Klohn Crippen Berger

# Boliden Tara Mines DAC

## Randalstown Tailings Storage Facility

## *Buttress Construction Works – Phase 1*

## *CQA Plan*



ERA0001A01

March 2025

March 11, 2025

Boliden Tara Mines DAC (BTMD)
Knockumber
Navan
Co. Meath, Ireland

**Mr. Gerd Janssens**
**Engineer of Record, Tara TSF**

Dear Mr. Gerd Janssens:

**Tara TSF DoR 2025-2026**
**Phase 1 Buttress CQA Plan**
**Draft**

Klohn Crippen Berger Ireland Ltd. (KCB) is pleased to submit the Construction Quality Assurance (CQA) Plan to Boliden Tara Mines DAC (BTMD) for the Buttress Construction Works – Phase 1 of the Randalstown Tailings Storage Facility (TSF).

This report is issued in draft for your review and comment.

Please contact the undersigned on bkeenan@klohn.com should you have any queries or concerns.

Yours truly,

**KLOHN CRIPPEN BERGER IRELAND LIMITED**

Brian Keenan

**Brian Keenan, CEng.**
**Senior Geotechnical Engineer**

CR:BK/CL



Klohn Crippen Berger Ireland Limited
MERITS, Unit D.8, Devoy Quarter, John Devoy Road ▪ Naas W91FE8V ▪ Co. Kildare ▪ Ireland
t +44.113.360.8990 ▪ www.klohn.com

# TABLE OF CONTENTS

# TABLE OF CONTENTS
(continued)



## List of Tables

# TABLE OF CONTENTS

(continued)

## List of Figures



## List of Appendices

# 1 INTRODUCTION

This document presents the Construction Quality Assurance (CQA) Plan for the Buttress Construction Works – Phase 1 of the Randalstown Tailings Storage Facility (TSF).

This document sets out the processes to comply with Condition 8.13.8 of Boliden Tara Mines Industrial Emissions Licence (IEL) P-0516-04, which requires that all basal and side wall containment engineering works proposed for any part of the TSF must be carried out under an Agency (Environmental Protection Agency) agreed CQA Plan.

## 1.1 Scope of CQA Plan

This CQA Plan contains a description of the CQA activities that will be used to manage the quality of the construction works at this site and ensure that the completed works meet and / or surpass the design criteria, plans and specifications. It is implemented through specific inspection activities that include visual observation, field testing and measurements, laboratory testing and evaluation of test data.

The CQA Plan identifies the personnel involved in the construction quality verification / confirmation, their inter-relationships and responsibilities. The CQA Plan also establishes the material reviewing and approving certification, reporting requirements, verification testing methods, sampling and analyses, and monitoring during remedial action.

An independent, suitably qualified CQA Engineer and / or Technician shall be present during the construction works to ensure application of and compliance with the CQA Plan.

A Construction Records Report (CRR), which is the equivalent to the CQA Validation Report required to be prepared and submitted to the Agency, will be produced following completion of the project to demonstrate compliance with this CQA Plan. Hereafter, the CRR will be referenced.

The goals of this CQA Plan are the verification that:

- The Quality Control Standards are valid for the construction objective.
- The Specified Tests are being implemented and correctly performed.
- The Quality Control Plan is working, and that the records are verified and maintained.

The CQA Plan contains among other items:

- A brief description of the design and proposed construction works.
- A description of the CQA activities that will be used to manage the quality of the construction works at this site.
- CQA personnel, role and responsibilities.
- Specification of materials for the works.
- The CQA procedures for the construction and placement of the engineered fill and protection geotextile, which are in general accordance with International Standards (IS EN), British Standards (BS EN) and Transport Infrastructure Ireland (TII) Standards.

- The frequency of testing for all the material components, which have been determined by KCB based on the scale and predicted consistency of materials and conditions. Form sheets to be used for CQA monitoring of the geotextile placement during the CQA are provided in Appendix I.
- Procedures for reviewing the QC procedures.
- Procedures for verifying construction.
- Procedures for CQA documentation and reporting.
- Procedures for conducting CQA field and laboratory testing.
- Monitoring field and laboratory testing activities.
- Procedures for documenting and correcting identified construction deficiencies.
- Details of the CQA documentation to be collated during the works and in the CRR.

## 1.2 Definitions

For clarification he following definitions are given:

- ***Construction Quality Assurance (CQA)*** - A planned and systematic pattern of all means and actions designed to provide confidence that items or services meet contractual and regulatory requirements.

  CQA refers to means and actions employed to assure conformity of the construction of the works to the technical specification and to this CQA plan.

- ***Construction Quality Control (CQC)*** - Those actions which provide a means to measure and regulate the characteristics of an item or service to contractual requirements.

  Construction Quality Control refers to those actions taken by Manufacturers, Installers, Contractors, or the Tara Mines Representative to ensure that the materials and the workmanship meet the requirements of the plans and specifications.

- ***Manufacturing Quality Assurance (MQA)*** – A planned system of activities that provides assurance that the materials were manufactured as specified in the certification documents and contract plans. It refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract plans for the project.

  MQA and CQA are performed independently of MQC and CQC. An effective MQA/CQA program can lead to identification of construction deficiencies.

- **CQA Team –** Appointed team responsible for the CQA of the construction works, consisting of the CQA Manager (BTMD internal person with KCB providing cover during absences) and CQA Personnel: CQA Engineers (KCB and BTMD designated personnel) and CQA Technicians for the Independent CQA Sub-Contractor.
- **CQA Manager –** A suitably qualified Geotechnical Engineer responsible to ensure Quality Control of the Work completed by the Contractor.
- **CQA Personnel** – CQA Engineers / Technicians on site that have the authority to approve aspects of the work as following the design criteria.

# 2 PROJECT OVERVIEW

## 2.1 Boliden Tara Mines

Boliden Tara Mines Designated Activity Company (BTMDAC or BTMD) is a wholly owned subsidiary of Boliden Mineral AB and is part of the Boliden Group, Sweden. Tara Mines is Europe's largest zinc and lead mine, and one of the top ten largest in the world. The mine is located approx. 2km northwest of the town of Navan in Co. Meath, Ireland, and approx. 60 km north-west of Dublin Airport.

Tara mines is an underground mine with the orebody now extending greater than 1km below surface. During normal operations, the mine produces approx. 2.1 Mt of tailings annually, and the coarse fraction is separated and used for backfilling underground. To date, ≈ 100 Mt of ore have been processed at Tara Mines at approximately 2.2 Mt to 2.6 Mt per year and the Life of Mine Plan extends to 2034. However, the newly discovered deposit, termed 'Tara Deep' is currently a major focus for exploration and development and has the potential to extend the LoMP.

Historically, approx. 40% of the tailings produced is used as backfill underground, when mixed with cement, with approx. 60% discharged to the Randalstown TSF. The Randalstown TSF is a discrete footprint, located approx. 3km to the north of the mine plant. The TSF has been built in six main stages during the period from 1974 to 2022 and is designed and operated under the conditions of the Industrial Emissions License (IEL) Register Number P0516-04.

The approx. footprint area (downstream toe of dams) of the Randalstown TSF is 320 ha. (Stages 1 to 5 ≈ 178 ha and the Stage 6 TSF ≈ 142 ha). The base elevation varies leading to dam height ranging from 18 m to 28 m below the final crest elevation at 1594.0 metres above mine datum (mAMD), equivalent to 67.11 metres above Ordnance Datum (mOD)).

The base elevation varies leading to dam height ranging from 18m to 28m below the current and final crest elevation at 1594.0 metres above mine datum (mAMD), equivalent to 67.11 metres above Ordnance Datum (mOD)).

Stages 1, 2 and 3 comprise unlined cells contained by the original starter dam. Stages 4A and 4B are the east and west upstream raises (7.5m), respectively, for the TSF. Stage 5A and 5B are subsequent upstream raises (5.5m) to the current and final crest elevation of 1594.0 mAMD. Stage 6 is an independent, composite lined facility, located adjacent and adjoining the north slope of the original TSF. Stage 6 has been constructed in two phases comprising an original starter dam and a downstream raise to the current and final crest elevation of 1594 mAMD. The total tailings design capacity of the TSF is approximately 59 Mt. The total tailings design capacity for Stages 1 to 5 is approx. 46 Mt and Stage 6 provides an additional storage of approx. 13 Mt.

A rock and glacial till fill buttress is proposed to be constructed on the downstream slope of and at the crest of the Stage 1, 2 and 3 starter dams. The purpose of this buttress is to provide support to the Stage 4 dam in order to increase the overall stability of the upstream raises; Stage 4 and Stage 5.

The planning approval for buttress works for TSF Stages 1 to 5 was granted to BTMD on 05 Sept 2024 and has a 3-year timeline to complete construction. BTMD has decided to build the buttress

in a phased manner, with Phase 1 to be constructed during 2025, which comprises the buttress for Stage 1 and Stage 2, in the East and South-East sectors of the TSF.

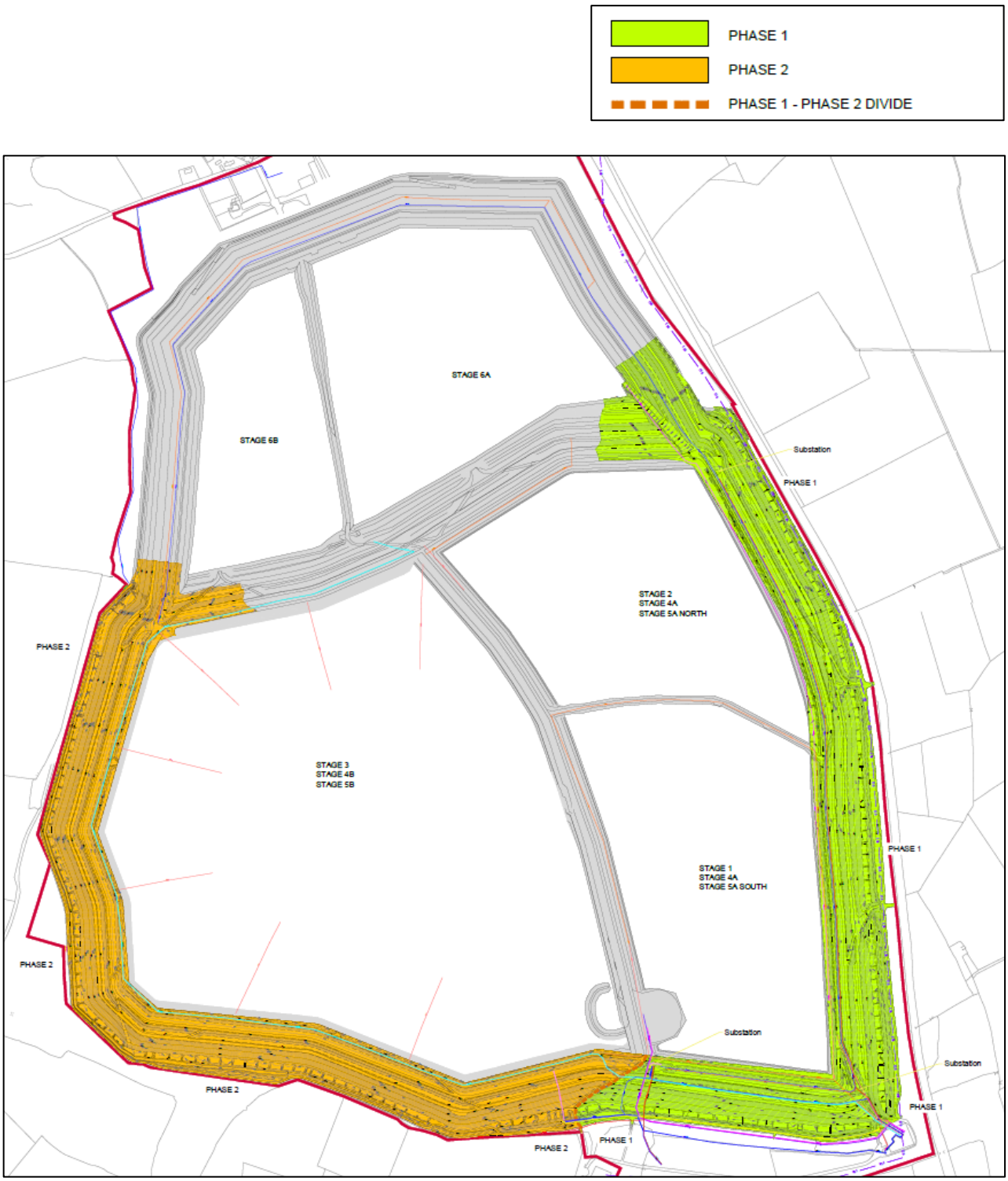
## 2.2 Site Location

Tara Mines Ltd. is situated at Knockumber, two kilometres northwest of Navan, County Meath. The Randalstown tailings storage facility (TSF) is located approximately 5 km to the north of the mine, and the existing facilities cover an area of about 180 ha (see Figure 2-1 and

Figure 2-2).

**Figure 2-1 Location: Ireland and the Tara Mine (Google Earth)**

**Figure 2-2 Tara Mine TSF - General Arrangement**



## 2.3 Design and Construction Overview

The Phase 1 Buttress construction works comprises a rock and glacial till fill buttress to be constructed on the downstream slope of and at the crest of the Stage 1 and Stage 2 Starter Dams and Stage 4A. The purpose of this buttress is to provide support to the Stage 4 dam and increase the overall stability of the upstream Stage 4 and Stage 5 raises.

The buttress development works will occur over two Phases, with Phase 1 comprising the East and South-East sectors of the TSF, while Phase 2 comprises of the West and South-West sectors.

The Works include all permanent and temporary works in connection with the civil works for Buttress Construction Works Phase 1 comprising:

- Removal of vegetation for entire footprint of the Buttress Construction Works, temporary stockpile and reinstatement upon completion of works.
- Importation and placing of and placing of circa 153,000 m3 of mine rock (Type F), importation and placing of circa 159,000 m3 of glacial till material (Type A) for the Buttress Construction Works Phase 1.
- Supply and placing of circa 11,800 m3 of drainage stone (Type C1, D1, E and G) for use as fill to the internal drainage systems, backfill to Perimeter Interceptor Channel (PIC), backfill finger drains, toe drain for Stage 1 and 2 and to construct drainage system at the crest of the starter dams for the buttress works.
- Allow for extension or relocation of all monitoring instruments in the footprint of the works.
- Construction of new access road and ramps.
- Supply and place, a geotextile separation layer, road subbase Type F1 material, 150 mm thick and road surfacing material, Type B, 100 mm thick and is to be used on top of the new buttress crest, perimeter access road and the permanent ramps.
- Supply and install drainage pipes and manholes within the PIC.
- Ancillary works including surface and groundwater management and protection for existing services, backfilling and raising of existing manholes as defined in detail in the Tender Documents.

Also coinciding with the Buttress Construction Works Phase 1 and incorporated into the contract is the requirement for the Contractor to manage the operations for the **TSF Waste Acceptance Procedure and compliance with EWC Code 17 05 04,** i.e. importation of greenfield glacial till and topsoil to site.

This procedure is detailed in Appendix F of Volume A: Works Requirements, Specifications and Drawings and requires the Contractor to obtain source approval for the waste, manage the waste documentation and to manage the waste on arrival to Site at its designated stockpiling area.

# 3 CQA MANAGEMENT

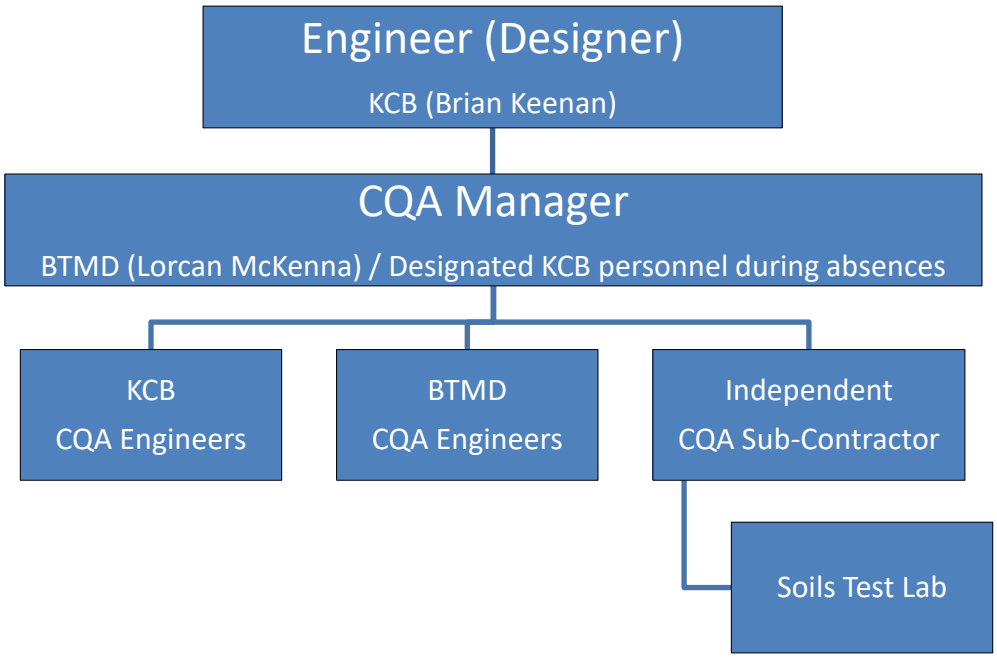
The principal organizations involved in the design and construction of the Buttress Construction Works – Phase 1 include the Facility Owner / Operator, Engineer (Designer) and CQA personnel, Main Contractor and Specialist CQA Subcontractor(s).

- **Owner / Operator:** BTMD owner / operator of the Randalstown TSF.
- **Engineer (Designer):** KCB is the appointed Designer for the works.
- **Main Contractor (Contractor):** Priority Construction Limited (PCL) is the appointed Main Contractor for the project. The Main Contractor has overall responsibility for construction of the works and for CQC during construction.
- **Independent CQA Sub-Contractor(s):** PCL shall appoint an Independent CQA Sub-Contractor for the testing of the earthwork materials.
- **CQA Team:** This team shall consist of the CQA Manager (BTMD internal person with KCB providing cover during absences) and CQA Personnel: CQA Engineers (KCB and BTMD designated personnel) and CQA Technicians for the Independent CQA Sub-Contractor procured by PCL.

## 3.1 CQA Roles

The CQA hierarchy for the project shall be as shown in the following diagram.

**Figure 3-1 CQA Hierarchy**




The KCB Engineer will be present on site at least once per month and it is proposed that a KCB CQA Engineer will be on site at least once per week during the construction works.

The CQA Manager will be on site full-time during the construction works.

The Independent CQA Contractor will be on site as required during the construction works.

## 3.2 CQA Responsibilities

**Engineer**

- Instruct design changes and/or approvals during the construction works.
- Review of the CQA daily logs, field and lab testing results and corrective actions.
- Attendance of construction progress and CQA related meetings, as required.
- Preparation of the CRR.

**CQA Manager**

- Implement the CQA Plan including assignment and management of the CQA Team.
- Review of field reports and geotechnical review of CQA related issues.
- Review of Work Method Statements and confirming approval/further action to BTMD.
- Review of design changes and coordination of such changes with BTMD and the Contractor.
- Chair of construction progress and CQA related meetings, as required.
- Perform independent on-site inspection and assessment of material stockpiles, any imported fill, borrow area materials and delivery and storage of materials (soil and geosynthetic) to site.
- Perform independent on-site inspection and assessment of the construction works, sampling and field testing.
- Prepare daily logs of the construction progress, inspection, sampling and testing.
- Coordination of CQA field testing, sampling and laboratory testing.
- Coordination of the surveying of subgrades, field test locations, as-builts and final surfaces.
- Complete CQA form sheets, as required, and ensure CQA form sheets are being completed by the Independent CQA Contractor.
- Verify that the equipment used in the field testing meets the testing requirement, calibrated and tests are conducted in accordance with the standardized procedures.
- Review of all field and lab testing and providing recommendations, as appropriate.
- Report inspection and testing results to the Engineer, BTMD and the CQA Team and identify works and/or materials for acceptance / rejection / re-testing / remedial action.
- Document and report all deviations to the Engineer.
- Ensure that corrective actions are implemented and verified.
- Filing of all project documentation on the Boliden Teams SharePoint
- Provide input and assist in the preparation of the CRR.

**CQA Engineer**

- Conduct on-site inspection and assessment of the material stockpiles, imported fill and delivery and storage of materials.
- Conduct on-site inspection and assessment of the construction works, sampling and field testing.
- Review of the CQA daily logs, field and lab testing results and corrective actions.
- Attendance of construction progress and CQA related meetings.

**Independent CQA Sub-Contractor**

- Perform independent on-site sampling and field testing of soils.
- Prepare daily logs of the soils sampling and testing.
- Coordinate the transfer and laboratory testing of the soil samples taken.
- Complete CQA form sheets.
- Verify that the equipment used in the field testing meets the testing requirement, calibrated and tests are conducted in accordance with the standardized procedures.
- Report, to the Employer's Representative and/or CQA Manager, the results of all inspections and testing.
- Assist in the preparation of the CQA Validation Report.

**Soil Testing Laboratory**

The Soils Testing Laboratory shall have experience in sampling and testing aggregates in accordance with the standards by IS EN, BS, ASTM and other applicable test standards. The selected laboratory will be required to be responsive to the project needs by providing test results within reasonable time frames. Final laboratory reports shall be certified by the Soils Testing Laboratory and submitted to the CQA Manager. It is preferable that the laboratory results be received in digital format as excel spreadsheets as well as in PDF format.

## 3.3 Site Meetings

In order to meet the project timeline, close coordination between BTMD, the Designer / Engineer, the CQA Manager, the CQA Engineers, the Independent CQA Contractor and the Contractor is essential. To meet this goal, the following meetings are proposed:

- **Pre-construction CQA Meeting**: This meeting shall be held prior to the start of the works to resolve any uncertainties in the application of the Design, CQA Plan and Method Statements. It shall be attended by BTMD, Engineer, CQA Manager, CQA Engineer(s), Main Contractor and Independent CQA Sub-Contractor (if required).
- **Daily Progress Meetings**: These shall be informal meetings held on Site during the day's activities and shall review the activities and discuss and potential construction problems. It shall be attended by the CQA Manager and the Contractor. The Engineer and/or CQA Engineers will attend on site visits that coincide.

- **Fortnightly Progress Meetings**: These shall be formal meetings held during the works to discuss progress, schedule, problems or deficiencies, review alternate resolutions and implement plans to timely and effectively resolve. It shall be attended by BTMD, Engineer, CQA Manager, CQA Engineer(s), Main Contractor and Independent CQA Sub-Contractor (if required).

**Meeting Minutes**: The CQA Manager will prepare minutes of the pre-construction and progress meetings; these will be issued in draft format to the Project Team for comment prior to a final version being distributed

## 3.4 Construction Material Submittals

Submittals for all materials proposed to be supplied for use in the works by the Contractor shall be provided to the Engineer and the CQA Manager, a minimum of one week prior to the delivery of materials to site.

The submittal shall be reviewed by the Engineer and CQA Manager for conformance with the Specifications and written approval / refusal communicated. Submittals that are not approved or determined to be insufficient for review shall be revised and resubmitted prior to delivery and/or use of the material on site.

## 3.5 Quality Control

Fill materials shall be subject to stringent inspection, sampling and testing to determine the suitability of the materials for the work and the moisture content and density of the materials in place.

The construction of the Buttress Construction Works Phase 1 and associated works within this Contract is required to be of a high calibre of workmanship and strict quality control will be applied throughout.

In-situ moisture-density data and laboratory test results shall be compiled and checked throughout construction of the Type A material by the CQA Team. The Engineer and CQA Manager shall be informed immediately of data not complying with the standards/specifications.

Prior to placement of each material discrete (loose) lift, the Contractor shall seek approval from the CQA Team that all relevant and required testing has been completed, surveyed and approved for the preceding lift. Where through the Contractors own actions and all relevant testing has not been completed, surveyed and approved for the preceding lift, the Contractor will be instructed to remove the pending lift until such testing can be completed by the CQA Team.

The Contractor is required to conduct a level survey of the formation level of each type of material and their completed levels:

- Verification of the perpendicular thickness of each material.
- Field Nuclear Density Gauge (NDG) tests on each lift of Type A and Type F materials.

## 3.6 CQA Inspection Activities

The CQA inspection activities shall solely address the construction and the installation of all the components for the Project, to ensure that the works meet or exceed the Specification.

Table 3.1 below addresses the general CQA activities applicable for the construction items required for the works.

Subsequent sections shall address key components separately and detail CQA activities and test methods unique to those components.

**Table 3.1 CQA Activities for Buttress Construction Works – Phase 1**

| Construction Item | CQA Activities |
|---|---|
| Survey Works | ▪ Confirm as-built surveys of surfaces stripped of vegetation and organics, invert of finger drains and ancillary items (instrumentation, manholes, pipework, ducting and cabling etc.).<br>▪ Confirm as-built surveys of material placement layers and in-situ test locations.<br>▪ Confirm as-built survey of the completed surfaces.<br>▪ Approve field adjustments.<br>▪ Provide as-test coordinates and elevations for field tests.<br>▪ The Contractor will make available the ongoing survey details in the form of drone or GPS surveys. |
| Existing Stockpiles / Imported Till Material / Imported Processed Rock fill / Imported Mine Rock fill | ▪ Inspect material when exposed and removed from the stockpiles and assess for suitability for use in the works.<br>▪ Inspect imported till material on arrival for direct use in the works / being stockpiled for suitability for use in the works.<br>▪ Inspect imported processed rock fill and mine rock fill for suitability for use in the works.<br>▪ Inspect stockpiling locations, access, sealing and management.<br>▪ All imported material shall be quantified through the weighbridge, except where explicitly stated in the Bill of Quantities (BOQ). |
| Construction Materials | ▪ Review Submittals for acceptance / rejection / additional info.<br>▪ Complete CQA Form Sheets for material delivery.<br>▪ Conduct visual inspection of the materials delivered.<br>▪ Monitor conformance sampling.<br>▪ Review conformance testing results.<br>▪ Review MQC documents.<br>▪ Maintain photographic record of delivered materials. |
| Subgrade Inspection | ▪ Inspect the trimmed and compacted subgrade following excavation works.<br>▪ Communicate acceptance / rejection / remedial action.<br>▪ Monitor and verify remedial action.<br>▪ Provide adjustments for design changes and/or unusual conditions.<br>▪ Complete CQA Form Sheets.<br>▪ Maintain photographic record of stripped surfaces. |

| Construction Item | CQA Activities |
|---|---|
| Surface and Groundwater Management | ▪ Monitor and assess performance and adequacy of surface water management systems installed.<br>▪ Communicate acceptance / rejection / remedial action.<br>▪ Monitor and verify remedial actions. |
| Fill Placement | ▪ Monitor till and rock fill material quality, delivery, placement, and compaction to confirm Specifications are being met.<br>▪ Monitor conformance sampling and in-situ testing.<br>▪ Conduct checks of position, elevation, lift, thickness and slope gradient.<br>▪ Ensure weather conditions are appropriate for placement.<br>▪ Provide adjustments for design changes.<br>▪ Communicate acceptance/rejection/remedial action.<br>▪ Monitor and verify remedial actions.<br>▪ Review conformance testing results.<br>▪ Maintain photographic record of construction progress. |
| Geotextile Placement | ▪ Confirm roll certification and report non-conformance.<br>▪ Monitor geotextile delivery, placement and lapping to confirm Specifications are being met.<br>▪ Monitor secure placement and overlap of the separation geotextile.<br>▪ Monitor conformance sampling.<br>▪ Ensure weather conditions are appropriate for placement.<br>▪ Provide adjustments for design changes.<br>▪ Communicate acceptance / rejection / remedial action.<br>▪ Monitoring and verify remedial actions.<br>▪ Complete CQA Form Sheets.<br>▪ Review conformance testing results.<br>▪ Maintain photographic record of construction progress. |
| Pipework | ▪ Confirm material certification and report non-conformance.<br>▪ Monitor pipework delivery, installation and connection to confirm Specifications are being met.<br>▪ Confirm pipework location, elevation and grade.<br>▪ Monitor grade, bedding and backfilling of pipework.<br>▪ Provide changes or adjustment for design changes.<br>▪ Communicate acceptance / rejection / remedial action.<br>▪ Monitor and verify remedial actions.<br>▪ Maintain photographic record of construction progress.<br>▪ Cleaning and camera surveying of completed pipelines. |
| Manholes and Concrete Works | ▪ Monitor removal of structures scheduled for demolition.<br>▪ Review survey alignments, chainage and layout.<br>▪ Confirm structure elevations, dimensions and openings.<br>▪ Confirm material certification and report non-conformance.<br>▪ Provide changes or adjustment for design changes.<br>▪ Communicate acceptance / rejection / remedial action.<br>▪ Monitor and verify remedial actions.<br>▪ Maintain photographic record of construction progress. |

| Construction Item | CQA Activities |
|---|---|
| Mechanical & Electrical | ▪ Confirm cable / ducting connection locations and details.<br>▪ Confirm material certification and report non-conformance.<br>▪ Monitor and assess in-situ testing.<br>▪ Provide changes or adjustment for design changes.<br>▪ Communicate acceptance / rejection / remedial action.<br>▪ Monitor and verify remedial actions.<br>▪ Maintain photographic record of construction progress. |

# 4 FILL MATERIAL

## 4.1 General

The materials shall be placed in layers of thickness appropriate to the compaction plant being used, and not greater than 350 mm for Type A materials and 500 mm for Type D1 and F materials in uncompacted depth. Layers shall have sufficient camber and evenness of placing and compaction to ensure free surface water run- off without ponding from each layer during its construction. Each layer of fill shall be placed over the full width of the required fill and shall be fully compacted and tested before the succeeding layer is placed.

Suitable materials shall be placed in a regular, progressive manner so as to cover the full area of the fill with minimum trafficking of the placed material prior to compaction. Where trafficking of placed material prior to the compaction is unavoidable owing to the nature of the works, such trafficking shall be regularly distributed over the area of the placed fill.

Suitable materials shall be filled in layers, placed in accordance with the Specification, to enable fill compaction beyond the edge of buttress, minimum 300 mm and subsequently trimmed back to the final profile.

Each placed layer of suitable material shall be compacted in a regular, progressive manner by multiple passes of compaction plant of a type and mass particularly suited to the efficient compaction of the placed material. Compaction of each layer shall be continued to the satisfaction of the CQA Team.

Compaction of the fill materials shall be in accordance with Table 6/4 Methods 2 and 3, as appropriate, in accordance with Clause 612 of the TII Manual of Earthwork Specification for National Roads (CC-SPW-00600), September 2024.

- A minimum of 6 passes of a minimum 10 tonne vibratory roller is required for all bulk granular materials.

Soft spots and areas of unsuitable materials identified by proof rolling shall be excavated and replaced with suitable material placed and compacted and / or shall be improved in-situ via compaction or the installation of appropriate geosynthetics.

The compacted thickness of each layer shall not exceed 300 mm for all Type A materials, except in the cases of free-draining and rock fill materials, Type D1 and Type F in which case the compacted thickness of each layer shall not exceed 500 mm.

If the Contractor, in the course of placing and compacting the suitable material fill, under-fills the required profiles, the Contractor shall not make good the area under-filled by placing and compacting extra material. The Contractor shall cut back the area of under-fill in such a manner as to permit the re-filling and compacting of the under-filled area in the same manner as specified for placement of suitable material fill. All additional works in cutting back, re-filling and compacting shall be entirely at the Contractor's own expense.

Where, by reason of the nature of the Works, it is necessary for the Contractor to traverse the compacted formation surface or level with construction plant, the Contractor shall temporarily raise the formation surface or level in compacted suitable material by not less than 300 mm before traversing with construction plant. The Contractor shall maintain the temporary layer

during the period of trafficking and shall at all times protect the permanent formation surface or level from damage or deterioration. The Contractor shall make good any damage or deterioration caused to the permanent formation surface or level by the passage of construction plant at their own expense.

For filled areas constructed of free-draining material or rock fill material, where surface voids remain following the compaction of a layer, the Contractor shall also blind the layer with a suitable, well-graded granular material and compact the blinding fully so as to fill all surface voids before placing the succeeding layer.

Where any material below the formation surface of filling is of a lower quality than that required in that position, it shall be excavated out to the extents and depths as directed by the CQA Team. Such excavations below formation level shall be fully drained by the Contractor and the excavation works shall be carried out in such a manner as to preserve the existing quality of both the materials being excavated and the in-situ materials being exposed. Excavations below formation level shall be backfilled with suitable material of the quality required for the formation level. The material shall be placed and compacted in accordance with the Specification and/or as directed by the CQA Team.

Backfilling below a water table (perched or standard) or in standing water shall be carried out using free- draining granular material or with rock fill material, as directed by the CQA Team. Compaction of this backfill material shall be carried out to the extent permitted by the site conditions using placing equipment or other appropriate means to the satisfaction of the CQA Team.

## 4.2 Materials

The buttress is constructed from several material types which include cohesive glacial till, granular glacial material and processed rock fill. It consists of the following material types:

- Topsoil
- Type A1 and A2, cohesive glacial gill, general fill and encapsulation of Type F, mine rock.
- Type A3, glacial granular material, general fill.
- Type B, road surfacing.
- Type C1, filter and protection material.
- Type D1, Backfill for Perimeter Interceptor Channel (PIC).
- Type E, 50 mm coarse drainage backfill for the manholes and the PIC, fill to wedge at downstream toe, fill for side slope drains, seepage drains, and finger drains.
- Type F, bulk mine rock fill.
- Type F1, coarse rock fill, for subbase to new permanent road.
- Type G, used as pipe bedding and is uniformly graded and uniformly sized of 12 mm diameter.

## 4.3 Topsoil

### 4.3.1 Topsoil Materials

Topsoil stockpiled from stripping shall be available for dressing the buttress side slope upon completion and other areas of the Site, as required.

Topsoil shall be excavated, transported and placed in stockpiles in such a manner as to minimize its deterioration for future reuse. Topsoil compaction shall be limited to the controlled and distributed passage of its transporting and placing plant. Topsoiled stockpiles, when completed, shall not be further trafficked by construction plant.

In the event of a shortfall of topsoil, the Contractor will be required to enter the "Simonstown Borrow" area and excavate from the existing stockpile for use in the buttress works. The Contractor if required to access Simonstown Borrow will do so by use of an existing road crossing which traverse the railway line and greenway line. The Contractor will be required to operate with a manned crossing and take all measures so as not to damage the existing rail and greenway infrastructure. The Contractor shall make good any damage or deterioration caused to the permanent formation surface by the passage of construction plant at their own expense.

### 4.3.2 Placement of Topsoil Materials

The Contractor shall excavate, haul, place and trim topsoil from the temporary stockpiles to construct a minimum 150 mm deep layer over the new buttress side slope.

## 4.4 Type A Materials

### 4.4.1 Type A1 and A2 Materials

Type A1 will be suitable material complying with the following:

- Material Type A1 and A2 shall be glacial silty sands and gravels obtained from the stockpiles / imported material with a Plasticity Index greater than 4%.
- The moisture content shall be between -2% and +6% of optimum as measured in the Standard Proctor method and the material shall be free of all unsuitable material and compacted to 95% of Standard Proctor in 300 mm lifts.
- Undrained Shear Strength of Remoulded Type 1 and A2 Material shall be in accordance with Clause 633 Specification for Road Works Series 600 – Earthworks and shall be minimum 50 kPa.
- Determination of Effective Angle of Internal Friction (ϕ') and Effective Cohesion (c') of Type A1 and A2 Material shall be in accordance with Clause 636 Specification for Road Works Series 600 – Earthworks and shall be minimum ϕ' = 30°; c'=0 kPa.
- Maximum particle size is 250 mm in the minimum dimension.

### 4.4.2 Type A3 Materials

Type A3 will be suitable granular material complying with the following:

- Material Type A3 shall be glacial silty sands and gravels obtained from the borrow area with a Plasticity Index less than 4%.

- The moisture content shall be between -2% and +6 of optimum as measured in the vibrating hammer method and the material shall be free of all unsuitable material and compacted to 95% maximum dry density as determined by the Standard Proctor method in maximum 300 mm depth lifts.
- Undrained Shear Strength of Remoulded Type A3 Material shall be in accordance with Clause 633 Specification for Road Works Series 600 – Earthworks and shall be minimum 50 kPa.
- Determination of Effective Angle of Internal Friction (ϕ') and Effective Cohesion (c') of Type A3 Material shall be in accordance with Clause 636 Specification for Road Works Series 600 – Earthworks and shall be minimum ϕ’ = 30°; c'=0 kPa.
- Maximum particle size is 250 mm in the minimum dimension.

### 4.4.3 Placement of Material (Type A1 and A2 Cohesive)

Glacial Type A1 and A2 material shall be placed and compacted using vibratory rolling equipment in the positions and to the profiles shown on the Drawings of Type A material. The glacial till material shall be placed in layers not exceeding 350 mm loose depth and shall be compacted to at least 95% of the Standard Proctor maximum dry density. The fill shall be placed level and evenly and shall be maintained at all times with a sufficient camber and a surface sufficiently even to enable surface water to be readily shed. The Type A1 and A2 material shall be keyed into the existing dam fill a minimum 350 mm, for each 350mm depth of compacted lift.

The moisture content shall be strictly controlled to within the range of -2% to +6% optimum moisture content determined by the Standard Proctor method. If necessary, water shall be added, or the fill shall be spread to dry, to achieve the required moisture content. These operations shall be fully included for in the tendered rates.

A stone correction shall be made to the field density and moisture content determinations in respect of stones above 20 mm in the glacial till material in order that the results can be compared with the laboratory results.

Any contaminated material shall be removed and replaced by clean Type A1 and A2 material at the Contractor's own expense and to the satisfaction of the CQA Team.

Any boulders larger than 250 mm minimum dimension shall be removed from the material either at source or after levelling, but prior to compaction. The cost of removal of the boulders shall be fully included in the Contractors rate for placement of the Type A cohesive till.

If the boulders are removed at the Buttress Works prior to compaction, these shall be transported back to the stockpile area for re-use elsewhere within the works.

Boulders can be broken down using a pneumatic hammer and used as Type F material although the boulders strength tends to be very strong.

### 4.4.4 Placement of Material (Type A3 Granular)

Glacial Type A3 material shall be placed and compacted using vibratory rolling equipment in the positions and to the profiles shown on the Drawings for Type A material. The glacial till material shall be placed in layers not exceeding 350 mm loose depth and shall be compacted to 95%

maximum dry density as determined by the vibrating hammer method (BS Standard etc). The fill shall be placed level and evenly and shall be maintained at all times with a sufficient camber and a surface sufficiently even to enable surface water to be readily shed. The Type A3 material shall be keyed into the existing dam fill a minimum 350 mm, for each 350mm depth of compacted lift.

The moisture content shall be as received from the stockpile strictly controlled to within the range of -2% to +6% optimum moisture content determined by the vibrating hammer method. If necessary, water shall be added, or the fill shall be spread to dry, to achieve the required moisture content. These operations shall be fully included for in the tendered rates.

A stone correction shall be made to the field density and moisture content determinations in respect of stones above 20 mm in the glacial till material in order that the results can be compared with the laboratory results.

The Contractor shall ensure the Type A3 material remains uncontaminated by any unsuitable material. Any contaminated material shall be removed and replaced by clean Type A3 material at the Contractor's own expense and to the satisfaction of the CQA Team.

Any boulders larger than 250 mm minimum dimension shall be removed from the material either at source or after levelling, but prior to compaction. The cost of removal of the boulders shall be fully included in the Contractors rate for placement of the Type A3 till.

If the boulders are removed at the Buttress Works prior to compaction, these shall be transported back to the stockpile area for re-use elsewhere within the works.

Boulders can be broken down using a pneumatic hammer and used as Type F material although the boulders strength tends to be very strong.

### 4.4.5 Testing Frequency Type A Material

Testing of Type A material will be carried out for each material at the frequencies given below, or as directed by the Engineer. The results of the compliance and conformance testing will be reported on specific grading data sheets.

**Table 4.1 Type A Material Testing Frequency**

| Parameter | Standard | Frequency |
|---|---|---|
| Moisture Content | BS 1377: Part 2 | 1 test / 2,000 $m^3$ |
| Particle Size Distribution | BS 1377: Part 2 | 1 test / 5,000 $m^3$ |
| Sedimentation - Hydrometer | BS 1377: Part 2 | 1 test / 15,000 $m^3$ |
| Liquid/Plastic Limits | BS 1377: Part 2 | 1 test / 5,000 $m^3$ |
| Optimum Moisture Content Standard Proctor | BS 1377: Part 4 | 1 test / 10,000 $m^3$ |
| In-situ Moisture (Nuclear) | BS 1377: Part 9 | 1 test / 500 $m^3$ |
| In-situ Density (Nuclear) | BS 1377: Part 9 | 1 test / 500 $m^3$ |
| Effective angle of internal friction (∅') and effective cohesion (c') | Clause 636 TII Series 600 | 1 test / 50,000 $m^3$ |

## 4.5 Granular Rock Materials

### 4.5.1 Type B Road Surface Material

The specification for this material, which conforms to the unbound granular materials A per SR 21 Annex D specification, is tabulated below. The material will be compacted with a minimum of four passes of a minimum 10 tonne smooth vibratory roller.

**Table 4.2 Type B Grading Envelope**

| Sieve Size (mm) | Coarse (% passing) | Fine (% passing) |
|---|---|---|
| 63 | 100 | - |
| 31.5 | 90 | 80 |
| 16 | 85 | 55 |
| 8 | 65 | 35 |
| 4 | 50 | 22 |
| 2 | 40 | 15 |
| 1 | 35 | 10 |
| 0.5 | 20 | 0 |
| 0.063 | 7 | 0 |

### 4.5.2 Type C1 Protection Material

The specification for this material is as per BS EN 933 (Table 4.3), and

- Shall be non-Plastic in accordance with BS 1377 Part 2.
- Water soluble sulphate content of less than 0.38% of sulphate (as SO3) when tested in accordance with IS EN 1744-1, Clause 10.

**Table 4.3 Type C1 Grading Envelope**

| Sieve Size (mm) | Fine (% passing) |
|---|---|
| 12 | 100 |
| 6.3 | 80 – 95 |
| 1.18 | 30 – 70 |
| 0.300 | 8 – 35 |
| 0.075 | 3 - 5 |

### 4.5.3 Type D1 Backfilling Perimeter Interceptor Channel

The specification for this material is as per BS EN 933 (Table 4.4), and

- Shall be non-Plastic in accordance with BS 1377 Part 2.

- Water soluble sulphate content of less than 0.38% of sulphate (as SO3) when tested in accordance with IS EN 1744-1, Clause 10.
- Resistance to Fragmentation in Category LA50 in accordance with BS EN 13242.
- Hardness: Flakiness Index in FI50 in accordance with BS EN 13242.

**Table 4.4 Type D1 Grading Envelope**

| Sieve Size (mm) | Coarse (% passing) | Fine (% passing) |
|---|---|---|
| 250 | 100 | |
| 100 | 100 | 30 |
| 75 | 60 | 10 |
| 50 | 40 | 0 |
| 20 | 15 | 0 |
| 10 | 10 | 0 |
| 1 | 6 | 0 |

### 4.5.4 Type E Coarse Drainage Material

This material is a drainage stone and is uniformly graded and uniformly sized of 50 mm diameter and a fine aggregate content of 5% passing the 10 mm sieve in compliance with BS EN 933 (Table 4.5), and

- Shall be non-Plastic in accordance with BS 1377 Part 2.
- Water soluble sulphate content of less than 0.38% of sulphate (as SO3) when tested in accordance with IS EN 1744-1, Clause 10.
- Resistance to Fragmentation in Category LA50 in accordance with BS EN 13242.

**Table 4.5 Type E Grading Envelope**

| Sieve Size (mm) | Coarse (% passing) | Fine (% passing) |
|---|---|---|
| 50 | 100 | 95 |
| 10 | 5 | 0 |

### 4.5.5 Type F Bulk Rock Fill Material

Type F shall be imported mine rock or other approved source and will be suitable material complying with the following:

- Maximum particle size is 350 mm in the minimum dimension.

### 4.5.6 Type F1 Road Subbase Rock Fill Material

Type F1 shall be imported rock and shall be granular material conforming to the Transport Infrastructure Ireland (TII) Series 600 Specification for 6F1 and 6F2 and shall comprise:

- Selected granular, hard, durable, well graded material.
- Natural gravel, crushed gravel, recycled aggregates, crushed rock and/or crushed concrete.
- 100% passing the 100 mm sieve and < 10% fine.
- Free of deleterious material and argillaceous rock.

### 4.5.7 Type G Fine Drainage Material

This material is uniformly graded and uniformly sized of 12 mm diameter and a fine aggregate content of 10% passing the 63 µm sieve, and

- Shall be non-Plastic in accordance with BS 1377 Part 2.
- Water soluble sulphate content of less than 0.38% of sulphate (as SO3) when tested in accordance with IS EN 1744-1, Clause 10.
- Resistance to Fragmentation in Category LA50 in accordance with BS EN 13242

### 4.5.8 Placement of Rock Fill (Type B)

Rock fill material Type B shall be placed to form the road surfacing material, 150 mm thick upon completion of the buttress.

The rock fill shall be compacted by a minimum 4 passes of a 10-tonne vibrating roller. The fill shall be placed level and evenly and shall be maintained at all times with a sufficient camber and a surface sufficiently even to enable surface water to be readily shed downstream.

### 4.5.9 Placement of Rock Fill (Type C1)

Screened rock fill Type C1, 200 mm thick shall act as a filter layer between the Type A materials and the existing TSF fill and the Type D1. The Type C Filter layer will prevent the loss of fine grains from the Type A material through the coarser material of the Type D1 drainage material.

A Type C1 filter layer, 200 thick mm shall also be placed on Type E stone for the finger drains that will direct seepage to the PIC.

A Type C1 toe drain, a lateral drain between finger drains 200 mm thick and 600 mm high shall be placed between the existing TSF and new Type A material to link between finger drains.

The Type C1 shall be placed to the line, dimensions and levels shown on the Drawings and compacted by use of wacker plate or other approved method by the CQA Team.

The Contractor shall ensure the placed Type C1 material is not eroded during rain events and must prevent the material dusting. Any eroded zones shall be repaired using Type C1 material and compacted. Any contaminated material shall be removed and replaced by clean Type C1 material at the Contractor's own expense.

### 4.5.10 Placement of Rock Fill (Type D1)

Where Type D1 material is required to backfill the PIC, it will be placed loosely with nominal compaction where possible with the construction plant/excavator bucket.

All vegetation, subsoil and topsoil shall be removed from the footprint of the Type D1. Prior to the placement of the Type D1, a separation geotextile layer of Terram 2000 or equivalent shall be placed under the footprint of the Type D1 in accordance with 10.2.

### 4.5.11 Placement of Rock Fill (Type E)

The placement of Type E drainage material shall be placed to form the drains on the crest of the starter dams, Stage 1 and 2 within the Type F. This Type E drain shall be 500 mm thick and placed with a sufficient camber to enable water to be readily shed downstream at a minimum slope of 2%.

The Type E shall be placed to the line, dimensions and levels shown on the Drawings and compacted with minimum 4 passes of a 10-tonne smooth roller (non-vibratory).

Further use of Type E drainage material shall be placed to backfill the manholes, seepage drains, Finger drains and side slope channels. Backfilling of the manholes will be by agreed method with the ER.

Any contaminated material shall be removed and replaced by clean Type E material.

### 4.5.12 Placement of Rock Fill (Type F)

The bulk rock fill material Type F, mine rock, shall be placed on the crest of the starter dams, Stage 1 and 2 in lifts not exceeding 500 mm. The rock fill shall be compacted to at least 92% maximum dry density as determined by the vibrating hammer method and in accordance with the dimensions and levels shown on the Drawings. The fill shall be placed level and evenly and shall be maintained at all times with a sufficient camber and a surface sufficiently even to enable surface water to be readily shed. The Type F material shall be keyed into the existing TSF fill a minimum 500 mm.

The moisture content shall be controlled to within the range of -2% to +6% optimum moisture content determined by the vibrating hammer method. If necessary, water shall be added, or the fill shall be spread to dry or mixed to achieve the required moisture content. These operations shall be fully included for in the tendered rates.

A stone correction shall be made to the field density and moisture content determinations in respect of stones above 20 mm in the material in order that the results can be compared with the laboratory results.

Any boulders larger than 350 mm minimum dimension shall be removed from the material either at source or after levelling, but prior to compaction.

If the boulders are removed at the Buttress Works prior to compaction, these shall be transported back to the stockpile area for re-use elsewhere within the works.

Boulders can be broken down using a pneumatic hammer and used as Type F material.

### 4.5.13 Placement of Rock Fill (Type F1)

Rock fill material Type F1 shall be placed to form the road subbase material, 300 mm thick upon completion of the buttress.

A layer of separation geotextile, Terram 2000 or equivalent shall be placed in accordance with the manufacturer's guidance over the Type A2 prior to the placement of the Type F1.

The rock fill shall be compacted by a minimum of 6 passes of a 10-tonne vibrating roller. The fill shall be placed level and evenly and shall be maintained at all times with a sufficient camber and a surface sufficiently even to enable surface water to be readily shed downstream.

### 4.5.14 Placement of Rock Fill (Type G)

The placement of Type G fine material shall be used as pipe bedding for the PIC drainage works. This material will be placed loosely with nominal compaction where possible with the construction plant/excavator bucket or other approved method by the CQA Team.

### 4.5.15 Testing Frequency Type B Material

**Grading testing of Type B material will be carried out at 1 test per 1000 $m^3$ per source** and in accordance with EN 933-1 or as directed by the Engineer. The results of the compliance and conformance testing will be reported on specific grading data sheets.

### 4.5.16 Testing Frequency Type C1 Material

**Grading testing of Type C1 material will be carried out at 1 test per 500 $m^3$ per source** and in accordance with EN 933-1 or as directed by the Engineer. The results of the compliance and conformance testing will be reported on specific grading data sheets.

**Liquid/Plastic Limits shall be carried out a 1 test per source and in accordance with BS 1377: Part 2. Water soluble sulphate content of less than 0.38% of sulphate (as SO3) when tested in accordance with IS EN 1744- 1, Clause 10.**

### 4.5.17 Testing Frequency Type D1 Material

**Grading testing of Type D1 material will be carried out at 1 test per 1000 $m^3$ per source** and in accordance with EN 933-1 or as directed by the Engineer. The results of the compliance and conformance testing will be reported on specific grading data sheets.

**Water soluble sulphate content of less than 0.38% of sulphate (as SO3) when tested in accordance with IS EN 1744- 1, Clause 10. An LA Abrasion test shall be carried out a 1 test per source and in accordance with IS EN 1097-2.**

### 4.5.18 Testing Frequency Type E Material

**Grading testing of Type E material will be carried out at 1 test per 500 $m^3$ per source** and in accordance with EN 933-1 or as directed by the Engineer. The results of the compliance and conformance testing will be reported on specific grading data sheets.

**Water soluble sulphate content of less than 0.38% of sulphate (as SO3) when tested in accordance with IS EN 1744- 1, Clause 10. An LA Abrasion test shall be carried out a 1 test per source and in accordance with IS EN 1097- 2.**

### 4.5.19 Testing Frequency Type F Material

Testing of Type F material will be carried out for each material at the frequencies given below, or as directed by the Engineer. The results of the compliance and conformance testing will be reported on specific grading data sheets.

**Table 4.6 Type F Testing Frequencies**

| Parameter | Standard | Frequency |
|---|---|---|
| Moisture Content | BS 1377: Part 2 | 1 test / 5,000 $m^3$ |
| Particle Size Distribution | EN 933 -1 | 1 test / 5,000 $m^3$ |
| Optimum Moisture Content Vibrating Hammer | BS 1377: Part 4 | 1 test / 10,000 $m^3$ |
| In-situ Moisture (Nuclear) | BS 1377: Part 9 | 1 test / 500 $m^3$ |
| In-situ Density (Nuclear) | BS 1377: Part | 1 test / 500 $m^3$ |
| Total Sulphur and Soluble Sulphate Contents | SR 21 Annex E | 1 test / 25,000 $m^3$ |

### 4.5.20 Testing Frequency Type F1 Material

**Grading testing of Type F1 material will be carried out at 1 test per 5,000 $m^3$** as directed by the Engineer's Representative. The results of the compliance and conformance testing will be reported on specific grading data sheets.

### 4.5.21 Testing Frequency Type G Material

**Grading testing of Type G material will be carried out at 1 test per 500 $m^3$ per source** and in accordance with BS 1377: Part 2 or as directed by the Engineer. The results of the compliance and conformance testing will be reported on specific grading data sheets.

**Water soluble sulphate content of less than 0.38% of sulphate (as SO3) when tested in accordance with IS EN 1744- 1, Clause 10. An LA Abrasion test shall be carried out a 1 test per source and in accordance with IS EN 1097-2.**

# 5 GEOTEXTILE

## 5.1 Manufacturer's Quality Control

Quality control certificates shall be supplied by the Contractor to the CQA Team or the batches of material delivered to site. The certificates shall be examined by the CQA Team to ensure that they relate to the materials delivered and that the required MQC had been carried out.

The separation / filter geotextile specified for use in the Works is Terram 2000, or an equivalent product approved by the Engineer and CQA Manager and shall meet the following criteria summarised below.

**Table 5.1 Terram 2000 Physical and Mechanical Property Acceptance Criteria**

| Parameter | Test Method | Specification |
|---|---|---|
| CBR Puncture Resistance | ISO 12236 | Min 2750 N |
| Wide Width Tensile Strength | ISO 10319 | Min 14 kN/m |
| Dynamic Cone Puncture | ISO 13433 | Min 26 mm |
| Tensile Elongation at break | ISO 10319 | Min 25% |
| Thickness | EN 964-1 | Min 1 mm |
| Mass per unit area | EN 965 | Min 200 grams/$m^2$ |

## 5.2 Monitoring of Geotextile Material Delivery and Inventory

The material should be delivered, handled and stored in accordance with the manufacturer's recommendations.

The CQA Engineer will observe the unloading of geosynthetic materials, undertake an inventory of the materials and verify that the type and quantities of material conform to that ordered and to the shipper's packing list. Each roll of geosynthetics delivered to site had affixed to it a label, complying with EN 30320, detailing the following:

- Manufacturers name, address and telephone number.
- Product identification.
- Batch and roll number.
- Roll length and width in metres.
- Roll weight in kilograms.
- Polymer type.

The supplier will supply quality control certificates for each roll batch showing sheet thickness, density, tensile stress, yield stress and elongation at break.

The CQA Engineer will visually inspect all delivered material and check that the unloading, transportation and placement of materials in the storage area(s) do not damage the materials.

The storage area should be flat and free draining in order to minimise the potential for damage. In addition, geotextile rolls should be delivered and stored in light-coloured tight wrappings in order to offer protection from ultra violet degradation. Any damaged material will be excluded from the works.

## 5.3 Geotextile Installation

Care shall be taken to avoid damaging the geotextile on removal of any wrappings and during the installation process or at any other time. Damaged lengths of geotextile shall be replaced with new material or repaired by an approved method.

The CQA Team will observe all geotextile deployment.

### 5.3.1 Formation

The subgrade shall be inspected prior to the installation of the geotextile material to ensure that no sizeable soil and rock particles or significant voids are present. These issues shall be remediated prior to the deployment of the geosynthetic panels.

### 5.3.2 Placement, Overlaps and Seaming

The geotextile seams will be aligned with seams parallel to the direction of maximum slope, where practicable, in line with accepted good practice. The layout of individual rolls or sheets shall be such that the number of overlaps is minimised. Panel seams shall be aligned parallel with the specified overlapping distance for the respective products based on the manufacturer's guidelines. A minimum overlap of 300 mm is recommended. Care should be taken to ensure that seaming does not affect the protection ability of the geotextile.

Operation of construction plant directly on the installed geotextile will not be permitted.

### 5.3.3 Damage and Repairs

Any holes or tears found in the panels are required to be repaired using a patch made from the same material lapped with a minimum of 500 mm overlap in all directions from the defect sewn into place in accordance with the project specifications. Tears in excess of 10% of the width of the roll require the removal and replacement of the complete panel with new material.

### 5.3.4 Placement of Subbase Material

Subbase material placed on top of the separation geotextile in such a manner as to ensure:

- The geotextile material is not damaged.
- Minimal slippage of the geotextile on underlying layers occurs.
- No excess tensile stresses occur in the geotextile.

### 5.3.5 Conformance Testing

Samples of geotextile for **conformance testing will be taken at a frequency one sample of separation geotextile per source delivered to site**.

As soon as practicable after the delivery of the geotextile to site, the installer will cut and label 1 m wide samples across the entire width of selected rolls for retention and/or conformance testing as directed by the CQA Team,

Three 1m$^2$ test samples shall be taken of geotextile delivered to site. One sample shall be tested by the Contractor for compliance with respect to weight and thickness. The second shall be sent to an offsite laboratory to undertake conformance testing for the following parameters.

**Table 5.2 Geotextile Conformance Testing Parameters**

| Parameter | Test Method |
|---|---|
| CBR Puncture Resistance | ISO 12236 |
| Wide Width Tensile Strength | ISO 10319 |
| Elongation at break | ISO 10319 |
| Thickness | EN 964-1 |
| Mass per unit area | EN 965 |

The other two samples shall be retained for reference.

If the laboratory compliance test results are deemed unsatisfactory, then the one of the remaining samples shall be tested. Failure of this second sample shall either result in further testing or exclusion of that batch number for use within the Works.

### 5.3.6 Construction Quality Assurance

The monitoring system will be documented in the CRR and will include the following:

- Inspection of all geotextile manufacturer's quality control certificates.
- Selection of geotextile samples for conformance testing prior to installation.
- Inspection of all geotextile conformance tests and.
- Inspection of all installed geotextile to ensure compliance with the specification.

# 6 CONSTRUCTION RECORDS REPORT (CRR)

Following completion of the project, the Engineer will issue a CRR summarising the construction activities and the quality assurance performed by the CQA Team. The report will have the same format as the CQA Plan document and will contain the following information:

- Parties and personnel involved with the project.
- Scope of work.
- Outline of project.
- Quality assurance methods.
- Completed record forms.
- Delivery and deployment of materials.
- Test results including field and laboratory tests, test locations, and the records of any failed tests with details of the remedial action taken referenced to the appropriate secondary testing.
- CQA Manager's daily records.
- Certification, signed by the CQA Manager / CQA Engineers.
- Photographs.
- As built drawings.

The CQA Manager's daily log will include the following details:

- Records of delivery, handling, and storage of materials.
- Weather conditions and whether the works are being undertaken with the weather windows specified in the working plan.
- Materials used to include source and quantity.
- Type of welding equipment used with details of any mechanical breakdowns.
- Testing procedure and reports of field tests.
- Remedial action on L geotextile and drainage system defects.
- Details of visits by the Engineer, CQA Engineers, Independent CQA Sub-Contractors and Regulatory Authority and site meetings.

The as-built drawings will include:

- Plans and sections of the works including levels, contours and slope angles.
- Location of all tests detailing test type and date.
- Location of all samples annotated with sample type and number.
- Location of all repairs.

The CRR will be submitted within 8 weeks after the work is completed on site, all the test results have been received, and all site records have been received.

# 7 CLOSING

This report is an instrument of service of Klohn Crippen Berber UK Ltd. (KCB). The report has been prepared for the exclusive use of BTMD for the specific application to the Boliden Tara Mine. The report's contents may not be relied upon by any other party without the express written permission of KCB. In this report, KCB has endeavoured to comply with generally accepted professional practice common to the local area. KCB makes no warranty, express or implied.

This is a draft report only and we solicit your review and comments within 4 weeks of submission. Upon issue of the final report, we request that all draft reports be destroyed or returned to KCB. This draft report should not be relied upon as a final document for design and / or construction.

Yours truly,

**KLOHN CRIPPEN BERGER (IRELAND) LIMITED**

**Chetana Ramanna, Ph.D., C.Eng.**
**Geotechnical Engineer**

**Brian Keenan, M.Sc. C.Eng.**
**Senior Geotechnical Engineer**

## REFERENCES

Bentley and Carter 1991, Correlations of Soil Properties, Bentley, S. P., Carter, M., Pentech Press Limited, 1991

BS EN 933 – Tests for Geometrical Properties of Aggregates, British Standards. https://doi.org/10.3403/BSEN933.

BS EN 1377-2:2022 – Methods of test for Soils for Civil Engineering Purposes – Classification Tests and Determination of Geotechnical Properties, March 2022.

BS EN 1097-2:2020 – Tests for Mechanical and Physical Properties of Aggregates – Methods for the Determination of Resistance to Fragmentation, April 2020.

Buttress Construction Works Phase 1 Volume A: Works Requirements, Specifications & Drawings, WSP IE0037031.8755.RPT.001.A0, December 2024.

Earthworks Specification for National Roads, TII Publications, CC-SPW-00600, September 2024.

IS EN 1744-1:2009 – Tests for Chemical Properties of Aggregates – Part 1: Chemical Analysis.

IS EN 13242:2013 – Aggregates for Unbound and Hydraulically Bound Materials for Use in Civil Engineering Work and Road Construction, January 2014.

SR 21: Guidance on the use of IS EN 13242:2002 + A1:2016 - Aggregates for Unbound and Hydraulically Bound Materials for Use in Civil Engineering Work and Road Construction, March 2016.

# APPENDIX I

## CQA Form Sheets for:

## Daily Log

## Geosynthetics *Inventory Log*

## *Subgrade Acceptance Log*

# *DAILY LOG*

## *Buttress Construction Works – Phase 1*

**SHEET 1 OF 2**

| | | | |
|---|---|---|---|
| **PROJECT NUMBER:** | | **PROJECT TITLE:** | **Buttress Construction Works – Phase 1** |
| **OWNER:** | **BTMD** | **CONTRACTOR:** | **Priority Construction Limited** |
| **LOCATION:** | **Randalstown Tailings Storage Facility** | | |
| **DATE:** | | **DAY:** | |
| **WEATHER:** | | | |
| **CLOUD COVER:** | | **PRECIPITATION:** | |
| **TEMPERATURE [°C]:** | **Min.:** | **Max. :** | |

**Note: Weather information obtained from: onsite observation and** Yr - Randalstown - Long term forecast

**1.0 CQA TEAM PERSONNEL ON SITE:**

**2.0 LABOUR & EQUIPMENT:**

**Priority Construction Limited: am to pm**

- 

**3.0 SUMMARY OF CONSTRUCTION PROGRESS:**

- 

**4.0 CQA TEAM ACTIVITIES:**

- 

**5.0 SURVEYOR'S ACTIVITIES:**

- 

**6.0 PROBLEMS AND RESOLUTIONS:**

- 

**7.0 MEETINGS AND DISCUSSIONS HELD (ATTENDEES AND ISSUES):**

- 

**8.0 INCIDENTS / ACCIDENTS / HEALTH AND SAFETY ISSUES:**

- 

**Photographic Record**

**Photographic Record**

**SUBMITTED BY CQA TEAM REPRESENTATIVE:** _____

# *INVENTORY LOG*

## *Buttress Construction Works – Phase 1*

Klohn Crippen Berger

**GEOSYNTHETIC INVENTORY CONTROL LOG**

**PROJECT NUMBER:** _____ **PROJECT TITLE:** Buttress Construction Works – Phase 1

**CLIENT:** BTMD **INSTALLER:** _____

**LOCATION:** Randalstown TSF

**MATERIAL TYPE:** GEOMEMBRANE GCL GEOTEXTILE GEOCOMPOSITE OTHER

**DATE OF ARRIVAL:** _____ **DATE OF INVENTORY:** _____

**MATERIAL MANUFACTURER:** _____ **INVENTORY MONITOR:** _____

**PRODUCT IDENTIFICATION:** _____ **CONDITION IN TRUCK:** _____

**TRUCK TYPE:** _____ **UNLOADING METHOD:** _____

| | BATCH OR LOT NO. | ROLL NUMBER | Manufactured Date | Inv. Delivery Date | MATERIAL DIMENSIONS LENGTH | WIDTH | THICKNESS OR WEIGHT | QC CERT Y / N | CONF. SAMP. Y / N | Panel No. | Panel No. | Panel No. | Panel No. | Panel No. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | | | | |

**CERTIFICATE OF ACCEPTANCE**
**OF SOIL SURFACE**

| | GEOSYNTHETIC INSTALLER | | PROJECT |
|---|---|---|---|
| **COMPANY** | | **LOCATION** | **Randalstown TSF** |
| **ADDRESS** | | **PROJECT** | **Buttress Construction Works – Phase 1** |
| | | **OWNER** | **BTMD** |

**I, the Undersigned, the duly authorized representative of** _____

**do hereby accept the area of soil surface bounded by** _____

_____

_____

_____

_____

**and shall be responsible for maintaining its integrity and suitability in accordance with the project specifications from this date to the completion of the installation.**

| NAME | SIGNATURE | TITLE | DATE |
|---|---|---|---|

**CERTIFICATE OF ACCEPTANCE RECEIVED BY CQA MANAGER**

| NAME | SIGNATURE | TITLE | DATE |
|---|---|---|---|

**CERTIFICATE OF ACCEPTANCE RECEIVED BY BTMD**

| NAME | SIGNATURE | TITLE | DATE |
|---|---|---|---|

***Klohn Crippen Berger Ireland Ltd.***