will not be given until the results of control testing are available. The Engineer may, if the test results show that adequate compaction has been achieved during construction, give approval on the basis of the test results proved.

If the Engineer is of the opinion that the minimum state of compaction has not been achieved, the Engineer shall confirm the extent of the area of fill requiring further work and further work shall be undertaken as the Engineer instructs to comply with the specification.

7.5 Slope Stability

The design of the permanent boundary slopes to the development is to be determined by the type and nature of the engineered fill and the height of the slope. However, generally outer permanent slopes will be no steeper than 1v:2.5h for stability purposes. The requirements for maintaining the stability of temporary slopes are as follows.

7.5.1 Assessment of temporary works slopes: cuttings

Temporary cut slopes will be formed in the short term in order to provide working areas for activities such as general Made Ground excavation and surface drainage and may be formed from Made Ground. For the anticipated limited lengths of cutting which are assumed to be open for a period of only 1-2 months as a general guideline slope gradients would not be greater than 1v:2h on the basis that the slopes are kept drained and drainage measures are put in place to ensure that pore water pressures are not allowed to build up in the slope. Steeper temporary slopes may be cut. However, these would be subject to additional slope stability analysis undertaken in the detailed design stage.

Consideration would be given to temporary slope stabilisation measures such as benching and sheet piling in the area of deeper excavations.

Slopes will be inspected daily to check their condition.

The method of inspection and reporting will be formalised and systematic.

7.5.2 Assessment of temporary works slopes: fill slopes

The formation of temporary stockpiles of materials scheduled for filling will be restricted to stockpiles no greater than 3 m high located in materials processing and stockpiling areas.

7.5.3 Assessment of permanent slopes

Any permanent slopes will be no steeper than 1v in 2.5h subject to stability analysis at detailed design stage.

7.6 Earthworks Control

7.6.1 General (Specified standards and measures to achieve a competent development platform)

The earthworks and remediation processes for soils, surface waters, perched waters and groundwater will be supervised and the acceptability (geochemical and geotechnical) of the earthwork fill materials, treated waters and groundwater quality after any remediation will be independently classified and assessed. The validation testing following earthworks compaction will also be independently reviewed.

The progression of earthworks activities will be continually monitored throughout the works at a frequency to be agreed.

A system will be put in place to identify and track all earthwork material movements including excavated materials, imported materials, material sentenced for off-site disposal and material undergoing on-site remediation.

All geochemical, geotechnical and validation testing data specifically relating to each of the various earthworks materials will be inputted into a testing database. The database will be made available in an agreed electronic format for review and upload.

7.6.2 Validation of Compaction (in situ test methods to show compliance)

Validation of compacted material will be by nuclear density gauge tests and sand replacement tests in accordance with BS 1377 Part 9. A specific gravity [particle density] test will be undertaken on each SRT sample.

Tests will be carried out across the area of ground to be validated. Results of the in-situ testing will be compared with the dry density plotted against moisture content curves for the type of material within each Class subjected to validation.

The specified maximum permissible air voids for the compacted earthworks materials in the areas of the access road, other hard standings and pavements is intended to be 5%. The specified minimum dry density is intended to be 95% of the maximum dry density from the 4.5kg lab compaction test. In the event of compacted earthwork fill materials having material properties outside the acceptability criteria, yet still achieving the minimum state of compaction as determined by in situ testing, the result of the in-situ testing shall take precedence, subject to an appropriate procedure for approving use of such materials.

In locations where the standard of compaction is deemed to be inadequate, further work will be undertaken to improve the state of compaction.

The fill material will be subject to plate bearing tests, with a maximum permissible settlement of 15 mm per 100 kN/m^2. An assessment of the potential settlement of the fill material and the implications for foundations will be undertaken following a review of the geotechnical testing as outlined in Table 1/5A.

7.6.3 Assessment of Desiccation Potential of Near-Surface Materials

Cohesive materials which are located within 1m of existing level in areas currently vegetated with trees, and which are potentially to be re-used as fill in the works, will be assessed for evidence of desiccation and thus for potential for future heave. The assessment will be carried out by reference to the field moisture content and the liquid and plastic limits. The scope and frequency of testing is set out in Table 1/5A. Where evidence of desiccation is found, re-use of the material will be restricted to areas outside of the structural footprint of the development plots.

7.6.4 Stockpiles (locations, sizes and maximum heights)

Stockpiling of materials will be undertaken in accordance with the requirements of tracking and storage of materials within the Materials Management Plan, see Section 11. Areas of the site will be designated for stockpiling of materials at different stages of the works. The source and type of materials present within stockpiles will be tracked and stored electronically. Stockpiles are not anticipated to be greater than 3m in height.

7.7 Sentencing of Site Won / Imported Materials (Process of testing, sentencing for remediation or direct use for the specified uses, criteria to be applied)

A schematic of the material movement of site won materials and imported materials and the stages where geochemical and geotechnical testing will be required is presented in Figure 12.1 within Section 12 (Management Plan for Materials). The schematic will indicate how materials will be sentenced when they pass or fail the acceptability / criteria at point of excavation and again at the point of placement following treatment.

7.8 Re-cycling and re-use of demolition materials

Available materials from the demolition of the former American Amusement Park floor slabs and remnant foundations will be re-cycled and re-used in the earthworks subject to the geotechnical and chemical re-use acceptability criteria set out in this reclamation strategy. Concrete and brick materials are likely to require processing to be re-used in the earthworks.

8. Remediation Works

8.1.1 Remediation of Soils

The Phase II Geo-environmental and Geotechnical Assessment recorded that all potential organic contaminants were recorded at concentrations below their laboratory limit of detection or their corresponding generic assessment criteria (GAC) for residential with plant growth or for commercial /industrial end uses. Three metal determinands recorded individual samples elevated in comparison to their corresponding GAC values. The three metals were arsenic (As), iron (Fe) and lead (Pb). However, the UCL95 values for the three metals were all below their corresponding GAC values.

Therefore, there is limited potential for encountering widespread gross contamination in soils that would impact upon human health. The colliery spoil materials in the northern areas of the site and the open cast overburden backfill across the majority of the site contain naturally occurring metals and metalloids which originate in the sulphide trace minerals in the mudstone strata. Whilst their concentrations can be higher than a typical CLEA based Tier 1 target, generally their bioavailability is low and they do not generally present a significant human health risk when the use of subsoil / topsoil in gardens, and the presence of a hard cover on roads, footpaths and building footprints, is taken into account.

As such where materials, following geochemical assessment against the appropriate Tier 1 RTV (see section 8.2), exhibit exceedances of determinands, or otherwise exhibit potential gross contamination they shall be segregated and either placed at a depth greater than 1m from finished level or sentenced for on-site remedial treatment. However, if the materials only fail due to determinands that are either non-volatile or negligibly volatile then they can be re-used within the development within 1m of the finished level if bio-accessibility testing and subsequent risk assessment demonstrates no significant risk to human health. Earthwork materials which do not meet the chemical acceptability requirements for re-use in residential areas can be re-used in commercial areas of the development.

8.1.2 Moisture modification and/or stabilisation/solidification: objectives and compliance criteria to be applied

Where materials have been dredged from Shipley Lake, and have passed the chemical re-use acceptability criteria following sampling and testing these materials will require geotechnical improvement following gravity induced dewatering which may be achieved by modification or stabilisation to further remove moisture. A laboratory trial will be required to determine the appropriate additive and mix rate. The objective of the moisture modification and/or stabilisation/moisture modification remediation technique is intended:

- to improve the strength of the Made Ground soil materials to allow compaction to achieve the criteria of 95% MDD and 5% air voids;
- to reduce the moisture content of Made Ground soil materials;
- to provide Made Ground soil material that meets the criteria for construction of a competent platform, suitable for appropriate foundation design.

Any material which cannot be reasonably well compacted due to high moisture content will require initial modification i.e. drying out the soil mass), and may need a further step to stabilisation whereby chemical transformation take place in the soil being treated. The degree of modification or stabilisation required will be dependent on its end use and the level of placement below formation level.

The materials that undergo modification and/or stabilisation/solidification treatment will need to meet the compliance criteria set out in Table 1/5b for them to be acceptable for use within the earthworks.

A potential secondary beneficial outcome of the stabilisation of the soil materials for geotechnical purposes will be a reduction in the leachability of metals from the stabilised materials.

Laboratory bench scale trials will be required to demonstrate that the likely design additive mixes chosen can successfully modify or stabilise the soil samples to a condition of acceptable geotechnical competence. As an initial guide a lime-only additive of the order of 1 – 2% should be sufficient to attain modification by driving off moisture, whereas and additive of the order of 3 – 3.5% should be sufficient to achieve full stabilisation.

8.1.3 Requirement for plant growth media in garden and 'green space' (applicable criteria for use of site won soils)

Testing of all plant growth media to be used in gardens and green space shall be undertaken at a minimum frequency detailed in Table 1/5b. The plant growth media from site-won materials shall be subjected to testing at source and at the point of placement.

The criteria for plant growth media are a combination of criteria protective of human health and protective of plant growth. The criteria protective of plant growth are taken from BS3882: 2015. The soil material to be used as plant growth media shall comply with the requirements of soil Remedial Target Values protective of human health. However, the phytotoxic (harmful to plants) determinands; Copper, Nickel and Zinc shall comply with the plant growth media targets presented in Table 8.1.

Table 8.1. Requirements for Plant Growth Media BS3882:2015

Determinand*	Units	Concentrations		
Soil pH Range	-	<6.0	6.0 – 7.0	>7
Copper (Nitric Acid Extractable)	mg/kg	<100	<135	<200
Nickel (Nitric Acid Extractable)	mg/kg	<60	<75	<110
Zinc (Nitric Acid Extractable)	mg/kg	<200	<200	<300

* All other determinands must comply with the Remedial Target Values (see section 6.1.7) which are protective of human health

8.1.4 Requirements for the Geochemical Sampling and Testing of Earthworks Materials: Point of Excavation and Point of Placement Table 1/5b: scope and frequency of testing of soils at point of excavation and again at point of placement as verification

8.1.4.1 Bulk Earthworks

Testing of all earthwork materials shall be undertaken at a minimum frequency listed in Table 1/5b.

All earthworks materials shall be subject to geochemical testing at point of excavation, at point of placement and following any treatment.

Where exceedances of the Acceptability Criteria are identified following statistical analysis then additional trial pits shall be undertaken around the area exhibiting elevated levels and samples taken at the appropriate depths in order to delineate the zone of exceedances.

Table 1/5b. Geochemical Testing to be Carried Out (Soils)

Work, Goods or Material	Test	Frequency of Testing
CHEMICAL CONTROL TESTING (Notes a, b, c, d and h)		
All material requiring excavation (excluding topsoil)	Soil Analysis Suite (Note e) and soil Leachability Suite (Note f)	1 test per 2,500m^3
All topsoil material requiring stripping	Soil Analysis Suite (Note e)	1 test per 500m^3 (with minimum of 3 samples per source)
All material following completion of filling	Soil Analysis Suite (Note e) and soil Leachability Suite (Note f)	1 test per 2,500m^2 @ Formation Level and 1 test per 2,500m^2 @ Formation Level - 1m
	Screening test for asbestos	1 test per 2,500m^2
ADDITIONAL CHEMICAL CONTROL TESTING (Note a, b, c, d and h)		
All imported materials for each individual source and type	Soil Analysis Suite (Note e) and soil Leachability Suite (Note f)	1 test per 500 m^3 with minimum 12 tests per material source

Work, Goods or Material	Test	Frequency of Testing
Imported landscape fill (topsoil / subsoil) for each individual source and type	Soil Analysis Suite (Note e) and soil Leachability Suite (Note f)	1 test per 500 m^3 with minimum 12 tests per material source
All materials having undergone treatment by modification/ stabilisation / solidification following maturation of a minimum of 7 days	Soil Analysis Suite (Note e), Soil Leachability Suite (Note f) (additional testing to be determined following laboratory trials)	1 test per 1,000m^3 of material placed into permanent works
All materials sentenced for off-site disposal	WAC Testing Suite	1 test per 100 m^3 with minimum 3 tests per batch of material

Notes applying to the Table 1/5b

a) Testing specified in this Table is to be undertaken on all materials.

b) Testing to be carried out shall be undertaken in accordance with the Specification for Highways Works, 600 Series and the following.

c) All chemical analysis shall be UKAS and MCERTS accredited as appropriate.

d) All sampling shall be carried out in accordance with the `Specification for Ground Investigation' (Publication No 3 in the site investigation in construction series) published by Thomas Telford Ltd, 1993. Reporting shall be in digital form, which is compatible with Microsoft Excel or Access, in addition to paper records as specified in Appendix III of the aforementioned documents.

e) Soil analysis suite to include the following determinands:

- Arsenic
- Boron (water soluble)
- Cadmium
- Chromium (total)
- Chromium (VI)
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Zinc
- Cyanide (free)
- Polycyclic Aromatic Hydrocarbons (speciated USEPA 16)
- Total petroleum hydrocarbons (TPH CWG C5-C35 aliphatic / aromatic split)
- Volatile Organic Compounds (VOCs)
- Phenols (total)
- pH
- Ammoniacal Nitrogen
- Soil Organic Matter
- Asbestos screen
- Asbestos identification and quantification if asbestos screen proves positive

f) Leachate analysis suite to include the following determinands:

- Arsenic
- Boron
- Cadmium
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Nickel
- Selenium
- Zinc
- Sulphate
- Ammoniacal Nitrogen
- Nitrate
- Nitrite
- pH
- BTEX
- Total Petroleum Hydrocarbons (carbon banded C5 – C40)
- Polycyclic Aromatic Hydrocarbons (speciated US EPA 16)
- VOCs
- SVOCs

g) Not used.

h) Limits of detection for chemical testing shall be as detailed in Table 8.2 and Table 8.3

Table 8.2. Analysis Suite of Chemical Laboratory Testing for Soils

Soils

Determinand	Method Detection Limit	Units
Arsenic	1	mg/kg
Beryllium	1	mg/kg
Boron (water soluble)	1	mg/kg
Cadmium	1	mg/kg
Copper	1	mg/kg
Chromium (total)	1	mg/kg
Chromium (VI)	1	mg/kg
Lead	1	mg/kg
Mercury	1	mg/kg
Nickel	1	mg/kg
Selenium	1	mg/kg
Zinc	1	mg/kg
Cyanide (Total)	1	mg/kg
pH Value	0.01	pH Units
Total Organic Carbon	0.1	%
Ammoniacal Nitrogen	10	mg/kg
Dependent Options		
TPH (Speciated) – CWG (C5-C35)	0.1	mg/kg
Asbestos Screen & identification	-	-
Asbestos quantification (PMOC)	0.001	%
Phenols (Total)	0.01	mg/kg
PAH (USEPA 16) speciated GC-FID	0.01	mg/kg
Volatile Organic Compounds (GC-MS)	0.001	mg/kg
Semi-Volatile Organic Compounds	0.001	mg/kg
BRE SD1 (2005) Testing Suite (Brownfield with potential for Pyrite)[#]	varies	-
Cairney Combustion Potential Test*	-	-

*Cairney Combustion Potential Test only to be undertaken on any coal material or made ground containing coal material (if such materials is used in the development) and where the Cairney Screening Test for Combustibility yields a Combustibility Grade of A or B.

Table 8.3. Analysis Suite of Chemical Laboratory Testing for Soil Leachate

Leachate		
Determinand	**Method Detection Limit**	**Units**
Arsenic	1	µg/l
Beryllium	1	µg/l
Boron	10	µg/l
Calcium	50	µg/l
Cadmium	0.4	µg/l
Copper	1	µg/l
Chromium	1	µg/l
Chromium (hexavalent)	1	µg/l
Iron	50	µg/l
Lead	1	µg/l
Manganese	1	µg/l
Mercury	0.05	µg/l
Nickel	1	µg/l
Selenium	1	µg/l
Sulphate	3	mg/l
Zinc	3	µg/l
PAH (USEPA 16) speciated GC-MS (**Lowest possible level of detection**)	0.01	µg/l
TPH (Carbon banded C5 – C40)	10	µg/l
BTEX by GC-MS	1	µg/l
pH Value	0.01	Units
Total Organic Carbon		
Ammoniacal Nitrogen	10	µg/l
Nitrate	100	µg/l
Nitrite	50	µg/l

8.1.5 Requirements for the Geochemical Acceptability of Earthworks Materials

The geochemical suitability of all earthworks materials to be used in the development within 1m of the anticipated formation level including garden areas and the footprint of buildings are to be assessed against site specific soil Remedial Target Values (RTVs) derived for risks to human health for a Residential with Plant Uptake End use as detailed in Table 8.4.

The soil Remedial Target Values for means of assessing human health risk from soils within 1m of the formation level at the site have been selected based on in-house Generic Assessment Criteria (GAC) derived using the CLEA v1.06 software (utilising toxicological and chemical parameter information from various sources including the EA, LQM/CIEH and CL:AIRE). The GAC provide a conservative Tier 1 screening assessment against which to compare the levels of contaminants recorded.

Table 8.4. Remedial Target Values (RTVs) for Bulk Earthwork Materials

Determinand	Residential RTV	Public Open Space (residential) RTV	Units
Metals and Inorganics			
Arsenic	37	79	mg/kg
Beryllium	1.7	63	mg/kg
Boron (water soluble)	290	21,000	mg/kg
Cadmium	11	120	mg/kg
Copper	2400	12,000	mg/kg
Chromium (total)	6	7.7	mg/kg
Chromium (VI)	6	7.7	mg/kg
Lead	200	-	mg/kg
Mercury	40	120	mg/kg
Nickel	130	230	mg/kg
Selenium	250	1,100	mg/kg
Zinc	3,700	81,000	mg/kg
Cyanide (Total)	78	-	mg/kg
Asbestos	0.001	0.001	%
Poly-cyclic Aromatic Hydrocarbons (PAHs)			
Acenaphthene	510	1,000	mg/kg
Acenaphthylene	420	1,000	mg/kg
Anthracene	1,000	1,000	mg/kg
Benzo(a)anthracene	11	29	mg/kg
Benzo(b)fluoranthene	3.3	7.2	mg/kg
Benzo(k)fluoranthene	93	190	mg/kg
Benzo(ghi)perylene	340	640	mg/kg
Benzo(a)pyrene	2.7	5.7	mg/kg
Chrysene	22	57	mg/kg
Dibenzo(ah)anthracene	0.28	0.57	mg/kg
Fluoranthene	560	1,000	mg/kg
Fluorene	400	1,000	mg/kg
Indeno(123cd)pyrene	36	82	mg/kg
Naphthalene	5.6	1,000	mg/kg
Phenanthrene	220	1,000	mg/kg
Pyrene	1,000	1,000	mg/kg
Total Petroleum Hydrocarbons (TPHs)			
Aliphatic >C5-C6	78	1,000	mg/kg
Aliphatic >C6-C8	230	1,000	mg/kg
Aliphatic >C8-C10	65	1,000	mg/kg
Aliphatic >C10-C12	180	1,000	mg/kg
Aliphatic >C12-16	330	1,000	mg/kg
Aliphatic >C16-21	540	1,000	mg/kg

Determinand	Residential RTV	Public Open Space (residential) RTV	Units
Aliphatic >C21-35	1,000	1,000	mg/kg
Aromatic >C5-C7	140	1,000	mg/kg
Aromatic >C7-C8	290	1,000	mg/kg
Aromatic >C8-C10	83	1,000	mg/kg
Aromatic >C10-C12	180	1,000	mg/kg
Aromatic >C12-C16	330	1,000	mg/kg
Aromatic >C16-C21	540	1,000	mg/kg
Aromatic >C21-C35	1,000	1,000	mg/kg
Other Determinands			
Phenol	200	690	mg/kg

* These are values based on published SGVs or GACs derived using CLEA model based on a sandy loam soil, pH 7 and soil organic matter content 1%. The values may be amended if soil organic matter content is closer to 2.5% or 6%.

** 1,000mg/kg maximum target concentration has been conservatively assumed for hydrocarbons. Hydrocarbon concentrations in excess of 1,000 mg/kg will require a site-specific risk assessment

$ AECOM derived GACs for residential with plant uptake end use.

Note – theoretical soil saturation limit given in brackets.

8.1.5.1 Compliance targets for specific end-uses

8.1.5.1.1 Total Soil Concentration

Subject to the RTVs in Table 8.1 for plant growth media, compliance targets for total soil concentration of materials within the upper 1m below formation level shall be as specified in Table 8.4 Soil Remedial Target Values for bulk earthworks. Note that it is anticipated that the soils to be used within the upper 1m below formation level will be sourced from the materials on site.

Compliance targets for the listed substances in materials located at depths greater than 1m below formation level may exceed the Remedial Target Values as specified in Table 8.4. However, no free product may be present within the soil materials (see section 8.1.5.3) nor may materials be present which contain volatile substances exceeding the relevant RTVs and/or have the potential to give rise to odour nuisance (see section 8.1.5.4).

Materials sentenced for use within gardens and/or landscaped areas of the site shall also conform to the requirements set out in section 8.1.3.

8.1.5.1.2 Ground Gas

The site has been classed as CS2, CS3 (Plot A only) and an NHBC Traffic Light classification of Amber 2, based on calculated GSVs and elevated concentrations of carbon dioxide recorded during the gas monitoring undertaken at the site. This indicates there is a moderate risk from ground gas at the site

The total organic carbon content of the soil materials will be measured and used as supporting lines of evidence to assist in determining the effectiveness of the remediation works in reducing the source of organic matter for gas generation. Following work undertaken by Card et al (2012) it is possible to assess the potential of Made Ground to generate gas based on the Total Organic Carbon content of the material. In addition, there is a requirement to combine forensic description of Made Ground materials with the laboratory testing. The example provided in Card et al (2012) indicates that if Made Ground contained 20% discrete materials at 20% TOC and the remaining 70% of the soil fraction has a TOC of 0.5% the overall TOC would be 6.4%.

Table 1 of Card et al (2012) indicates that a TOC content of ≤3% in Made Ground in place for >20 years equates to a Characteristic Situation 2 (CIRIA C665), which indicates a GSV value less than 0.7 l/hr. This value falls within the NHBC traffic light GSV range for Amber 1 and the lower portion of “Amber 2” (0.63 l/hr to 1.60 l/hr). Therefore, based on this guidance lines of evidence for ground gas will be provided by

- ≤3% TOC (≤5% soil organic matter content) criteria for use of materials beneath built development, excluding areas to be used for landscaping where there is no restriction on the TOC or soil organic matter content of landscaping soils;
- materials descriptions obtained during excavation and sentencing work;
- carbon dioxide and methane concentrations will be recorded during bioremediation of materials;
- ground gas monitoring will be undertaken during and following the remediation works.

8.1.5.1.3 Soil Leachate Concentration

The chemical suitability of soil leachate (solutes from soil pore water) concentrations is to be initially assessed against Tier 1 Assessment Criteria based on Environmental Quality Standards (EQS), and against Tier 3 criteria for ammoniacal nitrogen (representative of ammonia and ammonium). These criteria are detailed in Table 8.5.

Table 8.5. Tier 1 Assessment Criteria for Soil Leachate (DRAFT)

Determinand	Units	EQS[1]
Arsenic	µg/l	50
Beryllium	µg/l	12
Boron (water soluble)	µg/l	2000
Cadmium	µg/l	0.25
Chromium trivalent	µg/l	4.7
Chromium hexavalent	µg/l	3.4
Copper	µg/l	28
Lead	µg/l	7.2
Mercury	µg/l	0.05
Nickel	µg/l	20
Selenium	µg/l	-
Manganese	µg/l	20
Zinc	µg/l	125
pH	pH Units	6 – 9
Ammoniacal Nitrogen	mg/l	0.3 (0.6)
Sulphate	µg/l	400,000
Nitrate	mg/l	-
Chloride	mg/l	-
Cyanide (free)	µg/l	1
Cyanide (total)	µg/l	-
PAH (total)	µg/l	-
Anthracene	µg/l	0.1
Benzo(a)pyrene	µg/l	0.05
Fluoranthene	µg/l	0.1
Naphthalene	µg/l	2.4
Phenanthrene	µg/l	-
Benzo(a)anthracene	µg/l	-

Determinand	Units	EQS[1]
Chrysene	µg/l	-
Indeno(1,2,3-c,d)pyrene	µg/l	-
Benzo(g,h,i)perylene	µg/l	-
Aliphatics >C5-C6	µg/l	-
Aliphatics >C6-C8	µg/l	-
Aliphatics >C8-C10	µg/l	-
Aliphatics >C10-C12	µg/l	-
Aliphatics >C12-C16	µg/l	-
Aliphatics >C16-C21	µg/l	-
Aliphatics >C21-C35	µg/l	-
Aromatics >C5-C7	µg/l	-
Aromatics >C7-C8	µg/l	-
Aromatics >C8-C10	µg/l	-
Aromatics >C10-C12	µg/l	-
Aromatics >C12-C16	µg/l	-
Aromatics >C16-C21	µg/l	-
Aromatics >C21-C35	µg/l	-
Benzene	µg/l	10
Toluene	µg/l	50
Ethylbenzene	µg/l	20
Xylene	µg/l	30
Phenol	µg/l	7.7

[1] *EQS (Freshwater) – The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions, 2010 - Freshwater*

If exceedances of the Tier 1 Assessment Criteria in relation to soil leachate are identified then further detailed risk assessment shall be undertaken based on the Remedial Target Methodology v3.2 (Environment Agency, 2013).

8.1.5.2 Statistical Analysis

The geochemical elements of material suitability for use criterion shall be designated in accordance with industry approved statistical procedures. The Normalised Upper Bound (UCL95) will be assessed using methods described in guidance documentation produced by DEFRA & EA, 2002 and CL:AIRE, 2008.

Materials to be used within the development will be subject to separate statistical assessment of compliance criteria whereby the normalised upper bound shall be not greater than the respective RTVs.

No earthworks materials shall be used within the development until their geochemical suitability has been assessed. Where necessary, materials will be temporarily stockpiled in the Materials Processing and Stockpiling Area (MPSA).

Materials exhibiting concentrations of determinands lower than the RTVs shall be selected and stored separately for use within 1m of the formation level wherever possible.

8.1.5.3 Free Product

Where specific organic determinands are recorded at concentrations below the RTV but above the theoretical soil saturation limit then assessment shall be made as to the presence of free product within the soil matrix.

No site won materials and/or imported soils or materials shall be used within the bulk earthworks, where free product hydrocarbons are identified.

8.1.5.4 Contaminant Odour & Volatility

No material shall be used in the works within 1 m of the formation level, irrespective of whether the concentrations of organic determinands are within the RTVs, should this material have the potential to give rise to odour nuisance.

Materials exhibiting exceedances of metal / inorganic or non/negligibly volatile organic RTVs for residential with gardens end use shall be deemed geochemically suitable for use at depths greater than 1m below the formation level.

Table 8.6 classifies the main contaminants in terms of volatility. The list of determinands in the table is not exhaustive and where exceedances of organic determinands not included in the table are identified during geochemical testing an assessment as to their potential volatility shall be made before determining final placement or disposal options for the material in question. Materials containing potential volatile contaminants may be placed at depth subject to site specific risk assessment indicating that the potential risk is acceptable.

Table 8.6. Volatile and Negligibly / Non-Volatile Determinands

Determinand	Nature of Contaminant
Arsenic	Negligibly / Non-Volatile
Boron (water soluble)	
Cadmium	
Copper	
Chromium (total)	
Chromium (VI)	
Cyanide (total)	
Lead	
Mercury (inorganic form)	
Nickel	
Selenium	
Zinc	
Asbestos	
TPH Carbon Bands >C16	
PAH - Anthracene	
PAH - Benzo(a)pyrene	
PAH - Benzo(a)anthracene	
PAH - Benzo(b)fluoranthene	
PAH - Benzo(k)fluoranthene	
PAH - Benzo(ghi)perylene	
PAH - Chrysene	
PAH - Dibenzo(ah)anthracene	
PAH - Fluoranthene	
PAH - Indeno(123cd)pyrene	
PAH - Phenanthrene	
PAH - Pyrene	
Cyanide (free)	Volatile*
Total Phenols	

Benzene
Toluene
Ethylbenzene
Xylene
TPH Carbon Bands <C16
PAH - Naphthalene
PAH - Fluorene
PAH - Acenaphthylene
PAH - Acenaphthene

* Generally exhibits a Henrys Law Constant (dimensionless) > 2.5x10-3

8.1.6 Ground Gas

The objective of the reclamation works will be to ensure ground gas concentrations and flow are no worse than the Amber 2 level of the NHBC traffic light system for residential areas and Characteristic Situation 2 for commercial plots and non-residential properties in plot A.

8.2 Water Protection

8.2.1 Measures to avoid a pulse of contaminated perched water and/or to mitigate risk to receiving controlled waters form polluted shallow groundwater

Perched water in the Made Ground materials could contain elevated concentrations, in comparison to Environmental Quality Standards (EQS) of various metals (e.g. arsenic, beryllium, nickel, zinc), inorganic (e.g. ammonia, ammonium, sulphate) and organic (various PAHs) determinands and there is therefore a requirement for its collection and treatment before discharge.

All such encountered perched water shall be collected in a collection tank or lined lagoon before any treatment and discharge.

Chemical analysis of this incidental water shall be carried out at the frequencies given in Table 1/5d. The suite of determinands to be included in the laboratory analysis of this incidental water is detailed in the notes to Table 1/5d.

The incidental water shall either be:

- discharged to foul sewer under a trade effluent consent agreed with the local sewerage undertaker and/or;
- discharged to surface water under a water discharge activity environmental permit (“WDA-EP”) from the Environment Agency.

The ultimate discharge location shall be determined following consultation with the local sewerage undertaker and/or the Environment Agency during the detailed design stage of the works.

No discharge to foul sewer or surface water courses shall be made without the required consent.

8.2.1.1 Perched Water Capture and Treatment

Where perched water encountered during the progress of the earthworks contains concentrations of determinands that would breach any consent/permit for discharge then the water shall be subject to pre-treatment.

This treatment will be influenced by the nature of the exceedances and may include the use of the following treatment processes: settlement, flocculation, air stripping, aeration, chemical oxidation, granulated carbon adsorption. It is envisaged that an on-site treatment plant may be required to ensure that the concentrations of key determinands in the effluent discharge are within consented discharge limits.

If a WDA-EP is required consultation with the Environment Agency will be required to confirm the discharge limits for the key determinands during detailed design as this will greatly influence the scope and scale of the on-site treatment.

Although not considered likely, where treatment is not possible then the perched water shall be disposed of off-site by an appropriately certified waste disposal company. Such off-site disposal shall be undertaken in accordance with applicable legislation.

8.2.1.2 Surface Waters

Uncontaminated surface water run-off will be prevented from entering areas of open excavation, by means of ditches or bunds, to ensure it does not become contaminated. The uncontaminated water will be directed towards an appropriate lagoon before being discharged.

The point of discharge will be determined following consultation with local sewerage undertaker and/or the Environment Agency.

8.2.1.3 Protection of watercourses/waterbodies

During the works operations it will be necessary to ensure any watercourse close to the working area is protected. The primary existing waterbody is Shipley Lake from which, at its southern end, a stream flows to Nutbrook Canal to the south of the site. If a temporary WDA-EP is obtained from the Environment Agency, and/or a Trade Effluent Consent from Severn Trent plc in relation to relevant works on the site, this would set limits and criteria for the quality and rate of discharge from the site during the works operations.

In order to manage the discharge from the site, a construction stage surface water management plan shall be developed. The following principal items shall be included:

- a series of temporary land drains around the development discharging to discharge point(s);
- a monitoring and sampling point constructed at the point(s) of discharge;
- settlement lagoons, if required, constructed upstream of the discharge point(s);
- cut-off ditches around the perimeter of the site to prevent water discharging at any location other than the aforementioned discharge point(s).

The construction stage surface water management plan shall be prepared in conjunction with the programme of works and reviewed regularly during the works to ensure that it meets the objectives above. The requirement for settlement pond and testing will be dependent upon the Environment Agency WDA-EP or Trade Effluent Consent from Severn Trent plc requirements but should be sufficient to ensure there is no detrimental effect of the site works on the ecology and environment within the existing water course.

8.3 Permits and Licences (as required for operating the remediation processes)

8.3.1 Mobile Treatment Licences

It is anticipated that mobile treatment plant environmental permit(s) will be required in connection with carrying out activities included within the proposed remediation such as soil modification / stabilisation. Application for deployment of and the operation of the requisite mobile treatment plant(s) will be made by the remediation contractor in accordance with applicable legislative requirements.

8.3.2 WDA-EP / Trade Effluent Consent

A WDA-EP and/or Trade Effluent Consent will be required for the temporary discharge of perched water and other incidental water during the reclamation works.

8.4 Off-site Disposal of Materials

8.4.1 Disposal of Unsuitable Materials

Materials displaying characteristics that render them unsuitable for use in the development platform shall be segregated and sentenced for off-site disposal. It is envisaged that the volume of such material will be relatively small based on the findings of the previous ground investigation.

8.4.2 Criteria for deciding that materials are to be disposed off-site

Before the off-site disposal of material, the concentrations of the contaminants in the material shall be reviewed to determine whether the material would be classified as Hazardous Waste in accordance with the Hazardous Waste Regulations (England & Wales) Regulations, 2005 and associated guidance. Note that this determination is relevant only where it is intended to discard material as waste. It is not relevant to materials undergoing remediation and which will be used in the works.

All wastes to be disposed of off-site shall be subject to basic waste characterisation (e.g. source and origin of waste, composition of the waste, and the relevant European waste code) and waste acceptance criteria (WAC) testing at the frequencies given in Table 1/5b in accordance with the Environmental Permitting (England & Wales) Regulations, 2010.

The statutory limits that apply to the waste acceptance criteria are presented in Tables 8.7and 8.8. Waste materials shall only be disposed of at the appropriate classification of landfill for that type of waste. The landfill operator shall be issued with the basic characterisation and WAC testing results for review before disposal.

Table 8.7. Threshold Limits for Categorising Waste to Landfill as Hazardous, Non-Hazardous or Inert based on Soil leachate

LEACHATES for compliance using BS EN 12457-3 at L/S 10/kg (2 batch)	WASTE ACCEPTANCE CRITERIA (mg/kg UNLESS OTHERWISE STATED)		
	Inert Landfill	Stable, non-reactive hazardous waste in non-hazardous landfill	Hazardous landfill
Arsenic	0.5	2	25
Barium	20	100	300
Cadmium	0.04	1	5
Chromium (total)	0.5	10	70
Copper	2	50	100
Mercury	0.01	0.2	2
Molybdenum	0.5	10	30
Nickel	0.4	10	40
Lead	0.5	10	50
Antimony	0.06	0.7	5
Selenium	0.1	0.5	7
Zinc	4	50	200
Chloride	800	15,000	25,000
Fluoride	10	150	500
Sulphate (SO4)	1,000	20,000	50,000
Total dissolved solids (TDS)	4,000	60,000	100,000
Phenol index	1		
Dissolved Organic Carbon at own pH or pH 7.5-8.0	500	800	1,000

Note: These limits are for guidance. A landfill site may have different limits derived from this table, depending on its licence.

Table 8.8. Threshold limits for categorising waste to landfill as hazardous, non-hazardous or inert for solid soil.

SOLID WASTE SUITES	WASTE ACCEPTANCE CRITERIA (mg/kg UNLESS OTHERWISE STATED)			Total waste Suite
	Inert Landfill	Stable, non-reactive hazardous waste in non-hazardous landfill	Hazardous landfill ^	
Total organic Carbon (w/w%)	3%*	5%*	6%*	3%
Loss on ignition			10%	10%
BTEX (mg/kg)	6			6
PCBs (7 congeners) mg/kg)	1			1

Mineral Oil C10-C40 (mg/kg)	100		100
pH		>6	>6
Acid neutralisation capacity			
PAHs – total 17 including coronene	100		100

These limits are for guidance. A landfill site, receiving the waste, may have different limits derived from this table, depending on its licence.

Before off-site disposal materials requiring pre-treatment in accordance with applicable legislation will be pre-treated. Pre-treatment may take the form of the following combination of processes which shall be in accordance with applicable requirements of the landfill operator and Environment Agency.

- Removal and separate disposal of identified free product where these can be practicably separated from the soil matrix.
- Possible soil washing and screening to remove oversize brick, concrete and hardcore.

All off-site disposal of waste shall be undertaken by an appropriately registered waste carrier and each transfer shall be accompanied by a waste transfer note in accordance with the Waste (England and Wales) Regulations 2011.

9. Drainage Measures

9.1 Drainage Measures to be Undertaken during the Reclamation Works

Drainage measures will be implemented during the reclamation works. The drainage measures will be used to control runoff water across the site, and / or any perched water encountered during the works.

In order to manage the discharge from the site, a construction (remediation and reclamation) stage surface water management plan shall be developed. The following principal items shall be included:

- a series of temporary land drains around the development discharging to discharge point(s);
- a monitoring and sampling point constructed at the point(s) of discharge;
- settlement lagoons, if required, constructed upstream of the discharge point(s);
- cut-off ditches around the perimeter of the site to prevent water discharging at any location other than the aforementioned discharge point(s).

The measures required to control perched water are discussed in Section 8.2.

10. Ground Gas Protection Measures

10.1 Ground Gas Risk Mitigation for Residential Properties (post reclamation works / in the residential development)

Residential properties will be located in Plots R1, R2 and R3 of the site. Plot A (Care Home) has also been considered as a residential plot for the purpose of ground gas risk mitigation.

The primary step of the reclamation strategy is for ground gas monitoring to be undertaken across the site, utilise site data to undertake ground gas risk assessment, where risks are identified design mitigation measures.

The objective of the reclamation works will be to reduce ground gas concentrations and flow to a level compliant with the Amber 1 level of the NHBC traffic light system, with the proviso that conditions following reclamation will be no greater than Amber 2.

Ground gas protection measures for Amber 2 are considered to be the worst case anticipated to be present at the site. The final NHBC traffic light system classification for the site, following the post works period of ground gas monitoring, may be Green or Amber 1. Therefore, ground gas protection measures for residential properties within the development will be determined following completion of the assessment of the post-works ground gas monitoring data. It is noted that a gas protection membrane and ventilated sub-floor void is required for both Amber 1 and Amber 2 conditions, the difference being that for Amber 2 the membrane is to be fitted and fully certified by a specialist contractor.

The proposed reclamation works will modify the ground conditions, by increasing the in-situ density and decreasing air voids by compaction, by selective bioremediation of hydrocarbon impacted materials and organic rich materials.

It is recommended that gas protection measures for the residential properties follow the requirements of the NHBC Report Ed No4 (2007). Ground gas protection measures recommended by NHBC for low-rise housing development based on the Traffic Light Classification is presented in Table 10.1

Table 10.1. Ground Gas Protection Measures Required for the Traffic Lights

Traffic Light	Ground Gas Protection Measures Required
Green	Ground gas protection measures are not required.
Amber 1	Low-level ground gas protection measures are required, using a membrane and ventilated sub-floor void that creates a permeability contrast to limit the ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Amber 2	High-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Membranes used should always be fitted by a specialist contractor and should be fully certified (see Appendix E). As with Amber 1, ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Red	Standard residential housing is not normally acceptable without further Ground Gas Risk Assessment and/or possible remedial mitigation measures to reduce/remove the source of the ground gases. In certain circumstances, active protection methods could be applied, but only when there is a legal agreement assuring the management and maintenance of the system for the life of the property.

The gas protection measures will be required to be designed by a specialist contractor in accordance with the guidance given in BRE 211, BS 8485:2015 and NHBC Report Ed No 4 (2007).

10.2 Ground Gas Risk Mitigation Measures for Commercial Properties

A number of options are available to provide gas protection measures for commercial properties based on guidance within BS 8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

For a Characteristic Situation 2 (Low Hazard Potential) site a minimum gas protection score (GPS) of 1.5, 2.5 or 3.5 (dependent on building type – Type B, Type C or Type D, respectively) is required (see Table 4 in BS8485:2015). Tables 5, 6, and 7 in BS8485:2015 provide solution scores for various gas protection elements/systems. Various elements will need to be combined to achieve the appropriate gas protection score for Characteristic Situation 2 (GPS 1.5, 2.5 or 3.5 for Type B, Type C or Type D buildings, respectively).

For a Characteristic Situation 3 (Moderate Hazard Potential) site (Area A only) a solution score minimum of 2.5, 3 or 4 (dependent on building type – Type B, Type C or Type D, respectively) is required (see Table 4 in BS8485:2015). Tables 5, 6 and 7 in BS8485:2015 provide solution scores for various gas protection elements/systems. Various elements will need to be combined to achieve the appropriate solution score for Characteristic Situation 3 (GPS 2.5, 3 or 4 for Building Type B, Type C or Type D, respectively).

The gas protection measures shall be designed by a specialist contractor in accordance with the guidance given in BRE 211, BS 8485:2007 and NHBC Report Ed No 4 (2007).

11. Monitoring Requirements

11.1 Ground Gas Monitoring

A programme of ground gas monitoring shall be carried out before the commencement of the reclamation works, during those works and post completion at the frequencies given in Table 1/5c.

Table 1/5c. Ground Gas Monitoring

Work, Goods or Material	Test	Frequency of Testing
Ground Gas monitoring shall be undertaken before the works, during the works and for a minimum 12 months in residential areas and 3 months in commercial areas following completion of works	Ground Gas Monitoring (of parameters detailed in Table 11.1).	From standpipes installations located around the site to be sampled before the works, then at monthly intervals during the works, then at monthly intervals post works completion. An alternative to the 12 month post completion ground gas monitoring would be six months post work spot monitoring combined with the installation of GasClam type instruments in at least 2no selected monitoring wells in each residential plot to allow continuous ground gas monitoring over a period of 4 weeks in each of the residential plots.

To facilitate this, monitoring wells which are part of the current network will be used. In addition further monitoring wells shall be installed following the works, to replace the current monitoring wells which are anticipated to be damaged during the works. The locations of the proposed monitoring wells are shown on Drawing SHLK-AEC-XX-XX-DR-GE-0030

Where the concentrations of ground gases (and flow rates) recorded during the programme of monitoring are substantially elevated above levels previously recorded additional monitoring / increased frequency may be required at selected locations. However, the Reclamation Strategy is intended to mitigate the ground gas risk to Amber 1, with the proviso that it is no greater than Amber 2.

Where monitoring locations are within areas of the development that will be subject to earthworks excavations, placement of materials or construction the monitoring locations shall be preserved and monitored for as long as reasonably practicable.

Table 11.1 details the gases and other parameters that will be recorded during the scheduled ground gas monitoring programme. In addition to these parameters the weather and ground conditions shall be recorded at the time of monitoring.

All monitoring results shall be inputted into a monitoring results database. All monitoring results shall be presented in a standard electronic format. The results of the ground gas monitoring programme shall be included in the validation report to be produced following completion of the works.

Table 11.1. Gases and Other Parameters to be Monitored During Ground Gas Monitoring Programme

Gases / Other Parameters	Units	Accuracy
Methane	% LEL & % v/v	1 (LEL), 0.1 (v/v)
Carbon Dioxide	% v/v	0.1
Oxygen	% v/v	0.1
Hydrogen Sulphide	ppm	1
Carbon Monoxide	ppm	1
Atmospheric pressure	mBar	1
Downhole Pressure	mBar	1
Temperature	°c	0.1

Gas Flow Rate	l/hr	0.1
Groundwater Level	m bgl	0.01
Standpipe depth	m bgl	0.01

All monitoring results shall be inputted into a monitoring results database.

The results of the ground gas monitoring programme shall be included in the validation report to be produced following completion of the works for the proposed development.

11.2 Water Monitoring

A programme of groundwater, surface water and water arisings monitoring shall be carried out before commencement of the reclamation works, during those works and post completion for the suite of determinands and frequencies given in Table 1/5d. The scope, location and frequency of groundwater monitoring will be reviewed on the basis if the existing and supplementary ground investigation and upon risk based assessment of the need or otherwise for targeted in-situ groundwater treatment.

Table 1/5d. Geochemical Testing (Waters)

Work, Goods or Material	Test	Frequency of Testing
A:- Ground Water Monitoring		
Groundwater monitoring (sampling and laboratory testing) shall be undertaken from existing and proposed monitoring standpipes before the works, during the works	Water analysis suite (Note c) – TBC	From standpipe installations located within the site to be sampled to cover a minimum of 12months period - on 3 occasions before the works, then at monthly intervals during the works, then at monthly intervals post completion for 3 months (minimum.
B:- Surface Water Monitoring		
Surface water monitoring (sampling and laboratory testing) shall be undertaken before the works, during the works and for a minimum period of 2 years years after completion of the works.	Water analysis suite (Note c) – TBC	Samples to be obtained on 3 occasions before the works, then at monthly intervals during the works, then at monthly intervals post completion for a period of 3 months. From Shipley Lake and streams entering and exiting Shipley Lake and from the body of the lake at 4 locations upstream, adjacent to and downstream of site and from other surface water features (watercourses) in 4 locations on 3 occasions before the works, then at monthly intervals during the works, then at monthly intervals post completion for 3 months (minimum).
C:-Any Holding Tank / Lagoon for Incidental Arisings of Perched Groundwater (Pre and Post Treatment)		
Holding tank / lagoon water (where incidental water (including groundwater) has been stored) before treatment and discharge	Groundwater / Surface Water analysis suite (Note c) – TBC	Samples to be taken before and post treatment on a monthly basis during the works or at the frequency required in the discharge / trade effluent consent.

- Notes applying to the Table 1/5d

a) All chemical analysis shall be UKAS and MCERTS accredited as appropriate

b) Water analysis suite to include the determinands detailed in Table 11.2 and Table 11.3.

Table 11.2. On-site Testing Suite

Parameter	Unit	Stabilisation
Temperature	°C	± 0.2 °C
Electrical Conductivity (E.C.)	µS/cm	± 3%
Dissolved Oxygen (D.O.)	mg/L	± 10%
pH	unitless	± 0.1
Oxidation Reduction Potential (ORP)	mV	± 10 mV

Table 11.3. Water Laboratory Test Suite (Provisional)

Determinand	Limit of Detection	units
Antimony	2	µg/l
Arsenic	1	µg/l
Beryllium	1	µg/l
Boron	10	µg/l
Cadmium	0.4	µg/l
Calcium	0.012	mg/l
Copper	1	µg/l
Chromium	1	µg/l
Chromium (VI)	1	µg/l
Iron	50	µg/l
Lead	1	µg/l
Manganese	0.001	mg/l
Mercury	0.05	µg/l
Nickel	1	µg/l
Potassium	1	mg/l
Selenium	1	µg/l
Sodium	0.1	mg/l
Zinc	3	µg/l
Cyanide	0.001	µg/l
PAH (USEPA 16) speciated GC-MS (**Lowest possible level of detection**)	0.01	µg/l
TPH (Carbon banded C5 – C40)	10	µg/l
BTEX	1	µg/l
Phenols	0.1	µg/l
Volatile Organic Compounds (GC-MS)	1	µg/l
Semi-Volatile Organic Compounds (GC-MS)	1	µg/l
Sulphate	3	mg/l
Sulphide	10	µg/l
pH Value	0.01	Units
Ammoniacal Nitrogen	10	µg/l
Nitrate	100	µg/l
Nitrite	50	µg/l
Chloride	10	mg/l
Phosphate	0.1	mg/l
Dissolved Organic Carbon	3	mg/l

d) Range of determinands to be monitored and period of monitoring may be periodically amended following discussions with the Environment Agency. Final programme of monitoring should be agreed with the Environment Agency at the detailed design stage.

To facilitate this programme of monitoring, monitoring wells which are part of the current network shall be used as well as, further monitoring wells which shall be installed following the reclamation works to replace the current monitoring wells which are anticipated to be damaged during the works. The locations of the proposed monitoring wells are shown on Drawing SHLK-AEC-XX-XX-DR-GE-0030

Surface water monitoring of the watercourse entering the lake, Shipley Lake and the watercourse leaving the lake Canal shall be carried out before commencement of the reclamation works, during the works and post completion

at the frequencies given in Table 1/5d. The suite of determinands to be included in the laboratory analysis of surface waters is detailed in the notes to Table 1/5d.

Sampling of Shipley Lake and the watercourse entering and leaving the site will include at a minimum, upstream and downstream locations.

All incidental water shall be subject to sampling and subsequent laboratory analysis as detailed in Table 1/5d. Samples shall be obtained from holding tank(s)/lagoons.

All water chemical testing data shall be presented in a standard electronic format.

The chemical suitability of the groundwater and surface water are to be initially assessed against Tier 1 Assessment Criteria based on Environmental Quality Standards (EQS). These criteria are detailed in Table 11.4.

Table 11.4. Tier 1 Assessment Criteria for Water (Indicative at this stage)

Determinand	Tier 1 Assessment Criteria	Units
METALS		
Antimony	5 [A]	µg/l
Arsenic	50	µg/l
Beryllium	12	µg/l
Boron	2000	µg/l
Cadmium	0.08	µg/l
Copper	1	µg/l
Chromium	3.4	µg/l
Iron	1000	µg/l
Lead	1.2	µg/l
Manganese	123	µg/l
Mercury	0.07	µg/l
Nickel	4	µg/l
Selenium	10 [A]	µg/l
Sodium	200 [A]	µg/l
Zinc	10.9	µg/l
PAH		
Acenaphthene	18 [A]	µg/l
Acenaphthylene	18 [A]	µg/l
Anthracene	0.1	µg/l
Benz[a]anthracene	3.5 [A]	µg/l
Benzo[a]pyrene	0.00017	µg/l
Benzo[b]fluoranthene	0.017	µg/l
Benzo[g,h,i]perylene	0.0082	µg/l
Benzo[k]fluoranthene	0.017	µg/l
Chrysene	7 [A]	µg/l
Dibenzo[a,h]anthracene	0.07 [A]	µg/l
Fluoranthene	0.0063	µg/l
Fluorene	12 [A]	µg/l
Indeno[1,2,3-cd]pyrene	0.002	µg/l
Naphthalene	2	µg/l
Phenanthrene	4 [A]	µg/l
Pyrene	9 [A]	µg/l
TPH		

Determinand	Tier 1 Assessment Criteria	Units
TPH (>EC5-7) aromatic	10	µg/l
TPH (>EC7-8) aromatic	50	µg/l
TPH (>EC8-10) aromatic	300 [A]	µg/l
TPH (>EC10-12) aromatic	90 [A]	µg/l
TPH (>EC12-16) aromatic	90 [A]	µg/l
TPH (>EC16-21) aromatic	90 [A]	µg/l
TPH (>EC21-35) aromatic	90 [A]	µg/l
TPH (>EC5-6) aliphatic	15000 [A]	µg/l
TPH (>EC6-8) aliphatic	15000 [A]	µg/l
TPH (>EC8-10) aliphatic	300 [A]	µg/l
TPH (>EC10-12) aliphatic	300 [A]	µg/l
TPH (>EC12-16) aliphatic	300 [A]	µg/l
TPH (>EC16-21) aliphatic	300 [A]	µg/l
TPH (EC21-35) aliphatic	300 [A]	µg/l
BTEX		
Benzene	10	µg/l
Toluene	74	µg/l
Ethylbenzene	20	µg/l
m&p-Xylene	190 [A]	µg/l
o-Xylene	190 [A]	µg/l
Methyl tertiary butyl ether (MTBE)	5100	µg/l
VOCs [B]		
1,1-Dichloroethane	2.8 [A]	µg/l
1,2,4-Trimethylbenzene	15 [A]	µg/l
1,2-Dichlorobenzene	1000 [A]	µg/l
Benzene	10	µg/l
Carbon disulphide	810 [A]	µg/l
Chlorobenzene	300 [A]	µg/l
Isopropylbenzene	450 [A]	µg/l
m,p-Xylene	30	µg/l
Naphthalene	2	µg/l
Toluene	74	µg/l
Vinyl chloride	0.5 [A]	µg/l
SVOCs [B]		
Phenol	7.7	µg/l
1,2,4-Trichlorobenzene	0.1 [A]	µg/l
1,2-Dichlorobenzene	1000 [A]	µg/l
1,4-Dichlorobenzene	300 [A]	µg/l
2,4,5-Trichlorophenol	1200 [A]	µg/l
2,4,6-Trichlorophenol	200 [A]	µg/l
2,4-Dichlorophenol	4.2	µg/l
2,4-Dimethylphenol	360 [A]	µg/l
2,4-Dinitrotoluene	0.24 [A]	µg/l
2,6-Dinitrotoluene	0.048 [A]	µg/l
2-Chloronaphthalene	750 [A]	µg/l
2-Chlorophenol	50	µg/l

Determinand	Tier 1 Assessment Criteria	Units
2-Methylnaphthalene	36 [A]	µg/l
2-Methylphenol	930 [A]	µg/l
2-Nitroaniline	190 [A]	µg/l
4-Chloro-3-methylphenol	40	µg/l
4-Chloroaniline	0.37 [A]	µg/l
4-Methylphenol	1900 [A]	µg/l
4-Nitroaniline	3.8 [A]	µg/l
Acenaphthene	18 [A]	µg/l
Acenaphthylene	18 [A]	µg/l
Anthracene	0.1	µg/l
Azobenzene	0.12 [A]	µg/l
Benzo(a)anthracene	3.5 [A]	µg/l
Benzo(a)pyrene	0.00017	µg/l
Benzo(b)fluoranthene	0.017	µg/l
Benzo(g,h,i)perylene	0.0082	µg/l
Benzo(k)fluoranthene	0.017	µg/l
bis(2-Chloroethoxy)methane	59 [A]	µg/l
bis(2-Chloroethyl)ether	0.014 [A]	µg/l
bis(2-Ethylhexyl) phthalate	1.3	µg/l
Butylbenzyl phthalate	7.5	µg/l
Chrysene	7 [A]	µg/l
Dibenzo(a,h)anthracene	0.07 [A]	µg/l
Dibenzofuran	7.9 [A]	µg/l
Diethyl phthalate	200	µg/l
Dimethyl phthalate	800	µg/l
Fluoranthene	0.0063	µg/l
Fluorene	12	µg/l
Hexachlorobenzene	0.05	µg/l
Hexachlorobutadiene	0.6	µg/l
Hexachlorocyclopentadiene	0.41 [A]	µg/l
Hexachloroethane	0.33 [A]	µg/l
Indeno(1,2,3-cd)pyrene	0.1	µg/l
Isophorone	78 [A]	µg/l
Naphthalene	2	µg/l
n-Dibutyl phthalate	8	µg/l
n-Dioctyl phthalate	1.3	µg/l
Nitrobenzene	30	µg/l
n-Nitroso-n-dipropylamine	0.011 [A]	µg/l
Pentachlorophenol	0.4	µg/l
Phenanthrene	4 [A]	µg/l
Phenol	7.7	µg/l
Pyrene	9 [A]	µg/l
INORGANICS		
Sulphate	400	mg/l
pH Value	5.2	Units
Ammoniacal Nitrogen	300	µg/l

Determinand	Tier 1 Assessment Criteria	Units
Nitrate	50 [A]	mg/l
Chloride	250	mg/l
Cyanide	1	µg/l
Sulphate	400	µg/l

1 EQS (Freshwater) – The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions, 2010 – Freshwater.
2 A DWS values used as no EQS was available
3 B Test suites based on results for VOC and SVOC suites for 2015 monitoring (AECOM 2017)

It is a primary intention of this Reclamation Strategy to capture, test and if necessary pre-treat soil pore water and / or perched water encountered in the excavations and in the existing lagoons before discharge, as set out in 6.2.1. The Tier 1 assessment criteria are to be applied whenever captured and treated water is to be discharged to surface waters. If exceedances of the Tier 1 Assessment Criteria are identified, then further treatment will be undertaken.

The reference to Tier 1 Assessment criteria will also be made when assessing monitoring data, in order to determine whether the results are indicative of the prevailing groundwater and surface water conditions or whether the reclamation works have impacted the groundwater / surface water regime as a result of mobilisation of contamination.

Should this assessment conclude that the results are potentially indicative of a mobilisation of contaminants then the frequency of monitoring will be increased and a repeat monitoring round shall be undertaken to determine whether the elevated results relate to a one-off “pulse” of mobilised contaminants. Where the results consistently indicate elevated concentrations of determinands then additional remedial treatment measures may be required to limit the potential risks to groundwater and surface water arising from the works.

Any proposed additional mitigation measures will be submitted to the relevant authority for approval before implementation.

11.3 Additional Notes for Tables 1/5b (soil testing), 1/5c (gas monitoring) and 1/5d (water testing)

11.3.1 Particular sampling requirements for specialist chemical testing

Sampling and testing for specialist chemical testing shall comply with the specification requirements. Surface water samples are required at six surface water monitoring locations. Samples are to be tested for the determinands specified for water which are presented in Section 11.2.

11.3.2 Particular laboratory testing requirements

Where leachate analysis is specified, a sample of leachate shall be prepared from a soil sample following the procedure set out in British Standard (BS, 2002) BS 12457 Part 1 – one stage test using a liquid to solid ratio of 2:1 l/kg, unless otherwise stated.

The limits of detection shall be as set out in note b) of Table 1/5d.

11.3.3 Sampling for Chemical Testing

Samples will be taken which are representative of the material encountered.

11.3.3.1 Water Samples

Samples of groundwater shall be taken from each exploratory hole in which groundwater is found. Samples will be taken from surface sources at the six surface water monitoring locations.

11.3.3.2 Additional Samples

Additional samples may be taken where colour, odour or consistency indicates a change in the nature of the samples.

11.3.4 Sample Size

The size of each sample taken shall be sufficient to enable all specified laboratory analyses to be carried out, including subsequent dependent testing such as leachate preparation, to the specified detection limits. Minimum advisable sample quantities are one kilogramme for solid and three litres for water. Where more than one container is used for sampling from the same location the samples shall have the same sample number.

11.3.5 Sampling Procedure

Containers for samples shall be in accordance with the requirements of the analytical laboratory, such that specified levels of detection can be accomplished and sample contamination is avoided, subject to the particular requirements outlined.

All solid and water samples shall be placed in rigid air-tight containers filled to capacity and labelled to indicate the location and time of sampling and hazardous nature, if applicable. For soils, these containers shall be made either of PVC, polyethylene or borosilicate glass.

Containers for water samples should comply with the laboratory certification requirements. The samples shall be placed immediately in the container ensuring there is no air space at the top of the container.

11.3.6 Sample Preservation

11.3.6.1 Water Samples

Representative sub-samples of water shall be used for the on-site measurements and the remaining sample shall be filtered and preserved in the following manner.

On collection each water sample is to be filtered through a 0.45 micron filter and divided into three parts, of 1 litre each (total 3 litres). One of the three parts is to be acidified by the addition of sulphuric acid of sufficient quantity and strength to make the pH of the water sample < pH 2. A second of the three parts is to be made alkaline by the addition of sodium hydroxide solution of sufficient quantity and strength to make the pH of the water > pH 12. The third part of the sample is to receive no preservatives.

Filtration and preservation of water samples is to be conducted on site, immediately after sampling. Samples should then be stored out of light at a temperature between 2°C and 5°C and analysis should be initiated within 48 hours of sampling.

Preservation of water samples for specific parameters shall be in accordance with BS 6068 Section 6.3: 1986.

11.3.7 Sample Transport and Storage

The location and depth of all samples will be recorded. Samples shall be dispatched to the analytical laboratory within 24 hours of sampling. All samples shall be kept for a period of not less than one month after submission of the approved report.

11.3.7.1 Sample Storage

Soil samples shall be stored in an appropriate manner so as to maintain their physical integrity and their chemical stability while they are on site. The type of storage facility required will vary depending upon the type of sample, and the stability of the analytes of interest.

All samples shall be protected from extreme fluctuations in temperature and shall be kept in a dark container to protect them from direct sunlight. Soil samples containing biodegradable determinands shall be stored at a temperature below 4°C. Such samples may be temporarily stored in insulated cooler boxes with pre-frozen ice packs during the course of the working shift. For extended periods of storage, they should be kept in a refrigerator.

Procedures will be implemented to maintain security of samples in accordance with the laboratory certification requirements.

Water samples should not be stored on site but shall be dispatched to the laboratory at the earliest opportunity, preferably on the day of collection, so as to minimise the time between collection and analysis.

11.3.7.2 Sample Transport

Samples of soil or water should be stored in cool boxes containing pre-frozen icepacks during transport and kept in a refrigerated room at the laboratory at a temperature of <4°C.

11.3.8 Quality Control Samples

A quality control and quality assurance programme for chemical analysis will be developed.

11.4 Proposed Locations for Ground Gas and Groundwater Monitoring Wells

Gas and groundwater monitoring shall be undertaken within the monitoring wells already present on-site and in good working order. Monitoring of these wells is required for a period before the start of the reclamation and remediation works and during the works.

Where the monitoring wells are destroyed during the works, replacement gas and groundwater monitoring wells shall be installed in the locations shown on Drawing SHLK-AEC-XX-XX-DR-GE-0030, which will be used for the ongoing monitoring during the works and subsequently following completion of the works monitoring period.

11.5 Gas and Groundwater Monitoring Well Specification

On completion of the work activities on site, it will be necessary to install new gas and/or groundwater monitoring wells. New wells are required to supplement data from any surviving monitoring wells, and to replace instruments lost or irreparably damaged during the work activities.

The new monitoring wells shall be installed in boreholes formed using cable percussion methods at a minimum diameter of 150mm.

Each gas and/or groundwater monitoring well shall comprise a 50mm diameter slotted high-density polyethylene (HDPE) pipe and gas tap with a flush, lockable raised steel cover in accordance with Appendix I of 'Specification for Ground Investigation', 2nd Edition ICE Publishing (2012), except that the upper bentonite slurry seal / non-slotted tubing should be not less than 1m depth. The filter shall be clean, single size, silica gravel; gravel containing calcareous inclusions shall not be used. The well screen shall be in geotextile fabric with a 250 micron diameter pore size. The gas tap shall be removable to enable groundwater monitoring as necessary. The borehole identification shall be marked clearly on the installation cover. The construction of the groundwater and gas monitoring wells shall be to the details within Drawing AI.1 Schematic drawing of a standpipe installation with raised lockable covers and Drawing AII.1 Schematic drawing of a ground gas monitoring installation with raised lockable covers and associated text for both wells contained within Appendix I of the Site Investigation Steering Group (2012) UK Specification for Ground Investigation 2nd Edition ICE Publishing.

On completion of the installation of the standpipes, dedicated Waterra tubing, with a 16mm outside diameter and fitted with a foot valve, will be installed in the monitoring well.

11.6 Ground Settlement Monitoring locations and specification

Monitoring of ground settlement shall be undertaken in the areas of fill across the site. Rod and plate equipment [see Table 1/5a] will be placed at the of locations shown on Drawing SHLK-AEC-XX-XX-DR-GE-0031, distributed evenly in the areas of fill. Surface markers shall be installed at the number of locations shown on Drawing SHLK-AEC-XX-XX-DR-GE-0031 at formation level and shall be monitored at the same frequency as the rod and plate instruments.

12. Management Plan for Materials

12.1 Introduction

This section details the procedures and measures that shall be taken to classify, track, store, use and dispose of the materials that will be encountered during the reclamation works (Management Plan for Materials (MPM)).

It is intended that the MPM will complement and be an integral part of the overall Reclamation Strategy. Some of the details to be included in the MPM have been covered in previous sections of this Strategy. Where this is the case these sections shall be referenced.

12.2 Materials Classification

All materials that are anticipated to be encountered during the works or imported onto site to be used in the works are classified and identified in Table 12.1.

Table 12.1. Reclamation Material Identification and Classification

Material Type	Classification	Anticipated Final Destination of Material
On-site Topsoil / Subsoil to be stripped	T / S	Use as topsoil / subsoil within landscaped areas (in accordance with acceptability criteria)
On-site Natural Superficial Deposits	NG	Use as general fill (in accordance with acceptability criteria)
On-site processed demolition materials	PDM	Used as general fill (in accordance with acceptability criteria)
On-site Made Ground (General and opencast backfill	MG	Use as general fill (in accordance with acceptability criteria)
Imported Top-Soil and Sub-soil	IM	Use as topsoil / subsoil within gardens and landscaped areas (in accordance with acceptability criteria)

The material classification system shall enable the identification of different sources of the same type of material. This shall be achieved by designating each source with a unique number.

Where a particular material is not suitable for its proposed use destination then the material will be used at an alternative location on-site in accordance with the appropriate geochemical and geotechnical acceptability criteria.

12.3 Materials Tracking and Storage

The first stage of the tracking process is the identification and classification of the various separate works materials. This shall be undertaken following the system detailed in section 12.2.

A system will be put in place to identify and track all earthwork material movements including excavated materials, imported materials, material undergoing on-site remediation, and if material is sentenced for off-site disposal.

This will include the creation of a site-specific coordinate grid-system or end-use area system to geographically locate the areas of material excavation and use within the development area.

The tracking system will include the facility to identify the excavated materials that are to be temporarily stored separately on-site in the designated stockpiling area whilst awaiting the results of testing, waiting to be used on site or if waiting for any off-site disposal.

The tracking system will be maintained utilising an electronic database (e.g. excel, access) and key material movements will be tracked by a combination of GPS and database collation, allowing temporary stockpiles to be easily located and referenced to the applicable testing data for the material. The tracking system will be a dynamic system that will be updated daily.

In order to track material movements around the site efficiently a site-specific material transfer pro-forma will be implemented for the use of on-site personnel responsible for moving materials. An example of this pro-forma is shown in Table 12.2.

Table 12.2. Example Site Specific Material Transfer Pro Forma

Site Specific Material Transfer Pro-forma	
Reference Number:	
Place of collection (grid / GPS reference / stockpile reference):	
Date of excavation / collection:	
Description of material being transferred:	
Classification of material:	
Volume / Mass of Material Transported:	
How is material contained?	**Loose**
	Skip
	Drum
	Covered lorry
	Other
Point of temporary placement (which stockpile):	
Date of temporary placement:	
Date of Anticipated Future Move:	
Anticipated Future Destination:	
What contaminants (if any are known) are present:	
Additional Comments:	
Point of final placement (including depth):	
Date of final placement:	

As part of this database management system it would be prudent to have one person appointed as responsible for record keeping on site. This resident “land quality engineer” would be responsible for acquiring and collating all material movement and site testing data throughout the works.

Where materials that exhibit exceedances of determinands have been segregated and deemed suitable for on-site remedial treatment the tracking system shall record the progress of the material through the specific remedial process including all associated testing required to validate the material as part of that process.

Where materials that exhibit exceedances of determinands have been segregated and deemed unsuitable for on-site remedial treatment the tracking system shall record temporary storage of the material before off-site disposal including all associated testing and documentation required.

The records of all materials movements on-site and off-site will be kept in paper and electronic format for a minimum period of 2 years following completion of the works and production of the Verification Report.

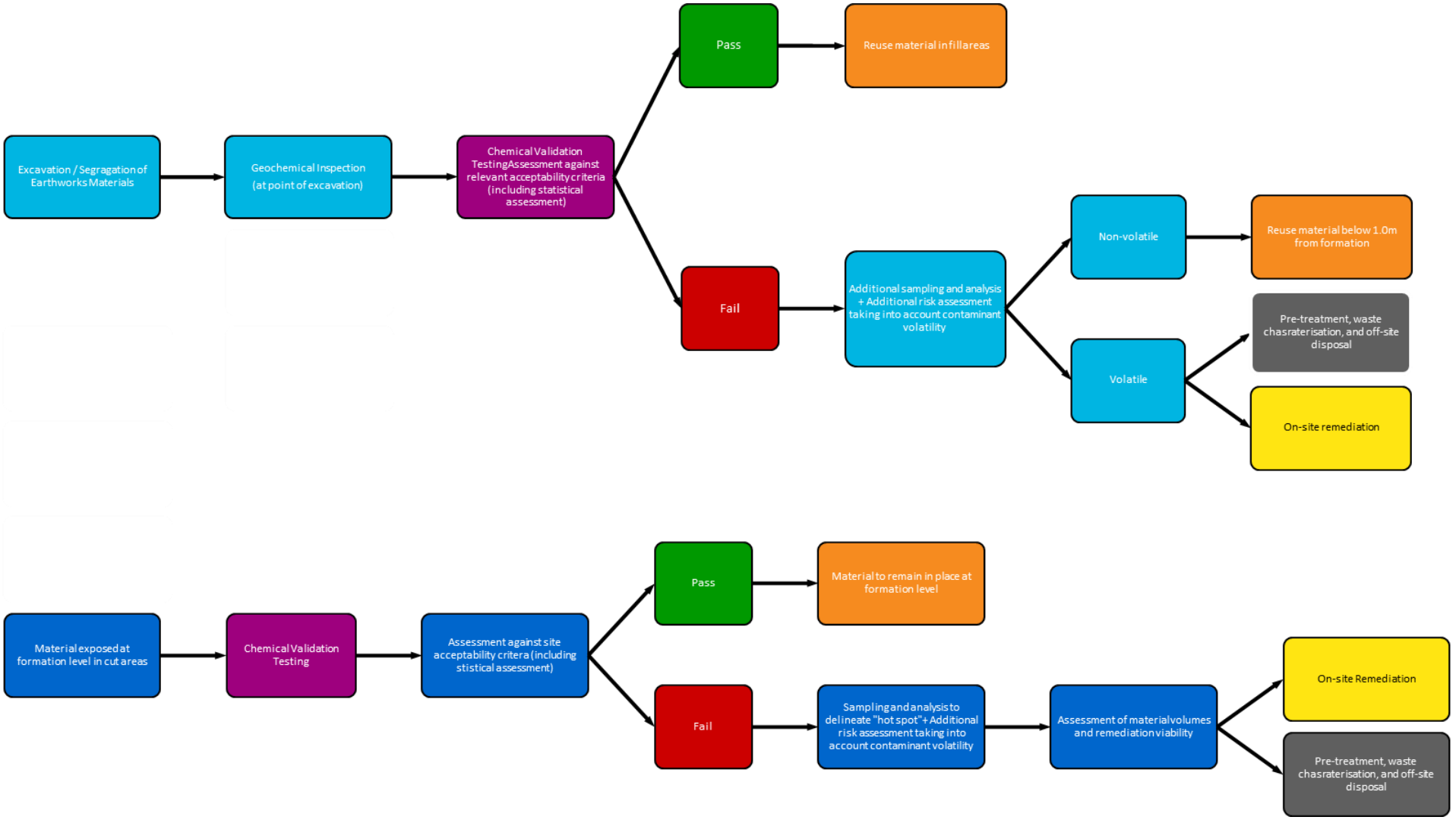
12.4 Data Management

Data will be stored electronically in a specifically designed database on site. Daily data uploads shall be undertaken. All data shall be geo-referenced and all stockpile sample nomenclature will ensure individual identification.

The database will integrate the statistical approach outlined in the Environment Agency publication R&D CLR 7 and allow the automatic classification of materials based on their intended point of placement.

On site data will also be presented as individual certificates of analysis in .pdf format.

Figure 12.1 Materials Management Flow Diagram



13. Verification Strategy

The objectives of the reclamation strategy are set out in Section 5.1 of this document. This section details the strategy to verify and demonstrate that the reclamation objectives have been met. Demonstrating

13.1.1 Demonstrating Material Geochemical Acceptability

The materials excavated and exposed during the works and any imported earthworks materials will be subject to a suite of chemical laboratory analysis appropriate to the ground conditions at the site. The results of the analysis shall be assessed against the RTVs, subject to statistical assessment and review of contaminant volatility, and the review process will be documented. No materials shall be used in the works or will remain in place, with respect to material exposed in cut areas, where the results indicate exceedance of the RTVs.

The review process will classify the material as either suitable for re-use, unsuitable for re-use or that further testing is required.

13.1.2 Demonstrating Material Geotechnical Acceptability

The materials excavated and exposed during the works and any imported earthworks materials will be subject to geotechnical laboratory analysis. The results of the analysis shall be assessed against the material classification criteria and the review process will be documented.

Compacted material will also be subject to in-situ and laboratory geotechnical testing to determine the achieved level of compaction. No material shall remain in place where, following comprehensive review, the results indicate the achieved level of compaction does not meet the required standard (subject to the compaction assessment protocol).

13.2 Monitoring

Groundwater, surface water and ground gas monitoring requirements are detailed in Section 11 of this Strategy document. The environmental monitoring will include sampling of groundwater, and surface water for a period of 12 months and monitoring of ground gas for a period of 12 months following the end of the remediation works in the area, see Table 1/5c. An assessment of the ground gas regime will inform the level of gas protection measures required for the new properties to be built on the residential and commercial development platforms. The objective of the reclamation works will be to reduce ground gas concentrations and flow to a level compliant with the Amber 2 level of the NHBC traffic light system for residential properties and no worse than Characteristic Situation 2 for commercial properties.

13.3 Validation / Verification Reporting

The Validation Report for the Shipley Lakeside Development Site Reclamation Works shall include the following:

- A general description of the reclamation works.
- Details of all excavated material classifications including site location references and volumes.
- Details of all imported material classifications and volumes.
- Results of all geochemical and geotechnical testing relating to all imported and treated materials.
- Results of compaction trials.
- The results of the assessments of material acceptability.
- Details of all geotechnical and geochemical remedial treatment undertaken (including process details, volumes, specific materials undergoing treatment, results of the treated material).
- Details of the final placement of excavated, treated and imported materials (linked to the assessment of material acceptability).
- Details of the materials sentenced for off-site disposal; including waste classification, volumes and disposal location.
- Results of all waste acceptance criteria (WAC) testing.

- All waste transfer documentation for the materials disposed of off-site.
- Details of any WDA-EP or trade effluent consents required as part of the works.
- Details of any in-situ treatment of shallow groundwater.
- The Environmental Permit details as applicable relating to (i) any on-site remedial treatment processes and (ii) any landfill operators accepting wastes from site.
- The monitoring records and laboratory analysis results for all the ground gas, groundwater and surface water monitoring.
- Details of any alterations / amendments made to the Reclamation Strategy.
- Details of any contingencies undertaken during the works.
- Details of all correspondence with the regulatory authorities during the works.
- As-built drawings showing surveyed levels of base of temporary excavations, temporary side slopes of excavations, positions of samples and tests carried out, and the MPM grid system.
- As-built drawings showing surveyed formation ground levels and positions of point-of-placement samples and tests carried out.

14. References

- British Geological Survey (1972) Sheet 125 Derby Solid and Drift (Scale 1:50,000);
- BRE, (2005). Special Digest 1 Concrete in Aggressive Ground;
- British Standard (2015) Code of practice for the characterisation and remediation of ground gas in affected developments. BS8485:2015;
- British Standard (2015) Specification for topsoil and requirements for use. BS3882:2015;
- British Standard (1990) Methods of test for Soils for civil engineering purposes Part 1 to Part 9. BS1377-1:1990 to BS1377-9:1990;
- British Standard (2000) Concrete - Part 1: Specification, performance, production and conformity. BSEN 206-1:2000;
- British Standard (2002) Characterisation of waste. Leaching. Compliance test for leaching of granular waste materials and sludges. One stage batch test at a liquids ration of 2l/kg for materials with a high solid content and particle size below 4mm without size reduction. BS 12457-1 :2002;
- British Standard (1986) Water quality. Sampling, Guidance on the preservation and handling of samples. BS 6068-6-6.3:1986;
- Card, G., Wilson, S. and Mortimer, S (2012) CL:AIRE Research Bulletin RB17 A Pragmatic Approach to Ground Gas Risk Assessment.
- CL:AIRE, (2010). Soil Generic Assessment Criteria for Human Health Risk Assessment;
- CL:AIRE, (2008). Guidance on Comparing Soil Contamination Data with a Critical Concentration;
- CIRIA, (2007). Report C665 Assessing risks posed by hazardous ground gases to buildings;
- DEFRA and the Environment Agency: 'Model Procedures for the Management of Land Contamination' – Contaminated Land Report (CLR) 11 (2004);
- Environment Agency, (2008). Updated Technical Background to CLEA Model (SC050021/SR3);
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- Environment Agency, (2008). Compilation of Data for Priority Organic Pollutants (SC050021/SR7);
- Environment Agency (2012) Additional guidance for Landfill (EPR 5.02) and other permanent deposits of waste. How to surrender your environmental permit. LIT5144/1056_12 Version 2;
- Environment Agency, (2000) Secondary model procedure for the development of appropriate soil sampling strategies for land contamination (P5-066/TR);
- Environment Agency, (2010) Verification of remediation of land contamination. (SC030114/R1);
- Environment Agency (2011), Horizontal Guidance H4 – Odour;
- Highways Agency (HA): 'Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works: Series 600 Earthworks' (Amendment – November 2009);
- LQM, (2009). Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition);
- UKWIR (2011) Guidance for the Selection of Water Supply Pipes to be Used in Brownfield Sites(Ref 10/WM/03/21)

Appendix A Earthworks acceptability criteria

REQUIREMENTS FOR ACCEPTABILITY AND TESTING OF EARTHWORKS MATERIALS

CLASS	GENERAL MATERIAL DESCRIPTION	TYPICAL USE	PERMITTED CONSTITUENTS (All subject to requirements of Clause 601 (SHW) and Appendix 6/1)	MATERIAL PROPERTIES REQUIRED FOR ACCEPTABILITY (in addition to requirements on use of fill materials in Clause 601 (SHW) and testing in Clause 631 (SHW)				COMPACTION REQUIREMENTS IN CLAUSE 612 (SHW)
				PROPERTY (See exception in previous column)	DEFINED AND TESTED IN ACCORDANCE WITH:-	ACCEPTABLE LIMITS WITHIN:		
						Lower	Upper	
1A	Well graded granular material	General fill	Any material, or combination of materials. Recycled aggregate.	(i) grading	BS 1377 Part 2	Tab 6/2	Tab 6/2	End product min 95% MDD and max 5% air voids
				(ii) uniformity coefficient	See Note 5	10	-	
				(iii) mc	BS 1377 Part 2			
1B	Uniformly graded granular material	General fill	Any material, or combination of materials. Recycled aggregate	(i) grading	BS 1377 Part 2	Tab 6/2	Tab 6/2	End product min 95% MDD and max 5% air voids
				(ii) uniformity coefficient	See Note 5	-	10	
				(iii) mc	BS 1377 Part 2			
1C	Coarse granular material	General fill	Any material or combination of materials Recycled aggregate	(i) grading	BS 1377 Part 2	Tab 6/2	Tab 6/2	End product min 95% MDD and max 5% air voids
				(ii) uniformity coefficient	See Note 5	5	-	
				(iii) Los Angeles coefficient	Clause 635	-	50	
2A	Wet Cohesive material	General fill	Any material, or combination of materials.	(i) grading	BS 1377 Part 2	Tab 6/2	Tab 6/2	End product min 95% MDD and max 5% air voids
				(ii) plastic limit (PL)	BS 1377 Part 2	-	-	
				(iii) mc	BS 1377 Part 2	PL-4%	PL x 1.3	
				(v) Undrained shear strength of remoulded material	Clause 633	50 kN/m^2	100 kN/m^2	

REQUIREMENTS FOR ACCEPTABILITY AND TESTING OF EARTHWORKS MATERIALS

CLASS	GENERAL MATERIAL DESCRIPTION	TYPICAL USE	PERMITTED CONSTITUENTS (All subject to requirements of Clause 601 (SHW) and Appendix 6/1)	MATERIAL PROPERTIES REQUIRED FOR ACCEPTABILITY (in addition to requirements on use of fill materials in Clause 601 (SHW) and testing in Clause 631 (SHW))				COMPACTION REQUIREMENTS IN CLAUSE 612 (SHW)
				PROPERTY (See exception in previous column)	DEFINED AND TESTED IN ACCORDANCE WITH:-	ACCEPTABLE LIMITS WITHIN:		
						Lower	Upper	
2B	Dry Cohesive material	General Fill	Any material, or combination of materials.	(i) grading	BS 1377 Part 2	Tab 6/2	Tab 6/2	End product min 95% MDD and max 5% air voids
				(ii) plastic limit (PL)	BS 1377 Part 2	-	-	
				(iii) mc	BS 1377 Part 2	App 6/1	PL - 4%	
				(v) Undrained shear strength of remoulded material	Clause 633	100 kN/m^2	-	
2C	Stony Cohesive Material	General Fill	Any material, or combination of materials.	(i) grading	BS 1377 Part 2	Tab 6/2	Tab 6/2	End product min 95% MDD and max 5% air voids
				(ii) plastic limit (PL)	BS 1377 Part 2	-	-	
				(iii) mc	BS 1377 Part 2	-	-	
				(v) Undrained shear strength of remoulded material	Clause 633	50 kN/m^2	-	
2D	Silty Cohesive Material	General Fill	Any material, or combination of materials.	(i) grading	BS 1377 Part 2	Tab 6/2	Tab 6/2	End product min 95% MDD and max 5% air voids
				(ii) mc	BS 1377 Part 2	-	-	
				(iv) Undrained shear strength of remoulded material	Clause 633	50 kN/m2	-	
2E	Reclaimed pulverised fuel ash cohesive material	General Fill	Reclaimed material from lagoon or stockpile containing not more than 20% furnace bottom ash	(i) mc	BS 1377 Part 2 See Note 4	To enable compaction to Clause 612		End product min 95% MDD and max 5% air voids
				(ii) bulk density	BS 1377 Part 9	App 6/1	App 6/1	
4	Various	Fill to landscape areas	See App 6/1	(i) grading	BS 1377 Part 2	-	125mm	See Clause 620 and App 6/1
				(ii) mc	BS 1377 Part 2	-	-	

REQUIREMENTS FOR ACCEPTABILITY AND TESTING OF EARTHWORKS MATERIALS

CLASS	GENERAL MATERIAL DESCRIPTION	TYPICAL USE	PERMITTED CONSTITUENTS (All subject to requirements of Clause 601 (SHW) and Appendix 6/1)	MATERIAL PROPERTIES REQUIRED FOR ACCEPTABILITY (in addition to requirements on use of fill materials in Clause 601 (SHW) and testing in Clause 631 (SHW))				COMPACTION REQUIREMENTS IN CLAUSE 612 (SHW)
				PROPERTY (See exception in previous column)	DEFINED AND TESTED IN ACCORDANCE WITH:-	ACCEPTABLE LIMITS WITHIN:		
						Lower	Upper	
5A	Topsoil, or turf, existing on site	Topsoiling	Topsoil or turf designated as Class 5A in the Contract	(i) grading	Clause 618	-	Clause 618	-
5B	Imported topsoil	Topsoiling	General purpose grade complying with BS 3882	-	-	-	-	-
5C	Imported Turf	Turfing	Material complying with BS3969	-	-	-	-	-
6A1	Selected well graded granular material	Below water	Natural gravel, natural sand, crushed gravel, crushed rock, other than argillaceous rock, crushed concrete, well burnt colliery spoil or any combination thereof	i) grading	BS1377 Part 2	As Class 6A. Tab 6/2	As Class 6A. Tab 6/2	No Compaction
				ii) uniformity coefficient	BS892	10	-	
				iii) plasticity index	BS1377 Part 2	Non Plastic	Non Plastic	
				iv) 10% fines	Clause 635	50kN	-	
6A2	Selected well graded granular material	Fill to soft areas and abandoned watercourses	Natural gravel, natural sand, crushed gravel, crushed rock, other than argillaceous rock, crushed concrete, well burnt colliery spoil or any combination thereof	i) grading	BS1377 Part 2	As Class 6A. Tab 6/2	As Class 6A. Tab 6/2	Tab 6/4 Method 5
				ii) uniformity coefficient	BS892	10	-	
				iii) mc	BS1377 Part 2 and Note 4	Optimum mc – 2.5%	Optimum mc	
				iv) plasticity index	BS1377 Part 2	Non plastic	Non plastic	
				v) optimum mc	BS1377 Part 4 Method 3.7	-	-	
				vi) 10% fines	Clause 635	50 kN	-	

REQUIREMENTS FOR ACCEPTABILITY AND TESTING OF EARTHWORKS MATERIALS

CLASS	GENERAL MATERIAL DESCRIPTION	TYPICAL USE	PERMITTED CONSTITUENTS (All subject to requirements of Clause 601 (SHW) and Appendix 6/1)	MATERIAL PROPERTIES REQUIRED FOR ACCEPTABILITY (in addition to requirements on use of fill materials in Clause 601 (SHW) and testing in Clause 631 (SHW))				COMPACTION REQUIREMENTS IN CLAUSE 612 (SHW)
				PROPERTY (See exception in previous column)	DEFINED AND TESTED IN ACCORDANCE WITH:-	ACCEPTABLE LIMITS WITHIN:		
						Lower	Upper	
6B	Selected coarse granular material	Starter layer	Natural gravel, natural sand, crushed rock, crushed concrete, slag, well-burnt colliery spoil or any combination thereof	i) grading	BS1377 Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 5
				ii) plasticity index	BS1377 Part 2	Non plastic	Non plastic	
				iii)10% fines value	Clause 635	50 kN	-	
6C	Selected uniformly graded material	Starter layer	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock crushed concrete well-burnt colliery spoil or any combination thereof	i) grading	BS1377 Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 3
				ii)uniformity coefficient	BS892	-	10	
				iii)plasticity index	BS1377 Part 2	Non plastic	Non plastic	
				iv)10% fines	Clause 635	50 kN	-	
				v) mc	BS1377 Part 2 and Note 4	optimum mc - 2 %	optimum mc + 1%	
				vi)optimum mc	BS1377 Part 2	-	-	
6F1	Selected granular material (fine grading)	Capping	Any material, or combination of materials, other than unburnt colliery spoil and argillaceous rock	i) grading	BS1377 Part 2	As Class 6F1. Tab 6/2	As Class 6F1. Tab 6/2	Tab 6/4 Method 6
				ii) optimum mc	BS1377	-	-	
				iii) mc	BS1377 Part 2 and Note 4	-	Optimum mc +1%	
				iv)10% fines values	Clause 635	30 kN	-	

REQUIREMENTS FOR ACCEPTABILITY AND TESTING OF EARTHWORKS MATERIALS

CLASS	GENERAL MATERIAL DESCRIPTION	TYPICAL USE	PERMITTED CONSTITUENTS (All subject to requirements of Clause 601 (SHW) and Appendix 6/1)	MATERIAL PROPERTIES REQUIRED FOR ACCEPTABILITY (in addition to requirements on use of fill materials in Clause 601 (SHW) and testing in Clause 631 (SHW)				COMPACTION REQUIREMENTS IN CLAUSE 612 (SHW)
				PROPERTY (See exception in previous column)	DEFINED AND TESTED IN ACCORDANCE WITH:-	ACCEPTABLE LIMITS WITHIN:		
						Lower	Upper	
6F2	Selected granular material (coarse grading)	Capping	Any material, or combination of materials, other than unburnt colliery spoil and argillaceous rock	i)grading	BS1377 Part 2	As Class 6F2. Tab 6/2	As Class 6F2. Tab 6/2	Tab 6/4 Method 6
				ii) optimum mc	BS1377 Part 4 (vib Hammer)	-	-	
				iii) mc	BS1377 Part 2 and Note 4	-	optimum mc + 1 %	
				iv)10% fines value	Clause 635	30 KN	-	
				v) chemical constituents	App 1/5 Table 1/5 Part B			
6F3	Selected Granular Material	Capping	Recycled bituminous planings & granulated asphalt but excluding materials containing tar or tar / bitumen binders. Recycled aggregate.	i) grading	BS1377 Part 2	-	As Class 6F2. Tab 6/2	Tab 6/4 Method 6
				ii) uniformity coefficient	BS892	-	-	
				iii) optimum mc	BS1377 Part 4 Method 3.7	-	-	
				iv) mc	BS1377 Part 2 and Note 4	optimum mc - 2%	optimum mc	
				v) bitumen content	BS 598 PART102	-	10%	

NOTES

1. App = Appendix

2. Tab = Table

3. Where in the Acceptable Limits column reference is made to App 6/1, only those properties having limits ascribed to them in Appendix 6/1 shall apply. Where Appendix 6/1 gives limits for other properties not listed in this Table such limits shall also apply.

4. Where BS1377: Part 2 is specified for mc, this shall mean BS1377: Part 2 or BS EN 1097-5 as appropriate.

5. The moisture content shall be determined on the material passing the 37.5mm BS sieve.

6. Class 4 material shall be of such size that it can be deposited in horizontal layers each not exceeding 450mm loose depth. Isolated boulders up to 0.085 m^3 in size may be incorporated in Class 4 material provided that the specified compaction requirements are met. No stone exceeding 0.015 m3 shall be placed less than 1m below finished earthworks outline.

7. Unless otherwise stated, compaction shall be in accordance with BS1377 Part 4 clause 7.2.4.4 using a 4.5 kg rammer. Material to be tested at moisture content at time of placement.

8. The acceptability of general cohesive fills may be controlled by field undrained shear strength (hand shear vane) to the minimum frequency given in Appendix 1/5. The validation of cohesive materials in the bases of over-excavations below formation shall also be made using the hand shear vane, for which the specified minimum strength shall be 60 kN/m^2

9. Each determination of undrained shear strength of remoulded material reported shall be the average of three hand shear vane tests carried out in the field. Supplementary undrained triaxial shear strength testing of remoulded material is required to validate hand shear vane values in accordance with Clause 633 and Table 6/1.

10. Material, otherwise complying, but failing to meet a shear strength criterion exceeding the upper limit for Class 2B, may be used subject to site trials by the Contractor to demonstrate that an adequate state of compaction is achieved.

11. For Tables 6/2, 6/3, 6/4, 6/5 and 6/6 see Specification for Highways Works Series 600 Earthworks.

Appendix B Shipley Lakeside Development Parameters Plan



Development Parameters Schedule

Plot Ref	Use	Planning Use Class	Plot Area (ha)	Anticipated Build Densities	Plot Level (Above Ordanace Datum)	Maximum Building Height (to ridge/apex)
A	Retirement Village	C2, C3	1.0	7,000m²	75.0 - 74.5m AOD	12 metres above FFL
B1	Neighbourhood Centre	A1, A2, A3, A5, D1	0.2	1,213m²	79.5m AOD	10 metres above FFL
B2	Neghbourhood Centre	A1,A2,A3,A5,D1	0.2	1,213m²	87.0 - 86.5m AOD	10 metres above FFL
C	Hotel and Restaurant/ Conference	A3, A4, C1	0.7	1,163m² plus 120 bedroom hotel	74.0 - 72.0m AOD	18 metres above FFL
F	Health and Care Campus	D1, C2	1.7	5,336m²	78.0 - 79.4m AOD	14 metres above FFL
E1 & E2	Business	B1	1.1	4,681m²	89.0 - 88.5m AOD	14 metres above FFL
D	Garden Centre/Leisure/ Training/Assembly	A1, D1, D2 Sui Generis	3.1	9,290m²	79.5 - 78.39m AOD	14 metres above FFL
R1	Residential Phase 1	C3	1.7	71 units based on a density of 44 per Ha	88.5 - 88.0m AOD	9 metres above FFL
R2	Residential Phase 2	C3	5.0	169 units based on a density of 36.5 per Ha	74.59- 70.86m AOD	12 metres above FFL
R3	Residential Phase 3	C3	3.2	67 units based on a density of 30 per Ha	74.7 - 71.0m AOD	9 metres above FFL

* FFL based upon 400mm above Plot Level

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CLIENT
WAYSTONE DEVELOPMENT LTD

PROJECT
Shipley Lakeside Development

DRAWING TITLE
SHIPLEY LAKESIDE DEVELOPMENT PARAMETERS PLAN

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The Contractor is to bring to the notice of Waystone Developments Ltd any discrepancies contained in this drawing prior to work commencement.

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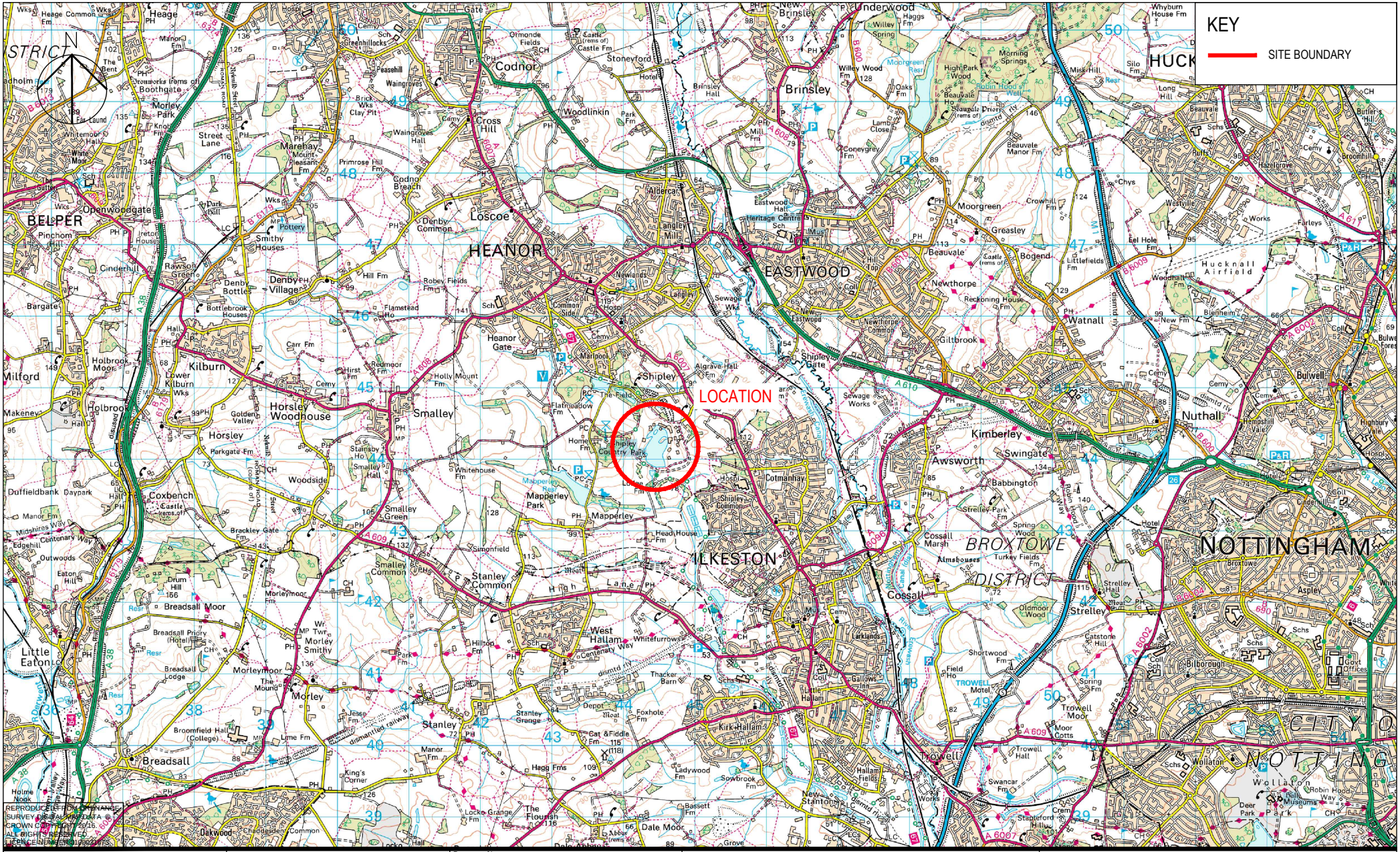
CONTRACT	SCALE	DATE
SL	1/2000@A1	04/01/2017
DRAWN BY	**CHECKED BY**	**APPROVED BY**
DT	DT/HMcL	HMcL

SL-DPP-MP-02

REV **D** 24/03/2017

Drawings



Project Title: SHIPLEY LAKESIDE DEVELOPMENT	Drawing Title: SITE LOCATION PLAN	Purpose of issue: DRAFT			
Client: WAYSTONE DEVELOPMENTS LTD		Designed: VO	Drawn: JPH	Checked: VO	Approved:	Date: 8/11/16
		AECOM Internal Project No.: 60469159		Suitability:	
		Scale @ A3: 1:50,000		Zone / Mileage:	

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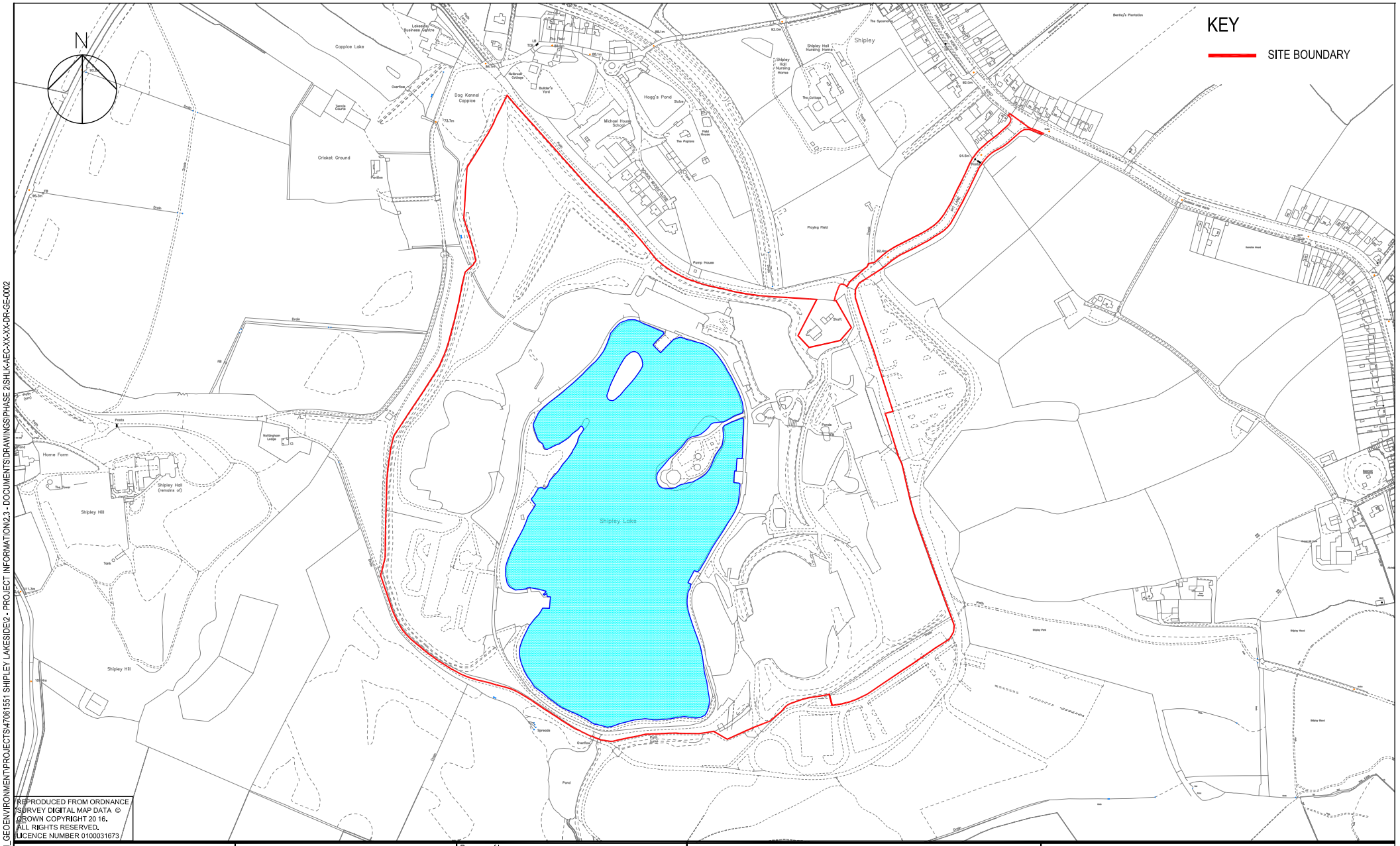
Drawing Number	Rev
SHLK-AEC-XX-XX-DR-GE-0001	-



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Project Title
SHIPLEY LAKESIDE DEVELOPMENT

Client
WAYSTONE DEVELOPMENTS LTD

Drawing Title
SITE LAYOUT

Purpose of Issue
FINAL

Designed	Drawn	Checked	Approved	Date
VO	JPH	VO		8/11/16

AECOM Internal Project No.
60469159

Suitability

Scale @ A3
1:5000

Zone / Mileage

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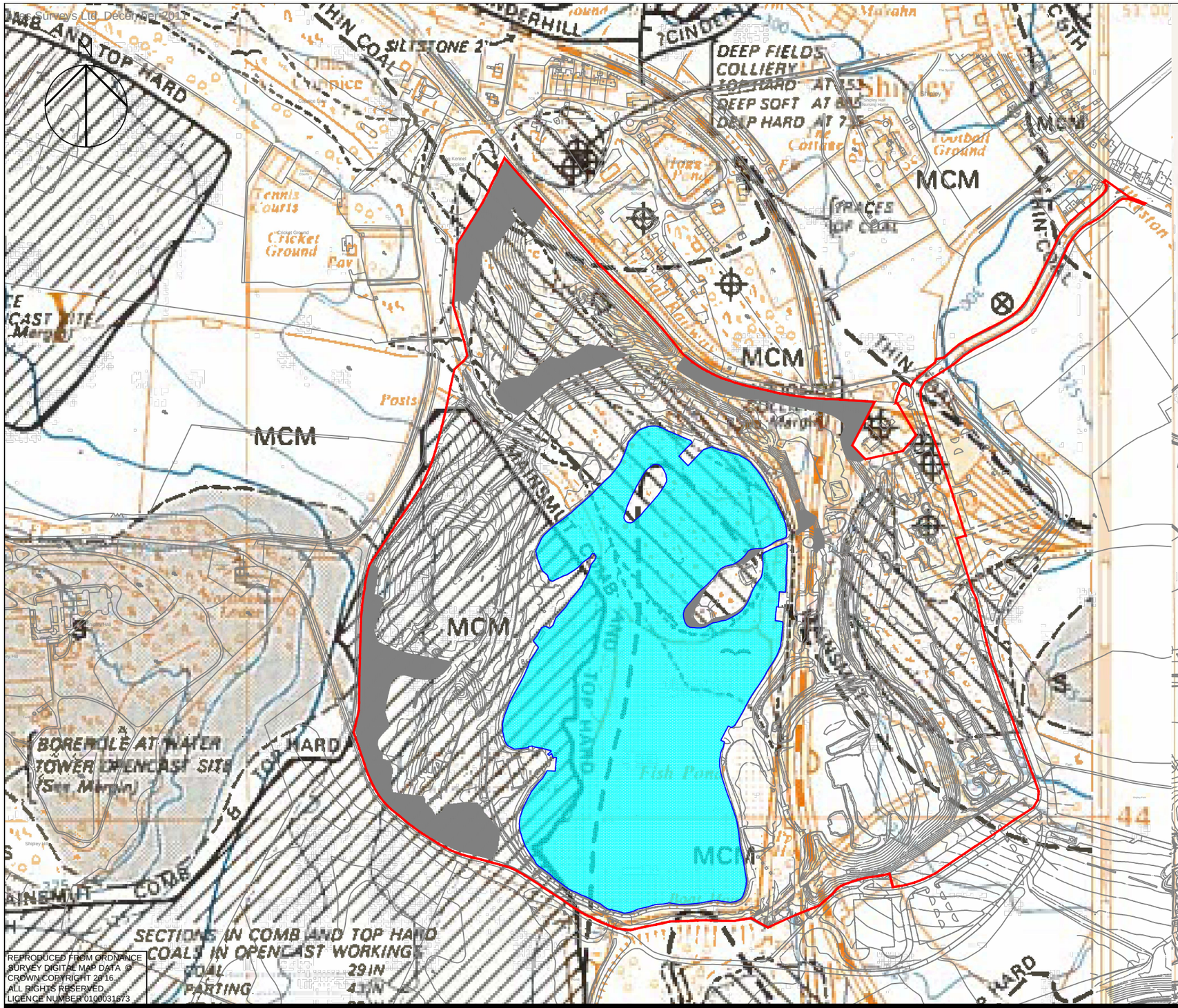
Drawing Number
SHLK-AEC-XX-XX-DR-GE-0002

Rev
-

Plot Date: 27 October 2016 14:59:04
File Name: \\CH-WIP-001\CH_GEOENVIRONMENT\PROJECTS\47061551 SHIPLEY LAKESIDE\2 - PROJECT INFORMATION\2.3 - DOCUMENTS\DRAWINGS\PHASE 2\SHLK-AEC-XX-XX-DR-GE-0002

Ian Stirrups Ltd. December 2017



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KEY

SITE BOUNDARY

INDEX AND EXPLANATION

DRIFT

RECENT AND PLEISTOCENE

- Alluvium
- 1st Terrace
- Boulder Clay

SOLID

PERMO-TRIASSIC

- PB — Bunter Pebble Beds
- LMS — Lower Mottled Sandstone

CARBONIFEROUS

MIDDLE COAL MEASURES / LOWER COAL MEASURES

- MCM — Undivided
- S — Sandstone
- LCM — Undivided
- S — Sandstone

See also Generalized Vertical Section

- Inclined strata, dip in degrees
- Horizontal strata
- Geological boundary, Drift
- Geological boundary, Solid
- Coal-crop
- Fault at surface (white on coloured copies)
- W KILBURN — Fault underground in horizon named (yellow on solid coloured copies) the note on side from which fault was proved
- Throw of fault where known is given in feet at point indicated, crossmark indicates downthrow side
- M — Marine Band

Project Title: SHIPLEY LAKESIDE DEVELOPMENT	Drawing Title: SITE GEOLOGICAL PLAN	Purpose of issue: FINAL		
Client: WAYSTONE DEVELOPMENTS LTD		Designed: VO	Drawn: JPH	Checked: VO / Approved: / Date: 8/11/16
		AECOM Internal Project No.: 60469159	Suitability:	
		Scale @ A3: 1:5000	Zone / Mileage:	

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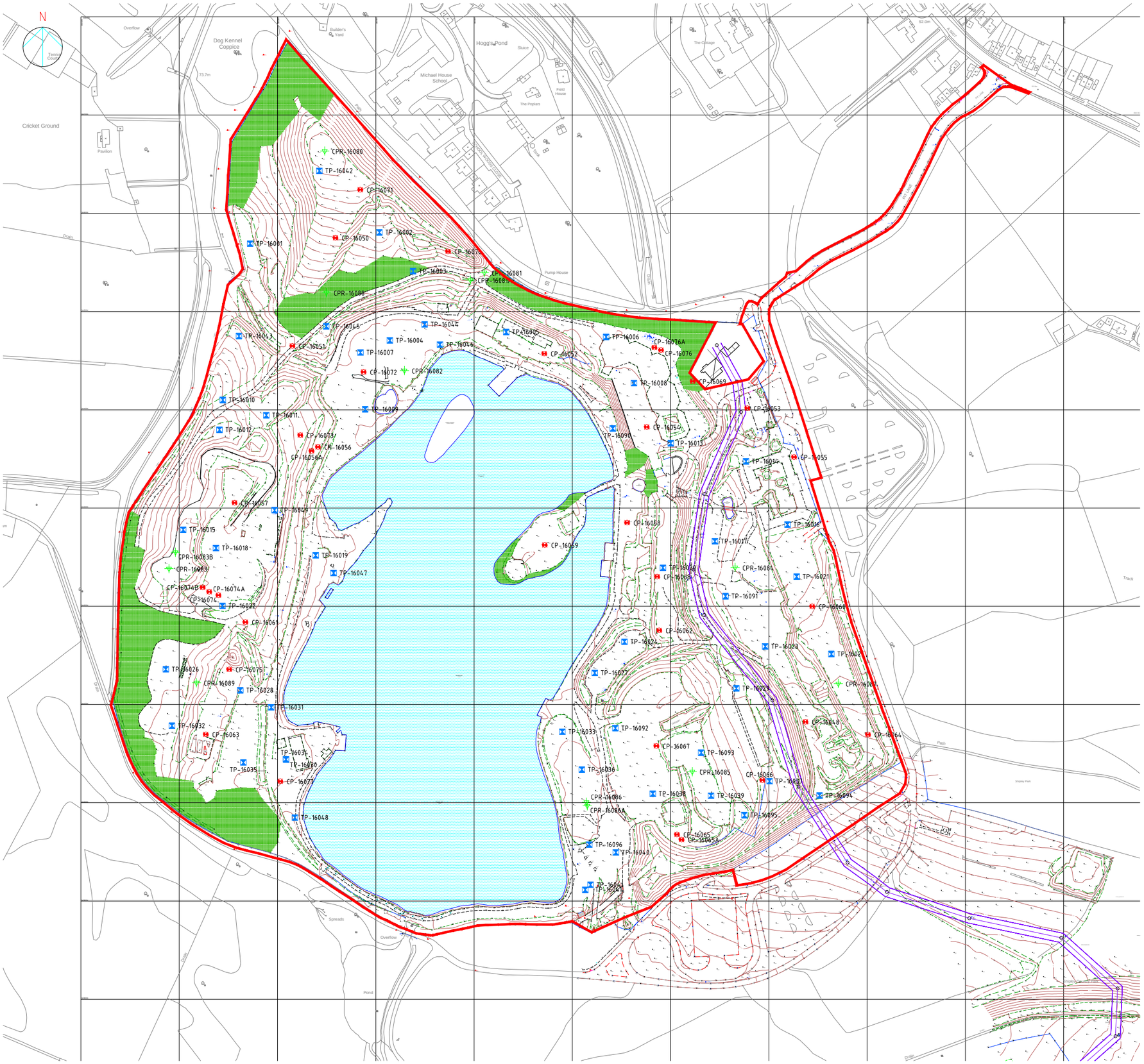

Ground Investigation Coordinates

NAME	EASTING (m)	NORTHING (m)
TP16001	444272.101	344569.410
TP16002	444403.744	344580.801
TP16003	444438.012	344541.324
TP16004	444414.410	344470.824
TP16005	444532.788	344479.402
TP16006	444634.465	344474.317
TP16007	444384.411	344458.488
TP16008	444662.869	344427.332
TP16009	444389.236	344400.701
TP16010	444244.302	344410.208
TP16011	444288.544	344394.666
TP16012	444240.904	344379.819
TP16013	444700.324	344366.172
TP16014	444776.914	344347.690
TP16015	444203.919	344278.045
TP16016	444819.219	344283.366
TP16017	444745.225	344266.341
TP16018	444237.333	344259.382
TP16019	444338.747	344252.016
TP16020	444692.301	344239.320
TP16021	444828.430	344230.345
TP16022	444243.890	344200.530
TP16023	444796.461	344159.270
TP16024	444653.147	344164.040
TP16025	444863.802	344151.537
TP16026	444186.261	344135.928
TP16027	444622.879	344132.283
TP16028	444262.070	344114.583
TP16029	444766.998	344116.608
TP16030	444308.633	344044.163
TP16031	444293.541	344097.246
TP16032	444192.484	344078.491
TP16033	444589.887	344072.394
TP16034	444308.521	344044.409
TP16035	444265.213	344041.099
TP16036	444609.763	344033.906
TP16037	444800.798	344022.044
TP16038	444681.983	344009.269
TP16039	444741.226	344007.308
TP16040	444644.373	343949.594
TP16041	444618.584	343916.580
TP16042	444342.528	344643.489
TP16043	444260.727	344475.274
TP16044	444449.788	344487.096
TP16045	444349.585	344485.183
TP16046	444465.394	344466.621
TP16047	444357.038	344233.959
TP16048	444317.556	343984.997
TP16049	444296.982	344297.991
TP16090	444641.280	344381.134
TP16091	444756.017	344210.408
TP16092	444643.874	344075.972
TP16093	444731.245	344051.057
TP16094	444851.692	344007.448
TP16095	444775.272	343987.477
TP16096	444617.309	343957.501
CP16048	444837.363	344082.505
CP16050	444358.956	344575.341
CP16051	444315.065	344465.147
CP16052	444571.554	344457.447
CP16053	444778.176	344401.767
CP16054	444675.842	344382.732
CP16055	444825.765	344352.112
CP16056	444341.132	344362.377
CP16056A	444334.602	344358.271
CP16057	444256.271	344305.526
CP16058	444655.818	344285.230
CP16059	444571.996	344262.537
CP16060	444844.269	344199.984
CP16061	444267.302	344184.024
CP16062	444688.521	344175.637
CP16063	444226.988	344069.735
CP16064	444901.037	344069.558
CP16065	444706.613	343967.815
CP16065A	444711.196	343962.544
CP16066	444793.476	344023.026
CP16067	444685.616	344057.941
CP16068	444686.427	344230.355
CP16069	444722.605	344429.226
CP16070	444473.607	344561.472
CP16071	444384.214	344624.225
CP16072	444387.608	344438.716
CP16073	444323.142	344374.354
CP16074	444239.828	344211.479
CP16074A	444230.427	344214.900
CP16074B	444223.746	344219.398
CP16075	444250.758	344135.848
CP16076	444690.390	344461.065
CP16076A	444683.641	344463.538
CP16077	444302.827	344021.931
CPR16080	444348.044	344663.669
CPR16081	444510.534	344539.849
CPR16081A	444496.321	344532.318
CPR16082	444429.185	344440.130
CPR16083	444189.516	344238.452
CPR16083B	444196.103	344255.154
CPR16084	444765.860	344239.636
CPR16085	444722.206	344031.718
CPR16086	444614.468	344000.662
CPR16086A	444615.292	343996.936
CPR16087	444870.920	344121.427
CPR16088	444349.739	344519.430
CPR16089	444217.507	344122.276

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KEY

- TP-16037 — TRIAL PIT
- CP-16050 — CABLE PERCUSSIVE BOREHOLE
- CPR-16080 — CABLE PERCUSSIVE BOREHOLE WITH ROTARY CORE FOLLOW ON
- INDICATIVE LOCATION OF MINEWATER CULVERT

Revision Details	By / Check	Date	Suffix

Purpose of issue

DRAFT

Client

WAYSTONE DEVELOPMENTS LTD

Project Title

SHIPLEY LAKESIDE

Drawing Title

GROUND INVESTIGATION EXPLORATORY HOLE LOCATION PLAN

Designed	Drawn	Checked	Approved	Date
VO	JPH	VO		8/11/16

AECOM Internal Project No.	Suitability
60469159	
Scale @ A1: 1:2000	Zone

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Drawing Number	Rev
SHLK-AEC-XX-XX-DR-GE-0004	-

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Plot Date: 12/7/2016 2:54 PM
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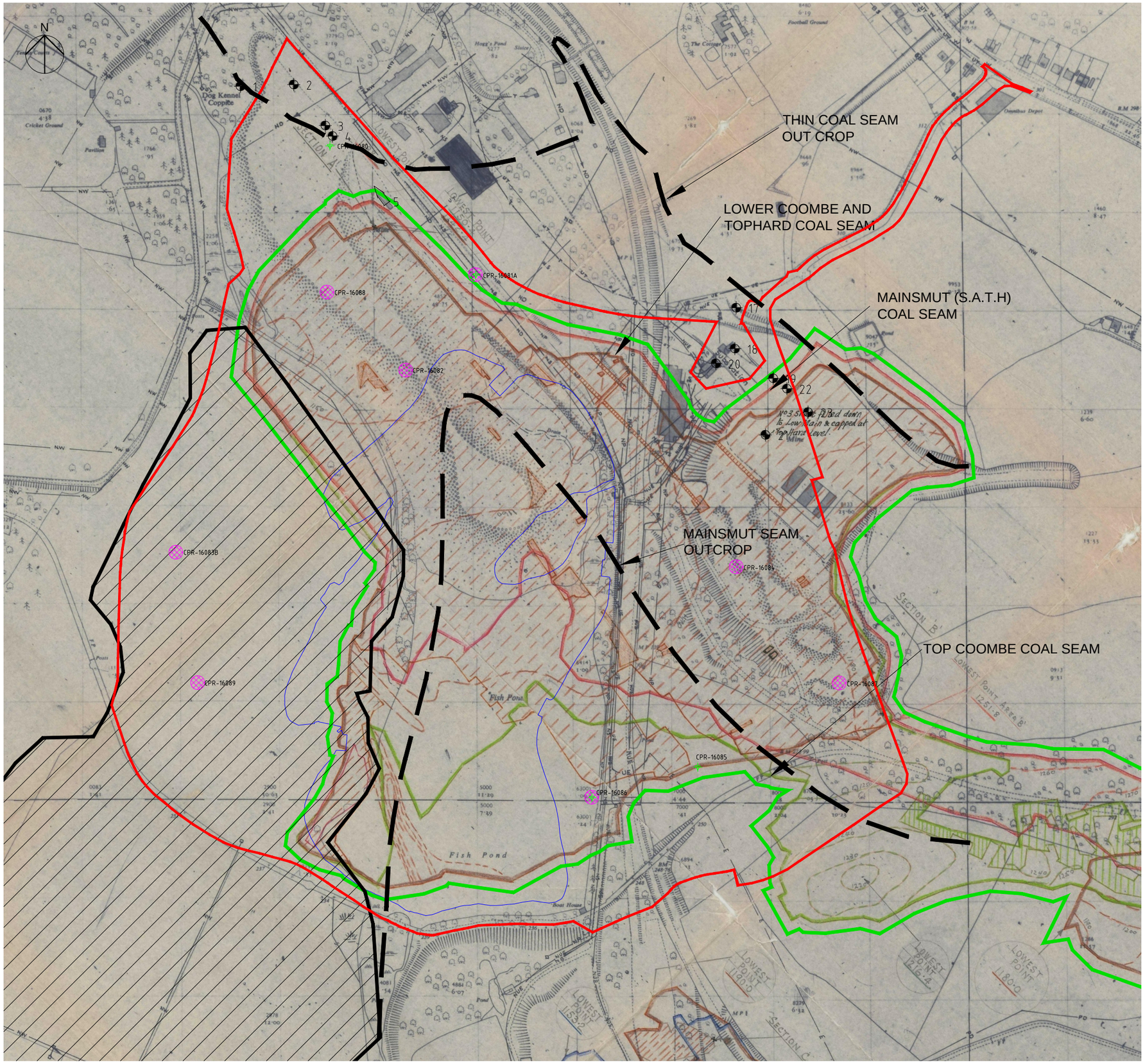

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Rev Date: 11/25/2016 12:43 PM
File Name: SHLK-AEC-XX-XX-DR-GE-0013

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NOTES

KEY

- MAINSMUT COOMBE AND TOP HARD SEAMS WORKED AND BACKFILLED AS INDICATED ON BGS GEOLOGICAL MAP
- SITE BOUNDARY
- INDICATIVE SHIPLEY OPENCAST BOUNDARY
- SEAM OUTCROPS INDICATED ON BGS GEOLOGICAL MAP
- 1 MINESHAFT
- ADIT
- CPR-16080 BOREHOLES WHERE COAL SEAMS WERE ENCOUNTERED
- CPR-16083B BOREHOLES WHERE VOIDS WERE ENCOUNTERED
- AREA OF SEAM WHERE OLD WORKINGS WERE LOCATED
- OUTLINE OF SHIPLEY LAKE

Revision Details	By / Check	Date	Suffix

Purpose of issue: DRAFT

Client: WAYSTONE DEVELOPMENTS LTD

Project Title: SHIPLEY LAKESIDE

Drawing Title: HISTORICAL MINING CONSTRAINTS

Designed	Drawn	Checked	Approved	Date
VO	JPH	VO		09/11/16

AECOM Internal Project No.: 60469159
Suitability:
Scale @ A1: 1:2000
Zone:

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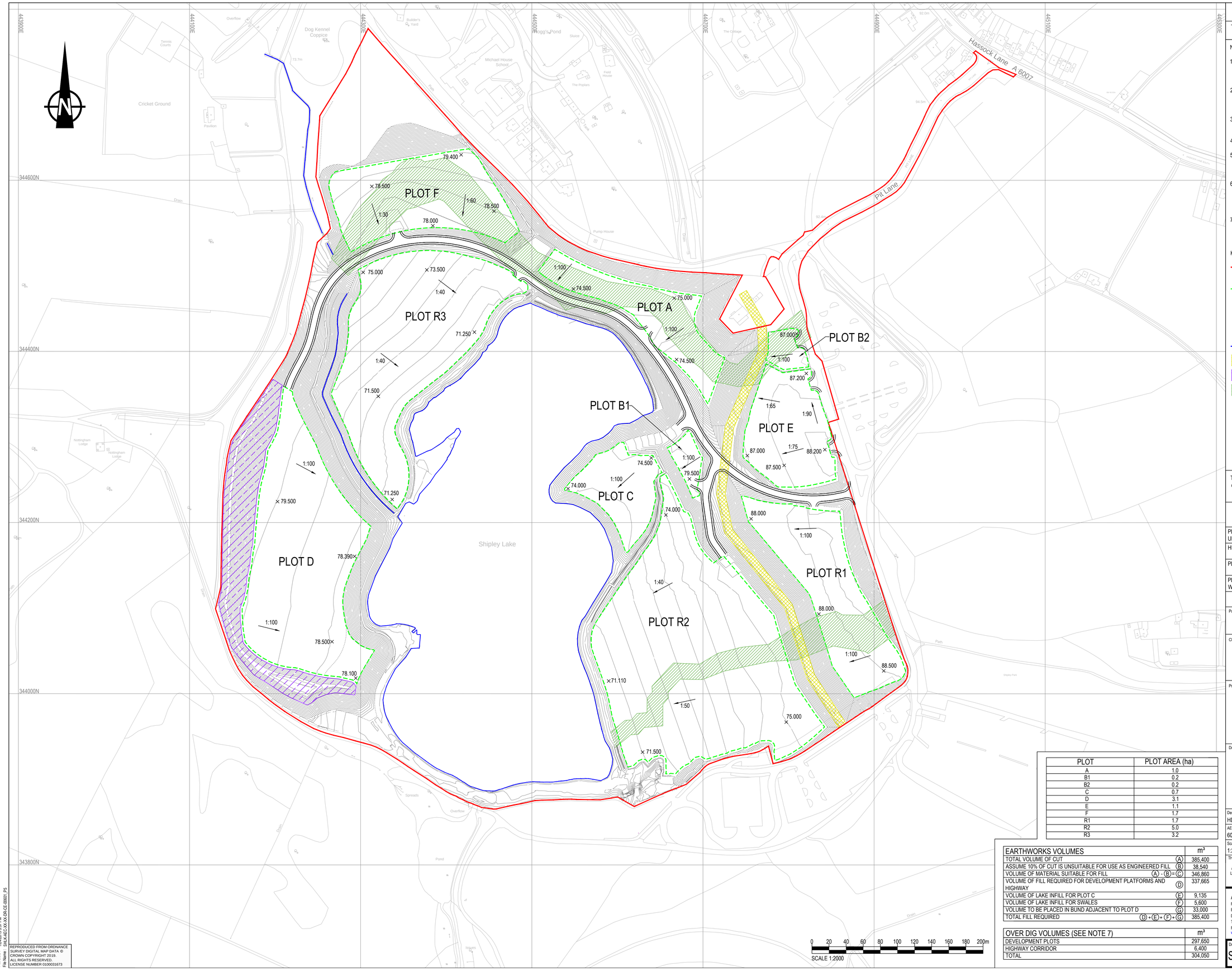
Drawing Number: SHLK-AEC-XX-XX-DR-GE-0013
Rev: -



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NOTES

1. ALL DIMENSIONS ARE IN METRES AND ALL LEVELS ARE IN METRES ABOVE ORDINANCE DATUM UNLESS OTHERWISE STATED.
2. THE PROPOSED EARTHWORKS LAYOUT IS BASED ON TOPOGRAPHICAL SURVEY SHIPLEY2D.DWG RECEIVED FROM WAYSTONE.
3. PROPOSED EARTHWORKS BATTERS HAVE TYPICALLY BEEN MODELLED AT A GRADIENT OF 1 IN 3.
4. CONTOURS SHOWN AT 0.5m SPACING.
5. THE PROPOSED DEVELOPMENT LAYOUT IS BASED ON DRAWING SL-DPP-MP-02 REVISION D PREPARED BY WAYSTONE, DATED 24.03.17.
6. EARTHWORKS VOLUMES ARE BASED ON CUT AND FILL FROM SURVEYED FINISHED GROUND LEVELS. IT IS ASSUMED THAT EXISTING SLABS AND FOUNDATIONS PRESENT ON SITE WILL BE CRUSHED AND REUSED AS PART OF THE WORKS.
7. OVER-DIG AND RECOMPACTION OF EARTHWORKS WILL BE REQUIRED IN ACCORDANCE WITH THE PARAMETERS OUTLINED IN THE RECLAMATION STRATEGY REPORT.

KEY

- PROPOSED SITE BOUNDARY
- PROPOSED PLOT BOUNDARIES
- 1:100 FALL DIRECTION AND GRADIENT
- × 79.500 SPOT LEVEL
- WATERCOURSE AND PROPOSED LAKE BOUNDARY
- EASEMENT FOR MINE WATER PIPE ROUTE
- SCREENING BUND
- HIGHWALL STANDOFF

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Revision Details	By / Check	Date	Suffix
PLOT E LAYOUT AND OVER DIG VOLUMES UPDATED	MS / GH	24.01.19	P5
HIGHWAY AND SUDS DESIGN UPDATED	MS / SS	20.12.18	P4
PLOT BOUNDARIES AMENDED	MS / TB	23.03.17	P3
PLOT R1 AMENDED FOLLOWING WAYSTONE COMMENTS	JW / MS	28.11.16	P2

Purpose of issue

PRELIMINARY

Client

WAYSTONE

Project Title

SHIPLEY LAKESIDE

Drawing Title

EARTHWORK LAYOUT

Designed	Drawn	Checked	Approved	Date
HD	JW	MS	GH	25.11.16

AECOM Internal Project No.: 60469159

Suitability:

Scale @ A1: 1:2000

Zone: -

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PLOT	PLOT AREA (ha)
A	1.0
B1	0.2
B2	0.2
C	0.7
D	3.1
E	1.1
F	1.7
R1	1.7
R2	5.0
R3	3.2

EARTHWORKS VOLUMES		m³
TOTAL VOLUME OF CUT	(A)	385,400
ASSUME 10% OF CUT IS UNSUITABLE FOR USE AS ENGINEERED FILL	(B)	38,540
VOLUME OF MATERIAL SUITABLE FOR FILL	(A) - (B) = (C)	346,860
VOLUME OF FILL REQUIRED FOR DEVELOPMENT PLATFORMS AND HIGHWAY	(D)	337,665
VOLUME OF LAKE INFILL FOR PLOT C	(E)	9,135
VOLUME OF LAKE INFILL FOR SWALES	(F)	5,600
VOLUME TO BE PLACED IN BUND ADJACENT TO PLOT D	(G)	33,000
TOTAL FILL REQUIRED	(D) + (E) + (F) + (G)	385,400

OVER DIG VOLUMES (SEE NOTE 7)	m³
DEVELOPMENT PLOTS	297,650
HIGHWAY CORRIDOR	6,400
TOTAL	304,050

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Drawing Number: SHLK-AEC-XX-XX-DR-CE-00601

Rev: P5

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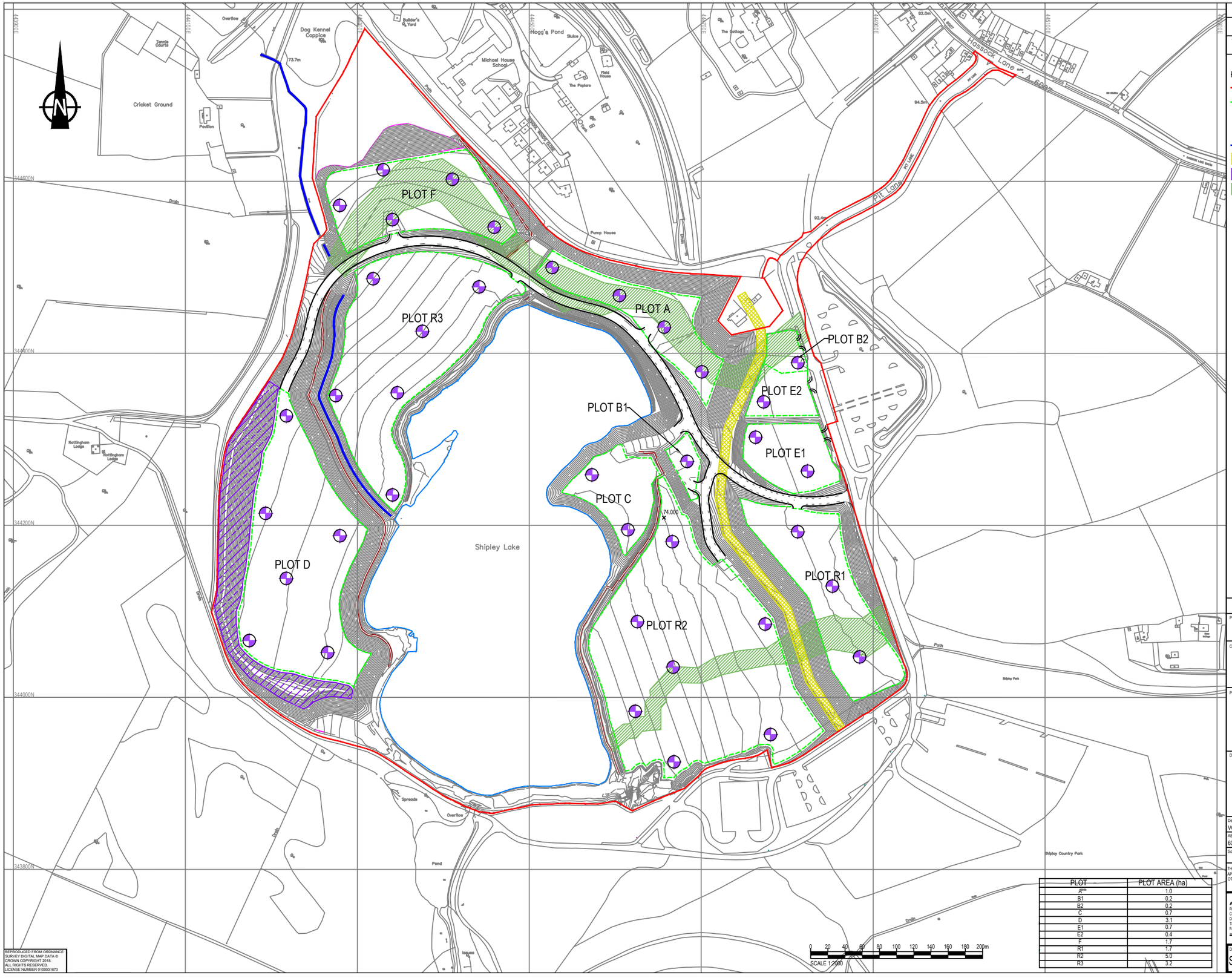

PLOT	PLOT AREA (ha)
A[Note]	1.0
B1	0.2
B2	0.2
C	0.7
D	3.1
E1	0.7
E2	0.4
F	1.7
R1	1.7
R2	5.0
R3	3.2

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KEY

- PROPOSED SITE BOUNDARY
- PROPOSED PLOT BOUNDARIES
- 1:100 FALL DIRECTION AND GRADIENT
- × 79.500 SPOT LEVEL
- WATERCOURSE AND PROPOSED LAKE BOUNDARY
- EASEMENT FOR MINE WATER PIPE ROUTE
- SCREENING BUND
- HIGHWALL STANDOFF
- GROUNDWATER AND GROUND GAS MONITORING LOCATIONS

Revision Details	By / Check	Date	Suffix

Purpose of issue: DRAFT

Client: WAYSTONE DEVELOPMENT LTD

Project Title: SHIPLEY LAKESIDE

Drawing Title: PROPOSED GROUNDWATER AND GAS MONITORING WELLS

Designed	Drawn	Checked	Approved	Date
VO	AAO	DJC	DJC	01/19

AECOM Internal Project No.	Suitability
60469159	
Scale @ A1	Zone

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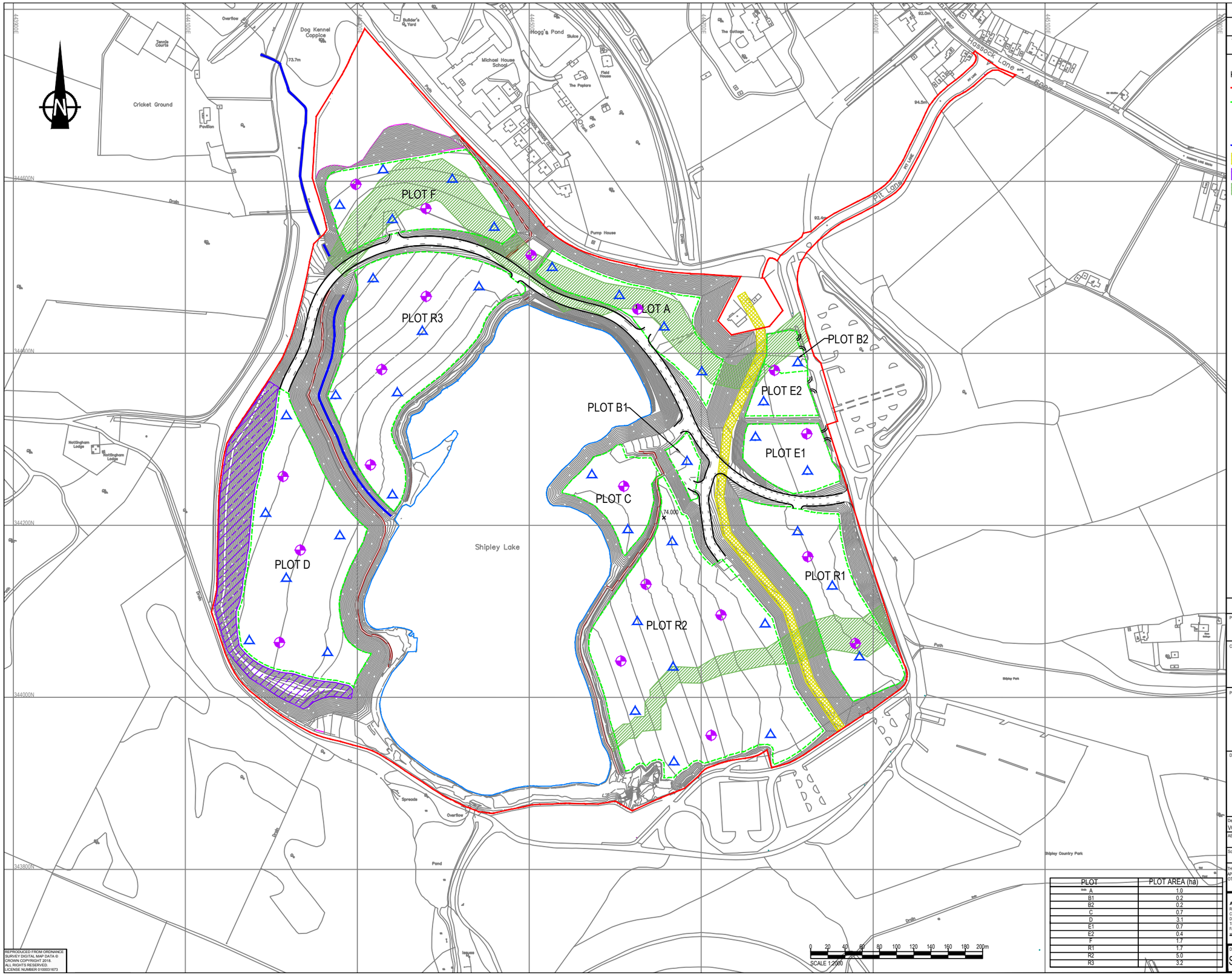
Drawing Number: SHLK-AEC-XX-XX-DR-GE-0030

Rev: -



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- EASEMENT FOR MINE WATER PIPE ROUTE
- SCREENING BUND
- HIGHWALL STANDOFF
- ROD AND PLATE PROPOSED LOCATIONS
- SURFACE MARKERS PROPOSED LOCATIONS

PLOT	PLOT AREA (ha)
A	1.0
B1	0.2
B2	0.2
C	0.7
D	3.1
E1	0.7
E2	0.4
F	1.7
R1	1.7
R2	5.0
R3	3.2

0 20 40 60 80 100 120 140 160 180 200m

SCALE 1:2000

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Revision Details	By / Check	Date	Suffix

Purpose of issue

DRAFT

Client

WAYSTONE DEVELOPMENT LTD

Project Title

SHIPLEY LAKESIDE

Drawing Title

PROPOSED LOCATION OF ROD AND PLATE SETTLEMENT MONITORING

Designed	Drawn	Checked	Approved	Date
VO	AAO	DJC	DJC	01/19

AECOM Internal Project No. | Suitability

Scale @ A1 | Zone

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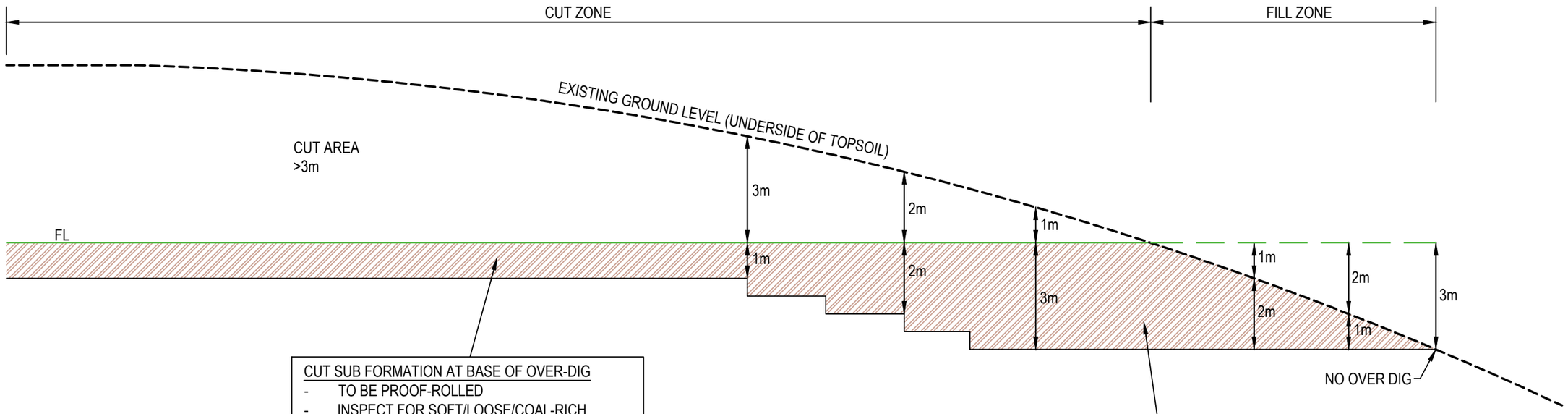
Drawing Number

SHLK-AEC-XX-XX-DR-GE-0031

Rev



KEY

OPENCAST / MADE GROUND MATERIAL TO BE EXCAVATED AND RECOMPACTED BELOW EXISTING LEVEL

NOTE

1. THE SHEAR STRENGTH OF COHESIVE MATERIAL IN THE BASES OF THE OVER-DIG EXCAVATIONS SHALL BE TESTED USING HAND VANE SHEAR EQUIPMENT. THE MINIMUM PERMISSIBLE SHEAR STRENGTH SHALL BE 50 kN/m².

ROAD CORRIDOR

IN CUT AREAS - 1m OVER-DIG
IN FILL AREAS - MIN 1.5m FILL

Project Title: SHIPLEY LAKESIDE	Drawing Title: RECLAMATION EARTHWORKS TYPICAL SECTION	Purpose of issue			
		Designed: DJC	Drawn: AAO	Checked: VO	Approved: DJC	Date: 01/19
Client: WAYSTONE LTD		AECOM Internal Project No.		Suitability	
		Scale @ A3: 1:125		Zone / Mileage	

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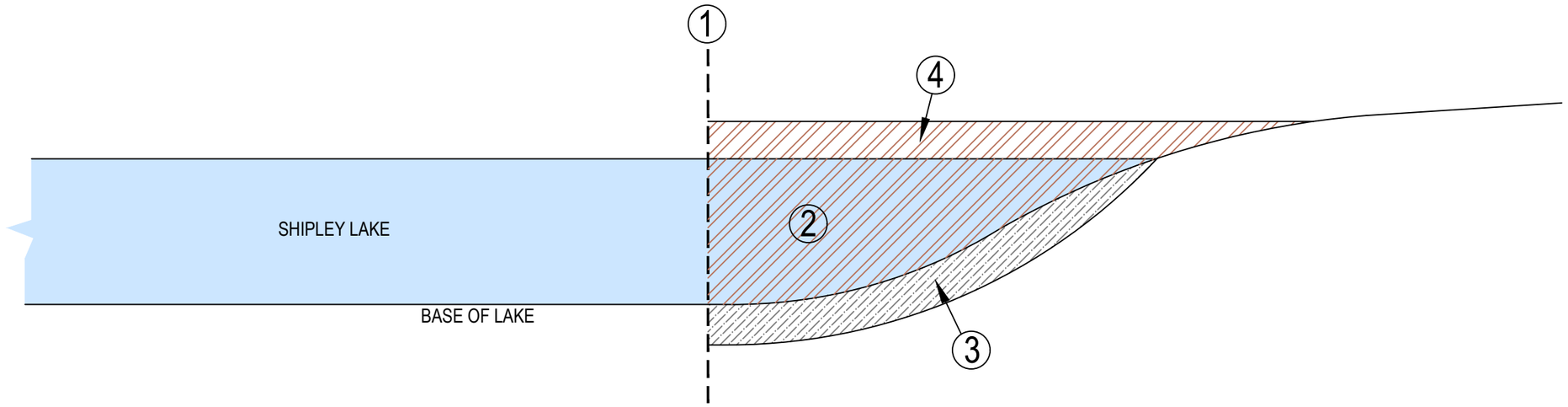
Drawing Number	Rev
SHLK-AEC-XX-XX-DR-GE-0032	1



① CUT-OFF WALL TO ISOLATE AREA TO BE RECLAIMED FROM REMAINDER OF LAKE
(POSSIBLY SHEET PILING OR OTHER CUT-OFF)

② DE-WATER INSIDE CUT-OFF

③ DREDGE BASE OF LAKE TO REMOVE SOFT MATERIAL

④ BUILD UP LAYERS IN COMPACTED FILL

Project Title
SHIPLEY LAKESIDE

Client
WAYSTONE DEVELOPMENT LTD

Drawing Title
OUTLINE DRAWING OF
SHIPLEY LAKE DREDGING
FOR PLOT C

Purpose of issue

Designed	Drawn	Checked	Approved	Date
DJC	AAO	VO	DJC	01/19

AECOM Internal Project No.	Suitability
Scale @ A3 N.T.S	Zone / Mileage

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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

IT IS ASSUMED THAT ALL WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROPRIATE METHOD STATEMENT.

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT.

KEY

- PROPOSED SITE BOUNDARY
- PROPOSED PLOT BOUNDARIES

HEIGHT RANGES

10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14

NOTE

DEPTHS OF CUT AND FILL SHOWN ARE BETWEEN EXISTING GROUND LEVEL AND PROPOSED FINISHED LEVELS AND DO NOT INCLUDE ANY ADDITIONAL OVER-EXCAVATION AND RE-COMPACTION THAT MAY BE REQUIRED

Revision Details	By / Check	Date	Suffix

Purpose of issue

DRAFT

Client

WAYSTONE LTD

Project Title

SHIPLEY LAKESIDE

Drawing Title

CUT / FILL PLAN

Designed	Drawn	Checked	Approved	Date
DT	SW	DT	DJC	01/19

AECOM Internal Project No.	Suitability
60469159	
Scale @ A1	Zone

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Drawing Number	Rev
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