AN APPLICATION FOR AN ENVRIONMENTAL PERMIT TO AUTHORISE THE DEPOSITION OF WASTE ON LAND AS A RECOVERY ACTIVITY FOR THE RESTORATION OF PHASES 12, 13A AND 13C AT BROOKSBY QUARRY, MELTON ROAD, BROOKSBY, LEICESTERSHIRE

STABILITY RISK ASSESSMENT

Report reference: TAR/BRO/TWC/3236/01/SRA
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CONTENTS

TABLES

FIGURES

APPENDICES

1. Introduction

1.1. Report Context

1.1.1. MJCA is commissioned by Tarmac Trading Limited (Tarmac) to prepare a Stability Risk Assessment (SRA) as part of an application for a bespoke Environmental Permit (EP) for the deposition of inert waste on land as a recovery activity at Brooksby Quarry, Melton Road, Brooksby, Leicestershire (herein referred to as the 'Site'). The Site is operated by Tarmac for the extraction of sand and gravel. The application includes the importation of inert materials in order to restore Phases 12, 13a and 13c of the Site (herein referred to collectively as the 'Application Area').

1.1.2. The Site comprises several phases of mineral workings which are at varying degrees of restoration. The Site, following mineral extraction, is being restored to agriculture, open water or nature conservation. With the exception of the Application Area and the area the subject of the existing Inert Waste EP Number EPR/CB3504CQ (which lies approximately 500m to the north east of the Application Area, all other phases of the Site are being restored using site derived overburden and quarry reject materials. The design and operation of the proposed excavation and recovery activities are consistent generally with the design and operation of previous phases at the Site. A previous SRA was prepared for the Site in 2017[1] as part of the Inert Waste EP Application Number EPR/CB3504CQ, information from which has been relied on in preparing this SRA.

1.1.3. The structure of this SRA is based on a template produced by the Environment Agency entitled "Stability Risk Assessment Report Version 1" dated March 2010 (Reference 1). The SRA presents relevant aspects of the site setting and the proposed design of the excavation and recovery operations. A risk screening stage identifies which potential stability risks need further assessment. The further assessment methodology is explained and the geotechnical parameters and target factors of safety used are described.

1.1.4. From the stability assessment it is concluded that those aspects of the Site design assessed in this SRA in relation to the site attenuation layer, waste mass and

[1] *An Application for a Bespoke Environmental Permit for the Permanent Deposit of Inert Waste as a disposal operation in order to complete the restoration of Brooksby Quarry, Leicestershire - Appendix F Stability Risk Assessment (SRA) Report. Report Reference: TAR/BRO/AW/5509/01/SRA dated November 2017*

restored land form achieve acceptable factors of safety. In relation to the existing slopes at the site these are assessed as part of the ongoing quarry regulation assessment. Copies of the more recent quarry regulation assessments undertaken at the site and which include the Application Area are attached at Appendix D.

1.2. Site Description

1.2.1. The SRA is based on the conceptual model presented in the Environmental Setting and Site Design (ESSD) report reference TAR/BRO/JAD/5654/01/ESSD dated August 2023 which is provided at Appendix F to the application report reference TAR/BRO/JAD/5654/01/AR dated August 2023. Details presented in the ESSD include:

- the Site location,
- the environmental setting of the Site,
- the Site geology and hydrogeology,
- the history of the Site,
- the Site design,
- the potential contamination migration pathways and receptors, and
- typical acceptance procedures to verify that inert restoration material only will be accepted at the site.

1.3. Site location

1.3.1. Brooksby Quarry is centred approximately on National Grid Reference (NGR) SK 672 153 and is located approximately 2km north-east of Rearsby and 2.5km south east of Thrussington in Leicestershire. The Site location is shown on Figure SRA 1. The Application Area is located in the north-west of the Site and is approximately centred at NGR SK 668 151.

1.4. Topography

1.4.1. A topographical survey of Brooksby Quarry and its immediate surroundings provided by Tarmac is presented in Appendix A.

1.4.2. Brooksby Quarry is located on both sides of a shallow valley which trends from the north-east to the south-west following the course of Rearsby Brook. Land to the north

of the brook rises gently to the north and to the north-east and the land to the south of the brook rises more steeply towards the south-east. The areas Application Area is located to the north of the brook. Original surrounding ground levels shown on the topographical survey fall from approximately 77m Above Ordinance Datum (m AOD) to the north of the Application Area to approximately 64m AOD to the south of the Application Area.

1.5. Geology

1.5.1. A detailed description of the geology at the Site is presented in the ESSD report, a brief summary of which is provided below.

1.5.2. The geology of the Application Area comprises superficial clays, sand and gravel deposits overlying Jurassic and Triassic bedrock. The superficial geology comprises clays, silts, sands and gravels of the Holocene colluvium and alluvium underlain in turn by diamicton and poorly sorted gravelly clays of the Middle Pleistocene Wolston Glaciogenic Formation comprising the Thrussington Till Member and the Early to Middle Pleistocene Bytham Sand and Gravel Formation. The Bytham Sand and Gravel Formation comprises the main mineral deposit at the Site.

1.5.3. The superficial geology overlies bedrock of the Upper Triassic Mercia Mudstone Group (Blue Anchor Formation and Branscombe Mudstone Formation). The mudstone and siltstones of the Branscombe Mudstone Formation subcrops on the north-western edge and close to the south-western corner of the Application Area and is overlain by dolomitic silty mudstones and siltstones of the Blue Anchor Formation.

1.5.4. The bedrock strata at and in the vicinity of the Site dip to the east generally and are faulted with three broadly south-west to north-east trending faults. One of the faults crosses close to the south of the Application Area. The second fault crosses the north-west of the Application Area to the north-western boundary of Phase 13c. The third fault is located approximately 310m to the north of the Application Area at the closest point. The northern two faults are recorded as being downthrown to the south and the southern fault is recorded as being downthrown to the north.

1.5.5. Mineral exploration and groundwater monitoring boreholes drilled at and in the vicinity of the Application Area found the superficial deposits to comprise generally

sandy gravelly clay overlying sand and gravel deposits. The sandy gravelly clay thickens with distance away from the Rearsby Brook to the north-west. The sandy gravelly clay overburden thickens from approximately 2m to approximately 7m from south-west to north-east across the Application Area. The elevation of the base of the sandy gravelly clay overburden typically increases between approximately 64mAOD and 65.5mAOD from the south-west to the north-east. The thickness of the Bytham Sand and Gravel Formation ranges between approximately 5m in the north-east of the Application Area to 3m in the south-west. The underlying bedrock was found to comprise clay, silt, siltstone or mudstone and was proven at a minimum thickness of 1m in a borehole located along the western boundary of the Application Area.

1.6. Hydrogeology

1.6.1. A detailed description of the hydrogeology is provided in the ESSD report and Hydrogeological Risk Assessment (HRA) report reference TAR/BRO/JRC/20021/01/HRA dated June 2023, a brief summary of which is provided below.

1.6.2. Based on the results of groundwater level monitoring carried out at the Site and presented in the ESSD report, it is considered that the Mercia Mudstone Group bedrock underlying the Site and comprising the Blue Anchor Formation and Branscombe Mudstone Formation have a low permeability as it comprises generally mudstones and siltstones. Groundwater in the superficial deposits is likely to be supported by the underlying bedrock. Groundwater levels measured within the superficial deposits fall from approximately 65mAOD recorded in borehole BH2/17 which is located approximately 200m to the east of the Application Area to approximately 60mAOD recorded in borehole CHEW which is located approximately 500m to the west of the Application Area. The location of boreholes at the site are shown on Figure SRA 3.

2. Proposed design of the Brooksby Quarry restoration

2.1. General Site Design

2.1.1. The design of the quarry slopes, the proposed construction of the attenuation layer and subsequent recovery operations for the Application Area are consistent generally with the excavation and restoration operations previously undertaken in the wider Site. As detailed in the ESSD the Application Area comprises three phases of mineral extraction, Phases 12, 13a and 13c which are proposed to be restored to agriculture. To achieve this, it will be necessary to import, as a recovery operation, approximately 326,500m^3 of inert restoration materials to Phase 12, 13a and 13c. A further approximately 46,500m^3 of cover soils will be placed over the inert restoration materials. A topographical survey of the Site provided by Tarmac is shown on the drawing included at Appendix A and the approved restoration scheme is shown on the drawing presented at Appendix B. Cross-sections through the proposed restoration profile are shown on the drawing presented as Figure SRA 2. The locations of the cross-sections are presented on Figure SRA 3.

2.1.2. As detailed in the ESSD it is considered that the waste does not comprise a contaminant source with the potential to have a significant detrimental effect on groundwater quality. Notwithstanding this, as the excavated side slopes include sand and gravel deposits it is proposed that an artificial attenuation layer equivalent to a natural geological barrier 1m thick is constructed against the side slopes of the excavated quarry void prior to the placement of restoration materials. The sand excavation works are complete at the site and backfilled site derived clayey overburden materials have been placed against much of the side slope area. An artificial attenuation layer shall be constructed against the side slopes where the backfilled overburden material cannot be verified to form a suitable attenuation layer, or where insufficient backfilled overburden material has been placed. Following verification and construction of the attention layer, the site shall be restored with imported inert waste materials. A schematic cross section of the construction of the artificial geological barrier is presented on Figure SRA 4.

2.2. Quarry Base Design

2.2.1. The base of the mineral extraction within the Application Area is generally flat with the elevation of the base ranging between approximately 58.0mAOD and

61.7mAOD. The base of the Application Area falls gently to the south. The base of the extractions comprises bedrock of the Blue Anchor Formation. Based on the information provided in the ESSD a minimum of 1m of silty clay comprising weathered bedrock has been proven in the boreholes excavated at the site beneath the mineral deposit at the Site confirming a natural geological barrier across the base of the Application Area and no significant pathway for vertical movement from the waste beneath the Application Area. Where thin layers of Bytham Sand and Gravel deposits remain in the base of the Application Area these will need to be cleared to allow inspection of the surface of the Blue Anchor Formation prior to the placement of waste. Where thin layers of Bytham Sand and Gravel deposits remain in situ at the foot of the sidewall these will need to be removed to allow the sidewall attenuation layer to be keyed in to the basal natural geological barrier to form a continuous attenuation layer across the base and up the side slopes of the Application Area.

2.2.2. Groundwater levels in the vicinity of the Application Area are recorded above the existing basal levels, within the superficial deposits. As detailed in the ESSD, it is considered that the low permeability bedrock of the Mercial Mudstone Group supports the overlying groundwater. Dewatering of the excavation is carried out during the excavation, construction and restoration of the Application Area and will continue until the backfilled Site derived overburden, sides slope attenuation layer and imported waste restoration material are above the natural groundwater level within the superficial deposits.

2.3. Quarry Side Slope Design

2.3.1. Based on the topographical drawing included at Appendix A and the cross section drawing presented in Figure SRA 2, the excavated quarry slopes are between approximately 6m and 12m high with slope gradients of up to 1v:1h. The extracted side slopes predominantly comprise overburden clays of the Thrussington Till Member overlying the Bytham Sand and Gravel Formation. The Site derived overburden clay of the Thrussington Till Member have been placed along the western, northern and eastern side walls at gradients of approximately 1v:2h in order to limit groundwater inflow into the void and to provide an access route into the Application Area extraction works. The eastern sidewall comprises the boundary with Phase 11 which has been restored using site derived clayey overburden. The placed and compacted site derived overburden clays, where present along the

western, northern and eastern sidewalls are anticipated to comprises an artificial attenuation layer between the waste to be placed in the Application Area quarry void and the Bytham Sand and Gravel Formation deposits and backfilled quarry phases surrounding the Application Area. The existing excavation, basal area, backfilled overburden areas and extracted slopes are the subject of ongoing geotechnical assessment as required by the Quarries Regulation 1999, copies of which are provided in Appendix D.

2.4. Attenuation Layer Design

2.4.1. As detailed in the ESSD, given that the overburden comprises sandy gravelly clays, it is anticipated that the placed site derived overburden clays in the side slopes of the Application Area will comprise an equivalent minimum 1m thick artificial attenuation layer with a hydraulic conductivity of no greater than 1 x 10^{-7} m/s. As a precaution and as a minimum, the upper 1m, perpendicular to the placed slope of the backfilled Site derived overburden, will be the subject of Construction Quality Assurance (CQA) to verify that it has been placed and compacted to achieve a hydraulic conductivity of no greater than 1 x 10^{-7} m/s consistent with the conditions of the permit. Where this cannot be verified through retrospective CQA, an artificial attenuation layer will be constructed over the site derived overburden slopes. Where site derived overburden has not been placed against the side walls of the excavation or as part of the restoration of the wider site outside of the proposed Application Area boundary, the sidewall attenuation layer will be constructed from suitably selected site derived cohesive fill materials, or similar local overburden or Mercial Mudstone materials imported from other nearby sites, and will be the subject of CQA consistent with the conditions of the permit. Where unexcavated sand and gravel deposits remain in-situ at the toe of the sidewalls, these will need to be removed so that the sidewall attenuation layer can be tied in to the basal natural geological barrier.

2.4.2. The procedures for the selection, placement, and compaction of the materials used to form the attenuation layer will be agreed with the Environment Agency through the preparation and approval of a CQA Plan in accordance with Environment Agency

guidance[2] to achieve a hydraulic conductivity of no greater than 1 x 10^{-7} m/s and a shear strength of no less than 40kPa.

2.4.3. The side slope attenuation layer will be constructed by placing the materials against the side slopes in lifts not exceeding 3m and to a minimum thickness of 1m perpendicular to the face of the slope. Slopes will be constructed to achieve a maximum gradient no steeper than 1v:2.5h. A schematic diagram showing the construction design of the attenuation layer is presented on Figure SRA 4.

2.4.4. Filling against the side slope attenuation layer will commence shortly after the construction of each lift of the side slope attenuation layer. Dewatering will continue during the construction of the attenuation layer and during placement of restoration materials until the level of the backfilled material is above the natural groundwater level within the surrounding sand and gravel deposits.

2.5. Restored Slope Design

2.5.1. It is estimated that it will be necessary to import up to approximately 326,500m^3 of inert restoration materials to the application area. An additional approximately 46,500m^3 of cover soils will be placed over the inert restoration materials in order to achieve the restoration profiles of the Application Area. The imported inert waste restoration materials will be placed progressively in horizontal layers. The final landform will be gently undulating with a subtle north to south trending spine with gentle falls to the south-west, south and south-east. Restored slope gradients are generally no greater than approximately 1v:10h and locally steepen to approximately 1v:6h in the south-east corner of the Application Area where an attenuation pond exists to the south of the Application Area boundary. The proposed restored gradients are shown on the drawing presented in Appendix B.

[2] *https://www.gov.uk/government/publications/deposit-for-recovery-operators-environmental-permits/engineering-construction-proposals-for-deposit-for-recovery*

3. Conceptual Site Stability Model (CSSM)

3.1.1. The principles of the site design as presented above have been used to define the individual slopes and materials which comprise each of the elements considered in the stability risk assessment.

3.1.2. In accordance with the Environment Agency SRA Template (Reference 1) there are six major components on the conceptual site model:

- The basal sub-grade
- The side slope sub-grade
- The basal attenuation layer
- The side slope attenuation layer
- The waste mass
- The capping and restoration

3.1.3. Qualitative or quantitative assessments are undertaken for each design element as identified by the risk screening of the conceptual models presented in Section 4.

3.2. Basal Sub-Grade Model

3.2.1. The base of the excavation is generally flat with typical maximum gradients of 1v:60h to 1v:100h and localised maximum gradients of no greater than 1v:10h and comprise weathered bedrock of the Blue Anchor Formation. As the base of the excavation is below the natural groundwater levels in the surrounding sand and gravel deposits, the mineral workings at the Site are dewatered.

3.3. Side Slope Sub-Grade Model

3.3.1. The side slopes comprise the in-situ overburden clays and silts, and the underlying sand and gravel deposits, or the backfilled site derived quarry overburden. The quarried side slopes have been excavated at gradients of up to approximately 1v:1h and to a maximum depth of approximately 12m. The backfilled side slopes have been placed at gradients of up to approximately 1v:2h. Groundwater present within the sand and gravel deposits will be dewatered to facilitate mineral extraction and restoration. Current excavations and slopes are subject to ongoing geotechnical

assessment as required by the Quarries Regulations 1999, copies of which, relating to the Application Area, are provided in Appendix D.

3.4. Basal Attenuation Layer Model

3.4.1. The base of the extraction comprises mudstones and siltstone of the Blue Anchor Formation which are considered to form a natural geological barrier and have a hydraulic conductivity of no greater than 1 x 10^{-7} m/s. As detailed in the ESSD at least 1m of silty clay comprising weathered bedrock has been proven beneath the mineral deposit at the Site confirming a natural geological barrier to be present across the base of the Application Area and no evidence of significant pathway for vertical movement from the waste beneath the Application Area.

3.4.2. It is understood that in places thin deposits of the unexcavated Bytham Sand and Gravels remain in situ in places. Where thin layers of Bytham Sand and Gravel deposits remain in the base of the Application Area these will need to be cleared to allow inspection of the surface of the in situ basal natural geological barrier formed by the underlying Blue Anchor Formation. Where thin layers of Bytham Sand and Gravel deposits remain in situ at the foot of the sidewall these will need to be removed to allow the sidewall attenuation layer to be keyed in to the basal natural geological barrier to form a continuous attenuation layer across the base and up the side slopes of the Application Area. The basal natural geological barrier will be the subject of CQA to verify that at a minimum it provides an equivalent of a 1m perpendicular thickness of material with a hydraulic conductivity of no greater than 1 x 10^{-7} m/s.

3.4.3. Should all or part of the underling Blue Anchor Formation not achieve the CQA requirements, an artificial basal attenuation layer will be constructed prior to the placement of restoration materials on the basal area of the excavation. Where required the basal attenuation layer will be constructed to a minimum perpendicular thickness of 1m and comprise carefully selected suitable overburden from the mineral extraction operations at the Site or similar local overburden or Mercia Mudstone materials imported from other nearby sites. The materials will be selected, placed and compacted to achieve a minimum undrained shear strength of 40kPa and a hydraulic conductivity of no greater than 1 x 10^{-7} m/s and will be the subject of CQA. Dewatering will continue during the construction of an attenuation layer to

maintain the groundwater levels in the surrounding sand and gravel deposits below the base of the construction works.

3.5. Side Slope Attenuation Layer Model

3.5.1. Areas of the western, eastern and northern side slopes of the Application Area comprise site derived quarry overburden backfill. The backfilled overburden comprises the excavated sandy gravelly clays which are likely to have a hydraulic conductivity of less than 1 x 10^{-7} m/s and therefore can be relied upon to form an artificial attenuation layer. As a precaution and as a minimum the upper 1m perpendicular thickness of the placed site derived quarry overburden backfill will be the subject of CQA to verify that it has been placed and compacted to achieve an equivalent of no less than 1m of perpendicular thickness of material with a hydraulic conductivity of no greater than 1 x 10^{-7} m/s.

3.5.2. Where overburden has not already been placed or should the placed overburden not achieve the CQA requirements, an artificial side slope attenuation layer will be constructed on the side slopes prior to the placement of restoration materials. The side slope attenuation layer will be constructed using carefully selected suitable overburden from the mineral extraction operations at the Site or similar local overburden or Mercial Mudstone materials imported from other nearby sites. The materials will be selected, placed and compacted to achieve a minimum undrained shear strength of 40kPa and a hydraulic conductivity of no greater than 1 x 10^{-7} m/s and will be the subject of CQA.

3.5.3. The side slope attenuation layer will be constructed in lifts of up to 3m in height with internal slope gradients no steeper than 1v:2.5h and to a minimum thickness of 1m perpendicular to the side slopes of the excavation. Dewatering will continue during the construction of an attenuation layer to maintain the groundwater levels in the surrounding sand and gravel deposits below the level of the construction works.

3.6. Restoration Material (Waste) Mass Model

3.6.1. The imported inert waste restoration materials will be placed generally in horizontal layers across the full width of the excavated areas so that no significant internal slopes are formed during the recovery operations. The upper surface of the

restoration material mass will have slope gradients no steeper than approximately 1v:10h.

3.6.2. Dewatering of the Application Area will continue throughout the recovery operations to maintain groundwater levels below the base of the restoration materials until the level of material placement is above the surrounding natural groundwater level.

3.7. Capping System and Final Restoration Landform Model

3.7.1. No capping system is proposed. The final restoration will consist of the placed suitable inert restoration materials to form a restored landform with slope gradients no steeper than approximately 1v:10h.

4. Risk Screening

4.1. Introduction to risk screening

4.1.1. A risk screening of the CSSM is presented in this section of the SRA. The risk screening considers each element of the CSSM and assesses whether the component of each element needs further detailed assessment.

4.2. Basal Sub-Grade Screening

4.2.1. The excavations at the Site are the subject of ongoing geotechnical assessment as required by the Quarries Regulations 1999. As a result it is unnecessary to undertake separate quantitative assessments of the basal sub-grade.

4.3. Side Slope Sub-Grade Screening

4.3.1. The side slopes excavations are the subject of ongoing geotechnical assessment as required by the Quarries Regulations 1999. As a result it is unnecessary to undertake separate quantitative assessments of the side slope sub-grade.

4.4. Basal Attenuation Layer Screening

4.4.1. With reference to the ESSD, HRA and as described in Section 1.6 above, it is understood that the Blue Anchor Formation which is to be relied upon as the basal natural in-situ geological barrier is not water bearing. Where the natural strata cannot be relied on to provide a geological barrier, an artificial attenuation layer will be constructed. The groundwater body at the Site sits within the superficial deposits and is supported by the underlying bedrock deposits. On this basis it is considered that basal heave does not pose an unacceptable risk to the basal attenuation layer at the site.

4.4.2. As the basal attenuation layer is generally flat and dewatering will continue during construction and subsequent recovery operations until the inert restoration materials are above natural groundwater levels, and that the main groundwater body at the

Site is above the basal attenuation layer, it is considered unnecessary to undertake quantitative analysis of the short-term and long-term stability.

4.5. Side Slope Attenuation Layer Screening

4.5.1. As each lift of the side slope attenuation layer will be constructed to a slope gradient of up to 1v:2.5h and up to a height of 3m it is appropriate to undertake a quantitative analysis of the short-term stability of each lift to verify that a suitable factor of safety against slope failure is achieved.

4.5.2. It is considered necessary to provide a quantitative analysis of the following short term scenarios:

- Side-slope attenuation layer constructed at a gradient of 1v:2.5h above in-situ sand and gravel superficial deposits at a gradient of 1v:1h (three separate 3m high lifts); and
- Side-slope attenuation layer constructed at a gradient of 1v:2.5h above already constructed overburden at a gradient of 1v:2h (four separate 3m high lifts) in the event that the overburden does not satisfy the CQA requirements for an attenuation layer.

4.5.3. As in the long-term the side slope attenuation layer will be supported by the imported waste restoration material placed against it, it is unnecessary to assess further its long-term stability.

4.5.4. It is unnecessary to assess the impact from groundwater pressures in the surrounding sands and gravels on the attenuation layer as dewatering will continue throughout the attenuation layer construction and restoration material placements operations to suppress groundwater levels until the level of material placement is above the surrounding natural groundwater level.

4.6. Restoration Material (Waste) Mass Screening

4.6.1. As the internal temporary slopes formed during the placement of restoration materials will be generally horizontal with no significant slopes constructed and as dewatering will continue during the restoration to maintain groundwater levels at a

depth sufficient to pose no significant risk it is unnecessary to undertake quantitative assessments of the restoration material mass.

4.7. Capping System and Final Restoration Landform Screening

4.7.1. No capping system is proposed.

4.7.2. As the restored landform within the quarry restoration area will have slope gradients no greater than approximately 1v:10h it is considered unnecessary to undertake quantitative slope stability assessments of the quarry site restoration. However as gradients of up to 1v:6h are proposed in the immediately surrounding restored slopes, outside of the quarry excavation but within the Application Area it is considered necessary to provide a quantitative analysis of the following long term scenario:

- The area of the final restoration constructed above the inert waste mass at gradient of 1v:10h steepening to 1v:6h outside of the excavation boundary but within the Application Area.

4.8. Life Cycle Phases

4.8.1. The Application Area will be infilled progressively. The critical phase in relation to stability will be during the construction of the side slope attenuation layer and the placement of supporting restoration materials against the side slope attenuation layer, during which the areas of excavation and infilling will need to be dewatered until the level of restoration materials has reached a level above the natural groundwater level.

5. Stability assessments for the Brooksby

5.1. Data Summary

5.1.1. The data used in the stability analysis and the data sources are presented in Table SRA 1.

5.2. Justification for Modelling Approach and Software

5.2.1. Based on the results of the risk screening a quantitative SRA has been undertaken to assess the short-term stability of each lift of the side slope attenuation layer and the short and long-term stability of the finished restoration scheme. All other elements have been assessed qualitatively in the risk screening as not needing further assessment.

5.2.2. The stability risk assessment analyses have been undertaken in general accordance with conventional British Standard methodologies using global factors of safety rather than incorporating partial factors into the individual parameters describing the slopes, strengths and forces. This is to maintain consistency with previous assessments undertaken at the site and Environment Agency Guidance (Reference 2).

5.2.3. The dimensions, slope gradients, elevation and parameters used in the analyses area presented in the following sections. The values for geotechnical parameters selected for use in the assessments area also presented in Table SRA 1. Target factors of safety used in the assessment are discussed in Section 5.5 and presented in Table SRA 2.

5.3. Computer software used in the analysis

5.3.1. Analysis of stability against rotational failure of the side slope attenuation layer is undertaken using the two-dimensional limit equilibrium programme Rocscience Inc. Slide 2 (Reference 3). Slopes are analysed using the Spencer method. The Spencer method has been selected as it is one of the more mathematically robust limit equilibrium methods and considers the shear and the normal inter-slice forces together with moment and force equilibrium. It is considered that this method is more

appropriate than simpler methods such as Bishop's Simplified Method or Janbu's Simplified Method.

5.4. Justification for Parameters Selected for Analysis

Parameters Selected for Basal and Side-Slope Sub-Grade Analysis

5.4.1. The superficial Thrussington Till Member of the side slope sub-grade are modelled as having an angle of friction of 30°, an apparent cohesion of 5kPa and a unit weight of 19kN/m^3. These values are based on values provided for stiff glacial clay by Hoek and Bray (Reference 4) and generally consistent with the parameters provided for the in situ overburden materials in the Quarries Regulations 1999 assessments, copies of which are provided in Appendix D.

5.4.2. The superficial Bytham Sand and Gravel deposits of the side slope sub-grade are modelled as having an angle of friction of 45°, an apparent cohesion of 0kPa and a unit weight of 19kN/m^3. These parameters represent a granular material with an angle of repose of 1v:1h, which is consistent with the description of the conceptual model for the quarry side slopes at the Site which form the sub-grade which are excavated at gradients of approximately 1v:1h. The unit weight of the side slope sub-grade materials is based on values provided for sand and gravel of mixed grain size by Hoek and Bray (Reference 4). The values used for the superficial sand and gravel deposits are generally consistent with the parameters provided in the Quarries Regulations 1999 assessments, copies of which are provided in Appendix D.

5.4.3. The underlying Blue Anchor Formation which forms the natural in-situ basal attenuation layer is modelled as having an angle of friction of 30°, an apparent cohesion of 50kPa and a unit weight of 19kN/m^3 which is based on values published in Cripps and Taylor (Reference 5) for very weak mudstones and generally consistent with the parameters provided in the Quarries Regulations 1999 assessments, copies of which are provided in Appendix D.

5.4.4. The site derived overburden which has been placed and compacted as the side slope sub-grade is modelled as having an angle of friction of 25°, an apparent cohesion of 2kPa and a unit weight of 18kN/m^3. These values are based on the materials being reworked slays sourced from the in situ Thrussington Till Member**.** The values used

are generally consistent with the parameters provided in the Quarries Regulations 1999 assessments, copies of which are provided in Appendix D.

Parameters Selected for Basal Attenuation Layer Analysis

5.4.5. As concluded in Section 4.4 above, no quantitative stability assessment of the basal attenuation layer is required.

5.4.6. ***Parameters Selected for Side Slope Attenuation Layer Analysis***

5.4.7. The models represent the construction of three separate 3m high lifts of the side slope attenuation layer against the excavated slope gradient shown on the worked out model, and four separate 3m high lifts of the side slope attenuation layer against the already constructed overburden at a gradient shown on the worked out model such that:

a. The basal sub-grade is a horizontal surface formed of weathered bedrock of the Blue Anchor Formation.

b. The excavated side slope sub-grade has a slope gradient of 1v:1h, a height of 10m and is formed of superficial sand and gravel.

c. The constructed Site derived overburden side slope sub-grade has a slope gradient of 1v:2h and a height of 10.6m, overlying the excavated sub-grade with a buried slope gradient of 1v:1h and a height of 12.5m and is formed of superficial sand and gravel deposits.

d. The side slope attenuation lifts have an internal slope gradient of 1v:2.5h and a maximum lift height of 3m and is modelled with a minimum horizontal thickness of 2.24m (to represent the minimum horizontal thickness necessary to maintain a minimum thickness of 1m perpendicular to a 1v:2h side slope).

e. Elevated groundwater levels and pressures are not assessed as dewatering will continue during the construction of the side slope attenuation layer and during infilling until the level of the restoration materials is above the natural groundwater level.

5.4.8. As the attenuation layer will be constructed from carefully selected suitable overburden from the mineral extraction operations at the Site or similar local

overburden or Mercia Mudstone materials imported from other nearby sites, that will be placed and compacted to achieve a minimum undrained shear strength of 40kPa, a shear strength of 40kPa is used to represent the attenuation layer in the models in their undrained state. A unit weight of 17 kN/m^3 is used in the modelling based on the lowest values provided for stiff glacial clay by Hoek and Bray (Reference 4). Drained parameters of angle of friction of 25°, and apparent cohesion of 2kPa and a unit weight of 17kN/m^3 have been adopted, generally consistent with the parameters used for the reworked site derived overburden materials.

Parameters Selected for Restoration (Waste) Material Mass Analysis

5.4.9. The inert waste is modelled as having an angle of friction of 22°, an apparent cohesion of 0kPa and a unit weight of 16kN/m^3. These values are conservative values based on values for silty soils by Hoek and Bray (Reference 4).

Parameters Selected for Capping System

5.4.10. No capping system is proposed and therefore no quantitative stability assessment is required as detailed in Section 4.7.

Parameters Selected for Final Restoration Landform Material Analysis

5.4.11. The restoration soils are modelled as having an angle of friction of 22°, an apparent cohesion of 0kPa and a unit weight of 16kN/m^3. These values are consistent with those selected for the inert waste and based on values for silty soils by Hoek and Bray (Reference 4).

5.5. Selection of Appropriate Factors of Safety

Factor of Safety for Basal Sub-Grade

5.5.1. Analysis of the stability of the basal sub grade is not necessary as detailed in Section 4.2.

Factor of Safety for Side Slope Sub-Grade

5.5.2. Analysis of the stability of the side slope sub grade is not necessary as detailed in Section 4.3.

Factor of Safety for Basal Attenuation Layer

5.5.3. Analysis of the stability of the basal attenuation layer is not necessary as detailed in Section 4.4.

Factor of Safety for Side Slope Attenuation Layer

5.5.4. A factor of safety of 1.3 has been selected for the assessment of the side slope attenuation layer as during a failure event of the attenuation layer the failure will be contained within the Site boundary, can be monitored and remediated, and would not extend outwards towards nearby buildings and infrastructure. This is consistent with Environment Agency guidance (Reference 2) and British Standards BS6031:2009 (Reference 6).

Factor of Safety for Restoration (Waste) Material Mass

5.5.5. Analysis of the restoration material mass is not necessary as detailed in Section 4.6.

Factor of Safety for Capping System

5.5.6. No capping system is proposed and therefore no quantitative stability assessment is required as detailed in Section 4.7.

Factor of Safety for the Final Restoration Landform

5.5.7. A factor of safety of 1.5 has been selected for the assessment of the restoration as a failure of the restored profile would expose the waste mass at the surface, and following completion there may be less stability monitoring and site controls. This is consistent with Environment Agency guidance (Reference 2) and British Standards BS6031:2009 (Reference 6).

5.6. Analysis

5.6.1. This sub-section provides the results of the quantitative analysis where identified as being needed as part of the risk screening. The results of the analysis are also presented in Table SRA 3.

Basal and Side Slope Subgrade Analysis

5.6.2. As discussed in Sections 4.2 and 4.3 above, no quantitative stability assessment of the basal and side slope subgrade is required.

Basal Attenuation Layer Analysis

5.6.3. As discussed in Section 4.4 above, no quantitative stability assessment of the basal attenuation layer is required.

Side Slope Attenuation Layer Analysis

5.6.4. The stability analysis of the three, 3m high lifts of the side slope attenuation layer constructed to a gradient of 1v:2.5h with a subgrade of the sand and gravel superficial deposits excavated to a slope gradient of 1v:1h yield factors of safety of between 2.169 and 5.509 which are above the target factor of safety of 1.3 and is therefore considered stable. The Slide 2 plots of the assessments are presented at Appendix C.

5.6.5. The stability analysis of the four, up to 3m high lifts of the side slope attenuation layer constructed to a gradient of 1v:2.5 with a subgrade of already placed overburden material to a slope gradient of 1v:2h yield factors of safety between 1.845 and 4.362 which are above the target factor of safety of 1.3 and is therefore considered stable. The Slide 2 plots of the assessments are presented at Appendix C.

Given the conservative selection of parameters, low risk due to slope failure and high factors of safety determined in the analysis no further sensitivity analysis has been undertaken.

Basal Attenuation Layer Analysis

5.6.6. As discussed in Section 4.4 above, no quantitative stability assessment of the basal attenuation layer is required.

Restoration Material (Waste) Mass Analysis

5.6.7. As discussed in Section 4.6 above, no quantitative stability assessment of the restoration material mass is required.

Capping and Final Restoration Landform Analysis

5.6.8. No capping system is proposed.

5.6.9. The stability analysis of the restored slopes steepening from 1v:10h within the quarry excavation area to 1v:6h outside of the quarry excavation but within the Application Area yields a long-term (drained) factor of safety of 5.381 which is above the target factor of safety of 1.5 and is therefore considered stable. The Slide 2 plots of the assessments are presented at Appendix C.

5.6.10. Given the conservative selection of parameters, low risk due to slope failure and high factors of safety determined in the analysis no further sensitivity analysis has been undertaken.

5.7. Assessment

5.7.1. This sub-section provides an assessment of the quantitative analysis where identified as being needed as part of the risk screening.

Basal and Side Slope Sub-Grade Assessment

5.7.2. The basal and side slope excavations and overburden placement at the site are the subject of ongoing geotechnical assessment as required by the Quarries Regulations 1999. As a result it is unnecessary to undertake separate assessments of the basal and side slope sub-grade.

Basal Attenuation Layer Assessment

5.7.3. As the basal attenuation layer is generally flat and dewatering will continue during construction and subsequent recovery operations until the inert restoration materials are above natural groundwater levels it is considered that the basal attenuation layer is stable.

Side Slope Attenuation Layer Assessment

5.7.4. The stability of the side slope attenuation layer has been analysed in the short-term and the resulting lowest factor of safety assessed is 2.169 which is above the target factor of safety of 1.3 and is therefore considered stable.

5.7.5. In the long-term the side slope attenuation layer will be supported by restoration materials placed against it and therefore is considered stable.

Restoration Material (Waste) Mass Assessment

5.7.6. As the internal temporary and final restored slopes will be generally horizontal and dewatering will continue during recovery operations to maintain groundwater levels below the level of restoration materials, the restoration material mass is considered stable.

Capping System and Final Restoration Landform Assessment

5.7.7. No capping system is proposed.

5.7.8. As the restored landform within the quarry excavation area will have slope gradients no greater than approximately 1v:10h it is considered that the restoration will be stable.

5.7.9. The stability of an area of the finished restoration landform profile with a final gradient of up to 1v:6h, located outside the quarry excavation area but in the Application Area, has been analysed in the long-term and the resulting factor of safety assessed is 5.381 which is above the target factor of safety of 1.5 and is therefore considered stable.

6. Monitoring

6.1. The risk-based monitoring scheme

6.1.1. The results of the SRA show that all elements of the proposed Application Area design, where assessed, are stable and where analysed achieve appropriate factors of safety.

6.1.2. A weekly visual inspection of the exposed sub-grade, attenuation layer and the restoration material mass for signs of settlement or instability is appropriate for monitoring at the Application Area until the final restoration is completed. The results of the weekly inspections will be recorded in the site diary during the operation of the Site. In the unlikely event that areas of concern are identified from the weekly inspection further assessment and remediation will be carried out as necessary.

6.1.3. It will be necessary to monitor and control groundwater at the Application Area during the recovery operations so that groundwater is dewatered in the superficial deposits overlying the base of the excavation until placement of restoration materials has reached a level above the natural groundwater level.

6.2. Basal and Side Slope Sub-Grade Monitoring

6.2.1. The basal and side slope sub-grade will be the subject of ongoing geotechnical assessment as required by the Quarries Regulations 1999.

6.3. Basal Attenuation Layer Monitoring

6.3.1. The verification of the natural in situ basal attenuation layer will be the subject of CQA to verify that a minimum perpendicular thickness of 1m is present and that the material present achieve a hydraulic conductivity of no greater than 1×10^{-7} m/s. Should the underling natural strata not achieve the CQA requirements, an artificial basal attenuation layer will be constructed. Prior to the construction of the attenuation layer a CQA Plan shall be prepared and agreed in accordance with Environment Agency guidance[2].

6.4. Side Slope Attenuation Layer Monitoring

6.4.1. The inspection and verification of the already placed overburden along the side slope will be the subject of CQA to verify that a minimum perpendicular thickness of 1m is

present and it has been constructed from materials which achieve a hydraulic conductivity of no greater than 1×10^{-7} m/s and has been keyed into the basal attenuation layer. Where the overburden has not been placed or should the placed overburden not achieve the CQA requirements, an artificial basal attenuation layer will be constructed in maximum 3m lifts to a maximum internal slope gradient of 1v:2.5h. Prior to the construction of the attenuation layer a CQA Plan shall be prepared and agreed in accordance with Environment Agency guidance[2].

6.4.2. Placement of inert restoration soils will commence shortly after construction of the attenuation layer to provide support to the side slope attenuation layer.

6.4.3. The side slope attenuation layer will be monitored for signs of instability and deterioration by weekly visual inspections as detailed above.

6.5. Restoration Material (Waste) Mass Monitoring

6.5.1. The restoration material mass will be monitored for signs of settlement or instability by weekly visual inspections as detailed above.

6.6. Capping System and Final Restoration Landform Monitoring

6.6.1. No capping system is necessary.

6.6.2. The restoration will be monitored for signs of settlement or instability by weekly visual inspections as detailed above.

7. References

1. Environmental Permitting (England and Wales) Regulations. 'Information in support of an application for a landfill permit – Stability Risk Assessment Report', Environment Agency, 2010

2. R&D Technical Report PI-385. 'The stability of landfill artificial geological barrier systems'. Environment Agency, 2000. Consists of two reports: TR1 - Literature review and TR2 – Guidance;

3. Stability Modelling with Slide2 Modeler Version 9.034 64bit. 2D Limit Equilibrium Analysis for Slopes (dated: April 2024). Rocscience Inc.;

4. 'Table 1 - Typical Soil and Rock Properties', Rock Slope Engineering, 1st Edition, Hoek and Bray, (dated: 1974);

5. 'Engineering characteristics of British over-consolidated clays and mudrocks, II/ Mesozoic deposits', Cripps and Taylor (dated July 1987);

6. British Standard BS6031 – 2009, Code of practice for Earthworks; and

7. 'Engineering construction proposals for deposit for recovery', Environment Agency guidance (dated 29 June 2023)[2].

TABLES

Table SRA 1

Geotechnical parameters used in the stability modelling

Material	Unit weight	Undrained parameters (short-term)	Drained parameters (long-term)
In-situ Thrussington Member overburden	ɣ = 19 kN/m^3 (1,3)	c' = 5 kPa (1,3) Ø = 30° (1,3)	
In-situ Bytham Sand and Gravel Formation	ɣ = 19 kN/m^3 (1,3)	c' = 0 kPa(1,3) Ø = 45°(3,6)	
Blue Anchor Formation	ɣ = 19 kN/m^3 (2,3)	c' = 50 kPa(2,3) Ø = 30°(2,3)	
Reworked overburden (Thrussington Member)	ɣ = 18 kN/m^3 (5,3)	c' = 2 kPa(5,3) Ø = 25°(5,3)	
Attenuation Layer Material	ɣ = 17 kN/m^3 (1)	c' = 40 kPa(4) Ø = 0°(1)	c' = 2 kPa(5,3) Ø = 25°(5,3)
Inert Waste	ɣ = 16 kN/m^3 (1)	c' = 0 kPa (1) Ø = 22° (1)	
Restoration Soils	ɣ = 16 kN/m^3 (1)	c' = 0 kPa(1) Ø = 22°(1)	

Notes: ɣ Unit weight
Ø' Friction angle
c' Apparent cohesion
C_u Undrained shear strength

(1) Value based on conservative estimates taken from Hoek and Bray, "Rock Slope Engineering", 1981.

(2) Value based on conservative estimates taken from Cripps and Taylor, ''Engineering characteristics of British over-consolidated clays and mudrocks, II. Mesozoic Deposits",1987.

(3) Value consistent the parameters provided in the Quarries Regulations 1999 assessments, copies of which are provided in Appendix D

(4) Value based on minimum specified undrained shear strength.

(5) Value based on the reworked overburden materials being sourced from the in situ Thrussington Till Member clays.

(6) Value is based on a friction angle for the angle of repose of 1v:1h observed in the excavated sand and gravel faces at the Site.

Table SRA 2

Target factors of safety

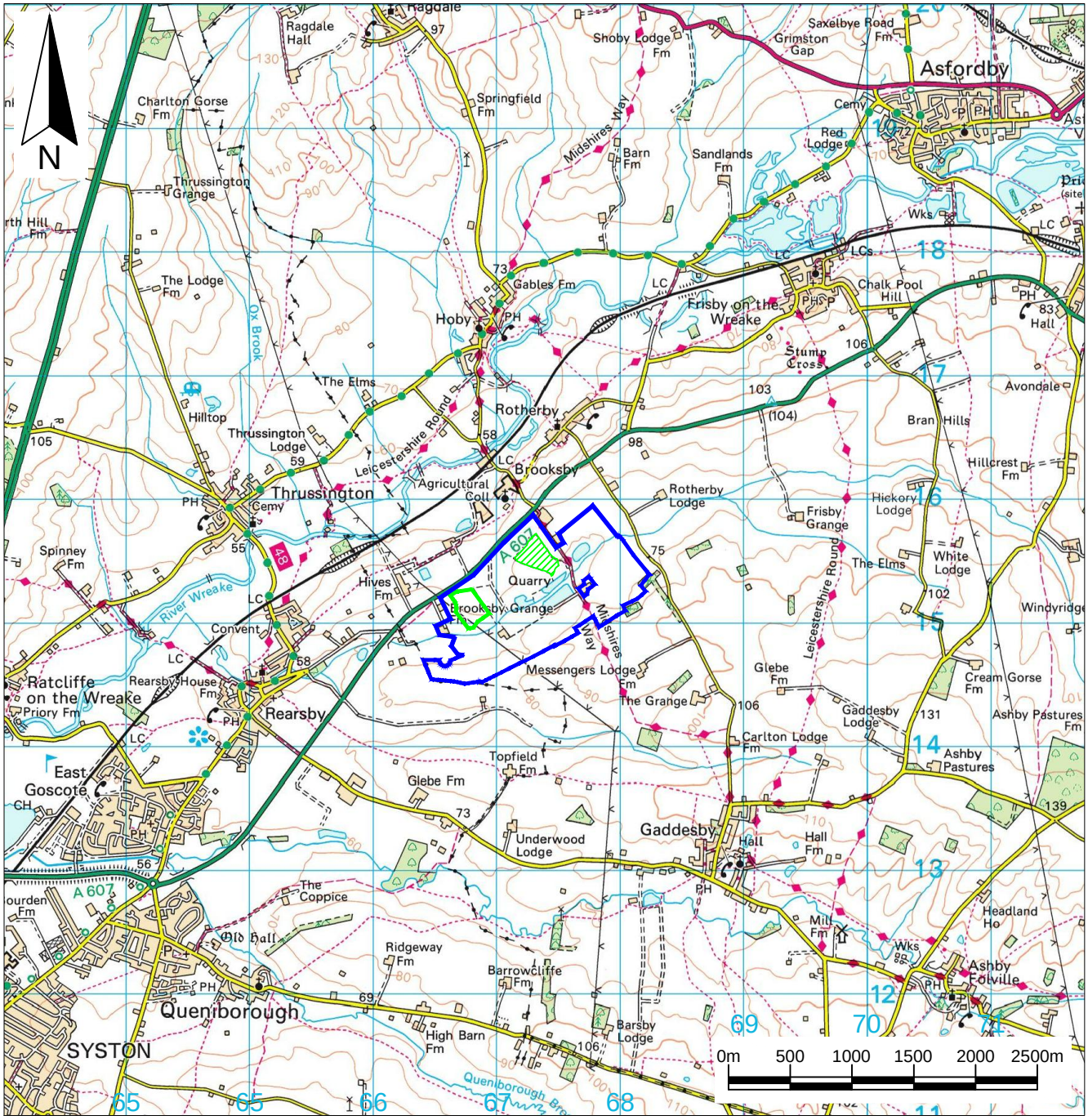
	Factor of Safety	
Component	**Short-term**	**Long-term**
Side Slope Attenuation Layer	1.3	n/a
Final Restored Landform	n/a	1.5

Table SRA 3

Results of the stability analyses

Model Component	Analysis		Calculations	Factor of Safety			Comment
				Target	Short-Term	Long-Term	
Basal and side slope sub-grade	Heave		n/a	Qualitative assessment demonstrates that basal heave will not affect the basal or side slope sub-grade.			Dewatering of the surrounding sands and gravels to continue until restoration levels are above natural groundwater levels.
	Basal Blue Anchor Formation sub-grade formation slope gradient		n/a	Basal sub-grade is generally flat and therefore no quantitative assessment is required.			Conclusion consistent with stability assessments undertaken for other areas of the Site.
	Excavated slopes within superficial deposits		n/a	Excavated slopes within the superficial deposits are the subject of ongoing geotechnical assessment as required by the Quarries Regulations 1999.			Copies of recent ongoing geotechnical assessments for the site, as required by the Quarries Regulation 1999, are provided in Appendix D.
Side Slope Attenuation Layer	Site derived overburden constructed to slope gradient of 1v:2h		n/a	Excavated slopes within the superficial deposits are the subject of ongoing geotechnical assessment as required by the Quarries Regulations 1999.			Copies of recent ongoing geotechnical assessments for the site, as required by the Quarries Regulation 1999, are provided in Appendix D.
	Side-slope attenuation layer constructed at slope gradient of 1v:2.5h on sub-grade of the sand and gravel superficial deposits excavated at slope gradient of 1v:1h and base of Blue Anchor Formation.	First lift	Appendix C Plot 1	1.3	5.509	n/a	Factor of safety greater than target.
		Second lift	Appendix C Plot 2	1.3	2.236	n/a	Factor of safety greater than target.
		Third lift	Appendix C Plot 3	1.3	2.169	n/a	Factor of safety greater than target.
	Side-slope attenuation layer constructed at slope gradient of 1v:2.5h on sub-grade of site derived overburden constructed at gradient of 1v:2h on the sand and gravel superficial deposits excavated at slope gradient of 1v:1h and tied into base of Blue Anchor Formation.	First lift	Appendix C Plot 6	1.3	4.362	n/a	Factor of safety greater than target.
		Second lift	Appendix C Plot 7	1.3	1.845	n/a	Factor of safety greater than target.
		Third lift	Appendix C Plot 8	1.3	1.942	n/a	Factor of safety greater than target.
		Fourth lift	Appendix C Plot 9	1.3	2.856	n/a	Factor of safety greater than target.
Waste mass	Rotation stability during placement		n/a	Waste placed in horizontal layers and therefore no quantitative assessment is required.			Final waste mass profile assessed as part of restoration restored landform.
Capping system	n/a		n/a	No capping system required.			No assessment needed.
Restored Landform	Restored landform with 1m of restoration soils constructed at maximum slope gradient of 1v:10h within the quarry excavation area steepening to slope gradient of 1v:6h excavated in the in situ superficial deposits outside of the quarry excavation area but within the Application Area.		Appendix C Plots 4 and 5	1.5	n/a	5.381	Factor of safety greater than target

FIGURES



Key / Notes

The approximate boundary of Brooksby Quarry Complex

The approximate boundary of Environmental Permit number EPR/CB3504CQ

The approximate boundary of the site the subject of the Environmental Permit application

Rev	Status	Drn	App	Chk	Date
	Final	KR	RT	DFR	29/11/24

Site: BROOKSBY QUARRY

Client: TARMAC A CRH COMPANY

Title: The site location

Figure SRA 1

Scale: 1:50,000@A4

Drawing Ref: TAR/BRO/11-24/24592

MJCA
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Baddesley Colliery Offices,
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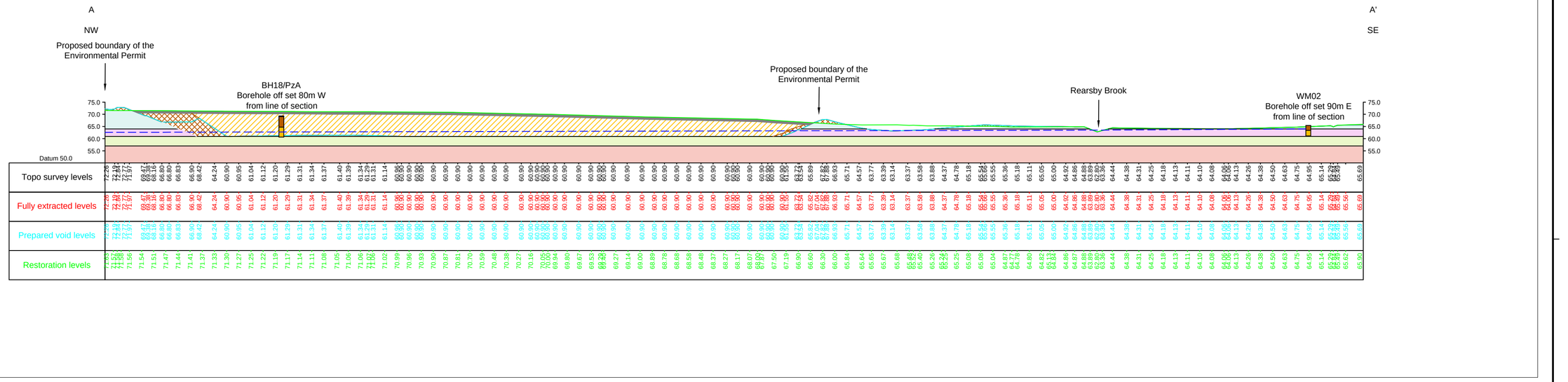
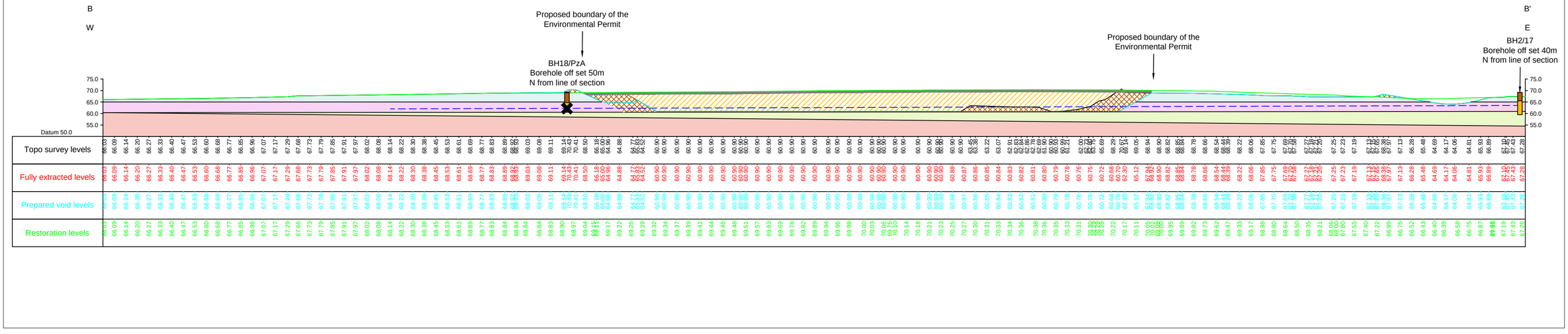
Fax : 01827 718507





Key / Notes

Soils

- Sand and gravel
- Silt and clay
- Interpolated groundwater levels recorded in May 2006 (pre-extraction groundwater levels)
- Restoration soils
- Inert waste (or onsite materials)
- Backfilled onsite material
- ✖ Compliance point for hazardous substances and non hazardous pollutants

- Thrussington Till Member of the Wolston Glaciogenic Formation
- Bytham Sand and Gravel Formation
- Blue Anchor Formation
- Branscombe Mudstone Formation

Notes:
Based on model references B355 BROOKSBY 2021-06-30 QU B.LSS, TOTAL VOID AVAILABLE.LSS and 02. PREPARED VOID TO PERMIT BOUNDARY.LSS

Location of cross sections shown on drawing reference TAR/BRO/03-23/23638

Rev	Status	Drn	App	Chk	Date
	Final	KR	RT	DFR	29/11/24

Site: BROOKSBY QUARRY

Client: TARMAC A CRH COMPANY

Title: Schematic cross sections through the proposed restored site

Figure SRA 2

Scale: 1:1,250@A2

Drawing Ref: TAR/BRO/11-24/24593

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Baddesley Colliery Offices, Main Road, Baxterley, Atherstone, Warwickshire, CV9 2LE.
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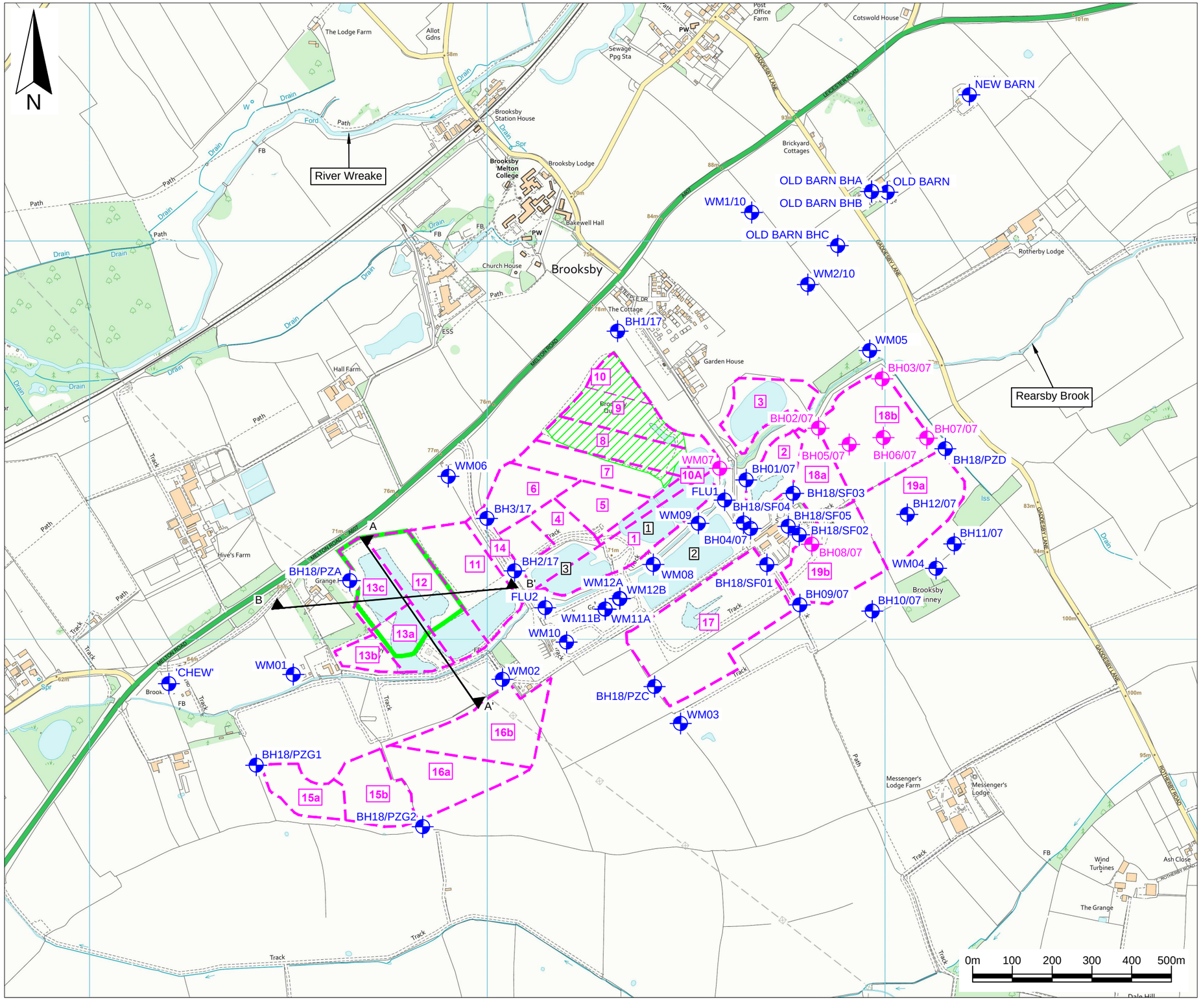

Key / Notes

- The approximate boundary of Environmental Permit number EPR/CB3504CQ
- Area the subject of the Environmental Permit application
- Phase boundaries
- Approximate location of an existing groundwater monitoring borehole
- Approximate location of a decommissioned or destroyed groundwater monitoring borehole
- 1 Clean Water Lagoon
- 2 Silt Lagoon
- 3 Discharge Polishing Lake
- Cross section locations (shown on drawing reference TAR/BRO/03-23/23641)

Rev	Status	Drn	App	Chk	Date
	Final	KR	RT	DFR	29/11/24

Site: BROOKSBY QUARRY

Client: TARMAC A CRH COMPANY

Title: Plan showing the approximate locations of the groundwater monitoring boreholes and cross sections at and in the vicinity of the site

Figure SRA 3 | Scale 1:10,000@A3

Drawing Ref: TAR/BRO/11-24/24594

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Technical advisers on environmental issues
Baddesley Colliery Offices, Main Road, Baxterley, Atherstone Warwickshire, CV9 2LE.
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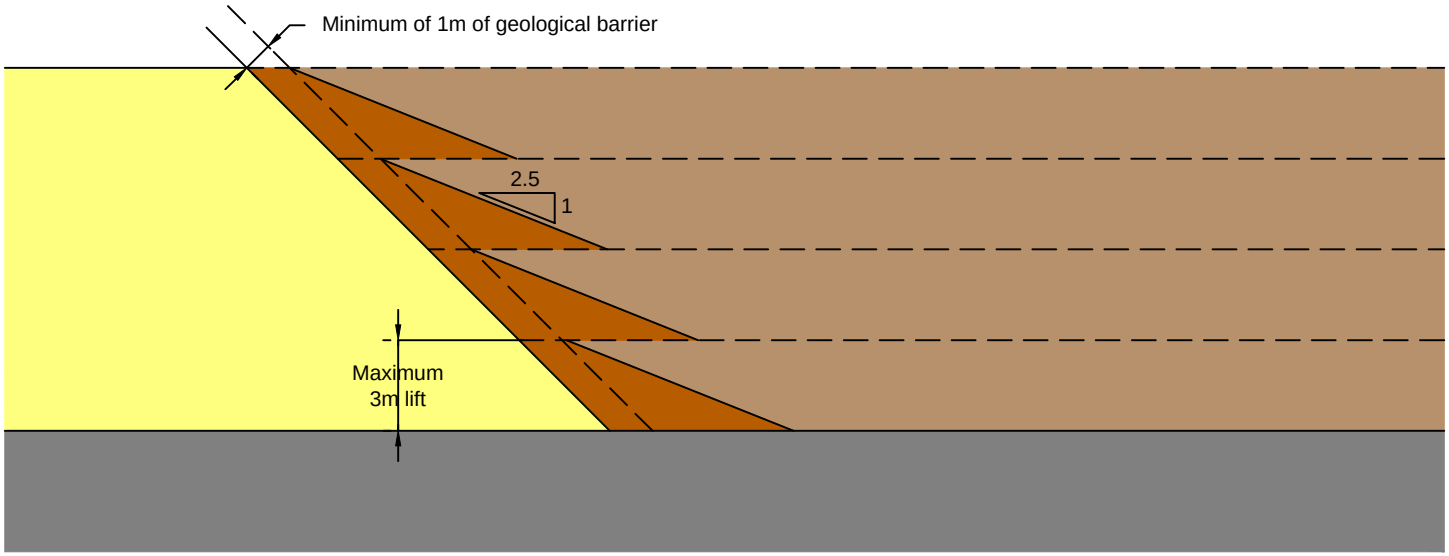

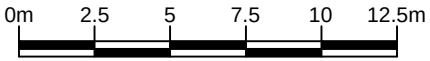

Key / Notes

- Superficial deposits/quarry backfill
- Triassic/Blue Anchor Formation strata
- Artificial geological barrier
- Inert waste recovery

Rev	Status	Drn	App	Chk	Date
	Final	KR	RT	DFR	29/11/24

Site
BROOKSBY QUARRY

Client
TARMAC
A CRH COMPANY

Title
Schematic drawing of the construction of the artificial geological barrier at Brooksby Quarry

Figure SRA 4

Scale
1:250@A4

Drawing Ref
TAR/BRO/11-24612

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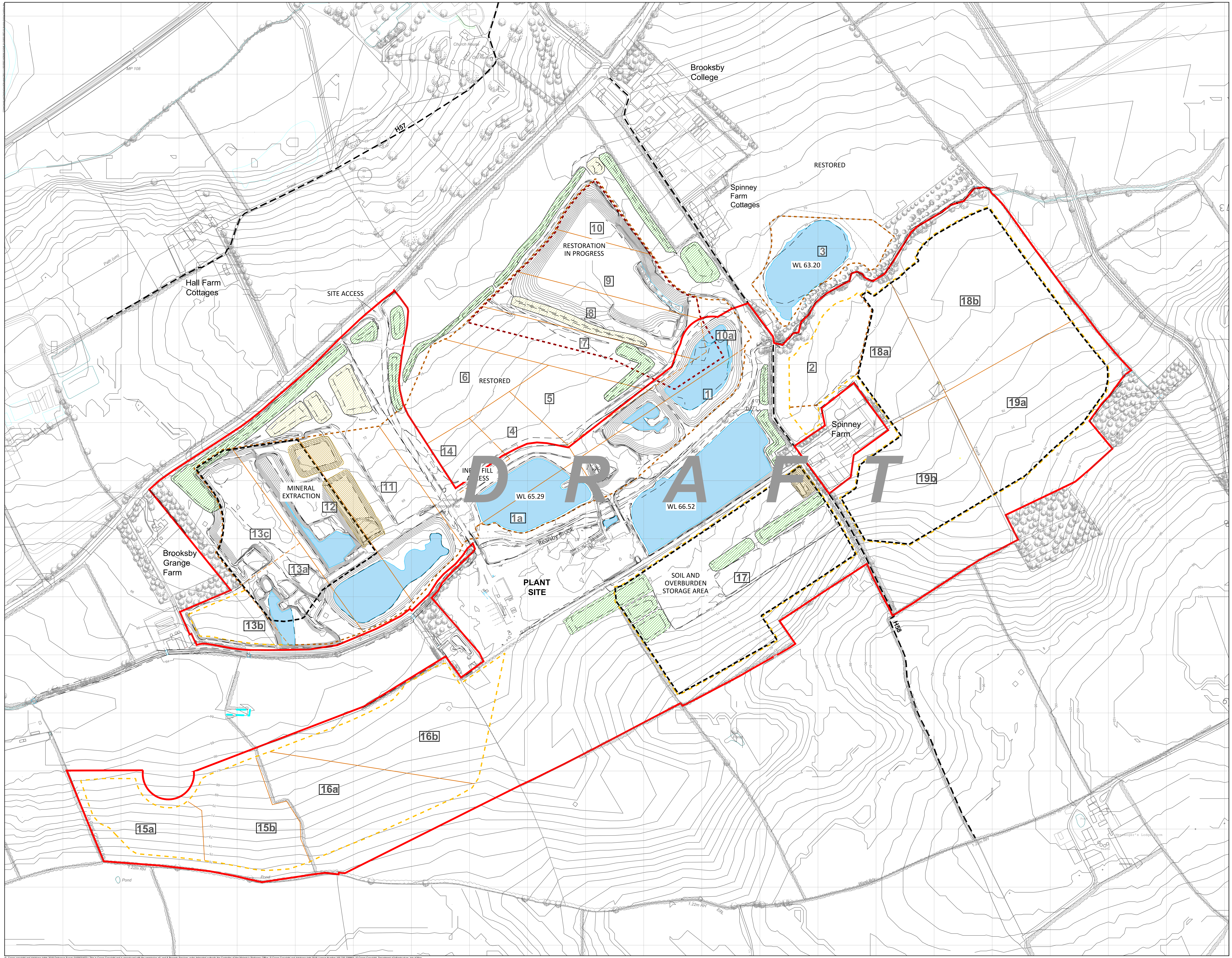
APPENDIX A

PROPOSED SOUTHERN EXTENSION EXISTING CONDITIONS (DAVID JARVIS ASSOCIATES DRAWING NUMBER B355-00071-01)



Legend

- Boundary: Application Site (PP2008/0443/06)
- Existing Vegetation
- Existing Contours at 1.0M Intervals
- Subsoil Store
- **Overburden Store**
- Topsoil Store
- Boundary: Consented Mineral Extraction
- Boundary: Consented Restoration Using Imported Inert Fill Materials
- Boundary: Proposed Restoration Using Overburden and Imported Inert Fill Materials
- Boundary: Consented Mineral Extraction Phase and Boundary
- H58 Existing Bridleway and Reference
- Boundary: Proposed Extension of Mineral Extraction Phase and Boundary

Notes

Related Drawings: DJA Drawing based on
- TARMAC drawing - BROOKSBY - QU 2018-15-10
- OS Data - OS_Profile_DTM_ASCII_16454_24995

Issue: Drawn by David Jarvis Associates Limited (CROWN COPYRIGHT. ALL RIGHTS RESERVED 2018 LICENCE NUMBER 0100031). This drawing is for Planning purposes only - Do not use this drawing for Construction. The information contained in the drawing should be used as a guide to the final forms and finishes of the landscape scheme. Any revisions to be approved by the Client and Local Authority

Scaling: Do not scale this drawing. Use given dimensions only.

Survey: Original survey provided by the Client.

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TARMAC
A CRH COMPANY

Site Name: B355 - Brooksby Quarry

Drawing Name: Proposed Southern Extension Existing Conditions

Drawn By:	Scale @ A0:
DJA	1:2,000
Date:	**Drawing Number:**
23/11/18	B355-00071-01

N

APPENDIX B

FINAL RESTORATION
(DAVID JARVIS ASSOCIATES DRAWING NUMBER B355-00071-11)

Legend

- Boundary: Application Site (PP/2008/0443/06)
- Existing Vegetation
- Existing Contours at 1.0M Intervals
- Boundary: Consented Mineral Extraction
- Boundary: Consented Restoration Using Imported Inert Fill Materials
- Boundary: Proposed Restoration Using Overburden and Imported Inert Fill Materials
- Boundary: Consented Mineral Extraction Phase and Boundary
- Existing Bridleway and Reference
- Boundary: Proposed Extension of Mineral Extraction Phase and Boundary
- Proposed Contours at 2.0M Intervals
- Proposed Tussocky/ Wet Grassland
- Area of Naturally Regenerating Grassland to be Retained
- Proposed Marginal Wetland Habitat (Natural Regeneration)
- Proposed Waterbodies
- Proposed Gate
- Proposed Woodland Planting
- Proposed Agriculture (Grazing Pasture)
- Proposed Ephemeral Scrape
- Proposed Woodland Scrub (Natural Regeneration)

Notes

Related Drawings: DJA Drawing based on
- TARMAC drawing - BROOKSBY - QU 2018-15-10
- OS Data - OS_Profile_DTM_ASCII_16454_24995

Issue: Drawn by David Jarvis Associates Limited (CROWN COPYRIGHT. ALL RIGHTS RESERVED 2018 LICENCE NUMBER 0100031). This drawing is for Planning purposes only - Do not use this drawing for Construction. The information contained in the drawing should be used as a guide to the final forms and finishes of the landscape scheme. Any revisions to be approved by the Client and Local Authority

Scaling: Do not scale this drawing. Use given dimensions only.

Survey: Original survey provided by the Client.

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TARMAC
A CRH COMPANY

Site Name: B355 - Brooksby Quarry

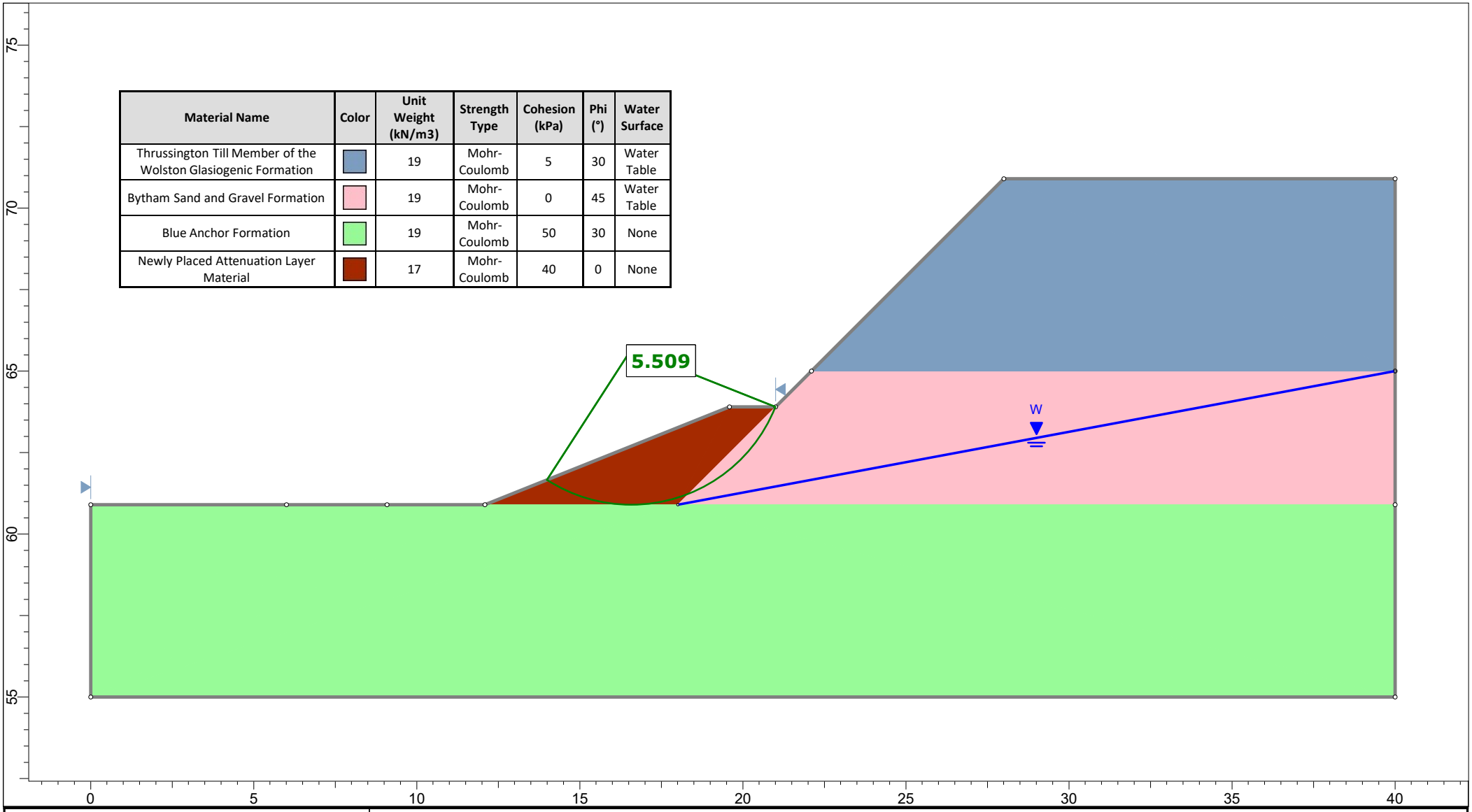
Drawing Name: Final Restoration

Drawn By:	Scale @ A0:
DJA	1:2,000
Date:	**Drawing Number:**
11/12/18	B355-00071-11

APPENDIX C

STABILITY ANALYSIS

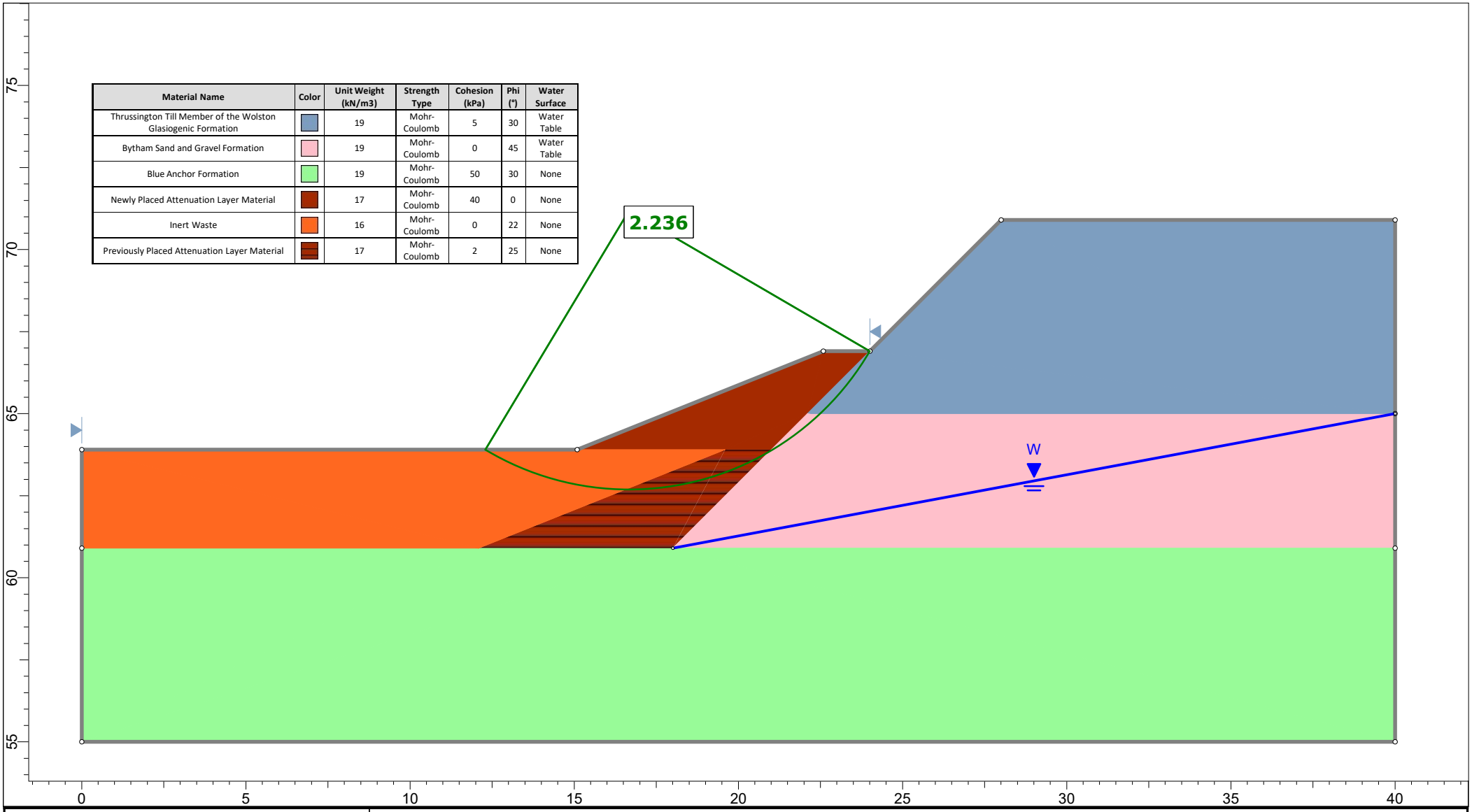
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Thrussington Till Member of the Wolston Glasiogenic Formation		19	Mohr-Coulomb	5	30	Water Table
Bytham Sand and Gravel Formation		19	Mohr-Coulomb	0	45	Water Table
Blue Anchor Formation		19	Mohr-Coulomb	50	30	None
Newly Placed Attenuation Layer Material		17	Mohr-Coulomb	40	0	None



Technical advisers on environmental issues

Project	Brooksby Quarry - Phases 12, 13A and 13C		
Client	Tarmac Trading Limited	*Scenario*	Sand and Gravel Sidewall - Attenuation Layer - First Lift
Drawn By / Checked By	RT / DFR	*Analysis Method*	Spencer
Date	26/11/2024 10:36:37	*File Name*	01 Sand and gravel Sidewall Model - First Lift.slmd

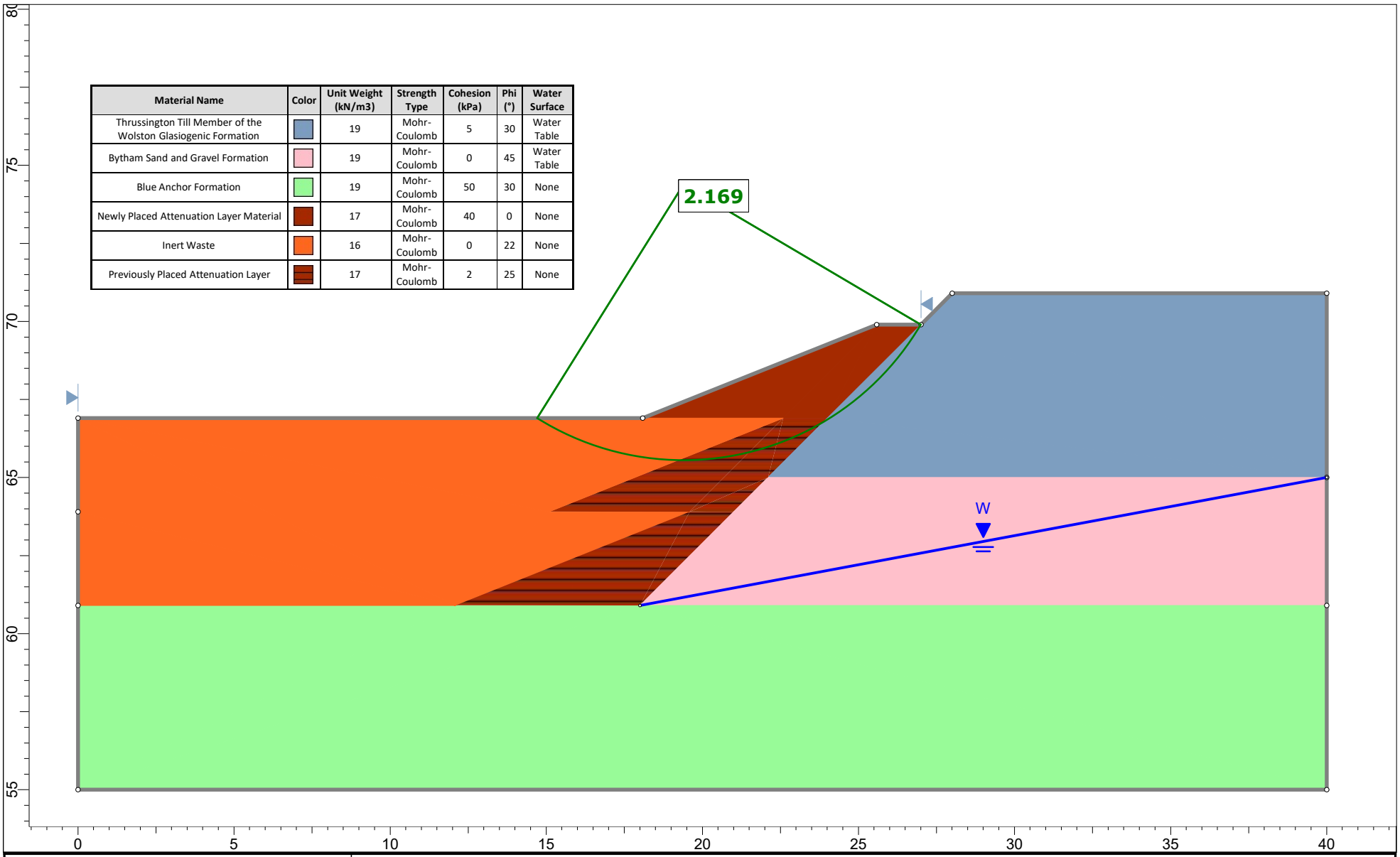
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Thrussington Till Member of the Wolston Glasiogenic Formation		19	Mohr-Coulomb	5	30	Water Table
Bytham Sand and Gravel Formation		19	Mohr-Coulomb	0	45	Water Table
Blue Anchor Formation		19	Mohr-Coulomb	50	30	None
Newly Placed Attenuation Layer Material		17	Mohr-Coulomb	40	0	None
Inert Waste		16	Mohr-Coulomb	0	22	None
Previously Placed Attenuation Layer Material		17	Mohr-Coulomb	2	25	None



Technical advisers on environmental issues

Project	Brooksby Quarry - Phases 12, 13A and 13C		
Client	Tarmac Trading Limited	*Scenario*	Sand and Gravel Sidewall - Attenuation Layer - Second Lift
Drawn By / Checked By	RT / DFR	*Analysis Method*	Spencer
Date	26/11/2024 10:50:46	*File Name*	02 Sand and Gravel Sidewall Model - Second Lift.slmd

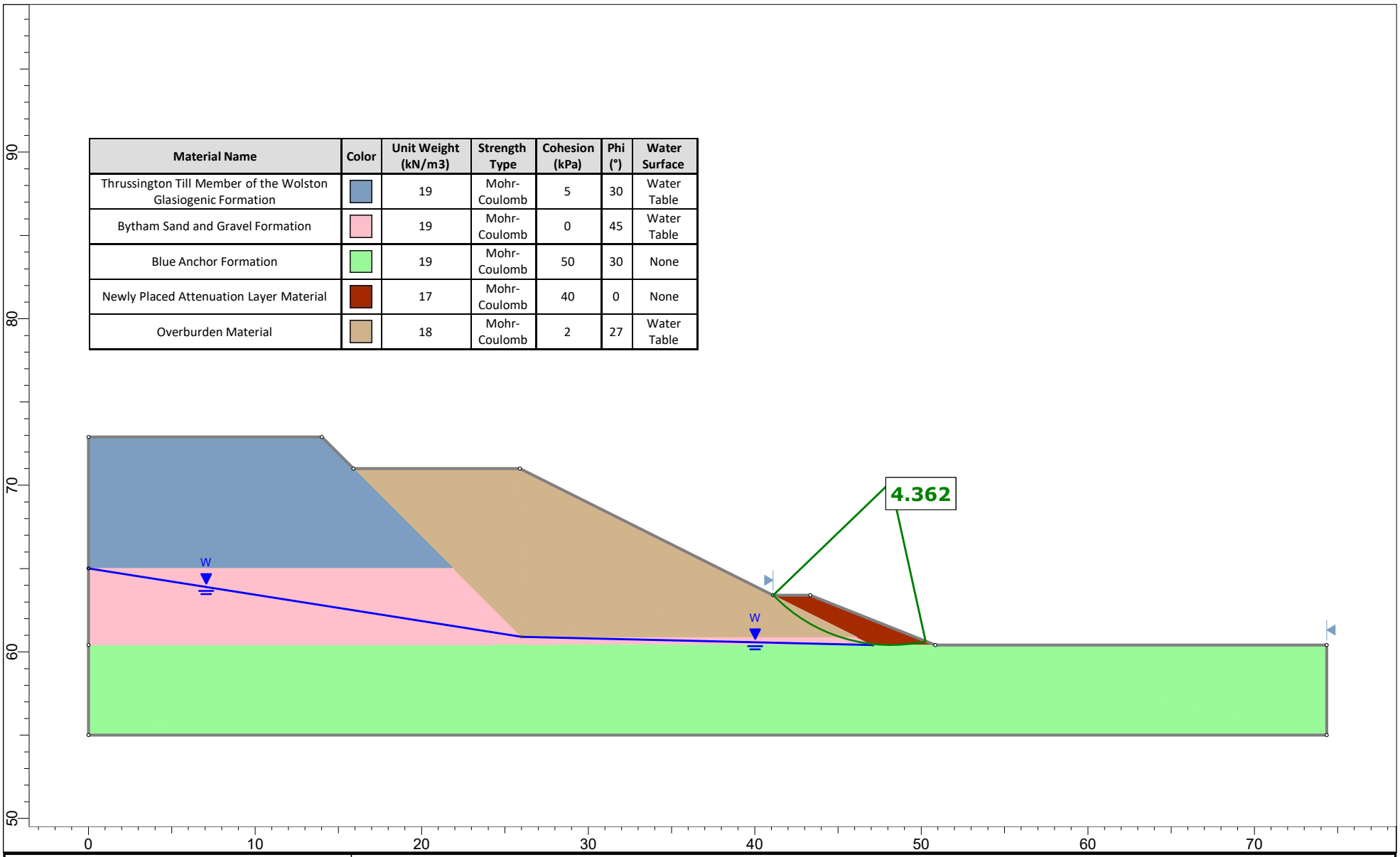
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Thrussington Till Member of the Wolston Glasiogenic Formation		19	Mohr-Coulomb	5	30	Water Table
Bytham Sand and Gravel Formation		19	Mohr-Coulomb	0	45	Water Table
Blue Anchor Formation		19	Mohr-Coulomb	50	30	None
Newly Placed Attenuation Layer Material		17	Mohr-Coulomb	40	0	None
Inert Waste		16	Mohr-Coulomb	0	22	None
Previously Placed Attenuation Layer		17	Mohr-Coulomb	2	25	None



Technical advisers on environmental issues

Project	Brooksby Quarry - Phases 12, 13A and 13C	
Client	Tarmac Trading Limited	*Scenario* Sand and Gravel Sidewall - Attenuation Layer - Third Lift
Drawn By / Checked By	RT / DFR	*Analysis Method* Spencer
Date	26/11/2024 10:58:47	*File Name* 03 Sand and Gravel Sidewall Model - Third Lift.slmd

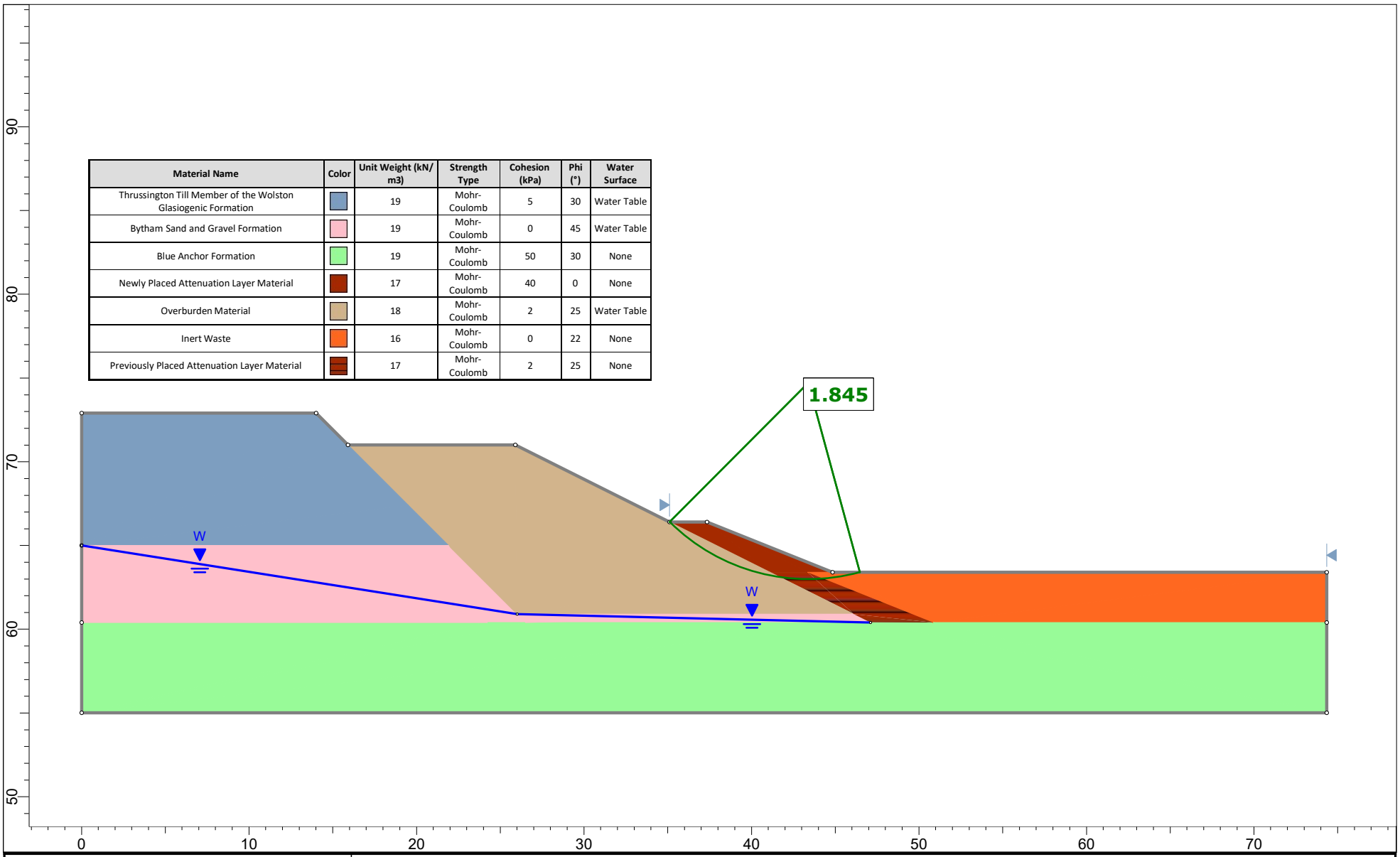
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Thrussington Till Member of the Wolston Glasiogenic Formation		19	Mohr-Coulomb	5	30	Water Table
Bytham Sand and Gravel Formation		19	Mohr-Coulomb	0	45	Water Table
Blue Anchor Formation		19	Mohr-Coulomb	50	30	None
Newly Placed Attenuation Layer Material		17	Mohr-Coulomb	40	0	None
Overburden Material		18	Mohr-Coulomb	2	27	Water Table



Technical advisers on environmental issues

Project	Brooksby Quarry - Phases 12, 13A and 13C		
Client	Tarmac Trading Limited	*Scenario*	Overburden Sidewall - Attenuation Layer - First Lift
Drawn By / Checked By	RT / DFR	*Analysis Method*	Spencer
Date	26/11/2024 11:26:32	*File Name*	04 Overburden Sidewall Model - First Lift.slmd

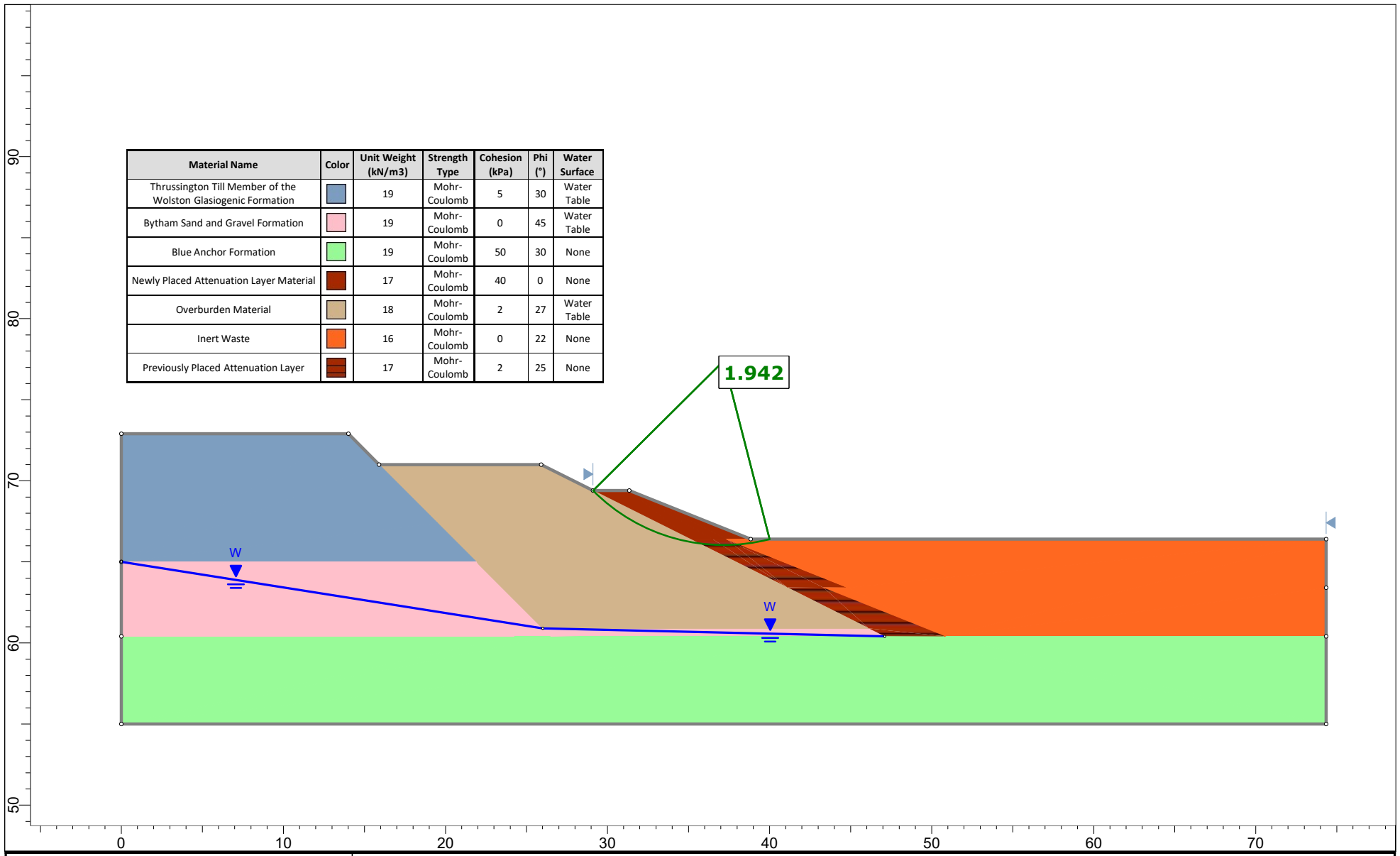
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Thrussington Till Member of the Wolston Glasiogenic Formation		19	Mohr-Coulomb	5	30	Water Table
Bytham Sand and Gravel Formation		19	Mohr-Coulomb	0	45	Water Table
Blue Anchor Formation		19	Mohr-Coulomb	50	30	None
Newly Placed Attenuation Layer Material		17	Mohr-Coulomb	40	0	None
Overburden Material		18	Mohr-Coulomb	2	25	Water Table
Inert Waste		16	Mohr-Coulomb	0	22	None
Previously Placed Attenuation Layer Material		17	Mohr-Coulomb	2	25	None



Technical advisers on environmental issues

Project	Brooksby Quarry - Phases 12, 13A and 13C		
Client	Tarmac Trading Limited	*Scenario*	Overburden Sidewall - Attenuation Layer - Second Lift
Drawn By / Checked By	RT / DFR	*Analysis Method*	Spencer
Date	26/11/2024 12:01:58	*File Name*	05 Overburden Sidewall Model - Second Lift.slmd

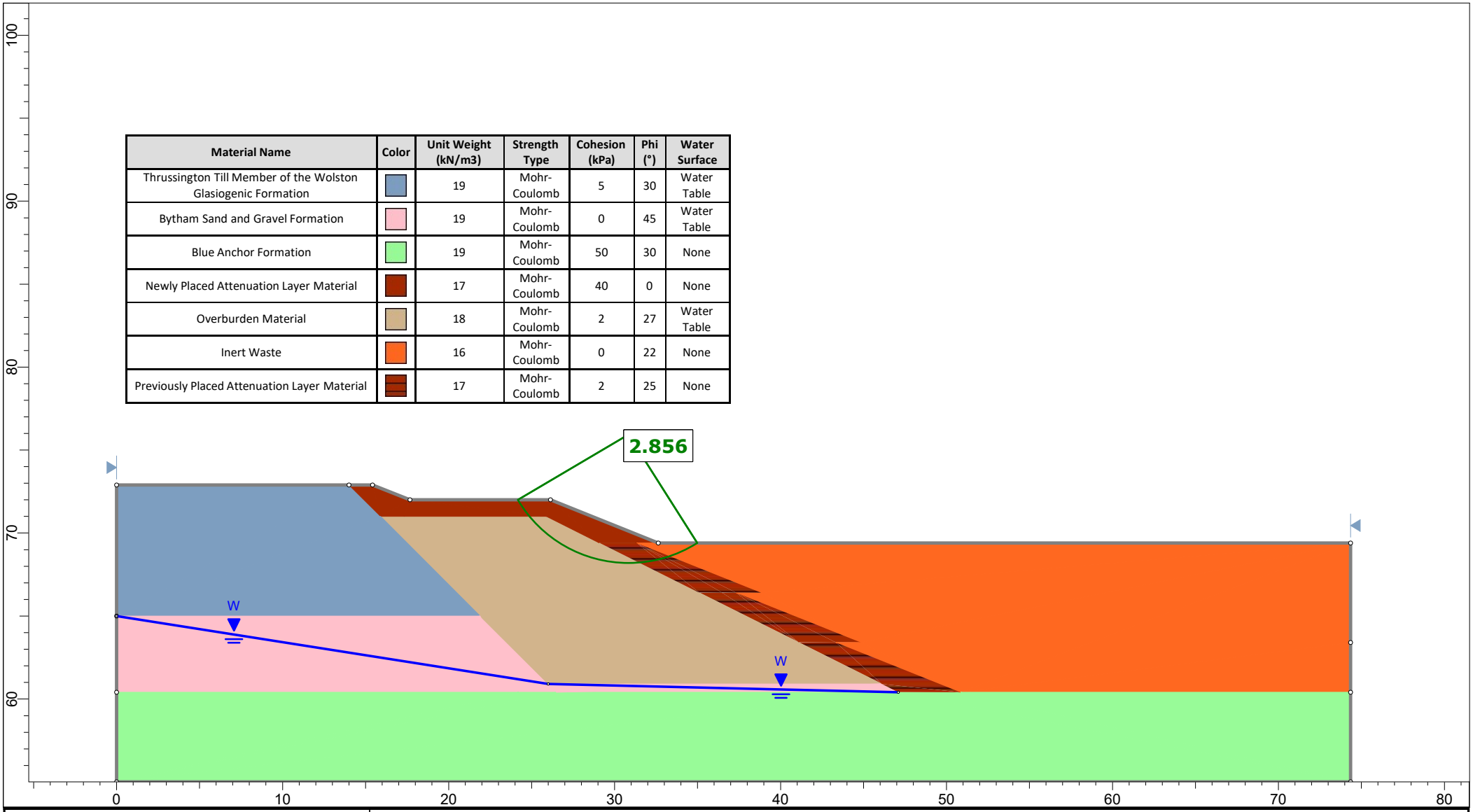
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Thrussington Till Member of the Wolston Glasiogenic Formation		19	Mohr-Coulomb	5	30	Water Table
Bytham Sand and Gravel Formation		19	Mohr-Coulomb	0	45	Water Table
Blue Anchor Formation		19	Mohr-Coulomb	50	30	None
Newly Placed Attenuation Layer Material		17	Mohr-Coulomb	40	0	None
Overburden Material		18	Mohr-Coulomb	2	27	Water Table
Inert Waste		16	Mohr-Coulomb	0	22	None
Previously Placed Attenuation Layer		17	Mohr-Coulomb	2	25	None



Technical advisers on environmental issues

Project	Brooksby Quarry - Phases 12, 13A and 13C		
Client	Tarmac Trading Limited	*Scenario*	Overburden Sidewall - Attenuation Layer - Third Lift
Drawn By / Checked By	RT / DFR	*Analysis Method*	Spencer
Date	26/11/2024 12:45:06	*File Name*	06 Overburden Sidewall Model - Third Lift.slmd

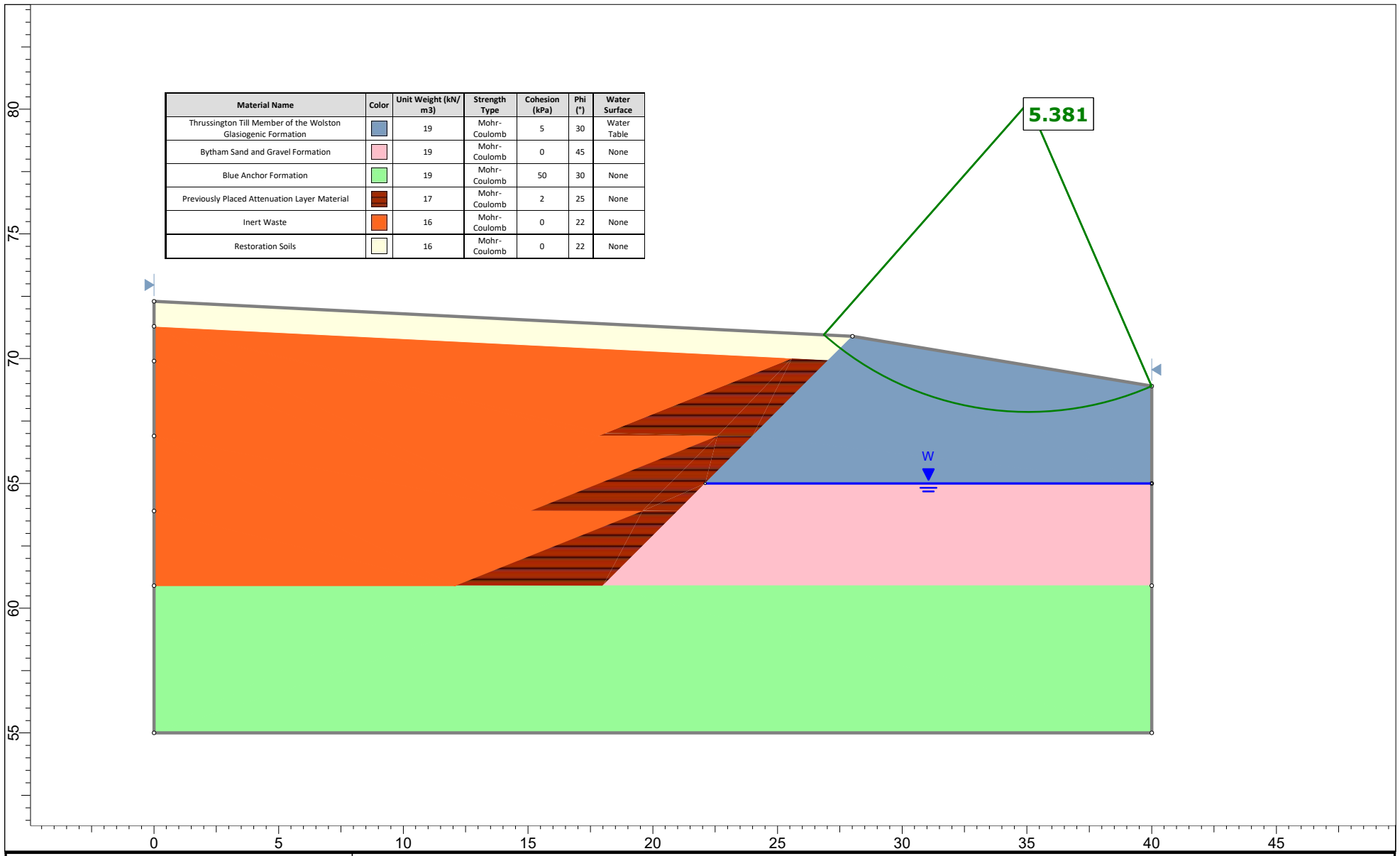
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Thrussington Till Member of the Wolston Glasiogenic Formation		19	Mohr-Coulomb	5	30	Water Table
Bytham Sand and Gravel Formation		19	Mohr-Coulomb	0	45	Water Table
Blue Anchor Formation		19	Mohr-Coulomb	50	30	None
Newly Placed Attenuation Layer Material		17	Mohr-Coulomb	40	0	None
Overburden Material		18	Mohr-Coulomb	2	27	Water Table
Inert Waste		16	Mohr-Coulomb	0	22	None
Previously Placed Attenuation Layer Material		17	Mohr-Coulomb	2	25	None



Technical advisers on environmental issues

Project	Brooksby Quarry - Phases 12, 13A and 13C		
Client	Tarmac Trading Limited	*Scenario*	Overburden Sidewall - Attenuation Layer - Fourth Lift
Drawn By / Checked By	RT / DFR	*Analysis Method*	Spencer
Date	26/11/2024 12:43:25	*File Name*	07 Overburden Sidewall Model - Fourth Lift.slmd

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Thrussington Till Member of the Wolston Glasiogenic Formation		19	Mohr-Coulomb	5	30	Water Table
Bytham Sand and Gravel Formation		19	Mohr-Coulomb	0	45	None
Blue Anchor Formation		19	Mohr-Coulomb	50	30	None
Previously Placed Attenuation Layer Material		17	Mohr-Coulomb	2	25	None
Inert Waste		16	Mohr-Coulomb	0	22	None
Restoration Soils		16	Mohr-Coulomb	0	22	None



Technical advisers on environmental issues

Project	Brooksby Quarry - Phases 12, 13A and 13C		
Client	Tarmac Trading Limited	*Scenario*	Restoration Scheme
Drawn By / Checked By	RT / DFR	*Analysis Method*	Spencer
Date	26/11/2024 12:38:59	*File Name*	08 Restoration Model Drained.slmd

APPENDIX D

QUARRY REGULATION ASSESSMENTS

Site:	**Brooksby Quarry**
Report Reference:	**19-371-R-001**
Report Undertaken By:	**Simon Railton BSc MSc MCSM MSc DIC CEng MIMMM CGeol FGS**
Date of Site Visit:	**October 2019**
Date next visit required:	**September 2021**

Introduction

This Review Report has two aims:

i. To act as an index to the Schedule 1 Reports relevant to the site

ii. To present the findings of the visit / audit focussing on:

- Whether the Schedule 1 Reports in place remain valid and relevant.
- Whether the Significant Hazards that exist on the site remain safe and secure.
- Highlighting where, if any, changes need to be made to the specific Schedule 1 Reports.
- That no further Significant Hazards have developed in the intervening period since the last Review Report / visit
- Highlight any improvements required of non-Significant Hazards.

Table 1. Index of Identified Significant Hazards

Name	Type	NGR	Status
Quarry Excavations	Excavations in sand and gravel	466800mE 315100mN	Active (Phases 11 to 14, Phases 12 and 13 under water)
Silt Lagoon No.1	Liquid Tip	467500mE, 315200mN	Active
Discharge Polishing Lake and Cleanwater Lagoon	Liquid Tip	467200mE, 315175mN (Discharge Polishing Lake 467500mE, 315370mN Cleanwater Lagoon	Active

Table 2. Evidence of HSE Notification of Significant Hazards

Significant Hazard	**Evidence of HSE Notification***
Quarry Excavations	Yes
Silt Lagoon No.1	Yes
Discharge Polishing Lake and Cleanwater Lagoon	Yes

NB * Confirmation reported in 2018 Geotechnical Assessment and Review Report

Table 3. Index of Schedule 1 Reports relevant to the site

Report	Date First Issued	Feature Type	Features Covered	Revision Date	Full or partial reissue
Geotechnical Assessment Excavation - (Oct 2018 Murray Rix Geotechnical)	Apr 2008	Excavations in sand and gravel	Phases 1 to 10, see Photograph 1 (backfilled excavation).		
Geotechnical Assessment Silt Lagoon No.1 - (Oct 2018 Murray Rix Geotechnical)	Nov 2006	Liquid Tip	Active silt lagoon, see Photograph 2.		
Geotechnical Assessment Discharge Polishing Lake and Cleanwater Lagoon - (Oct 2018 Murray Rix Geotechnical)	Oct 2008	Liquid Tips	Discharge Polishing Lake and Cleanwater Lagoon, see Photograph 3.		

Table 4. Validity of Schedule 1 Reports, Compliance of Existing Development and Confirmation of Stability

Report	Valid of Sch 1	Compliance	Comments
Geotechnical Assessment Excavation - (Oct 2018 Murray Rix Geotechnical)	No	NA	The assessment only covers Phases 1 to 10 and assesses slopes excavated at 45°, which is significantly steeper than recently excavated slopes at site. The maximum depth of the excavation is >7.5m. It is considered the Schedule 1 Report should be updated to reflect current excavation practices at site (and proposed restored design).
Geotechnical Assessment Silt Lagoon No.1 - (Oct 2018 Murray Rix Geotechnical)	No	NA	Newly constructed silt lagoons have replaced the former Cleanwater Lagoon. It is understood that Silt lagoon No.1 is no longer to be used for active silt deposition. Report no longer considered valid.
Geotechnical Assessment Discharge Polishing Lake and Cleanwater Lagoon - (Oct 2018 Murray Rix Geotechnical)	No	NA	Newly constructed silt lagoons have replaced the former Cleanwater Lagoon. It is understood that Silt lagoon No.1 is no longer to be used for active silt deposition. Report no longer considered valid.

Table 5. Recommended Changes to Schedule 1 Reports

Report (or element of report)	Recommended Changes	Timescale for completion
Geotechnical Assessment Excavation - (Oct 2018 Murray Rix Geotechnical)	New Schedule 1 Report required for Excavation Areas.	End Apr 2020
Geotechnical Assessment Silt Lagoon No.1 - (Oct 2018 Murray Rix Geotechnical)	New Schedule 1 Report required for Silt Lagoon No.1, Discharge Polishing Lake and former Cleanwater Lagoon.	End Apr 2020
Geotechnical Assessment Discharge Polishing Lake and Cleanwater Lagoon - (Oct 2018 Murray Rix Geotechnical)	New Schedule 1 Report required for Silt Lagoon No.1, Discharge Polishing Lake and former Cleanwater Lagoon.	End Apr 2020

Appraisal of other Excavations and Tips

All Excavations and Tips that were not deemed to represent a Significant Hazard have been appraised to determine whether it is justifiable to class them “non-significant” or “Low Risk Hazard Tips” (in general accordance with the Tarmac internal standards and definitions).

Completed appraisal sheets for the individual features are included in Section I; with a summary of the conclusions contained within Table 6.

Periodically these non Significant Hazards require reappraising to ensure their continued safety and stability. These appraisals may comprise either a desk top review for minor soil and screening banks or a physical inspection for larger features, “Low Risk Hazard Tips” and those non significant features where change has occurred. For non significant hazards where nothing has changed, the original appraisal forms are not reissued, but instead are deemed to remain valid. The following flow diagram outlines the appraisal process and how these relate to the identified Significant Hazards.

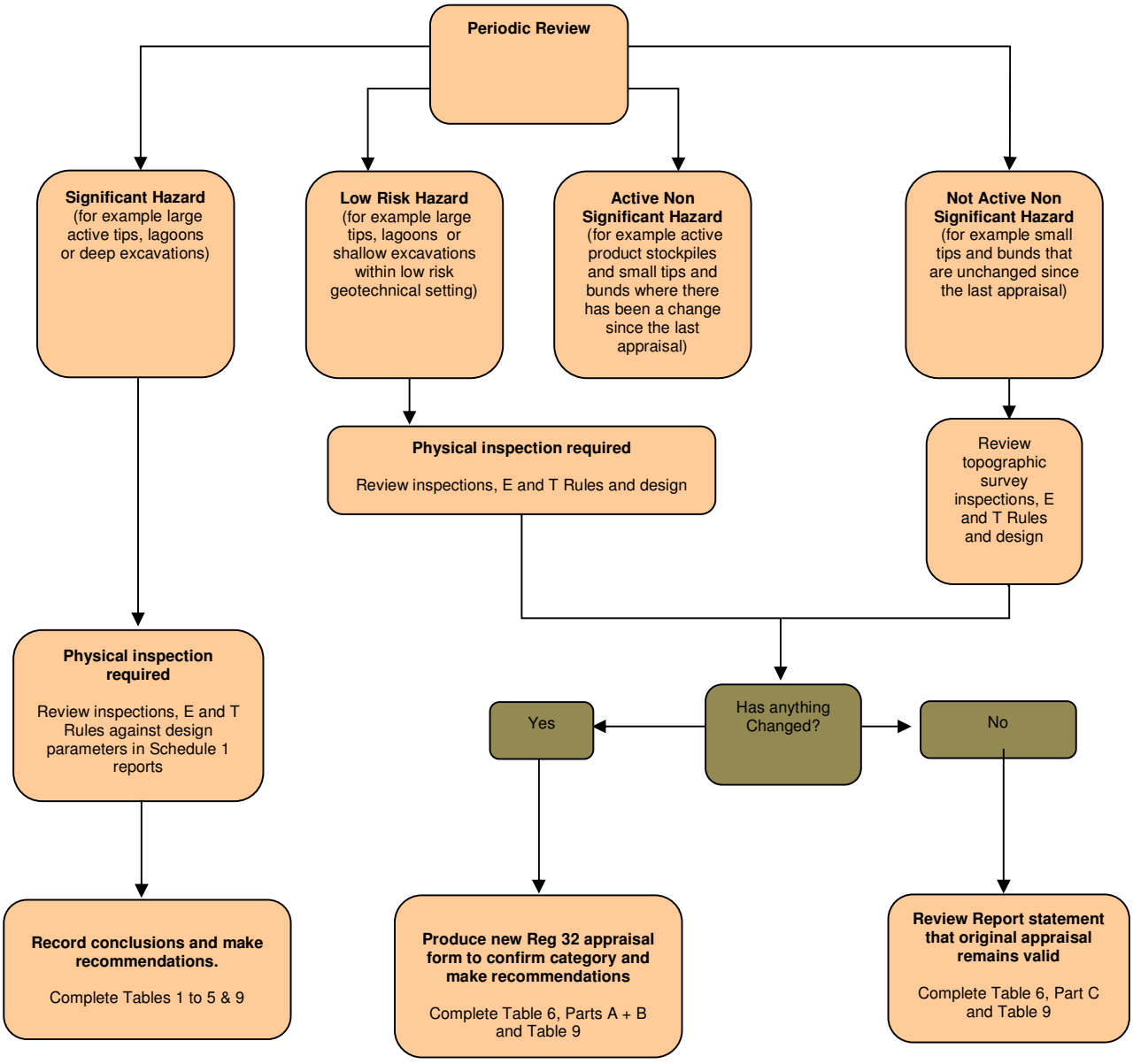


Table 6. Results of Appraisal of Excavations and Tips Not currently registered as Significant Hazards

FEATURE				APPRAISAL		REVIEW OF APPRAISAL		
Name*	**Type**	**NGR**	**Status**	**Date**	**Significant Hazard**	**Date of Review**	**Nature of Review**	**Does the initial appraisal remain valid?****
Aggregate Stockpiles	Solid Tips	Various Locations	Active	Oct 2017	No	Oct 2019	Inspection/topographic	Yes
Restored (backfilled) excavations (Phases 4 to 7), Phases 8 to 10 (current inert landfill operation), see Photograph 4, proposed restoration slopes Phases 11 to 14.	Solid Tip	467150mE, 315400mN, 467300mE, 315600mN, 466800mE, 315150mN	Inactive Phases 4 to 7, All other areas active	Oct 2019	No	-	Inspection/topographic	Yes
Soil and Overburden Storage Mounds, see Photograph 5.	Solid Tips	Various Locations	Inactive	Oct 2017	No	Oct 2019	Inspection/topographic	Yes

* See Drawing No.19-371-D-001 for location of features appraised.
** Refer to latest Appraisal Sheet where initial appraisal no longer valid

Table 7. Review of Excavation and Tips Rules

The Excavation and Tips Rules have been reviewed as part this assessment.

Reference: E & T Rules Brooksby Quarry (dated December 2019)	Yes	No
Do the Rules adequately reflect all relevant measures specified within the Schedule 1 Report (as per Schedule 1, paragraph 8)	No	
Will the Rules adequately control likely isolated minor failures (as per ACOP paragraph 286)	Yes	
Are there any other recommended changes?	Yes	

If No, see additional recommendations in Table 9.

Table 8. Review of Site Inspection Regime

Reference: E & T Rules Brooksby Quarry (dated December 2019)	Yes	No
Does the Inspection Regime adequately reflect all relevant measures specified within the Schedule 1 Report (as per Schedule 1, paragraph 8)	No	
Will the Inspection Regime adequately control likely isolated minor failures (as per ACOP paragraph 286)	Yes	

If No, see additional recommendations in Table 9.

Table 9. Table of Recommendations

Feature	**Recommendations**	**Timescale for Completion**	**Date completed**	**Signature (Quarry Manager)**
General Comments	1. Tarmac to confirm if future responsibility for landfilling operation lies with them. If Tarmac are to take over running of the landfill site, it should be demarcated outside of the quarry boundary and Quarries Regulations 1999. Additionally, Tarmac to confirm design (stability risk assessment report) and CQA for construction. 2. It is reminded that appraisals are required for all new features at site and for any significant changes to existing features.	Immediately For information		
Excavation	1. New Schedule 1 Report required for Excavation. 2. Prohibit access to Phases 11 to 13. Currently these areas are flooded and inadequate edge protection is in place. 3. Tarmac to confirm stand-offs to electricity pylons; site observations did not indicate instability, however, crest of cut slopes appear close to foundations. Furthermore, significant seepage from the base of the slope situated adjacent to the	End Apr 2020 Immediately Immediately Monitor stability via		

	north pylon was noted. No evidence of slope distress noted. See Photograph 6. 4. Restoration Lake; high water level within lake compared to flooded Phase 13 excavation, narrow dividing bund separates the two water bodies. It is recommended that the water level within the Restoration Lake be reduced to equalise the head differential across the dividing bund. See Photograph 7. 5. Install lifebuoys and signage at Restoration Lake. 6. Phase 2 Excavation has recently been flooded and extensive erosion of side slopes of the excavation was noted in the vicinity of the electricity cable post. As discussed on site it is recommended that the area of erosion be backfilled with coarse granular rock (the larger the blocksize the better). Once the washed out section of slope has been re-instated, the excavation may then be de-watered prior to resuming excavation. Monitor the stability of the electric cable post and the excavation via routine daily inspections. See Photograph 8. 7. Continue to monitor stability of east slope Phase 10 excavation (currently being backfilled), numerous circular slips have occurred. Currently there is adequate stand-off behind the crest of the slope to the quarry boundary. See Photograph 9.	weekly inspections Immediately Immediately Monitor stability via routine daily inspections		
Active Silt Lagoon	1. New Schedule 1 Reports required for Discharge Pond, Cleanwater Lagoon and Silt Lagoon No.1. 2. Recent flooding of the Rearsby Brook has resulted in considerable surface erosion and washout of the northeast margin of the new silt lagoons. It is recommended the area of washout be re-instated using coarse granular rock (not shale). See Photograph 10. 3. Install lifebuoys and signage at the active silt lagoon complex. 4. Continue to maintain access restrictions and operate with min. 1m freeboard. It is noted that due to the recent flooding there is currently <1m freeboard.	End Apr 2020 Monitor stability via routine daily inspections / remedial works to be carried out by end Jan 2020 Immediately For information		
Excavation and Tips Rules	The following new item to be inserted: Backfilling and restoration of excavated slopes.	Immediately		

Conclusions of site visit and review

A review of the existing excavation and tip areas and associated geotechnical documentation (including the "Schedule 1" Geotechnical Assessment Reports and the Excavation and Tips Rules) has been undertaken.

- An index of the existing Significant Hazards and Schedule 1 reports relevant to the site has been compiled.

- The validity of the current Schedule 1 reports and compliance of the existing developments to those reports has been confirmed.

- Where necessary, recommendations have been made for any required changes to the Schedule 1 reports.
- An appraisal of all Excavations and Tips that were not deemed to represent a Significant Hazard at the time of carrying out the latest site visit has been undertaken.

- A review of the site Excavation and Tips Rules and Inspection Regime has been undertaken in order to determine whether they:
    - adequately reflect all relevant measures specified within the Schedule 1 Report (as per Schedule 1, paragraph 8)
    - adequately control likely isolated minor failures (as per ACOP paragraph 286)

- Where necessary, recommendations have been made regarding any required changes or improvements to existing documentation or Excavation and Tip features (including non-Significant Hazards).

It is concluded that the next site inspection and Review of Brooksby Quarry should be undertaken in 23 months, ie. on or before September 2021.

Photo 1. Backfilled Phases 5-8.

Photo 2. View of Silt Lagoon No.1, looking north.

Photo 3. Recently constructed silt lagoons.

Photo 4. Inert Landfill (Phase 10)

Photo 5. Overburden Mounds.

Photo 6. Electric pylon, seepage at toe of batter slope.

Photo 7. Differential head across dividing bund between flooded Phases 12/13 Excavation and restoration lake (RHS of photo).

Photo 8. Flooded phase 2 excavation (area in front of personel) washed -out when brook flooded.

Photo 9. Surface erosion Phase 10 east slope.

Photo 10. Surface erosion New Silt Lagoons.

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web: www.keygs.co.uk

QUARRY APPRAISAL FORM

Company:		Tarmac	Site:	Brooksby Quarry	
Feature appraised		**Backfilling of Excavations (Phases 1 to 14)**			
NGR	Various	Various	Does feature exist yet?	Y	
Has the feature been subject to a 'Schedule 1' Geotechnical Assessment?				N	
Conclusion of 'Schedule 1' Geotechnical Assessment – significant hazard?				-	
Reason for appraisal	1) Routine reappraisal	☒	2) New feature	☐	
	3) Significant change in surrounding circumstances	☐	4) Following instability \ dangerous occurrence	☐	
	5) Proposed extension or significant change to existing feature.	☐	6) Other (enter details below)	☐	

SOLID TIP	
Does the solid tip/stockpile cover **>10 000m^2**?	Yes
Is the height of the solid tip/stockpile **>15m**?	No
Is the gradient of the land covered by the solid tip/stockpile **>1v:12h**?	No

LIQUID TIP	
Are the contents of the liquid tip >**4m higher than land within 50m of it**?	
Is the content of the liquid tip **>10 000m^3**?	

EXCAVATION IN ROCK	
Are any of the rock faces > **15m high**?	
Are any of the benched rock slopes > **15m but <30m high, and steeper than 45^0 (ie 1v:1h)**	
Is any part of the excavation > **30m deep**?	

EXCAVATION IN SOIL	
Is any part of the excavation **>7.5m deep and steeper than 27^o (ie 1v:2h)**?	
Is any part of the excavation **>30m deep**?	

If you have answered yes to any of the above questions the feature should be considered to be a significant hazard and should be subject to a 'Schedule 1' Geotechnical Assessment.

If the structure moved, would the failed mass be likely to endanger any person, structure, etc on or off site? Y/N	N
Backfilling of excavation to restore original ground level. Not feasible for failure to occur or areas beyond quarry to be affected.	

APPRAISAL OF SIGNIFICANT CHANGE	
Details of proposed change	
N/A	
Consequences of proposed change	
Does it increase risk/exposure to any personnel on site?	
Does it increase risk/exposure to any plant or infrastructure on site?	
Is there any potential for failure beyond the site boundary?	
Any other factors	

Does the feature represent a Significant Hazard?	**N**
Is a 'Schedule 1' Geotechnical Assessment report required?	**N**

Appraisal carried out by:	Simon Railton	Position:	Geotechnical Specialist
Signed:		Date:	20th December 2019

Key

		Data Supplied Y	N	n/a
	Quarry Curtilage		X	
	Boundary of Existing Significant Hazards	X		
	Boundary of Existing Significant Hazards (boundary limit undefined)		X	
	Boundary of Proposed Significant Hazards (Rocksand Tips)	X		
	Mine Workings (active or abandoned) (where known)		X	
	Buried Quarry Workings (excludes tips) (where known)		X	
	Cave Systems (where known)		X	
	Active or Former Landslopes (where known)		X	
	Springs (where known)		X	
	Artesian Wells (where known)		X	
	Watercourses (where known)		X	
	Faults (where known)	X		

Other relevant natural or man-made features (marked on plan as appropriate)

Notes

Plan contoured to Ordnance Datum Newlyn (at vertical intervals ≤5m).

Plan orientated and correlated with Ordnance Survey National Grid.

Plan marked with squares corresponding to 100x100m grid.

Rev.	Revision Detail	Drawn	Date
01	First Issue	RW	02/01/20

CLIENT: TARMAC A CRH COMPANY

PROJECT: BROOKSBY QUARRY

TITLE: PLAN ON GEOTECHNICAL ASSESSMENT

Drawn:	Checked:	Date:
RW	SR	Jan '20
Scale: 1:2500	Original Sheet Size: A1	Status: DRAFT

Drawing No. **19-371-D-001** Revision: **01**

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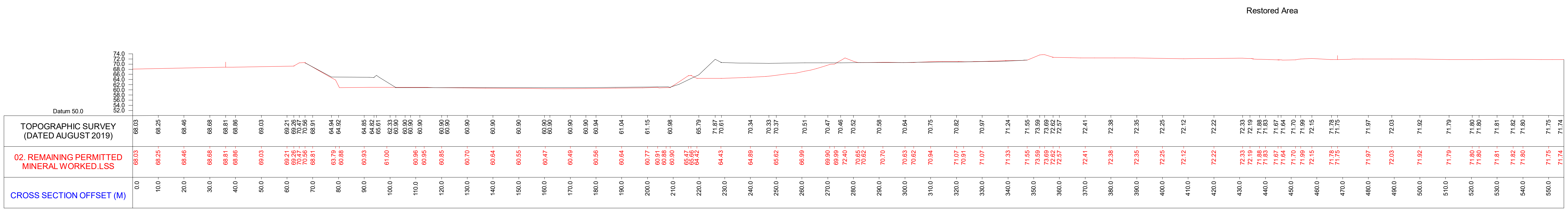
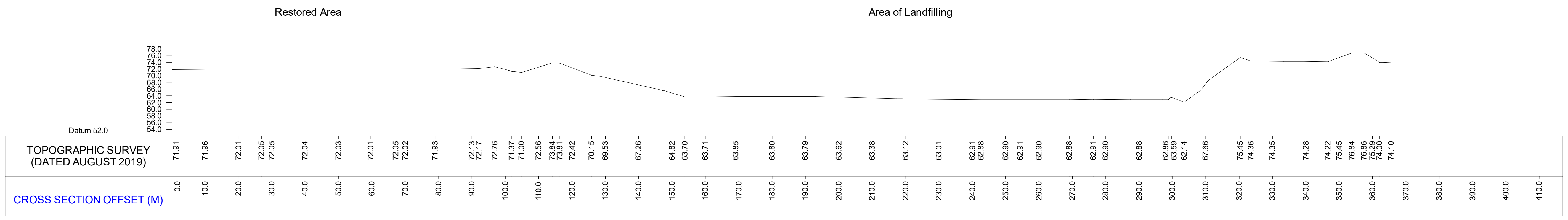
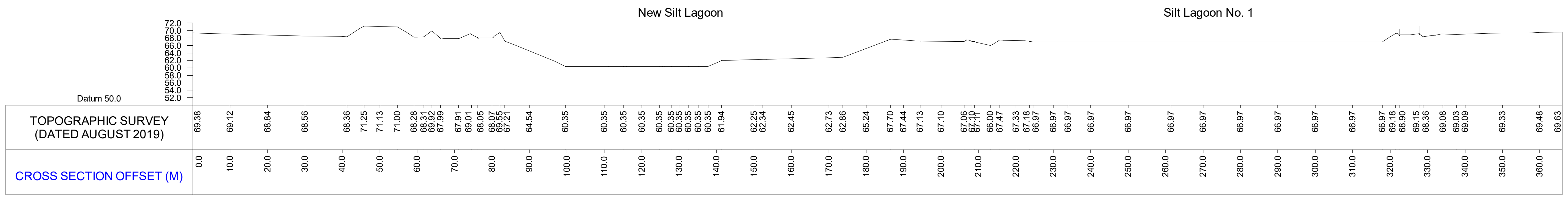


SECTION 1 - 1'



SECTION 2 - 2'



SECTION 3 - 3'

NOTES

1.

Rev.	Revision Detail	Drawn	Date
01	First Issue	RW	02/01/19

CLIENT:

TARMAC
A CRH COMPANY

PROJECT:

BROOKSBY QUARRY

TITLE:

CROSS SECTIONS

Drawn:	Checked:	Date:
RW	SR	Jan '20
Scale: 1:1250	Original Sheet Size: A2	Status: DRAFT

Drawing No. 19-371-D-002

Revision: 01

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KEY | GS

GEOTECHNICAL SITE REPORT on DEPARTURE

Site Name: Brooksby Site Manager: D. Price

Date: 29/10/19

REASON FOR VISIT / AREAS INSPECTED

Geotechnical assessment requested by Tarmac

ACCOMPANIED BY

D.P., C.S., G.K.

SUMMARY OF TRAINING

4hrs CPD - Geotechnical inspections D.P., G.K.

RECOMMENDATIONS

	TIMESCALE
1 Schedule 1 Reports required for new silt lagoons, Tarmac to provide LSS design for excavn. Assess if a S.H.?	As part of GA
2 Prohibit access to Phases 11-13 (inadequate E.P.s & flooded). check pylon stand-offs. Noted seepage from base of slope adjacent to north pylon (include in weekly inspections).	Monitor via routine inspection
Dewater restoration lake, head differential between flooded excavations to be equalised.	Immediately
No signage / lifebuoys restoration lake.	Immediately
3 Confirm status of landfill operation. If Tarmac to take over control, confirm design (Stability Risk Assessment Report), CQA for construction. Temporary shut operation to confirm status.	Immediately
Edge protection bunds to be improved.	For info.
Weekly inspections to monitor stability of failures, east slope.	"

A REVISIT HAS BEEN ARRANGED FOR: Oct 2020

Engineer Signature: [signature]

Name: S. RAILTON

Site Signature: [signature]

Name: DAVID PRICE

Original to be kept in the Site's Health & Safety Document

4/ Active silt lagoons - currently flooded. Dewater to achieve 1m freeboard. No lifebuoys & signage. End Jan '20.
Re-instate area of washout with course granular rock.

5/ Phase 2 working - recent erosion following flooding of brook, adj. to electric post.
Recommend backfill excavation with coarse granular rock (below water) immediately. Dewater excavation. Immediately

6/ No further remedial works.

7/ Appraisal for all new features or significant changes for info. are required.

Site:	**Brooksby Quarry**
Feature Reference:	**Excavation**
Report Reference:	**19-371-R-003**
Date of Report:	**January 2020**

The excavation at Brooksby Quarry has previously been designated a Significant Hazard and registered as Notifiable Excavation with the HSE.

In accordance with the requirements of Regulation 33 of the Quarries Regulations 1999 and at the request of Tarmac, a Geotechnical Assessment has been produced for the Excavation at Brooksby Quarry.

1. Site survey

The latest topographic survey data for the Excavation at Brooksby Quarry is shown on Drawing No.19-371-D-005, included at the back of this report.

The drawing is based on survey data provided by Tarmac (survey reference model: 'B355 BROOKSBY 2019-08-20 QU', survey dated August 2019).

2. Site investigation

Apart from the geological information contained within the 2013 Review Report no other Geological models for Brooksby Quarry have been provided.

Geology

The geological map for the area (Geological Survey of Great Britain (England and Wales) Sheet 156, Leicester) indicates that the geology of the area is represented by alluvium and glacial deposits. These superficial deposits overlie bedrock of the Lias Group.

3. Cross-sections based on site investigation

Relevant critical cross-sections showing the Excavation have been produced, see Drawing No.19-371-D-006.

4. Plans based on site investigation

All available information is shown on Drawing No.19-371-D-005.

5. Assumptions made before analysis

The following provides a record of the assumptions relevant to the assessment of ground conditions relating to the stability of the feature being assessed.

- Analyses have been undertaken on the current excavation area at Brooksby Quarry.
- The analyses are based upon critical cross-section 1-1' shown on Drawing No.19-371-D-005. The analyses have been carried out for the as-built excavated slope profile and the assumed final restoration profile.
- KGS have not been provided with any geological models relating to the current excavation area, thus, several assumptions relating to ground conditions have been made during this assessment.
- It is assumed that the base of mineral is coincident with that of the Lower Lias Clay and that the excavation void will be fully restored to the original ground elevation as per the adjacent restored workings.
- The commercially available Rocscience Inc. SLIDE software package was used to carry out the analyses.
- The limiting equilibrium theory has been used to assess the stability of the various ground models. The theory estimates the resisting forces (for maintaining the stable slopes) and disturbing forces (inducing the slopes to fail) within ground and then calculates the ratio of the resisting over the disturbing forces. This ratio is known as the Factor of Safety (FoS); a ratio greater than 1.0 indicating that the slopes are marginally stable or stable and values of less than 1.0 indicating that the slopes are or could become potentially unstable.
- Within the excavation slopes rotational failure is considered to be the most likely form of instability. The stability of the relevant slip surfaces has been analysed using vertical slice limit equilibrium methods (using the Bishop simplified). For each analyses a search for failure surfaces passing through the toe of slope has been carried out.
- The following shear strength parameters have been assumed for the analyses at Brooksby:

Material[1]	Cohesion, c' (kN/m^2)	Angle of friction, ϕ' (degrees)	Density (kN/m^3)
Sand and gravel (and backfill materials)	0	35	20
Lower Lias Clay (bedrock)	5	27	20

Groundwater conditions are as indicated on cross-sections 1-1' and 2-2' shown on Drawing No.19-371-D-004 and indicate working conditions.

The following provides a record of information that was not available when undertaking the assessment.

- Laboratory or field determined shear strength parameters for materials subject to stability analysis.
- Geological model indicating base of mineral and depth of old workings.

6. Findings of analysis

The following provides the results of the stability analyses carried out for the cross-sectional slope profile(s) described in Section 5. Details of the analyses are included at rear of this report.

1 The shear strength parameters have been assumed by KGS, based upon knowledge of similar materials, ground conditions elsewhere and with reference to outline parameters given in the GWP Tips Handbook.

RESULTS OF STABILITY ANALYSES			
Cross-Section	**Comments**	**Minimum FoS (at crest of slope)**	**Reference**
Section 1-1' (working excavation)	The FoS at crest of slope (FoS 2.5m, 5m and 19m behind crest of slope)	1.24 (1.30, 1.50 and 1.87)	Figure 1
Section 1-1' (restored excavation)	-	>1.50	Figure 2

The results of the analyses indicate that for cross-section 1-1' a minimum FoS value of c.1.24 was reported at the crest of slope, the FoS increases to 1.30 at 5m behind crest of slope. A minimum FoS value of 1.50 was reported for the restored quarry void.

A minimum FoS value of between 1.2 and 1.3 is usually considered appropriate in such circumstances.

7. Design coming out of analysis

The current excavation is considered to be overall stable based on the aforementioned assumptions. The excavation slopes should continue to be maintained in accordance with the Site Rules.

8. Requirements during and after construction

a) Inspections and Supervision

All excavation slopes adjacent to working areas, roads or other areas of access must be inspected before work starts to ensure that any potential instability or work activities do not create significant risks. In other cases where the rate of deterioration or the risk is high, inspection will also be required at least once a shift. These inspections may identify a need for maintenance work, or influence its frequency (reference Regulation 12, Approved Code of Practice Note 97).

Should any significant hazards be identified by this process, further Geotechnical Assessment will be necessary and appropriate action should be taken to treat or manage any significant risks to the health and safety of personnel in the vicinity.

Routine inspections and appraisals by quarry personnel (and future assessments undertaken by Geotechnical Specialists) should monitor ground conditions and ensure that any significant changes are identified that could impact upon the overall stability of the excavation slopes (for example excessive water seepages).

b) Specification of necessary Engineering Works and Safety Measures

The Quarries Regulations 1999 place a duty on the quarry operator to maintain the excavation to ensure that instability or movement likely to give rise to a health and safety risk is avoided (reference Regulation 30).

<u>If an imminent risk of serious personal injury is discovered during an inspection</u> (as described above), immediate action must be taken to safeguard those at risk. Situations where such action is likely to be appropriate include loose ground above a roadway or workplace or missing edge protection on roads (reference Regulation 12, Approved Code of Practice Notes 99 and 100).

Remedial Works

Other than applying the advised Design Parameters, Engineering Works and Safety Measures, no additional remedial works are required at this stage;

9. Conclusions on safety, stability and hazard status

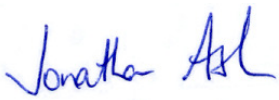
Under definitions given in Regulation 32 of the Quarries Regulations 1999, the Excavation at Brooksby Quarry is deemed to present a Significant Hazard.

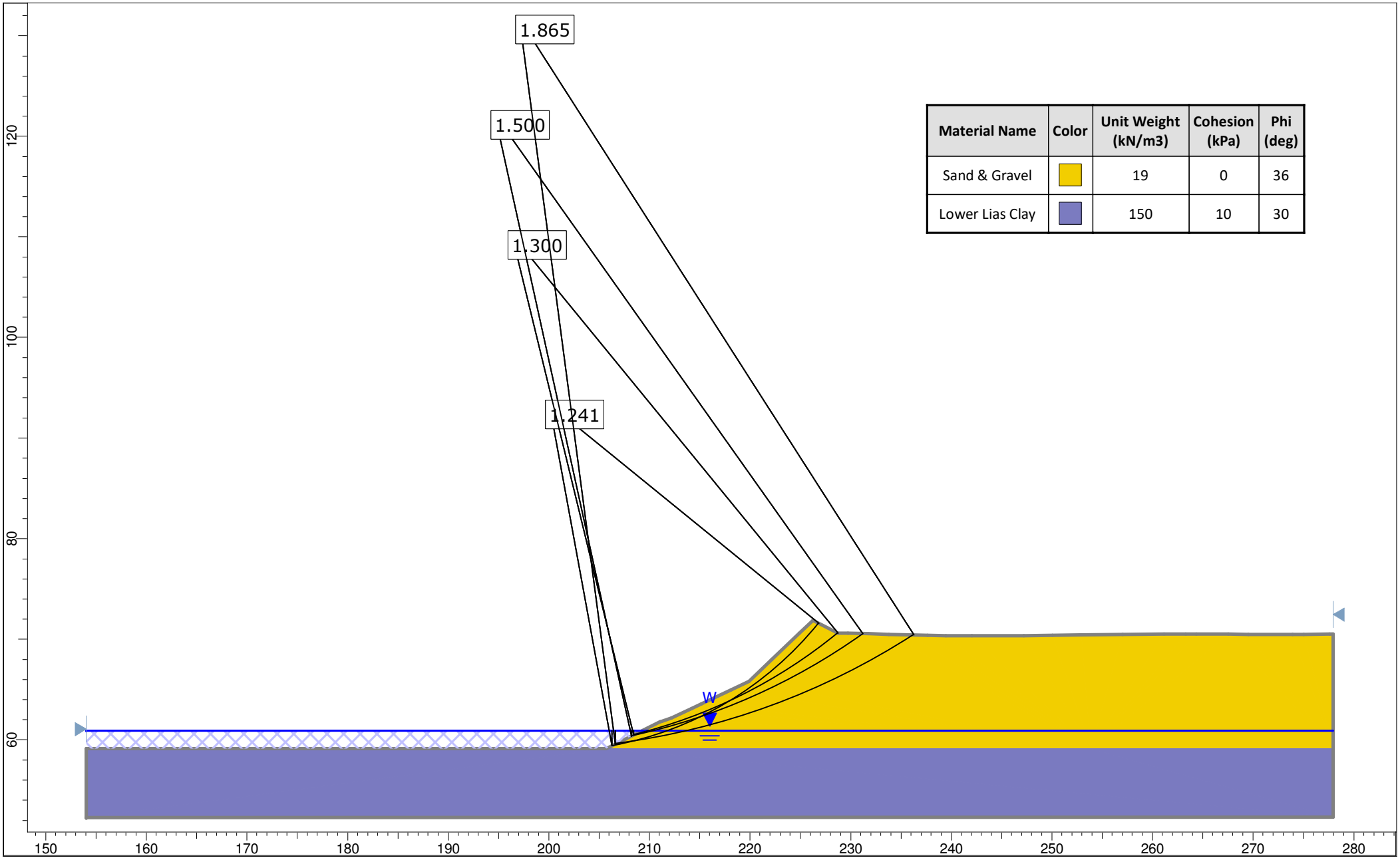
In accordance with the requirements of Regulation 37, the structure should remain registered as a Notifiable Excavation HSE.

The assumptions made and analyses undertaken as part of the current assessment conclude that the Excavation should remain overall stable when operational and following restoration providing the guidance provided in this report is adhered to.

Report Prepared By: S Railton BSc MSc MCSM MSc DIC CEng MIMMM CGeol FGS:

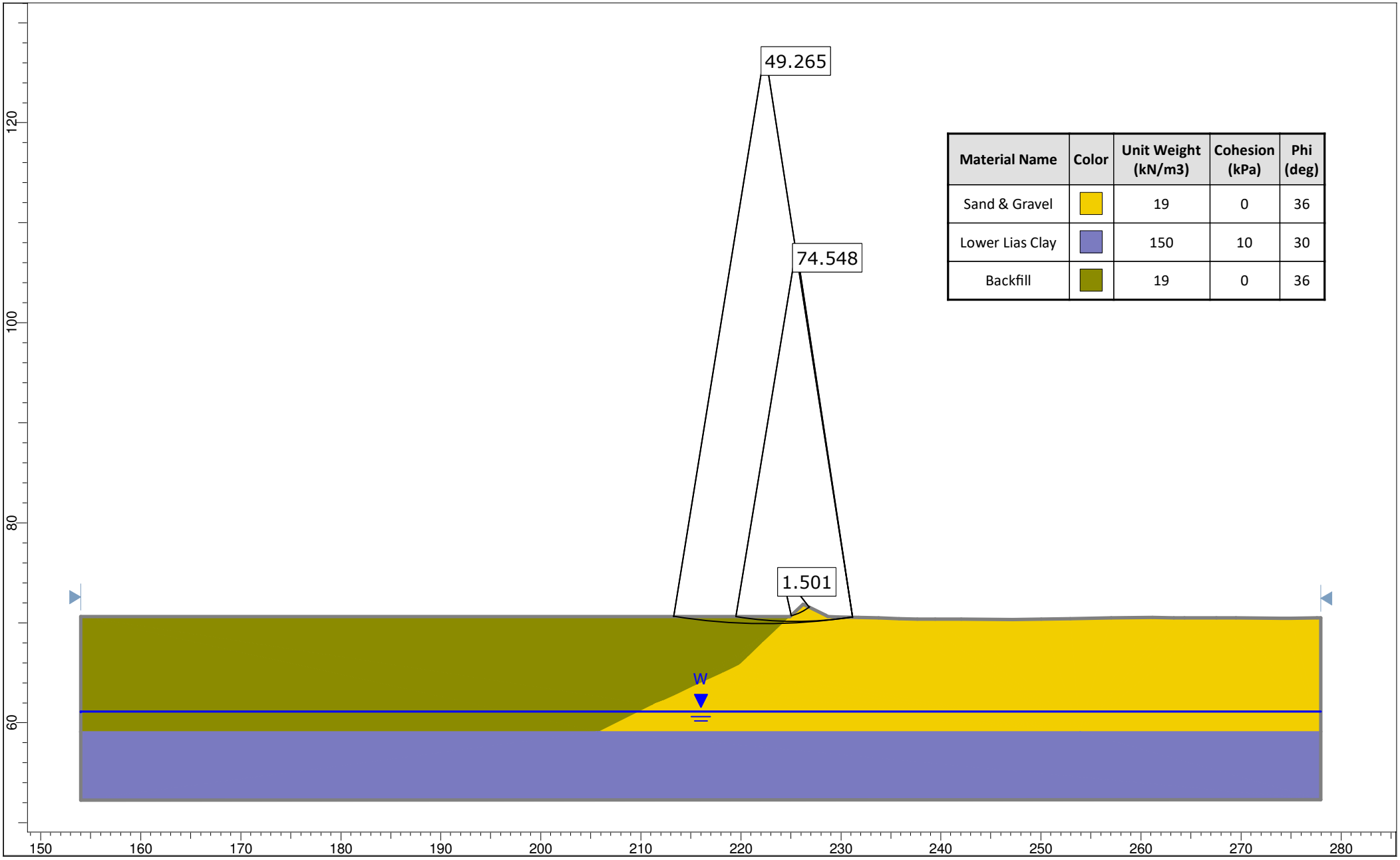
Report Approved By: J Ash: BSc MSc CEng MIMMM FGS:





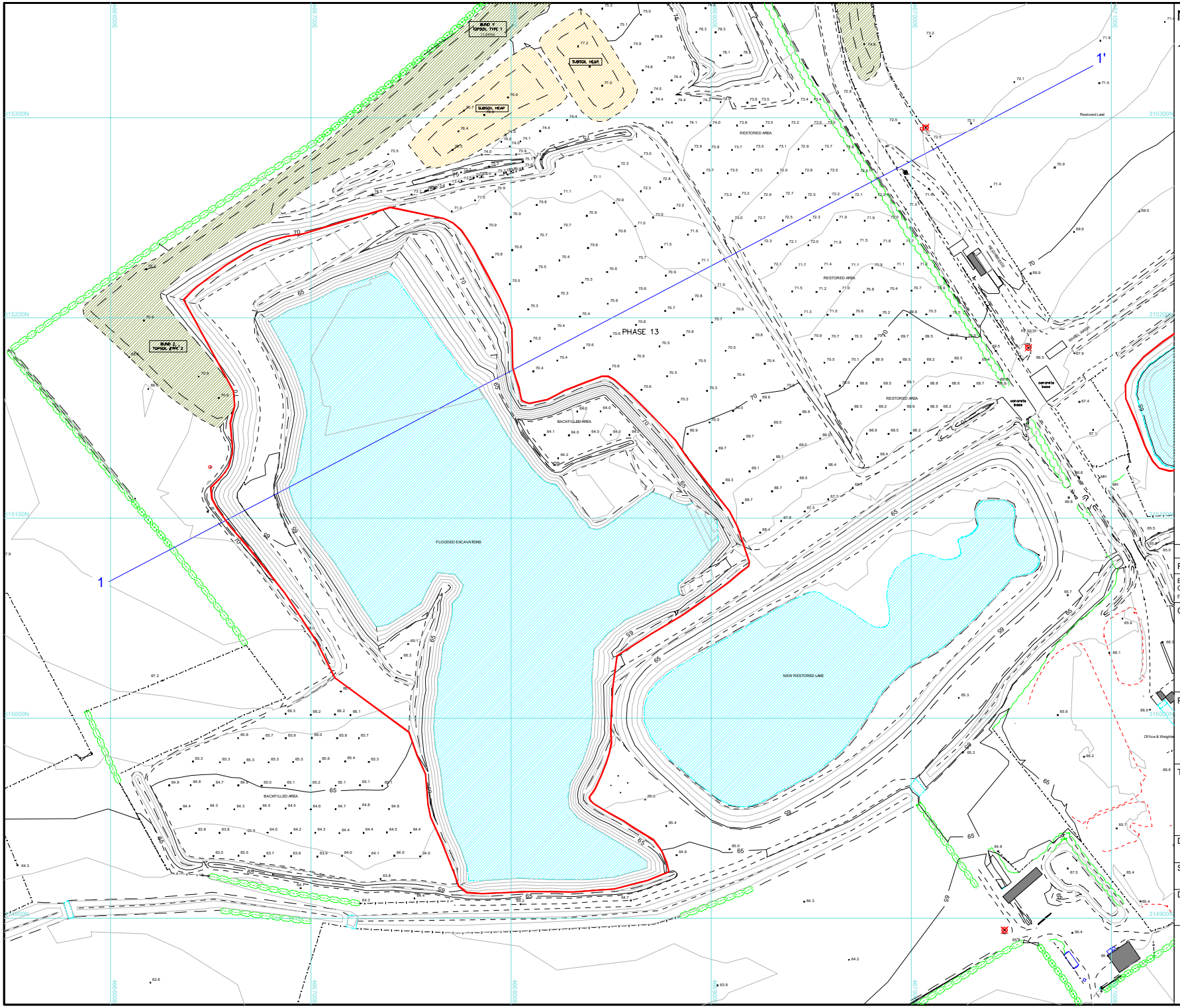
Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Sand & Gravel		19	0	36
Lower Lias Clay		150	10	30

SECTION 1.slmd



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Sand & Gravel		19	0	36
Lower Lias Clay		150	10	30
Backfill		19	0	36

SECTION 1 - RESTORATION SLOPE.slmd



NOTES

1.

Rev.	Revision Detail	Drawn	Date
01	First Issue	RW	09/01/20

CLIENT: TARMAC A CRH COMPANY

PROJECT: BROOKSBY QUARRY EXCAVATION

TITLE: SITE PLAN

Drawn:	Checked:	Date:
RW	SR	Jan '20
Scale: 1:2500	Original Sheet Size: A4	Status: DRAFT

Drawing No. 19-371-D-005

Revision: 01

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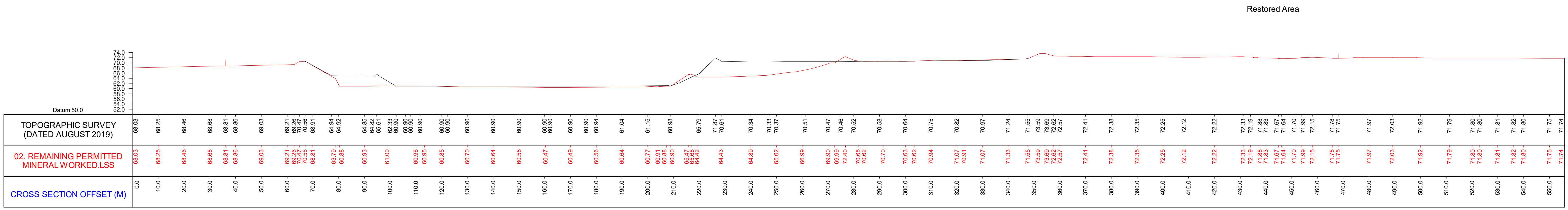

SECTION 1 - 1'

Rev.	Revision Detail	Drawn	Date
01	First Issue	RW	12/01/20

CLIENT:

TARMAC
A CRH COMPANY

PROJECT:

BROOKSBY QUARRY

TITLE:

CROSS SECTIONS

Drawn: RW	Checked: SR	Date: Jan '20
Scale: 1:1500	Original Sheet Size: A3	Status: DRAFT

Drawing No. **19-371-D-006**

Revision: **01**

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