

Earthworks Construction Specification

ETC-08-04

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1 Scope and Purpose

1.1 Purpose

The purpose of this Specification is to construct a stable foundation and formation suitable for ballast and track to be constructed upon along with associated earthworks for drainage elements, such that it maintains stability and meets safety and performance standards over the design life.

Earthworks material types and compliance requirements are provided in the Earthworks Materials Specification (reference ARTC document ETC-08-03).

Earthworks are to be carried out in conjunction with other work such as surface and subsurface drainage works and environmental control measures.

1.2 Scope

This Specification defines the requirements for construction of railway earthworks for the Inland Rail Programme (the Programme).

Works under this Specification comprise the supply of all labour, materials and plant for the proposed earthworks required for the construction of the Project.

The works include (but are not limited to) the following items that are be carried out in accordance with the Contract:

- Setting out of the works.
- Construction and testing of all cut and fill earthworks and associated site preparation works.
- Supply, placement and testing of all formation materials, including structural fill and capping.;
- Provision of temporary and permanent drainage.
- Rehabilitation of the site of any temporary deviations required.
- Provision of all relevant/prescribed documentation to meet PQP requirements.
- Compliance with Construction Environmental Management Plan.

1.3 Precedence

The following order of precedence shall be adopted when undertaking construction of earthworks which form part of the Works:

- The Drawings;
- This Specification;
- ARTC ETC-08-01
- ARTC Standard Drawings,
- Australian Standard requirements, regulations and industry guidelines,

Where there is a discrepancy, the Contractor shall request clarification in writing from the Superintendent prior to proceeding with the works containing the discrepancy.

1.4 Programme Documents

The execution of earthworks in accordance with this Specification requires compliance to overarching Programme requirements. The Contractor's attention is drawn to the following documents:

- Project General Conditions of Contract;
- The Programme Environmental Management Plan;
- The Project Primary Approval Document and Conditions of Approval; and
- The Programme Quality Plan.

1.5 Procedure Owner

The Standards Manager is the Procedure Owner and is the initial point of contact for all queries relating to this procedure.

2 Definitions

Unless defined otherwise in the relevant Contract, terms used in this Specification will have the following meanings assigned in Table 1 to Table 3 and Figure 1 to Figure 4.

Table 1 Contractual Definitions

Term	Definition
Approve(d)	Means approved in writing by the Superintendent.
Contract	Commercial document entered into between the Principal and the Contractor detailing the terms of the engagement of the Contractor by the Principal contractually obligated to perform the Works.
Contractor	Any partnership, joint venture, company, corporation, or trust who has entered into a Contract with the Principal to perform the Works prescribed in this Specification.
Designer	The engineering company/individual engaged by the Principal or the Contractor to design the Project.
Design Services Agreement	Means the agreement entered in to or to be entered in to between the Principal and Designer for feasibility and detailed design.
Drawing	The latest approved revision of the project drawings.
Earthworks Materials Specification	Means the document titled Earthworks Materials Specification (ARTC document ETC-08-03).
Geotechnical Engineer	A qualified geotechnical engineer, geologist or engineering geologist, with experience and knowledge in soil-structure interactions to assess the ground conditions found on site, compare with those assumed for design and decide when variations in conditions will be referred to the Superintendent.
Lot	A portion of material or a section of the Works which has been constructed and supplied under uniform conditions and contains material of uniform quality and is homogeneous with only minor and random variation in characteristics (such as density, moisture, thickness, material type, colour, and finish) or a single finished item of work which includes several materials or work types (e.g. construction of a culvert in place).
Principal	A client who awards a contract to a Contractor for completion of a job or project in accordance with terms of the contract.
Project	A package of works within the Programme as determined by ARTC.
Programme	Means the Inland Rail Programme.
Project Quality Plan	Means the Contractor's Project Quality Plan (PQP) for the Project, prepared in accordance with the Programme Quality Plan.
Project Specific Specification	Will mean a Specification developed by the Contractor for a project specific requirement that is not covered under the latest revisions of ARTC and the Programme standards and specifications.
Quality System	A documented Quality System prepared by the Contractor in accordance with this Specification and Australian Standard for Quality System AS/NZ ISO 9001.

Term	Definition
Rail Corridor	The rail corridor is the land on which the railway is built. It comprises all property typically bounded from fence line to fence line, or if there are no fences, everywhere within 15 m either side of the outermost parts of track, unless otherwise indicated.
Site	Means the location or portion of land related to the Project works. The site may include land both inside and outside of the rail corridor.
Specification	A Specification consists of a written document that delineates the requirements regarding the materials, products, equipment, systems, standards, workmanship and quality aspects involved with the execution of the work to be undertaken and fulfilment of the Contract. Reference to this specification document includes all other relevant documents referred to in this specification.
Standard	A Standard consists of a written document that delineates the minimum requirements regarding the materials involved in the fulfilment of the contract.
Superintendent	Means the person(s) appointed by the Principal to act as the nominated Principal's Representative.
Works	Means the whole of the work to be executed in accordance with the Contract, including variations provided for by the Contract.

In addition to the definitions listed in Table 1 the following railway construction definitions appearing in this Specification will have the following meanings:

Table 2 Railway Construction Definitions

Term	Definition
Ballast	Ballast is a free draining coarse aggregate used to support railway tracks.
Batter	A constructed slope (cut or fill) commonly of uniform gradient.
Bench	Bench is a near horizontal break in a slope (cut or fill) with crossfall and width configuration determined by slope design.
Borrow Area/Pit	An area/pit where excavations are made for the procurement of additional material.
Bound Material	A granular material with sufficient stabilising agents added to produce a material with a nominated tensile strength.
California Bearing Ratio	A measure of the load-bearing capacity of soils, typically in a re-compacted and saturated state or insitu.
Capping Layer	A layer, or layers of graded crushed rock, or other engineered fill, within the Formation, usually provided for the purpose of sealing the earthworks from surface water and structurally supporting the track.
Cess	The area from the edge of the ballast profile to either the crest of the embankment or the toe of the cutting.
Cess Drain	The surface drain outside the sleepers to drain water from the ballast.
Characteristic Value	A value assigned to a basic variable associated with a prescribed probability of not being violated by unfavourable values during the reference period. It is determined by the analysis of several individual test results, tested using the same methods, using a statistical process. In some situations, the characteristic value may have an upper and lower value.

Term	Definition
Compaction	The process whereby the dry density of a material is increased by mechanical or other means.
Compacted Lift	The thickness of a placed fill or capping material after compaction.
Contaminated Materials	Any material containing substances considered actually or potentially hazardous or harmful to people, the environment, water supply or agriculture, based on applicable legislation and standards.
Cutting/Cut	Earthworks constructed by excavation.
Design CBR	The Californian Bearing Ratio (CBR) determined by design for nominated test conditions using statistical analysis or other appropriate methods.
Earth Excavation	Rippable or excavatable material. All materials such as earth, clay, sand, gravel, weathered or loose rocks which can be removed by ripping or excavation, without regard to stockpiling, loading or carting, as defined for bulk excavation and confined excavation non-rippable materials in the Section 7.2 of this Specification.
Earth Fill	Fill material consisting of fine and coarse particles distributed throughout the layer filling any voids so that when compacted produces a dense stable embankment.
Embankment	Earthworks constructed by placement of general earth fill or rockfill for the purpose of constructing an overlying formation.
Equivalent Opening Size	Equivalent opening size, defined as O_{95} , taken to be the mean value of the test results obtained in accordance with AS 3706.1 and AS 3706.7.
Existing Surface Level	The elevation of the ground surfaces of a site prior to the Works, and includes previous man made alterations which may have increased or decreased the height or contours of the land.
Fill	Earth or rock materials placed as a part of the construction process.
Floor of Cutting	The lowest plane of an excavation as shown on the Drawings
Formation	Earthworks constructed by material, usually capping and structural fill, placed between the Subgrade Level and Formation Level (Refer to Figure 4).
Formation Level	The design level of the formation surface, also referred to as the top of formation.
Foundation	The soil or rock material immediately underlying and supporting any earthworks undertaken as part of the Works.
Foundation Level	The level of the foundation on which the formation, embankment or foundation treatment is constructed.
Foundation Treatment	A special layer at either the base of an embankment, or below Subgrade Level in a cutting, constructed for the purpose of reinforcing, strengthening or draining the foundation.
General Earth Fill	An earth fill material complying with the requirements of the Earthworks Materials Specification.
General Earth Fill Lower	The bottom portion of a Zoned Embankment (Refer to Figure 2).
General Earth Fill Upper	The top portion of a Zoned Embankment (Refer to Figure 2).

Term	Definition
Geosynthetics	The range of polymeric products comprising eight main categories: geotextiles, geogrids, geonets, geomembranes, geosynthetic clay liners, geofoam, geocells and geocomposites.
Homogenous Embankment	Earthworks constructed by placement of a uniform General Earth Fill material meeting requirements of the Earthworks Materials Specification. Not a Zoned Embankment.
Layer	One or more uniformly compacted lifts of a compacted material.
Lift	The placement of a fill material within the compacted thickness limits in this Specification.
Loose Lift	The thickness of a placed fill material prior to compaction.
Main line	The line normally used for running trains through and between locations.
Maximum Dry Density	The dry density which can be achieved under a specified compaction effort at the Optimum Moisture Content (OMC).
Moisture Ratio	The ratio of moisture content to Optimum Moisture Content (OMC).
Optimum Moisture Content	The percentage of moisture in a soil at which the soil can be compacted to its greatest density for a specified amount and type of compaction effort.
Outer Zone	The portion of a Zoned Embankment encapsulating structural fill and general earth fill (Refer to Figure 2).
Planting Media	Material used as a planting medium for landscaping.
Rock	In this Specification, is any material that cannot be ripped at production rates defined in Table 5 of this Specification.
Rockfill	A material, meeting the requirements of the Earthworks Materials Specification, which when placed, produces an embankment deriving its stability from the mechanical interlock of the coarser particles, rather than from the compaction of finer material around the coarser particles. Rockfill may contain large open voids.
Select Fill	Material for use adjacent to structures or in other distinct applications that require specific properties defined for that purpose.
Spoil	Material surplus to the Contract requirements which shall be disposed of on or off the Site.
Stabilisation	The permanent physical and chemical alteration of materials to enhance their physical properties.
Stripped Surface Level	The ground surface after clearing and grubbing and topsoil stripping operations have been completed.
Structural Fill	A material, meeting the requirements of the Earthworks Materials Specification, usually placed to provide a gradational structural support zone between the Subgrade Level and Capping Layer.
Subgrade Level	The finished surface of an embankment or cutting upon which the formation is constructed.
Topsoil	The upper most layer of the soil usually dark in colour and rich in organic material.
Track	The infrastructure upon which rolling stock travels. Track can be designated as uni-directional or bi-directional. Track is formed through the combination of rails, rail connectors, sleepers, ballast, points, crossings, and substitute devices where used. Also referred to as the Track Structure (Refer to Figure 4).

Term	Definition
Unsuitable Material	All material identified as unsuitable, as defined in the Earthworks Materials Specification, for use as a foundation for earthworks or structures or for use as fill material in its present position or condition.
Zoned Embankment	An embankment comprised of zones of different types of fill materials.

The abbreviations listed below where used in the Specification, will have the following meaning:

Table 3 Abbreviations

Abbreviation	Meaning
ANZECC	Australian and New Zealand Environment and Conservation Council
ARTC	Australian Rail Track Corporation
AS	Australian Standard
BoD	Basis of Design
CBR	California Bearing Ratio
EOS	Equivalent Opening Size
ITP	Inspection Test Plan
MDD	Maximum Dry Density
MR	Moisture Ratio (% of OMC)
NATA	National Association of Testing Authorities
NEPM	National Environmental Protection Measure
OMC	Optimum Moisture Content
PI	Plasticity Index
PQP	Project Quality Plan
RMS	Roads and Maritime Services - NSW
QA/QC	Quality Assurance / Quality Control
SMDD	Standard Maximum Dry Density

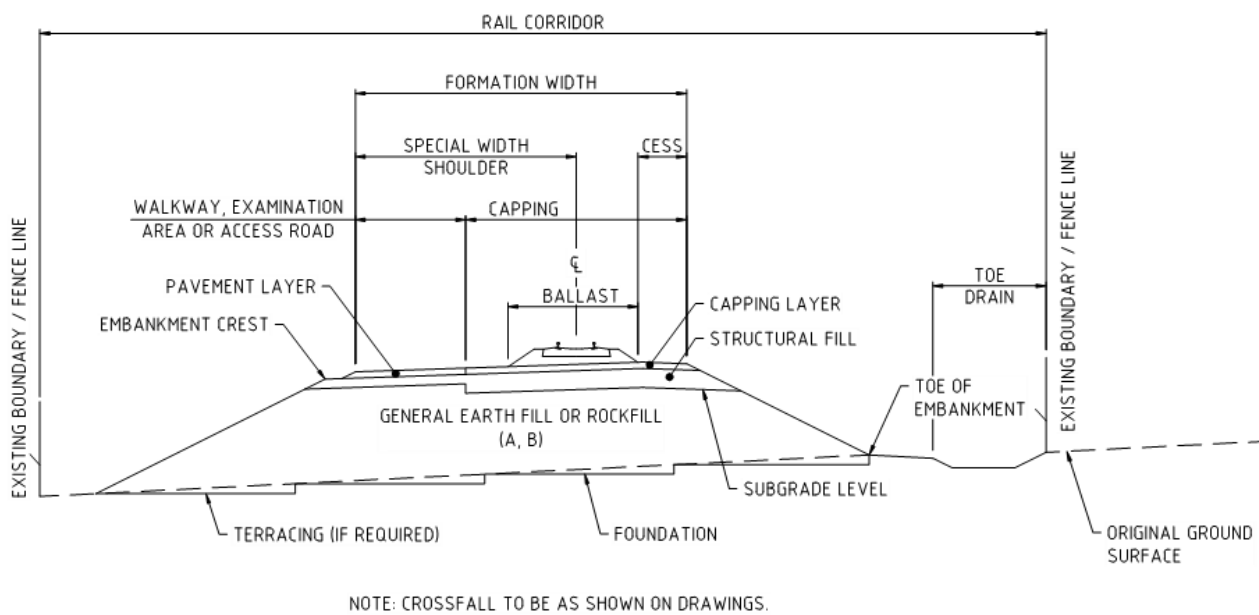


Figure 1 Schematic of Homogeneous Embankment Cross Section

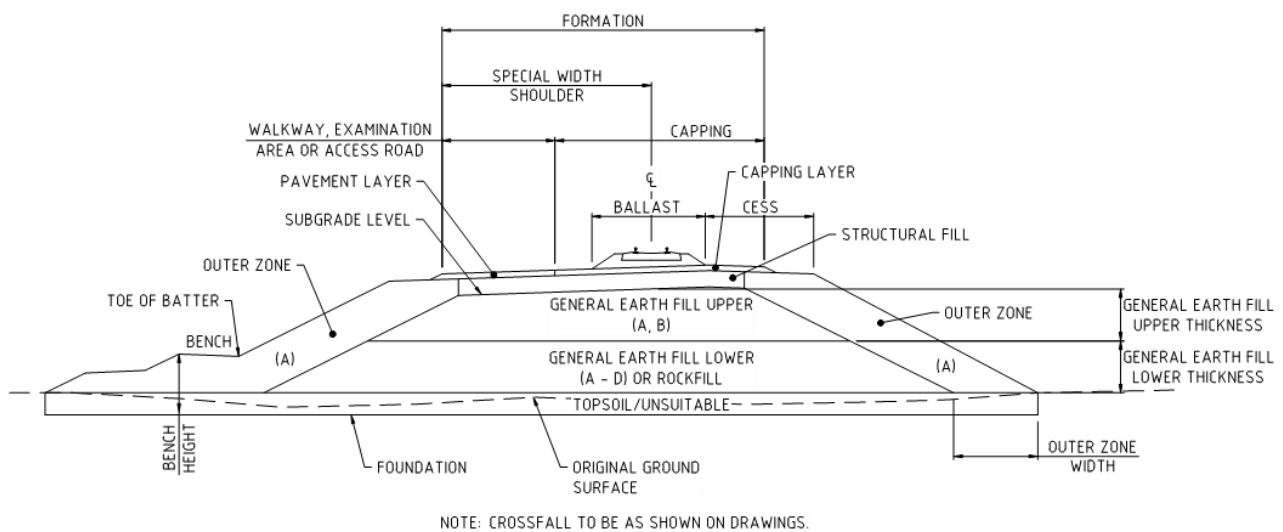
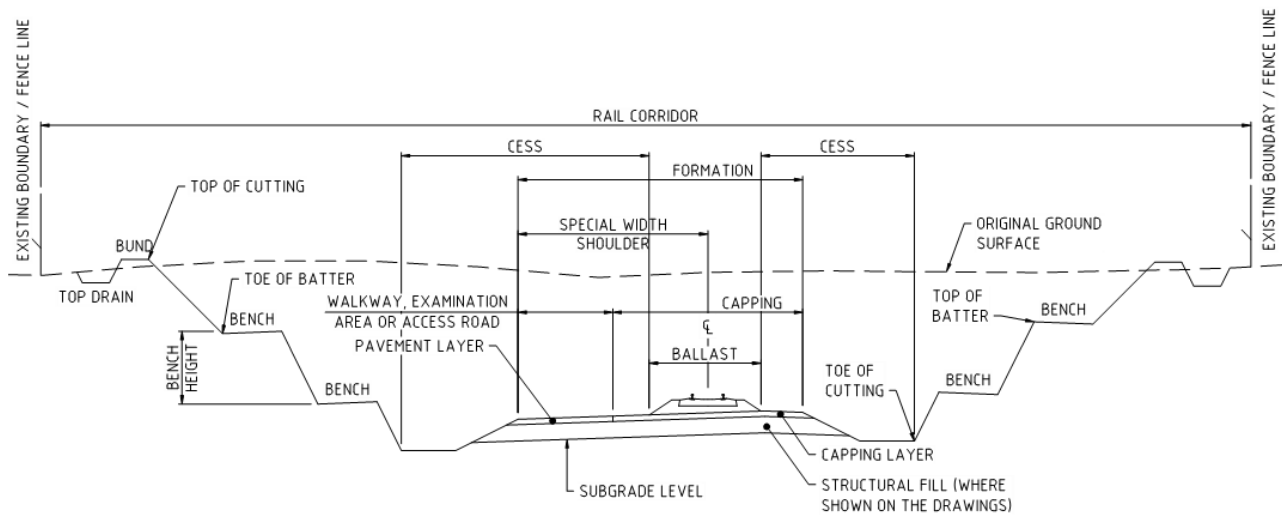
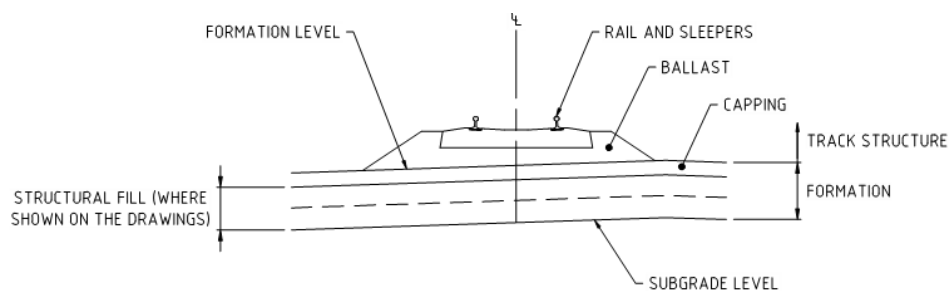


Figure 2 Schematic of Zoned Embankment Cross Section



NOTE: CROSSFALL TO BE AS SHOWN ON DRAWINGS.

Figure 3 Schematic of Cutting Cross Section



NOTE: CROSSFALL TO BE AS SHOWN ON DRAWINGS.

Figure 4 Schematic of Formation and Track

3 Codes and Standards

All design, materials, equipment, workmanship and installations will comply with the latest revision of the Programme Standards and Specifications, ARTC Engineering Standards, relevant rail authorities and Australian Standards (AS) relating to the relevant element or component of Works unless otherwise noted in this Specification.

The following codes and standards apply for the Project, and any discrepancy between standards and this Specification must be referred to the Superintendent for clarification.

AS1012	Methods of testing concrete
AS1141	Methods for sampling and testing aggregates
AS1289	Methods of testing soil for engineering purposes
AS1672	Building Limes
AS1726	Geotechnical Site Investigations
AS/NZS2041	Buried Corrugate Metal Structures
AS2159	Piling – Design and Installation
AS2187	Explosives – Storage and Use
AS2758	Aggregates and rock for engineering purposes
AS3600	Concrete structures
AS3706	Geotextiles – Methods of test
AS/NZS3725	Design for installation of buried concrete pipes
AS3972	General purpose and blended cements
AS3798	Guidelines on earthworks for commercial and residential developments
AS4133	Methods of testing rocks for engineering purposes
AS4489	Test Methods for Limes and Limestones
AS5101	Methods for preparation and testing of stabilised materials
AS7636	Railway Structures
AS7638	Railway Earthworks

AS/NZ ISO 9001:2008 Quality management systems – Requirements

Latest ARTC Engineering Standards and Codes of Practice available from www.artc.com.au/.

Changes to the ARTC Specifications relating to this Specification are listed in Appendix A.

4 General

4.1 Private Property

No private property shall be removed, relocated or altered without the approval of the Superintendent.

4.2 Services

All work areas are to be subject to a complete services search. The search is to identify all internal (rail operator) and external (public utilities) services associated with the Works.

All services are to be identified on a plan provided by the Contractor indicating service depth and location with respect to the rail corridor. All services to be clearly marked on site and appropriate protection measures taken.

4.3 Construction Water

Construction water quality shall not compromise the design life of rail infrastructure in contact with earthworks (including via leachates or runoff). An example is the adverse effects which can arise from the use of water with high chloride concentrations for compaction or from the incorporation of acid generating soils or rocks within the Works without appropriate control measures.

The Contractor is to evaluate the suitability of non-potable water by field and laboratory testing at the discretion of and as approved by the Superintendent. This includes but is not limited to ensuring the chemical composition of the water does not contribute to an environment exceeding any adjoining structure's design exposure classification as specified on the Drawings, or does not affect the establishment of vegetation.

5 General Earthworks

5.1 Protection of Earthworks and Structures

The Contractor is responsible for the protection of earthworks and structures, specifically:

- Installation and maintenance of effective erosion and sedimentation control measures in accordance with the Programme Environmental Management Plan.
- Provision and maintenance of measures for drainage of the working areas without scouring from the surface run-off. Do not allow water to pond in the working areas resulting in wetting up of the existing pavement, formation or foundation material, except where ponding is off the formation and forms part of a planned erosion and sedimentation control system.
- Taking all precautions to minimise any ingress of water into the earthworks material including shaping to avoid ponding. When rain is likely, or when no work is planned for the following day in a particular area being worked, seal off ripped material remaining in the floor of cuttings and material placed on embankments, using a smooth drum roller.
- Should earthworks material become over-wet (above the specified moisture content for compaction), replace or dry out the material.
- Do not allow earthworks material in embankments to dry out to the point where excessive shrinkage occurs, and the surface is pulverised by traffic generating excessive dust.
- No excavation shall be undertaken which effects the stability or integrity of any structure (e.g. overbridges and retaining walls) without prior approval by the Superintendent.
- Permanent erosion and sediment controls such as topsoiling, grassing or hydroseeding and hydromulching or other controls shall be carried out as specified at the earliest practicable date.
- Temporary and permanent works shall be limited to safe heights and slopes. Excavation shall be carried out in such a manner and sequence so as to prevent erosion or slips, working faces shall be limited to safe heights and slopes, and provide proper drainage at all times to avoid ponding and erosions.

The Contractor is responsible for all cost and time delays associated with the repairs to damaged earthworks resulting from failure to comply with the requirements outlined above.

5.2 Access to the New Foundation and New Formation

If the Contractor requires access to a part of the Site where no access has been provided, the Contractor shall supply to the Superintendent all plans for obtaining such access and shall not commence work on the access until approval has been given.

The completed formation shall be used as an access road only where approved by the Superintendent. Where approved, it shall be used in such a manner to afford minimum damage to the capping layer, formation, ditches, shoulders and slopes. Construction traffic on new and reconstructed formations shall be managed such that uniformity of compaction parallel and perpendicular to the tracks is maintained. All repairs required to restore the capping material or the formation to its original condition shall be at the Contractor's expense.

No additional payment will be made to the Contractor for provision of additional roads or the upgrading of existing access roads.

Transportation and distribution of materials and construction shall be suspended if, in the opinion of the Superintendent, the formation is too wet to enable work to proceed.

5.3 Permanent Erosion and Scour Protection

Permanent erosion and scour protection shall be provided in accordance with the Drawings and be constructed in a progressive manner over the course of the Works, thus minimising the use of temporary works where possible.

5.4 Drainage of Works

During construction the Contractor shall provide for the effective diversion of surface water from the Works. These requirements shall apply equally to off-site construction including access roads and borrow area and stockpiles.

The Contractor shall provide efficient pumping equipment on site and shall keep trenches and excavations dewatered at all times during construction.

At all times during construction, water is not permitted to pond on or adjacent to an embankment unless stated otherwise on the Drawings or authorised by the Superintendent. At the close of work each day, the surface of the embankment shall be left free draining.

5.5 Permanent Drainage

Permanent drainage shall be installed in accordance with the Drawings.

[1] WITNESS POINT

Process Witnessed:	Construction of permanent drainage
Submission Details:	Grade conforms to design, no cracks or open joints present, no soil, rock or other material are present inside of pipes and culverts
Identifiable Record:	Signed ITP

5.6 Materials Management

General earthworks include the management of all materials in the earthworks, as detailed in the Earthworks Materials Specification and on the Drawings. This includes material from excavations, the procurement and control of imported materials, materials from borrow sites, and placing of these materials in embankments or disposing of it in areas other than embankments.

When surplus excavated material from other works under the Contract (such as trenching for drainage pipes or utility conduits) is used in the construction of embankments or backfilling of trenches, the requirements of this Specification also apply to such material.

The Contractor is responsible for:

- Any assumptions made in relation to the nature and types of the materials (meeting requirements of the Earthworks Materials Specification) as encountered in excavations or imported, and the bulking and compaction characteristics of all such materials which are then incorporated in the Works;
- Determining suitable sources of material and any processing needed to satisfy the requirements of the Earthworks Materials Specification;
- The design, and the cost of construction and maintenance of all tracks, roads, haul roads, pads and other earthworks structures required for the proper execution of the Works;
- The Contractor shall adjust the method of working and programme of work such that sufficient hard and durable rock scour protection, as per Section 8.5, is available when required;
- Managing procurement of materials to ensure sufficiency of materials of the specified quality; and
- Achieving a high utilisation of structural fill and capping material from excavations, unless otherwise proven uneconomical.

If the Contractor causes a deficiency of fill material by electing not to use acceptable material from excavations in the embankments and formation or by constructing embankments with dimensions other than those shown on the Drawings or authorised by the Superintendent, the Contractor must make good that deficiency from sources of material meeting the quality requirements specified in the Earthworks Materials Specification. The cost of making good such deficiency of material will be borne by the Contractor.

5.7 Clearing and Grubbing

Clearing includes the removal from the site of all trees, stumps (parts above ground), logs, boulders/rocks up to 1.0 m in size which are exposed or lying on the surface, saplings, bushes, scrub or similar growth, levelling of obsolete terraces, ditches, windrows, minor man-made structures, obstructions and property improvements (e.g. fences and livestock yards) and any surface feature that is considered unsuitable for incorporation into the works.

Grubbing includes removal of the base of stumps, roots, buried logs, the underground parts of structures and other obstructions that obtrude, encroach upon or otherwise obstruct the work and other subsurface material considered unsuitable by the Superintendent for incorporation in the Works. All property improvements shall be similarly removed. Should any trees or boughs lean over the boundaries, they shall be removed.

Clearing and grubbing also includes:

- Setting aside marketable timber.
- Setting aside vegetative material suitable for processing to produce organic mulch.
- Placing fallen logs and branches suitable for fauna habitat or erosion and sediment control clear of construction activities.
- Salvage of fences, posts, signs, structures and other obstructions that interfere with the Work, as specified in Contract documents or as directed by the Superintendent.
- Mulching of trees and shrubs where specified.

- Promptly backfilling any holes remaining after trees and stumps have been grubbed. Backfilling is to be with a sound material, compacted to at least the relative compaction of the adjacent existing ground and completed in a manner which prevents infiltration and ponding of water. This shall include topsoiling and vegetating holes where shown on the Drawings or directed by the Superintendent.
- Disposing of all cleared and grubbed materials which are not to be reused.

No clearing and grubbing shall be done unless approved by the Superintendent. No property or existing infrastructure (e.g. pipes, buildings, crops, signs and fences) shall be removed, relocated or altered without the approval of the Superintendent.

[1] HOLD POINT

Process Held:	Clearing and grubbing
Submission Details:	a) Plans showing extent of clearing and grubbing; and b) All the necessary approvals and consents, including environmental approvals.
Release of Hold Point:	The Superintendent will approve work prior to authorising the release of the Hold Point.
Identifiable Record:	Approved plans signed by Superintendent and Contractor

Clearing and grubbing operations shall be limited to the area shown on the Drawings.

The Contractor shall plan and carry out clearing operations to avoid erosion, contamination and sedimentation of the site, surrounding areas, watercourses, streams and other drainage systems.

Grubbing operations shall be carried out to a minimum depth of 0.3 m below the foundation level.

Trees, shrubs, other landscape features and improvements within the limits of the Works which are designated by the Superintendent for preservation shall not be removed or damaged and shall be protected during the progress of the work in a manner satisfactory to the Superintendent.

The Contractor shall take all necessary precautions to ensure that natural vegetation and fauna habitat outside the areas defined for clearing and grubbing are maintained without damage or disfiguration for the duration of the Contract.

Grass and topsoil shall not be removed as part of clearing or grubbing works.

All damage incurred to the Principal's property and to adjoining property during clearing operations shall be made good by the Contractor at its own expense.

The Contractor will only be paid once for clearing and grubbing works.

[2] HOLD POINT

Process Held:	All works, after completion of clearing and grubbing, which will alter the ground surface as surveyed.
Submission Details:	<ul style="list-style-type: none">a) Survey Report of the existing surface levels of the section of Works, in accordance with the Contractor's PQP, submitted at least 3 working days before the proposed date for altering the surfaces.b) For the section of Works, notification that:<ul style="list-style-type: none">i. The survey set out has been carried out, including set out of the cut to fill intersection point and extent of the Transition Zone as specified in Section 6.4.ii. Erosion and sedimentation controls have been implemented;iii. Clearing, grubbing and removal of cleared materials for that section of the Works has been completed.
Release of Hold Point:	The Superintendent will inspect the surfaces and set out, and may direct further action prior to authorising the release of the Hold Point. Further action may include altering the limits of the cut/fill transition.
Identifiable Record:	<ul style="list-style-type: none">a) Hold point release record;b) Survey report; andc) Approved plans signed by the Superintendent and Contractor.

5.8 Topsoil

5.8.1 Removal of Topsoil

Removal of topsoil shall be performed to provide a stable base for the works to be constructed.

Topsoil shall be removed to a depth as shown on the Drawings or as directed by the Superintendent and stockpiled clear of the Work. Topsoil shall not be removed in locations where a bridging layer is to be constructed in accordance with Section 6.2.7, unless directed otherwise by the Superintendent.

Topsoil removal shall only commence in areas where earthworks are to occur within 1 week.

The Contractor shall plan and carry out removal of topsoil to avoid erosion, contamination and sedimentation of the Site, surrounding country, watercourses and streams.

Where directed by the Superintendent, after removal of the topsoil:

- Stockpile non-contaminated topsoil in accordance with Section 5.8.2 and Section 5.11. The Contractor is to identify if non-contaminated topsoil is suitable for planting media and where so, stockpile separately; and
- If the topsoil has been identified as contaminated material, spoil the topsoil in accordance with Section 5.10.3.

After removing the topsoil, the Contractor shall determine the surface levels in each cutting and embankment at sufficient locations to determine the volume of excavation and filling for general earthworks and the volume of Unsuitable Material.

5.8.2 Topsoil Stockpiles

Locate topsoil stockpiles in accordance with Section 5.11. Topsoil stockpiles must be located separately to other stockpiles and clear of the Works for use in revegetation unless directed otherwise by the Superintendent.

Before stockpiling topsoil, carry out a survey to determine the surface levels at each stockpile area, at sufficient positions to later determine the volumes of topsoil placed at the location.

Topsoil stockpiles must:

- Be free from subsoil, other excavated materials, contaminated materials, refuse, clay lumps and stones, timber or other rubbish.
- Unless specified otherwise on the Drawings, be trimmed to a regular shape to facilitate quantity measurement, and with a height not exceeding 2.5 m and batter slopes not steeper than 2H:1V.
- Not be trafficked unless approved by the Superintendent.
- Have their batters track rolled or stabilised by other means approved by the Superintendent.

5.9 Unsuitable Material

5.9.1 General

It shall be the sole responsibility of the Contractor to prove that material is Unsuitable Material as defined in the Earthworks Materials Specification. Where previously unidentified Unsuitable Material or potentially Unsuitable Material is encountered on the Site, the Contractor shall, before proceeding to treat such material, notify the Superintendent.

The Contractor shall carry out a survey to determine the surface levels at sufficient locations before and after removal of all Unsuitable Material to determine the volume of Unsuitable Material removed. Alternatively, the Superintendent may agree to determination of volume by manual measurement (with a tape measure or other means) and calculation. The dimensions of the removal shall be included in the Work as Executed Drawings.

[3] HOLD POINT

Process Held:	Earthworks after Unsuitable Material is identified.
Submission Details:	Identification and classification of Unsuitable Material, proposed actions to record the volumes, manage stockpiling, spoiling or treatment of the Unsuitable Material.
Release of Hold Point:	The Superintendent will inspect the surfaces and the encountered materials, and may direct further action prior to authorising the release of the Hold Point.
Identifiable Record:	<ul style="list-style-type: none">a) Hold point release record; andb) Survey or agreed volume approved by the Superintendent before and after management of Unsuitable materials

All costs associated with reworking or replacing any material that the Superintendent deems to have become unsuitable because of inappropriate construction activities shall be borne by the Contractor. Inappropriate construction activities include poor surface drainage, restricted or inoperative subsurface drains, contamination, excessive sized plant where the imposed load exceeds the material strength, poorly maintained plant allowing leakage of oils and water onto the formation, and leaving the surface unsealed allowing moisture ingress during wet weather.

As directed by the Superintendent, material removed as unsuitable can be:

- Reworked and replaced;
- Directed to spoil;
- Stockpiled where suitable and approved by the Superintendent;
- Incorporated into the Works elsewhere in accordance with the relevant specifications at the point of use and specific geotechnical advice and approval;
- Treated and then incorporated into the Works in accordance with the relevant specifications at the point of use and specific geotechnical advice and approval; or
- Removed from site in accordance with Section 5.10.

5.9.2 Type U1 – Inherently Unsuitable

Inherently unsuitable material cannot be included in the Works, even as general earthworks because of its inherent properties (e.g. peat, excessive organic content, anthropogenic materials such as bricks).

Where embankments are sufficiently low to prevent bridging over Inherently Unsuitable Material, the Unsuitable Material must be excavated to a depth of 300 mm to the lateral extent directed by the Superintendent. If Unsuitable Material remains in the exposed excavation, further excavations shall continue under the direction of the Superintendent. The excavation shall be reinspected by the Superintendent at the completion of each and every excavation increment of Unsuitable Material.

The excavation shall be backfilled with fill compatible with the formation design, and in compliance with the Earthworks Materials Specification.

All excavated Unsuitable Material shall be disposed of to spoil, in a designated area off site determined by the Contractor and approved by the Superintendent.

Inherently Unsuitable Material may be bridged in accordance with Treatment Type E6 of Section 6.2 where shown on the Drawings.

5.9.3 Type U2 – Unsuitable by Virtue of Position

Unsuitable Material by Virtue of Position are defined in the Earthworks Materials Specification. These materials shall be treated in accordance with Section 6 of this Specification.

5.9.4 Type U3 – Unsuitable by Moisture Content

If the Superintendent considers that the Contractor has not protected the material and the material is unsuitable only because of its high or low moisture content, the Superintendent may direct that the material be dried out or moisture conditioned and incorporated in the works. No additional payment will be made for the drying out or moisture conditioning of the material (see Section 5.1). If the Contractor allows any material to become unsuitable because of Contractors inappropriate construction activities, all costs associated with reworking or replacing such Unsuitable Material must be borne by the Contractor. Examples of inappropriate construction activities include poor surface drainage, restricted or inoperative subsurface drains, contamination, excessive sized construction plant where the imposed load exceeds the material strength, poorly maintained construction plant allowing leakage of oils and water onto the formation, and leaving the surface unsealed allowing moisture ingress during wet weather.

The Contractor shall promptly notify the Superintendent of all areas of the foundation and all layers within the subgrade that ruts excessively, yield or show signs of distress or instability.

All Unsuitable Material by Moisture Content is to be left on site unless directed otherwise by the Superintendent. Where there are materials that cannot be treated and re-used within the Works or stockpiled on the site, such material is to be disposed of in accordance with Section 5.10 of this Specification.

5.10 Disposal of Spoil

5.10.1 General

All excess materials removed during the course of construction shall be disposed or stockpiled as specified by the Superintendent.

While handling and disposing of spoil, the Contractor must:

- Not end tip spoil down embankment batters.
- Schedule its operations so as to minimise haulage distances and to dispose of spoil at the closest location.
- Sort and separate excavated material on site for use in the permanent works, unless otherwise stated in the Contract.
- Dispose of excavated material, which in the opinion of the Superintendent cannot be selected, processed or mixed in a practical manner to make it suitable for use in the permanent works, unless otherwise stated in the Contract.

- Dispose of all inherently unsuitable and perishable materials off-site at a facility approved by the Superintendent.

Before spoiling commences, the Superintendent may direct a survey, at sufficient locations, so as to determine the surface levels at each spoil site to later determine the volumes of material spoiled.

5.10.2 Non-contaminated Materials

Non-contaminated spoil generated from the Work under the Contract shall be disposed of in the manner and at locations authorised or agreed to by the Superintendent. The Contractor shall use up all available areas within the Site before proposing alternative locations.

Disposal of non-contaminated material shall be by the following means, in order of preference:

- 1) Targeted embankment widenings to create hardstands at the end of cuttings or other appropriate locations.
- 2) Uniform widening of embankments.
- 3) Flatter batter slopes being provided on embankments.
- 4) Uniform filling of selected areas within the rail corridor.
- 5) Stockpiling within the Site.
- 6) Disposal at an approved off site location.

Embankment widening or batter flattening work is deemed to form part of the embankment construction and must be carried out in accordance with Section 12. Spoil placed in embankments shall be classified, spread and compacted in accordance with Section 13 of this Specification and the Earthworks Materials Specification for materials in zoned embankments. The Contractor shall maintain effective drainage for the whole of the embankment.

If the Contractor proposes to use spoil locations outside the Site, the Contractor must obtain all the necessary approvals and consents, including environmental approvals, and provide copies of them to the Superintendent at least 5 working days prior to commencing the disposal of material at these off site locations.

Payment for disposal of spoil comprising non-contaminated material within the Site is deemed to be included in the earthworks rates.

5.10.3 Contaminated Materials

Spoil materials that meet the contaminant concentration criteria which confirms suitability for reuse or application within commercial / industrial land use criteria, as specified within all Statutory Requirements and the National Environment Protection (Assessment of Site Contamination) Measure Amendment 2013 (NEPM 2013), must be beneficially reused or managed within the rail corridor (e.g. fill, capping, ballast or other beneficial reuse) where risks to human health and the environment can be mitigated and where feasible. This reuse shall be undertaken in accordance with all state and federal legislative requirements, limits contamination of non-contaminated material, and as authorised or agreed to by the Superintendent and the Principal.

Where spoil materials are found to be contaminated at levels that are unsuitable for reuse within a commercial/industrial land use scenario as specified in all Statutory Requirements and by the NEPM 2013, the management of the materials must be undertaken to ensure that risk of harm to human health and the environment is mitigated, and in accordance with all applicable ARTC property

leasing obligation and state and federal legislative requirements. Should management onsite be proposed, approval from the Principal must be obtained. All management of contaminated material must be done in accordance with the relevant state legislation and approvals/permits in place.

If management or disposal methods for spoil materials and sites are not specified, it is the Contractor's responsibility to determine the method(s) and location(s) for management and disposal of the contaminated material and obtain approval from the Superintendent, the Principal's contamination guidelines and the relevant regulatory authorities.

The Contractor shall notify the Superintendent at least one (1) month prior to excavation of all material that is contaminated at levels posing a risk of harm to human health or the environment, and removal of all contaminated material from the Site, and provide details of the contaminant sampling and assessment performed and the proposed method and location of management, remediation and disposal.

Sampling and assessment, management, treatment and disposal of all material that is contaminated in any way by the Contractors operations will be borne by the Contractor.

5.11 Stockpiles

5.11.1 Stockpile Areas

The Contractor shall locate stockpiles at the areas nominated in the Drawings or Specifications such that they do not adversely impact the track and formation, drainage, sight distances, the surrounding environment, existing infrastructure, utilities and operational access, while where applicable, minimising the need to cross existing track during construction.

Where no such areas are nominated, or if the Contractor proposes to locate their stockpiles in areas other than those nominated, a proposal is to be submitted with details of the maximum dimensions of the proposed stockpiles, for approval by the Superintendent at least 10 working days before stockpiling is due to commence. The Contractor shall obtain all the necessary approvals and consents, including environmental approvals, and provide copies of them to the Superintendent.

Stockpiles shall be physically separated from engineered fills to prevent future misidentification of engineered fill.

Stockpile sites in Private Property shall be restored following completion of the Works in accordance with land owner agreements and to the satisfaction of the Superintendent.

5.11.2 Stockpile Management

Materials assigned to be stockpiled shall be segregated, stored separately and protected to prevent mixing, cross contamination and loss of material.

Different types of site won materials shall be segregated as far as practicable and stored separately to prevent mixing and cross-contamination.

All stockpiles shall be clearly labelled in accordance with the PQP for quality control.

The stockpile site should be secured, and access controlled to prevent illegal dumping and the public from entering the site.

5.11.3 Permanent Stockpiles

Permanent Stockpiles shall be placed where shown on the Drawings up to the maximum height and batter geometry shown on the drawings. If not shown on the Drawings, locations shall be as agreed with the Superintendent. The surface of the Stockpiles shall be stabilised to prevent erosion and dust generation.

5.12 Borrow Sites

5.12.1 General

External borrow sites where required shall be selected by the Contractor and meet the requirements of Section 5.12.3 below.

Fill imported from borrow sites shall comply with the Earthworks Materials Specification and Section 5.6 of this Specification.

Borrow areas shall be maintained in a tidy, graded and formed condition such as to drain into natural watercourses and to avoid soil erosion.

The Contractor shall remove only such materials and excavate only to such levels as previously approved by the Superintendent. If the Contractor removes material without the approval of the Superintendent it shall fill, compact and rehabilitate the area at its own cost.

5.12.2 Borrow Areas Shown on Drawings

For borrow areas shown on the Drawings, site preparation shall be carried out in accordance with Section 5.7 of this Specification.

Prior to excavation, topsoil is to be removed and stockpiled in accordance with Section 5.8. Topsoil shall be respread over the excavated area as shown on Drawings or directed by the Superintendent.

At Completion, the Contractor shall leave the borrow areas in a tidy and safe condition. Unless otherwise approved by the Superintendent, carry out restoration of borrow areas as shown on the Drawings.

Material brought on to the Site must comply with all relevant government authority requirements, such as waste material classification, licensing and disposal guidelines.

5.12.3 Borrow Areas Not Shown On Drawings

Borrow sites selected by the Contractor shall be approved by the Superintendent. The Contractor shall arrange for permission to use borrow sites from the property owners on terms satisfactory to the Principal and shall pay all associated royalties and fees.

The Contractor is responsible for all costs involved in opening up, maintaining and restoring any borrow areas arranged by the Contractor.

Borrowing operations off the Site shall be carried out in compliance with all Statutory Requirements. Borrow material shall be sourced in accordance with the NEPM, based on the intended land use, and in accordance with the Project's conditions of approval. Borrow material shall not contain actual or potential acid sulfate soils or acid rock.

Prior to commencing excavation from a borrow area the Contractor shall submit the following details to the Superintendent for approval:

- Plans and cross sections of the areas to be excavated
- Proposed drainage system during and on completion of excavation, including erosion and sediment control measures to be implemented
- Test certificates demonstrating compliance to the environmental requirements of the Contract
- Applicable land owner agreements
- Access routes to the borrow areas.

Generally, the Superintendent will require that:

- The borrow excavations shall not adversely impact the track structure, formation, public utility plant, drainage lines or Principal's boundary fence.
- Batter slopes in the excavation be flatter than 3H to 1V (horizontal to vertical).
- Each borrow area slope away from the railway formation when excavation is completed.
- Bases of the borrow pits be at least 1 m above nearby creek beds and be sloped towards the creek beds at a slope steeper than 0.5 %.
- The slope of cut batters at such borrow areas must be no steeper than 3H:1V.
- Material to not be disposed of in the borrow area unless otherwise approved.
- On completion of borrowing operations, the area shall be trimmed to a neat and tidy shape that is able to freely drain. Previously stockpiled topsoil shall be spread uniformly over the area.
- Following completion of borrowing works, the Contractor shall submit all documentation demonstrating compliance with all Statutory Requirements.

The top of the batter from the resulting excavation of the borrow areas must not be closer than 3 m to any existing or proposed fence line, road reserve boundary or edge of excavation or embankment.

A specific geotechnical assessment of excavation stability may be required by the Superintendent.

The Contractor shall provide adequate long term drainage management for the borrow areas.

Development, operation and reinstatement of borrow areas shall comply with the environmental requirements of the Contract.

5.13 Earthworks Near Structures

5.13.1 General

During the construction process, the Contractor shall protect all pipes, conduits and structures, against damage by its equipment and operations. All damage or deflection caused to structures by backfill operations is to be immediately reported to the Superintendent. Any damage to structures through the construction process is to be repaired at the expense of the Contractor.

Light weight compaction equipment should be used within 3 m of structures to avoid damage and where directed by the Superintendent. Further limitations are presented in Table 4 below.

Table 4 Compaction Methods Near Structures

Structure	Minimum Width and Height of Selected Fill	Compaction Method
Bridge abutment and wing walls	3 m wide for full height	Light weight compaction equipment for full structure height for a distance of $\frac{2}{3}H$ (H=overall height of structure), to a maximum width of 1.2 m
Pipe culverts	300 mm width each side and above top pipes	Light weight compaction equipment from the base of excavation, for distance D, above the top of pipe (D=diameter of pipe), to a maximum depth of 0.7 m
Box culverts and culvert wing and retaining walls	H/3 wide for full height, to a maximum of 2.4 m	Light weight compaction equipment for full structure height for a distance of $\frac{2}{3}H$, to a maximum width of 1.2 m

The Contractor is to ensure drainage is maintained and provided around existing structures. Select fill material complying with the requirements of the Earthworks Materials Specification shall be used adjacent to structures as required in Section 5.13.2. Filling around structures shall ensure that the difference in levels of fill on either side of the structure is no greater than 1 m at any time. Any excavation within the zone of influence shall be approved by the Superintendent prior to excavation.

5.13.2 Fill Adjacent to Structures

Fill adjacent to box culverts and bridge abutments shall be in accordance with the Earthworks Materials Specification and the Drawings. Where not shown on Drawings, the following shall apply:

- Place select fill adjacent to structures where the fill depth is greater than 3 m. Select fill material shall comply with the Earthworks Materials Specification.
- Place structural fill adjacent to structures where fill depth is less than or equal to 3 m. Structural fill material shall comply with the Earthworks Materials Specification.

Fill adjacent to pipe culverts shall be select fill, bedding sand or other drainage materials (as specified in ETC-08-03) as shown on the Drawings or in accordance with relevant Australian Standards.

Compaction of fill is to commence adjacent to the structure and proceed away from the structure.

5.13.3 Excavation Adjacent to Existing Structures and Footings

The method of earthworks construction adjacent to structures shall be at the discretion of the Superintendent and shall take into account the age, condition, nature and quality of the structure. This may necessitate consultation with a structural engineer. Dilapidation surveys and Survey Monitoring are to be undertaken where specified or at the discretion of the Superintendent and as shown on the Drawings.

Excavation adjacent to existing structures and footings shall be performed to the dimensions shown on the Drawings.

5.14 Backfill of Trenches

Material used for backfill of trenches shall comply with requirements of the Earthworks Materials Specification. The material type for each lift of backfill shall match the materials at the same depth in the embankment or formation. Materials shall be placed and compacted in successive horizontal layers, with a compacted layer thickness no greater than 150 mm, to the specified compaction level for the material provided in Section 13.4.

5.15 Track Slews

Unless stated otherwise on the Drawings or directed by the Superintendent, at locations of track slews between 100 mm and 300 mm, the Contractor shall remove the existing ballast shoulder and grade the formation out from original alignment sleeper ends. Prior to proceeding with placement of the overlying formation or ballast, a proof roll shall be undertaken on the graded surface in accordance with Section 13.5.

Track slews greater than 300 mm shall be constructed in accordance with the Drawings.

6 Foundation Treatments

6.1 General

Foundation treatments are to be carried out as per the design or as approved by the Superintendent. Section 6 shall be read in conjunction with Appendix B of this Specification.

A range of foundation treatments under embankments (Section 6.2) and in cuttings (Section 6.3) may be used by the Contractor based on Site conditions and design requirements.

Taking into account the site, traffic, access, insitu materials and environmental/climatic conditions, the Contractor shall select appropriate equipment and techniques and use them in such a manner that minimises surface heaving or other foundation damage during preparation of the foundation and construction of overlying layers. This may include construction of other measures (such as sub-surface drainage) in conjunction with the nominated foundation treatments, as shown on the Drawings or as approved by the Superintendent.

The Contractor shall carry out foundation treatments as prescribed Section 6.2 and Section 6.3 and Appendix B, unless otherwise shown on the Drawings, specified or approved by the Superintendent. Foundation treatments may be applied individually or in combination, as shown on the Drawings or approved by the Superintendent. Cutting foundation treatments are to extend the full width of the formation.

The Contractor shall maintain the foundation after treatment in its conforming condition until construction of the overlying layer commences. The Contractor will bear the cost of any additional foundation treatments required as a result of damage to the foundations that is caused, or allowed to occur, by the Contractor.

6.2 Embankments

6.2.1 Applying Treatments

After preparation of the embankment foundation, the Contractor is to present the area for inspection by the Superintendent prior to constructing embankment foundation treatments. Proof rolling may be directed by the Superintendent in accordance with Section 13.5 of this Specification.

[4] HOLD POINT

Process Held:	Type and Extent of each Embankment Foundation Treatment Lot
Submission Details:	<ul style="list-style-type: none"> a) Survey report; b) Notification of completion of clearing operations; c) Notification that topsoil has been removed in accordance with Section 5.8 (unless treatment Type E4, Type E5 or Type E6 are specified)
Release of Hold Point:	<p>The Superintendent:</p> <ul style="list-style-type: none"> a) Will consider the submitted documents; b) Will inspect the embankment foundation area and may seek advice from the designer's geotechnical representative to confirm the type and extent of treatment; and c) May direct further action prior to authorising the release of the Hold Point. Further action may include removal of Unsuitable Material in accordance with Section 5.9, or treatment in accordance with Section 5.10.
Identifiable Record:	Survey report, Signed ITP by the Superintendent and record of all advice received.

6.2.2 Type E1 – Loosen and Compact

Unless specified otherwise on the Drawings, the Contractor shall carry out Type E1 treatment for all embankments less than 3 m in height. For embankments equal to or greater than 3 m in height, embankment foundation treatments shall be at the discretion of the Superintendent unless shown otherwise on the Drawings.

Foundation treatment Type E1 shall be undertaken as follows:

- 1) Loosen the material at the Stripped Surface Level by ripping to a depth of between 200 mm to 300 mm in the direction parallel to the axis of the embankment.
- 2) Adjust the moisture content of the loosened material and compact it to the relative compaction of 95% SMDD unless specified otherwise in the Drawings.
- 3) Where specified on the Drawings, place approved geosynthetic(s) on top of the prepared foundation.

6.2.3 Type E2 – Excavate and Replace

Foundation treatment Type E2 shall be undertaken as follows:

- 1) Excavate to a depth below the Stripped Surface Level equal to the nominated thickness of the backfill. Backfill depth shall be as shown on the Drawings or to a depth sufficient to result in a non-deforming and non-yielding platform suitable for placement and compaction of subsequent fill layers. Where approved by the Superintendent, geosynthetics may be used to limit the depth of excavation.

- 2) Place fill material in accordance with the Drawings or as directed by the Superintendent and in compliance with the Earthworks Materials Specification.
- 3) Compact material in accordance with the requirements of this Specification.

6.2.4 Type E3 – Stabilised Foundation

For treatment Type E3, the Contractor shall construct a stabilised layer in accordance with the Earthworks Materials Specification and the Contractor's Project Specific Specification for stabilised material.

Foundation treatment Type E3 shall be undertaken by treating the foundation using one of the methods described below:

- a) Increase the strength of the insitu material by undertaking stabilisation in accordance with Section 10.4 of this Specification; The steps to be undertaken are the same as that for foundation treatment Type E1 except that after loosening of the material at the Stripped Surface Level, a stabilising agent (binder) is mixed into the loosened material in accordance with the Earthworks Materials Specification and the Contractor's Project Specific Specification for stabilised material; or
- b) Construct a stabilised layer using premixed stabilised material meeting the requirements of Section 10.5 of this Specification. The steps to be undertaken are the same as that for foundation treatment Type E2 except that after excavation (to Foundation Level), premixed stabilised material is placed in accordance with the design and conforming to the Earthworks Materials Specification and the Contractor's Project Specific Specification for stabilised material.

6.2.5 Type E4 – Geosynthetic(s)

Foundation treatment Type E4 shall be undertaken as follows:

- 1) Where shown on the Drawings or directed by the Superintendent, excavate to a depth below the Stripped Surface Level equal to the backfill thickness nominated for the foundation treatment design.
- 2) Place a layer (or multiple layers) of geosynthetic. The geosynthetic shall be supplied and placed in accordance with Section 11.
- 3) Place fill material in accordance with the design and conforming to the requirements of the Earthworks Materials Specification.

6.2.6 Type E5 – Drainage Blanket

Foundation treatment Type E5 shall be undertaken as follows:

- 1) The Contractor shall ensure the foundation beneath the drainage blanket allows the drainage blanket to drain after it is placed. A clear drainage path is to be maintained throughout the layer, particularly at the outer edges of the embankment.
- 2) Place a geotextile complying with Section 11 of this Specification.
- 3) Construct a drainage blanket layer with a minimum compacted thickness of 300 mm. The drainage blanket material must be spread and placed in such a way as to avoid segregation and to ensure that it is not contaminated with foreign materials. The drainage blanket material must meet the properties shown in the Earthworks Materials Specification, be compacted in

accordance with Section 13 of this Specification and conform to level tolerances stated in Section 8.4.

- 4) Place a geotextile, complying with Section 11, at the interface of the drainage blanket material and the embankment fill, thus fully encapsulating the drainage blanket material.
- 5) Provide drainage outlets at the ends of the drainage blanket layer as shown on the Drawings or directed by the Superintendent.

The grading of the drainage blanket material shall be adjusted, within the limits specified in the Earthworks Materials Specification, as to ensure that it provides a stable foundation for compaction of the overlying embankment.

6.2.7 Type E6 – Bridging Layer

Foundation treatment Type E6 shall be undertaken as follows:

- 1) Demonstrate that it is impracticable to achieve the compaction specified on the drawings or where no such value is provided, 95% SMDD.
- 2) Closely mow grass and cut trees and shrubs off at ground level.
- 3) If directed by the Superintendent, prior to placing the bridging layer, place a geotextile complying with the requirements of Section 11.
- 4) Construct a bridging layer over the embankment foundation area to provide a stable platform upon which a conforming earthworks layer can be constructed. The bridging layer material shall be end-dumped, spread in a single layer and be constructed from rock fill material. The maximum thickness of the bridging layer when completed must not exceed 800 mm.
- 5) Place a geotextile separation layer or graded rock fill overlay over the bridging material.

The Superintendent may require the construction of a trial section of the bridging layer prior to authorising placement of the bridging layer in other areas.

Compaction of layers immediately above bridging layer needs to be conducted with care, particularly avoiding the use of large vibrating rollers, to prevent the development of compaction-induced pore pressures and de-stabilisation of the embankment.

Protection for exposed granular material shall be considered to prevent undermining of the formation.

6.2.8 Type E7 – Special Treatment

Treatment Type E7, refers to the adoption of a project specific foundation treatment as shown on the Drawings or as directed or agreed by the Superintendent.

6.3 Cuttings

6.3.1 Applying Treatments

Cutting foundation treatments are to be carried out after excavation to the Subgrade Level.

Prior to carrying out cutting foundation treatments in materials other than medium strength or stronger rock, the Contractor is to carry out tests to determine the grading, CBR and PI values of the material immediately below Subgrade Level, in the floor of the cutting, using the test methods stated

in the Earthworks Materials Specification. The Contractor may obtain samples for the grading, CBR and PI tests from test pits prior to completion of excavation.

After reaching the cutting Subgrade Level, the Contractor is to present the area for inspection by the Superintendent prior to constructing cutting foundation treatments. Proof rolling may be directed by the Superintendent in accordance with Section 13.5 of this Specification.

[5] HOLD POINT

Process Held:	Type and Extent of each Cutting Foundation Treatment Lot
Submission Details:	<ul style="list-style-type: none"> a) Survey report; b) Notification of completion of clearing operations; c) Notification that Subgrade Level has been achieved; d) Type of cutting foundation treatment being adopted; and e) Any relevant test records.
Release of Hold Point:	<p>The Superintendent:</p> <ul style="list-style-type: none"> a) Will consider the submitted documents; b) Will inspect the excavated floor of the cut; and c) May direct further action prior to authorising the release of the Hold Point. Further action may include removal of Unsuitable Material in accordance with Section 5.9, or treatment in accordance with Section 5.10.
Identifiable Record:	Survey report, Signed ITP by the Superintendent and record of any third party advice

6.3.2 Type C1 – Loosen and Compact

Foundation treatment Type C1 shall be undertaken as follows:

- 1) Remove and replace any Inherently Unsuitable Material in accordance with Section 5.9;
- 2) Loosen the material below the Subgrade Level by ripping to a depth of between 200 mm to 300 mm for the width of the structural fill layer as shown on the Drawings, or the width of the capping layer plus width of cess drain on each side (whichever width is the greater). The maximum particle dimension in the loosened material must not exceed 100 mm;
- 3) Adjust the moisture content of the loosened material and compact it to, unless specified otherwise on the Drawings, a relative compaction of 100% SMDD; and
- 4) After compaction, trim the foundation treatment to Subgrade Level, matching the same design crossfall as the Formation Level with conformance to the tolerances stated in Section 7.5.2.

6.3.3 Type C2 – Excavate and Replace

Foundation treatment Type C2 shall be undertaken as follows:

- 1) Excavate to a depth below the Subgrade Level equal to the nominated thickness of the backfill. Excavate and replace any Inherently Unsuitable Material exposed at the base of the excavation in accordance with Section 5.9.
- 2) If directed by the Superintendent, determine the grading, CBR and PI values of the material in the floor of the cutting (at Foundation Level) by the Test Methods stated in the Earthworks Materials Specification.
- 3) Compact the material exposed at the floor of the excavation (Foundation Level).
- 4) Place fill material in accordance with the Drawings or as directed by the Superintendent and in compliance with the Earthworks Materials Specification.
- 5) After compacting in accordance with Section 13 of this Specification, trim the foundation treatment to Subgrade Level, matching the same design crossfall as the Formation Level with conformance to the tolerances stated in Section 7.5.2.

6.3.4 Type C3 – Stabilised Foundation

For treatment Type C3, the Contractor shall construct a stabilised layer in accordance with the Earthworks Materials Specification and the Contractor's Project Specific Specification for stabilised material.

Foundation treatment Type C3 shall be undertaken as follows:

- 1) Treat the subgrade of the cutting by one of the methods described below:
 - a) Increase the strength of the insitu material by undertaking stabilisation in accordance with Section 10.4 of this Specification.

The steps to be undertaken are the same as that for foundation treatment Type C1 except that after loosening of the material below the Subgrade Level, a stabilising agent (binder) is mixed into the loosened material in accordance with the Earthworks Materials Specification and the Contractor's Project Specific Specification for stabilised material; or
 - b) Construct a stabilised layer using premixed stabilised material meeting the requirements of Section 10.5 of this Specification.

The steps to be undertaken are the same as that for foundation treatment Type C2 except that after compaction of the floor of the cutting (at Foundation Level), premixed stabilised material is placed in accordance with the design and conforming to the Earthworks Materials Specification and the Contractor's Project Specific Specification for stabilised material.
- 2) After compaction, trim the foundation treatment to Subgrade Level, matching the same design crossfall as the Formation Level with conformance to the tolerances stated in Section 7.5.2

6.3.5 Type C4 – Geosynthetic(s)

Foundation treatment Type C4 shall be undertaken as follows:

- 1) Excavate to a depth below the Subgrade Level equal to the structural fill thickness nominated for the foundation treatment. Trim the floor of the excavation (Foundation Level) to conform to the tolerance stated in Section 7.5.2. Remove and replace any Inherently Unsuitable Material in accordance with Section 5.9.
- 2) If directed by the Superintendent, determine the grading, CBR and PI values of the material in the floor of the cutting (at Foundation Level) by the Test Methods stated in the Earthworks Materials Specification;
- 3) Place a layer of geosynthetic on the floor of the cutting. Supply and placement of the geosynthetic in accordance with Section 11.
- 4) Place structural fill material in accordance with the design and conforming to the requirements of the Earthworks Materials Specification.
- 5) After compacting in accordance with Section 13 of this Specification, trim the foundation treatment to Subgrade Level, matching the same design crossfall as the Formation Level with conformance to the tolerances stated in Section 7.5.2.

6.3.6 Type C5 – Drainage Blanket

Foundation treatment Type C5 is to be adopted where shown on the Drawings and in all hard rock cuttings where groundwater is known or suspected to occur or where approved by the Superintendent. Treatment Type C5 shall be undertaken as follows:

- 1) Excavate to a depth below the Subgrade Level equal to the nominated thickness of the drainage blanket and trim the floor of the cutting (Foundation Level) in such a manner as to ensure drainage of the cutting occurs. The Contractor shall ensure the foundation beneath the drainage blanket allows the drainage blanket to drain after it is placed. A clear drainage path is to be maintained throughout the layer.
- 2) Remove, replace or treat all Unsuitable Material present in accordance with Section 5.9 of this Specification.
- 3) For materials other than rock, compact the material exposed at the floor of the cutting with no less than 6 passes of a 12t vibrating roller.
- 4) Except for where the cutting is in rock, place a geotextile complying with the requirements of Section 11, at the interface of the foundation and drainage blanket material.
- 5) Construct a drainage layer with a minimum compacted thickness of 300 mm. The drainage layer material must be spread and placed in such a way as to avoid segregation and to ensure that it is not contaminated with foreign materials. The drainage blanket material must meet the properties shown in the Earthworks Materials Specification, be compacted in accordance with Section 13 of this Specification and conform to level tolerances stated in Section 7.5.2.
- 6) Place a geotextile, complying with the requirements of Section 11, at the interface of the drainage blanket material and the overlying structural fill or capping layer, thus encapsulating the drainage blanket material.
- 7) Provide end drainage outlet treatment as shown on the Drawings, or directed by the Superintendent.

The grading of the drainage blanket material shall be adjusted, within the limits specified in the Earthworks Materials Specification, as to ensure that it provides a stable foundation for compaction of the overlying layers.

6.3.7 Type C6 – Blinding Layer

Foundation treatment Type C6 is to be adopted where shown on the Drawings or in all uneven hard rock cuttings where groundwater is not present. Foundation treatment Type C6 shall be undertaken as follows:

- 1) Place a blinding layer comprising of capping material in accordance with the Earthworks Materials Specification or other material approved by the Superintendent.
- 2) The thickness of the blinding layer shall be such that a smooth and stable surface is provided at Subgrade Level that conforms to the geometry shown on the Drawings.
- 3) After compacting in accordance with Section 13 of this Specification, trim the foundation treatment to Subgrade Level, matching the same design crossfall as the Formation Level with conformance to the tolerances stated in Section 7.5.2.

6.3.8 Type C7 – Special Treatment

Foundation treatment Type C7, refers to the adoption of a project specific foundation treatment as shown on the Drawings or as directed or agreed by the Superintendent. For example, special treatments may be required to manage variable conditions such as rock floaters and corestones in a clay matrix.

6.4 Transition Zones

[6] HOLD POINT

Process Held:	Type and Extent of each Transition Lot
Submission Details:	<ul style="list-style-type: none"> a) Survey report; b) Notification of completion of clearing operations; c) Notification that Subgrade Level has been achieved; d) Type of transition treatment being adopted; and e) Any relevant test records.
Release of Hold Point:	<p>The Superintendent:</p> <ul style="list-style-type: none"> a) Will consider the submitted documents; b) Will inspect the excavated base of the transition; and c) May direct further action prior to authorising the release of the Hold Point. Further action may include removal of Unsuitable Material in accordance with Section 5.9, or treatment in accordance with Section 5.10.
Identifiable Record:	Survey report, Signed ITP by the Superintendent and record of any third party advice

6.4.1 New to Existing

A transition from an existing formation to a new formation shall be in accordance with the Drawings.

6.4.2 Type T1 – Formation Thickness Transition

A transition zone is required at each location of a variation in structural fill layer thickness to avoid detrimental variations in formation stiffness supporting the track structure.

General transitions shall be constructed as shown in Detail B of Appendix B and as shown on the Drawings. The transition zone shall extend over the length shown on the Drawings, or if not shown on Drawings, as agreed by the Superintendent.

6.4.3 Type T2 – Cut to Fill Transition

A cut to fill transition zone is required when no structural fill is specified in the cutting or if the thickness of structural fill overlying the embankment differs from the thickness of structural fill in the cutting by more than 200 mm.

The Contractor shall trim the base of the transition excavation as shown on the Drawings, or if not shown on Drawings, at a minimum gradient of 2% towards the transverse drain.

Following excavation to Subgrade Level in the cut, the Contractor shall carry out further excavation in the cut to fill transition zone, to a depth equivalent to the Subgrade Level of the adjoining embankment.

This additional excavation must extend into the cut for a distance of 10 m from the intersection line resulting from the intersection of the plane of the Subgrade Level in the cut with the plane of the stripped surface, as shown in Detail A of Appendix B. The 10 m is measured perpendicular to the line of intersection between the two planes.

The cut to fill transition treatment shall extend for the full width of the formation however, must not extend into the cut batter.

6.5 Terracing

Where embankments are to be constructed on or against any slopes or batter of existing embankments (including batters resulting from the partial construction of embankments under the Contract), and the existing slope or batter is steeper than 10H:1V in any direction, the Contractor is to cut horizontal terraces into such slopes or batters which will be covered by the embankment to be constructed.

6.5.1 Type T3 – Terracing

The existing slope or batter is to be stepped progressively in successive terraces as shown in Detail C of Appendix B. Cut the terraces to a minimum depth of 300 mm at the steps except where the existing slope or batter is 4H:1V or steeper, in which case the terraces must be cut to a minimum depth of 600 mm at the steps.

Cut the terraces progressively as the embankment is placed.

Inspect the floor of each terrace in accordance with Section 5.9 to check for any Unsuitable Material. Unless directed otherwise by the Superintendent, incorporate the material thus excavated in embankments in accordance with the Earthworks Materials Specification, Section 10 of this Specification, or dispose of it as spoil in accordance with Section 5.10.

Unsuitable Material as defined in Section 5.9 exposed at the base of a terrace during the widening shall be treated in accordance with Section 5.10. Loose or unstable materials exposed at the base of a terrace during the widening shall be compacted to the requirements of Section 13 or removed and replaced.

7 Excavation of Cuttings

7.1 General

Excavation of cuttings includes the following:

- Excavation of earth and rock material within the batter limits to the levels, grades, slopes and dimensions shown on the Drawings.
- Benching or terracing of cut batters.
- Cleaning of batter surfaces.
- Foundation treatments in accordance with Section 6.3.

Materials of all classes encountered in cuttings shall be excavated and placed in embankments if suitable, or removed to spoil if unsuitable. Unsuitable Material is to be treated in accordance with the Section 5.9. Disposal of surplus suitable fill shall be at the approval of the Superintendent.

The occurrence of low strength shear zones, relict soil horizons and seepage zones in excavations may require localised support as directed by the Superintendent. Such works should be based on site specific geotechnical design.

The completed batter face shall be inspected by a Geotechnical Engineer to assess the requirements for removal of any loose or potentially unstable blocks, or additional support systems as determined by the exposed soil and rock conditions.

The degree of compaction of material in the subgrade of cuttings shall be as specified in the Drawings or otherwise of that specified for structural fill in Section 13 of this Specification.

Excavation in cuttings shall be carefully planned before work starts so it can be carried out safely. The Contractor shall consult with all relevant persons involved in the work, including the Superintendent, Geotechnical Engineer, mobile plant operators and Designer where applicable. Planning for excavations shall consider, but not limited to:

- Nature and/or condition of the ground and/or working environment.
- Effect of weather conditions on the Works.
- Static and dynamic loads near the excavation.
- Management of surrounding vehicular traffic and ground vibration.
- Type of equipment used for excavation work.
- Rippable and non-rippable material.

7.2 Non-Rippable Material

7.2.1 Bulk Excavations

Non-rippable material in bulk excavations shall be material which cannot be ripped at a production rate exceeding those stated in Table 5 and all boulders greater than 1 m³.

Table 5 Bulk Excavation — Production Rate Limit for Non-Rippable Material

Crawler Tractor – Net Engine Power (kW)	Production Rate Limit (m ³ /hour)
≥ 150 < 200	<50
≥ 200 < 300	<75
≥ 300 < 400	<90
≥ 400 < 500	<105
≥ 500 < 600	<120
≥ 600	<135

The 'production rate' for bulk excavations means the rate at which material can be ripped with a heavy duty, single tine, parallelogram ripper approved by the manufacturer of the crawler tractor for use with the particular model of crawler tractor; without regard to stockpiling, loading or carting.

The manner in which production rate limits are determined is at the discretion of the Superintendent.

When the Contractor encounters material which the Contractor considers to be non-rippable, a **Hold Point** shall apply. The Contractor shall arrange for a ripping test, as defined in Table 5, and shall advise the Superintendent who shall be present to witness the test.

[7] HOLD POINT

Process Held:	Excavation of non-rippable Material.
Submission Details:	Ripping test witnessed by the Superintendent to determine the production rate, as per Table 5.
Release of Hold Point:	The Superintendent will consider the ripping test and determine rock excavation conditions, prior to authorising the release of the Hold Point.
Identifiable Record:	Report approved by Superintendent and signed ITP

Excavations in non-rippable material shall be to the lines, levels, grades/slopes, and dimensions on Drawings or as re-determined by the Superintendent on the basis of site inspection and geotechnical advice during the excavation and at completion of excavation.

7.2.2 Confined and Trench Excavations

Non-rippable material in confined and trench excavations shall be material which cannot be ripped at a production rate exceeding those stated in Table 6.

Table 6 Confined and Trench Excavations — Production Rate Limit for Non-Rippable Material

Net Engine Power (kW)	Maximum Bucket Width (mm)	Production Rate Limit (m ³ /hour)
≥ 55 < 65	450	<1.5
≥ 85 < 100	600	<3

Net Engine Power (kW)	Maximum Bucket Width (mm)	Production Rate Limit (m ³ /hour)
≥ 115 < 135	750	<4.5
≥ 155 < 175	900	<7
≥ 200 < 235	1050	<10
≥ 235	To be confirmed by trials	

The 'production rate' for confined and trench excavations means the rate at which material can be excavated with a heavy duty toothed bucket or rock bucket (approved by the manufacturer of the crawler excavator for use with the particular model of crawler excavator) for excavation only; without regard to stockpiling, loading or carting. The bucket teeth shall be fitted with high penetration boots.

7.3 Cut Batters

Cut batters should be constructed in accordance with the Drawings. The batter slopes in cuttings may be re-determined by the Superintendent, following a site inspection and investigation during excavation. Where the Superintendent re-determines a slope, the Contractor may be entitled to claim a variation in quantities in the earthworks schedule.

If the Contractor excavates the slope of a cutting beyond the specified line and the tolerance applicable thereto, the Superintendent may authorise a minor change in the general slope of the cutting to suit the convenience of the Contractor, but such a change shall not be regarded as a redetermination of the slope under this Section, and no payment will be made for any increase in excavation quantities resulting from the change in slope.

Batters will generally require progressive flattening at the ends of cuttings owing to the presence of less stable material. Round off the tops of cuttings to the dimensions shown on the Drawings unless otherwise directed.

The surface of batters in the cutting must be free of rills except for that resulting from pre-splitting or line drilling boreholes. Treat the face of the batter progressively where such treatment is shown on the Drawings.

Clear the cut faces of any loose or unstable material progressively as the excavation proceeds. The Superintendent may direct that any overhanging, loose or unstable material, whether outside or behind the specified slope, be removed.

Batters shall be carried around curves in an even and regular manner.

7.4 Cuttings in Rock

A **Hold Point** is required prior to commencement to excavation of a rock cutting.

[8] HOLD POINT

Process Held:	Excavation of a rock cutting.
Submission Details:	a) Relevant survey reports. b) Plan for reuse of excavated material.
Release of Hold Point:	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.
Identifiable Record:	Relevant survey reports and signed ITP

In rock cuttings with slopes of 1H:1V or steeper, batters are to be inspected and assessed for stability immediately following completion of excavation to the toe of the batter.

Prior to assessment by the Superintendent or Geotechnical Engineer, the Contractor shall clean the batters and remove all loose and unstable blocks which are too large to be removed, by hand or machine, unless otherwise directed by the Superintendent. The Contractor is to continue cleaning until all loose rock and soil material is removed, and all rock and joint surfaces are sufficiently exposed so that the Superintendent or Geotechnical Engineer can assess their condition and likely effect on the stability of the batter.

The Contractor shall also clean the surface of all benches, unless otherwise directed by the Superintendent.

[9] HOLD POINT

Process Held:	Excavation in rock below the top of cutting and below bench level.
Submission Details:	Presentation of cleaned batter and bench/floor surfaces for geotechnical inspection.
Release of Hold Point:	The Superintendent or Geotechnical Engineer will inspect the cleaned surfaces and may direct further action prior to authorising the release of the Hold Point. Further action may include additional cleaning (if the condition of the faces cannot, in the opinion of the Superintendent or Geotechnical Engineer, be adequately assessed), and stabilisation works, prior to or concurrent with any further work within the cutting.
Identifiable Record:	ITP signed by Geotechnical Engineer or Superintendent.

Following inspection, the Superintendent may direct additional stabilisation works, including changes to the batter slope.

7.5 Tolerances in Cuttings

7.5.1 Batters

Batters in cuttings must not have undulations in the general plane of the batter. Excavation of batters must comply with the tolerances given in Table 7.

Table 7 Cutting Batter Tolerances

Location	Tolerance from Design Profile (mm)	
	Slope 1H:1V or flatter	Steeper than 1H:1V
At level of toe of batter	+0 / -150	+0 / -200
2 m above toe of batter and beyond	+100 / -300	+100 / -300
Between level of toe of batter and 2 m above toe of batter	Interpolate	Interpolate

Notes:

- 1 Plus (+) is towards the formation and minus (-) is away from the track. Tolerances are to be measured to a horizontal plane.
- 2 Bench widths must not be less than those shown on the Drawings.

If the batter is over-excavated beyond the tolerance applicable for the batter slope line, or after cleaning the batter is beyond the tolerance applicable, restore the batter to the specified slope and stability to the Superintendent's satisfaction. Proposals for restoration must take into account long term stability, durability, and consideration of urban design solutions. The cost of restoring or re-forming the batter will be borne by the Contractor.

The batter shall be constructed with a consistent profile to the satisfaction of the Superintendent.

For batters steeper than 1H:1V, if any section of the batter up to a height of 3 m above the toe of batter has been over excavated beyond the tolerance limit specified, the Superintendent may direct that the batter be re-formed to the average batter slope using a specified treatment.

7.5.2 Floor of Cutting

Finish surface levels on the floors of cuttings and transitions shall not exceed the tolerances detailed in Table 8. The tolerances in Table 11 have precedence.

Table 8 Cutting Level Control Tolerances

Location	Tolerance from Design Profile (mm)
Floor of the cutting other than in rock	+0 to -40
Floor of the cutting in rock	+0 to -80

Notes:

- 1 Minus (-) is away from the track and plus (+) is towards the track. Tolerances are measured perpendicular to the formation surface.
- 2 The floor of cuttings other than rock shall not deviate more than 20 mm over any 3 m length.

7.6 Benching in Cuttings

Construct benches at cut batters as shown on the Drawings, to provide drainage and erosion control, to provide geotechnical stability, and to allow access for maintenance purposes. Notwithstanding the tolerances permitted under Table 7, bench widths must not be less than those shown on the Drawings.

The floor of the bench must not vary from levels shown on the Drawings by more than the tolerances shown in Table 8, but the bench must have a crossfall to drain water away from the cut face immediately below the bench. Provide and maintain longitudinal drainage to prevent ponding of water on the benches, overtopping of batters and direct water away from the formation along natural contours.

Construct bench drains, where shown on the Drawings, progressively as each batter face is completed.

Maintain and regularly clean the benches of any loose materials throughout the Contract period. The cost of such maintenance and cleaning of benches is deemed to be included in the rates generally.

7.7 Blasting

7.7.1 General

This section outlines requirements for blasting in cuttings and is not applicable to tunnels.

Blasting of cuttings shall be undertaken as outlined below and in accordance with the requirements of the relevant local and state authorities, government regulations, license conditions and relevant Australian Standards.

The Contractor shall provide a Blasting Management Plan and any dilapidation surveys as required by the Superintendent prior to commencement of blasting.

[10] HOLD POINT

Process Held:	Start of each blast.
Submission Details:	At least a week prior, submit details of Blasting Management Plan: <ul style="list-style-type: none">a) proposed blasting design and estimated vibration and air blast at sensitive receivers; andb) measures to limit noise and to ensure that vibration from blasting does not adversely affect nearby structures.
Release of Hold Point:	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.
Identifiable Record:	Superintendent signed Blast Management Plan

The Blasting Management Plan must include a detailed procedure to be followed in the event of a misfire of the charges.

Prior to commencement of any blasting activities, the Contractor must obtain all necessary approvals and licences from the appropriate authorities.

When blasting operations are being carried out, take precautions relating to the safety of persons and animals. Close any roads likely to be affected by the blasting to traffic and erect the appropriate signs in accordance with state government road authority requirements.

The Contractor shall undertake a dilapidation survey following blasting at the discretion of the Superintendent.

7.7.2 Blasting Records

The Contractor shall maintain accurate records of each blast including the details listed below:

- Date, identification number and time of blast.
- Location, number and diameter of blast holes loaded.
- Site plan showing (at a minimum) locations and identification numbers.
- Depth of each drill hole loaded.
- Inclination of drill holes.
- Burden(s) and spacing(s).
- Types and amounts of explosives used.
- Maximum instantaneous charge.
- Initiation Plan.
- Length and type of stemming in each blast hole.
- Ground vibration and noise levels at measuring locations.
- Regulatory notifications.
- Details and all relevant documentation relating to all breaches which have occurred.

The records must be written as the holes are loaded, and must be signed by the shotfirer. The Contractor shall provide a copy of the records to the Superintendent on the day of the blast.

7.7.3 Pre-Splitting or Line Drilling

7.7.3.1 General

Use pre-splitting or line drilling to produce a uniform and neat batter surface after excavation and reduce over-break. The boreholes used in pre-splitting or line drilling must be straight, parallel and in the designed plane of the batter.

The diameter, spacing, and loading of presplit holes shall be designed so as to result in a neat break.

If the depth of the cut is more than can be drilled from the top, the Contractor shall include in their Blasting Management Plan a methodology that complies with the Drawings.

The Superintendent will give consideration to an alternative method of excavation and preparation of the cut face so as to produce a result equivalent to that produced from pre-splitting or line drilling. Approval to such alternative methods will be granted at the absolute discretion of the Superintendent, who may require a trial section of the proposed method to be carried out to demonstrate its suitability.

7.7.3.2 Hole Diameter and Hole Spacing

Where pre-splitting or line drilling is carried out, the centre-to-centre spacing of drill holes must not exceed the values in the Table 9 below.

Table 9 Hole Diameter and Spacing for Pre-splitting or Line Drilling

Cut Batter Treatment	Hole Diameter (mm)	Maximum Hole Spacing (mm)
Pre-splitting	38-51	450
Pre-splitting	51-64	750
Pre-splitting	76-89	900
Line Drilling	< 51	150
Line Drilling	51-76	250

7.7.3.3 Pre-splitting or Line Drilling Prior to Blasting

Prior to commencing blasting, batters with gradients 1H:1V or steeper must be pre-split or line drilled to the design batter profile to the spacings shown in Table 9 to produce a uniform and neat batter surface after excavation which is acceptable to the Superintendent.

Such burden blasting must not damage the batter face.

7.7.4 Control of Airblast

The airblast (noise) at noise sensitive locations must not exceed the overpressure limits required by relevant state authorities, environmental licences, approvals, nearby asset owners and the ANZECC Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration. In general, a monitoring location will be sited at the perimeter of the noise sensitive location at the point closest to the maximum charge.

The Contractor shall monitor airblast to verify that the specified limits are not exceeded. The equipment used for such monitoring must be calibrated annually by a National Association of Testing Authorities (NATA) accredited testing facility or manufacturer's facility approved by the Superintendent. All readings from the monitoring must be reported on test certificates, which must indicate clearly compliance or non-compliance with the requirements of this Specification. Provide a copy of the monitoring record to the Superintendent.

In the event that the measured airblast exceeds the specified limits, suspend further blasting work and take additional steps and precautions to ensure that, for any future blast, the limiting airblast must not be exceeded. Do not resume any blasting until details of the additional steps and precautions have been provided to the Superintendent.

7.7.5 Control of Ground Vibration from Blasting

Ground vibration at sensitive locations must not exceed the limits required by relevant state authorities, environmental licenses, approvals, nearby asset owners and the ANZECC Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration. In general, a monitoring location will be sited at the perimeter of the structure or building at the point closest to the maximum charge. The measurement process for determining verification of compliance with ANZECC is to be in accordance with AS 2187.2.

The equipment used for monitoring must be calibrated annually by a NATA accredited testing facility or manufacturer's facility approved by the Superintendent. All readings from the monitoring must be reported on test certificates, which must indicate clearly compliance or non-compliance with the requirements of this Specification. Provide a copy of the monitoring record to the Superintendent.

To minimise the risk of peak particle velocity limits being exceeded, develop a blasting site relationship between peak particle velocity, distance and blasting charge and submit to the Superintendent.

8 Embankments

8.1 General

Embankment construction includes:

- Preparation of foundation areas over which fill material is to be placed as described in Section 6 and backfilling of excavations undertaken for foundation treatments;
- Placement and compaction of conforming material in areas from which Unsuitable Material has been removed in accordance with Section 5.9, and in areas where material below the Subgrade Level has been removed in cut/fill transitions;
- The placement and compaction of fill material, both general fill and materials of specified quality in nominated zones throughout the Works, including at spill through bridge abutments where subsequent pile foundation works are to be undertaken; and
- Works to the geometry shown on the Drawings.

The Contractor shall programme and manage the Works as detailed in the PQP so that material of the quality specified in the Earthworks Materials Specification is available when required. Embankments shall be constructed, up to Subgrade Level, from materials approved by the Superintendent for use in embankments and obtained from cuttings and borrow areas. If there is a deficiency of materials from cuttings, the Superintendent may approve that cuttings be widened, benched or cutting batters flattened. Materials from other sources may be supplied if approved by the Superintendent.

Prior to placement, the Contractor shall process those materials which do not meet the requirements of the Earthworks Materials Specification to achieve conformity. The Contractor is to select the methods of excavation, transport, depositing and spreading of the fill material so that the placed material in any Lot is homogeneous.

The embankment batter slopes shown on the Drawings may be re-determined by the Superintendent depending upon the materials encountered.

The full width of the embankment shall be compacted to the requirements specified in Table 19.

8.2 Earth Fill Embankments

8.2.1 Earth Fill Material

8.2.1.1 Homogenous Embankment

Homogenous earth fill embankments are to be constructed using General Earth Fill materials meeting the requirements of the Earthworks Materials Specification.

Coarse fragments must be broken down to smaller sized particles and evenly distributed throughout the layer to prevent the formation of voids and to produce a dense compact embankment. To meet this requirement, additional fine grained material may need to be obtained from other places within the Site or by a change in the method of winning and processing the material.

8.2.1.2 Zoned Embankments

The Contractor shall construct an embankment that maximises the use of cut or locally won source materials and minimises the amount of imported fill materials.

The zoned embankment definitions for the cross section are shown in Figure 2, with placement depth criteria and material requirements in Section 13 of this Specification and the Earthworks Materials Specification.

In general, the Outer Zone material shall be general fill Type A durable, erosion resistant material, the Upper Zone shall be general fill Type A and Type B, and the Lower Zone may be general fill Type C, Type D and rockfill, all in accordance with their respective placement depth criteria specified in the Earthworks Materials Specification.

8.2.1.3 Bridge Abutments

At bridge abutments, Select Fill material conforming to the Earthworks Materials Specification is to be placed within the zone shown on the Drawings, or where not shown, in accordance with Standard Drawing B0305.

Each lift must be compacted in accordance with the requirements for Select Fill Adjacent to Structures as detailed in Section 13 of this Specification.

8.2.2 Earth Fill Placement and Compaction

Earth fill embankments shall be constructed by placing approved fill materials in horizontal layers for the full width of the embankment. Each layer shall have a compacted thickness not exceeding those specified in Section 13 unless demonstrated by field trials and approved by the Superintendent. Compaction of fill shall occur for the full width of the embankment. This may require the embankment to be overfilled and cut back.

Earth fill material for embankment construction is to be placed in lifts parallel to the grade line.

Coarse fragments shall be broken down and well distributed through the filling, and sufficient fine material shall be placed around the larger material as it is deposited to fill the voids and produce a dense compact embankment. Where insufficient fine material is present to fill the voids, additional fine material shall be obtained from other places in the work or by a change in the method of winning.

Where the Contractor wishes to compact any fill material in lifts exceeding those specified in Section 13 (for the material type), they shall demonstrate by trial compaction to the Superintendent's satisfaction, that the compaction plant is capable of efficiently achieving the specified relative compaction through the lift thickness.

Earth fill is not to be placed on a lift which has a moisture content outside the specified moisture content range; is soft, unstable or rutted; or which has become mixed with foreign matter. The underlying layer shall be corrected to comply with the corresponding requirements of Section 13 before spreading of the next fill lift.

8.3 Rock Fill Embankments

8.3.1 Rock Fill Material

Material for rock fill must comply with the Earthworks Materials Specification. The constituent particles must be of uniform strength and soundness. Material that does not meet the requirements

for rock fill must be broken down further into finer particles, or have additional fines incorporated, and used elsewhere.

The Contractor shall adjust the working methods employed in the excavation of cuttings so as to produce rock fill material of the grading and rock strength specified. Such working methods may include screening and, if necessary, secondary processing.

8.3.2 Rock Fill Placement and Compaction

The Contractor shall nominate to the Superintendent the proposed areas of rock fill. Unless shown otherwise on the Drawings, do not place rock fill in areas where earth fill has previously been constructed.

The Contractor shall shape and treat the foundations under rock fills to maintain drainage and to ensure that erosion of the foundation will not occur. Where shown on the Drawings or directed by the Superintendent, place a geotextile, complying with the requirements of Section 11, over the foundation area prior to placing the rock fill.

Rock fill material is to be placed and spread in such a way as to avoid segregation and to ensure that it is not contaminated with foreign material. The completed rock fill lift thickness must not exceed that specified in Table 18 of this Specification, unless approved otherwise by the Superintendent.

Rockfill shall not be placed within 3 m of structures without prior approval by the Superintendent.

The Contractor shall not dump rock within 5 m of structures.

8.3.3 Surplus Rock Fill Material

If the Contractor requests and is given approval by the Superintendent to construct an earth fill embankment in some or all of the nominated rock fill locations, and a surplus of rock, capable of being processed for rock fill, is later found to exist, then surplus shall be treated by either:

- Processing the material for use as general fill;
- Removal of general fill, and placement of the surplus rock as rock fill, at the Contractors cost; or
- Disposed of as spoil.

8.4 Embankment Tolerances

8.4.1 Batter Slopes

When completed, the batters of embankments must conform to those shown on the Drawings unless otherwise authorised or re-determined by the Superintendent.

The tolerances for construction of embankment batters are detailed in Table 10.

Table 10 Embankment Batter Tolerances

Location	Tolerance from Design Profile (mm)
At formation level	-0 / +150
Between top of formation and 1 m below top of formation	-0 / +150
Beyond 1 m below top of formation	-0 / +300

Notes:

- 1 Minus (-) is towards the formation and plus (+) is away from the track. Tolerances are to be measured to a horizontal plane.

Undulations in the general plane of the batter are not acceptable. The completed batter must be free of rills running down the face of the batter. Batter profiles shall be uniform through their entire length and continue in regular lines around curves.

The Contractor shall promptly remove any loose material on the batters as the work progresses.

Placement of additional material on the existing embankment batters must be carried out in the same manner as that specified for placement of hillside embankments in Section 6.5.

8.4.2 Level Controls

The Contractor shall finish the surface levels of the earthworks layers and zones to the design surface levels less the nominated thicknesses of the relevant overlying courses and zones to within the tolerances detailed in Table 11.

Table 11 Embankment Level Control Tolerances

Location	Tolerance from Design Profile (mm)
Top of the structural fill layer other than in rock	+0 to -50
Top of the general fill zone	+40 to -40
Floor of the benches	+0 to -100
Finished surface of the capping layer	+0 to -15 3 m straight edge (or equivalent method) <10 mm difference
Capping layer crossfall	between 1V:25H and 1V:35H

Notes:

- 1 Minus (-) is away from the track and plus (+) is towards the track. Tolerances are measured perpendicular to the formation surface.

8.5 Scour Protection for Embankments

8.5.1 General

Where shown on the Drawings, the Contractor shall provide scour protection of clean, hard, durable rock over embankment batters (including embankments at bridge structures) meeting rock protection requirements of the Earthworks Materials Specification.

The Contractor may elect, with the approval of the Superintendent, to place surplus rock conforming to Section 8.3.3 as rock facing. The scour protection shall be placed outside of the general embankment dimensions.

8.5.2 Placing Rock Protection

Placement of the rock protection shall be in layers as per the design after the earthworks construction. Place the rock with its least dimension vertical, and such that mechanical interlock between the larger stones occurs.

Provide a geotextile, complying with the requirements of Section 11, as a separation between the earth fill material and the rock protection.

Fill the space between larger rocks in the rock facing and adjacent fill material with progressively smaller rocks to form a graded filter which prevents the leaching out of fines from the fill material but which does not overfill the voids between larger rocks, or cause the larger rocks to lose contact with one another.

Remove any excess of fine material surrounding any rock placed within the rock facing by removing the rock, removing the excess fine material and re-placing the rock.

9 Formation

9.1 Placing and Compacting Structural Fill and Capping Materials

The finished cutting and embankment surfaces including capping layer shall conform to the profile specified on the Drawings and be in accordance with tolerances specified in Section 7.5.2 and Section 8.4.2 of this Specification. The finished surface immediately below the capping layer and the finished surface of the capping layer shall have no depressions or ridges which could hold water or prevent full drainage.

The top of the structural fill and capping layers shall be compacted, trimmed to the final profile and tested (including but not limited to proof rolling) to meet the design requirements.

Structural fill and capping materials shall be spread in uniform horizontal lifts for the full width of the lift that will provide the specified compacted thickness. Spreading shall be undertaken by a method that will ensure segregation does not occur, and so as not to rut or disturb the compacted material beneath it.

Where required for compaction purposes, water shall be added and mixed uniformly with the structural fill and capping material by approved mechanical means. Compaction shall continue until the layer shows no further movement under the compacting equipment and the density specified in Table 19 is achieved.

The Contractor may proceed in the absence of conformity records for Hold Points contained in Section 9.2 and 9.3 at their own risk.

9.2 Structural Fill Layer(s)

All structural fill shall be supplied and/or won to meet the materials requirements of the Earthworks Materials Specification.

The structural fill layer shall be constructed in a continuous layer to a minimum compacted thickness defined in Table 18, Table 19 or as specified otherwise on the Drawings, to a level 30 mm above the base of the capping layer.

[11] HOLD POINT

Process Held:	Covering of structural fill layer
Submission Details:	Verification of conformity of each Lot of structural fill placed, with relevant test and survey reports.
Release of Hold Point:	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.
Identifiable Record:	Lot conformity records

9.3 Capping Layer

Immediately prior to the placement of the capping, the structural fill layer shall be trimmed by grading to the final profile and compacted by a minimum of three passes of a smooth steel drum roller that has a static mass not less than 10 tonnes.

All formation capping material shall be supplied to meet the requirements of the Earthworks Materials Specification.

[12] HOLD POINT

Process Held:	Placement of each Lot of Capping.
Submission Details:	Test reports verifying conformity of each Lot of material for use in Capping Layer.
Release of Hold Point:	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.
Identifiable Record:	Material Lot conformity record

The top of the capping layer shall be graded and trimmed and additional capping material shall be added as necessary to produce an even, tight and dense surface. The finished rolled surface shall be true to profile to a tolerance as defined by Section 8.4.2 and shall be free of depressions and ruts.

[13] HOLD POINT

Process Held:	Covering of each Lot of Capping.
Submission Details:	Verification of conformity of each Lot of Capping placed, with relevant test and survey reports.
Release of Hold Point:	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.
Identifiable Record:	Lot conformity record

Where new works join existing track, the levels and crossfall of the capping layer shall be placed in accordance with the drawings to ensure proper drainage of both the new and existing formation.

10 Stabilisation

10.1 Stabilised Material

Stabilised fill shall meet stabilised materials criteria specified in the Earthworks Materials Specification and the Contractors Project Specific Specification for use of stabilised materials.

[14] HOLD POINT

Process Held:	Use of stabilised material in the subgrade, embankment fill and formation.
Submission Details:	Provision of a stabilised material design by the Designer and Project Specific Specification for stabilised material, including results and details of laboratory testing, stabilisation method, stabilisation trial section, stabilisation quality control and stabilisation quality assurance details.
Release of Hold Point:	The Superintendent will consider the submitted document, prior to authorising the release of the Hold Point.
Identifiable Record:	Approved Project Specific Specification for the stabilised material and the stabilisation quality plan

10.2 Stabilised Fill Layers

Each stabilised fill layer worked shall be parallel to the finished fill surface and shall extend the full width of the treatment area. The stabilised fill shall be placed in compacted layers not greater than 300 mm nor less than 100 mm to achieve a uniformity, free from evidence of any segregation.

Each lift of stabilised fill shall be completed within the specified timeframe. Where the treatment area is greater than one day's production, the layer may be subdivided into lifts, with overlapping runs and construction joints staggered horizontally and vertically over the area.

Overlying layers shall not be placed until the stabilised fill layer has been cured to meet the performance requirements of the Project Specific Specification for stabilised materials.

Adjoining stabilisation passes shall be completed with a minimum overlap of 300 mm. Any overlaps in adjoining stabilised materials must be completed within the working time of each material respectively.

Where multiple lifts are placed, each lift shall extend a minimum 500 mm past the underlying lift, so as to reduce differential movement between the stabilised layer and the adjoining material.

The stabilised material's moisture content, as specified in the Contractors Project Specific Specification for stabilised materials, must be uniformly maintained while placing and compacting the stabilised material. The Contractor shall apply a uniform compactive effort, both longitudinally and transversely, while meeting the requirements for density, width, shape, level and surface finish as

specified in the Contractors Project Specific Specification for stabilised materials and this Specification.

Each layer of stabilised material must be tested and shown to comply with the requirements of the Contractors Project Specific Specification for stabilised materials and this Specification, prior to placing subsequent layers. The Contractor may proceed in the absence of conformity records for Hold Points contained in the Contractors Project Specific Specification for stabilised materials and this Specification at their own risk.

10.3 Stabilisation Trial Section

The Contractors Project Specific Specification for stabilised materials shall provide details on how the Contractor shall carry out a preliminary trial of the proposed stabilising operations for each material and binder type proposed to be used for stabilised fill. The trial shall determine:

- The effectiveness of the plant, including depth of stabilisation (maximum 300 mm per single pass unless approved otherwise by the Superintendent).
- The number of passes of the stabilising machine necessary to achieve the specified mixing.
- The desirable moisture content, temperature and working time for compaction operations.
- The number of passes of the compaction machine necessary to achieve the specified compaction.
- The compacted depth of layer being worked, including the allowance for trimming to spoil and level tolerances.
- Compliance of stabilised material to the Earthworks Materials Specification and the Contractors Project Specific Specification for stabilised materials.
- Development of QA/QC testing schedule, including alternative test methods (detailed in the Earthworks Materials Specification).

The trial section shall be located within the Works area and shall remain open for inspection and testing as required by the Designer.

[15] HOLD POINT

Process Held:	Stabilised fill trial section in the embankment and formation open for inspection and testing as required by the Designer.
Submission Details:	<ul style="list-style-type: none">a) Provision of a stabilised material test results which demonstrate compliance with design criteria and specification requirements.b) The Contractor's Project Specific Specification for stabilised materials inclusive of the results of the trial.
Release of Hold Point:	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.
Identifiable Record:	Stabilised material test results, approved revisions of the Contractor's Project Specific Specification for stabilised materials

The trial section shall be tested with a range of field and laboratory test methods to provide correlations between the test methods, conformation of design parameters and the suitability of compliance acceptance limits in the Earthworks Materials Specification. Test methods may include but not be limited to those specified in the Earthworks Materials Specification.

The results of the trial testing programme will be reviewed by the designer, approved by the designer and Superintendent, and used to review and change, if needed, the testing schedule detailed in the Contractors Project Specific Specification for stabilised materials.

10.4 In Situ Stabilisation Method

The spreading equipment shall be a stabilising agent spreader which has been specifically designed for such work. The spreader shall be capable of uniformly distributing the stabilizing agent and accurately controlling the spread rate such that when mixing is complete, the stabilisation agents content shall be in accordance with the Contractors Project Specific Specification for stabilised materials (as required by the Earthworks Materials Specification). The spreader shall be equipped with gates to vary the width of spread and with electronic weigh scales to give daily totals of product used.

Cutting, pulverising, mixing, adding water and spreading of mixed material shall be accomplished using a stabilising machine specifically designed for stabilisation.

The stabilising machine shall also satisfy the following requirements:

- It shall be capable of producing a uniformly mixed material throughout the specified depth of the work.
- It shall not disturb the layer beneath the lift to be stabilised.
- It shall be equipped with a variable depth of cut control, and an accurate gauge to measure depth of cut which is readily visible to the operator.

- It shall have provision for adding water automatically through a system comprising a pump, flow meter, variable control valve and full width spray bar.

The Contractor shall keep daily records of the amounts of stabilising agent used and actual spread rates obtained per section treated and submit them to the Superintendent on a weekly basis.

The percentage of stabilising agent determined in accordance with this Section shall be maintained within $\pm 10\%$ by mass of the stabilising agent content specified in Contractors Project Specific Specification for stabilised materials (as required by the Earthworks Materials Specification) throughout the stabilisation works.

10.5 Plant Mixed Stabilisation Method

Stabilised material may be supplied as a plant mixed product which meets the design requirements of the Earthworks Materials Specification and the Contractors Project Specific Specification for stabilised materials.

Immediately prior to placement of the stabilised material, lightly scarify or tyne the surface on which it is to be placed to a depth not exceeding 25 mm.

Process the mix in a mixing plant of the driven pugmill type. The mixing plant may be either a batch or continuous type. The mixing plant shall be fitted with a measuring device to allow accurate measurement of the amount of stabilising binder and additives being added to the mix. The mass of charge in a batch mixer or the rate of feed to a continuous type mixer shall not exceed that which will permit complete mixing of all material.

The mixing plant shall be operated in accordance with the manufacturer's recommendations. Mixing of material shall be continued until the quarry material, binder, retarder and water are evenly distributed through the mass and a uniform mixture of unchanging appearance is obtained.

The plant must be capable of processing the nominated lot sizes within the curing period and of incorporating the stabilising agent to an accuracy of $\pm 10\%$ of the nominated rate. The process operation must effectively avoid segregation occurring in the mix.

Production of each nominated mix shall be such that the proportion of stabilising binder incorporated is within the specified tolerances. The Contractor shall implement a testing regime to demonstrate that the binder content complies with Contractors Project Specific Specification for stabilised materials and the Earthworks Materials Specification.

At the end of each day's production, the average percentage of stabilising binder added to the plant mixed stabilised material shall be calculated (as a percentage of the dry mass of the material being bound, to 0.05%), from:

- The total amount of binder used that day (determined from delivery dockets, silo dippings, etc.); and
- The total quantity of material mixed and placed in the works that day (determined by appropriate measurement).

During transportation to the site, the load shall be completely covered with a tarpaulin or similar heavy cover to protect the material against the effect of sun and rain. The cover shall not be removed until the load is about to be tipped.

The rate of delivery shall be sufficient to enable all spreading, shaping and compaction to be carried out within the working time as defined by the supplier.

10.6 Stabilisation Quality Requirements

10.6.1 In Situ Stabilisation

For in situ stabilisation method (Section 10.4) the Contractor shall prepare and implement a Stabilisation Quality Plan that includes:

- Details of binder design criteria, including design strength and material types, complying with the requirements of the Earthworks Materials Specification.
- Details of the type of stabilisation plant proposed, including type, output capacity and method of controlling binder content and moisture content (including methods to ensure uniformity).
- Method for determining stabilised material density and binder spread rate.
- Details of trial (Section 10.3).
- Details of any retarder to be used with binder.
- Details of the curing period and conditions required prior to the placement of the next layer.
- Records demonstrating sulfates or other deleterious chemicals are not present in sufficient quantities to effect stabilisation.
- Procedures for calibration of plant (including frequency).
- Detailed procedures for stabilised fill construction.

10.6.2 Plant Mix Stabilisation

For plant mix stabilised method (Section 10.5) the Contractor shall prepare and implement a Stabilisation Quality Plan that includes:

- Details of binder design criteria, including design strength and material types, complying with the requirements of the Earthworks Materials Specification.
- Details of the type of mixing plant proposed, including type, proposed location, output capacity and method of controlling binder content and moisture content (including methods to ensure uniformity).
- Procedure for verifying binder content, including evidence of reliability of the procedure.
- Method for determining working time limit.
- Details of trial (Section 10.3).
- Details of any retarder to be used with binders.
- Details of the curing period and conditions required prior to the placement of the next layer.
- Records demonstrating sulfates or other deleterious chemicals are not present in sufficient quantities to effect stabilisation.
- Procedures for calibration of plant (including frequency).
- Procedures for material handling, including loading of mixer and control of segregation during loading and mixing.
- Detailed procedures for stabilised fill construction.

11 Geosynthetics

11.1 General

Geosynthetics (including geogrids, geonets, geomembranes, geosynthetic clay liners, geofoam, geocells and geocomposites) shall comply with specifications, Australian Standards and recommendations of their manufacturer, and be approved for use by the Superintendent prior to ordering.

The Contractor's PQP must detail how the Contractor will manage, test and control the quality of Geosynthetics.

The requirements of this section are applicable to geotextiles for use as separation or filtration elements in earthworks.

Woven geotextiles, geogrids or other geosynthetic products used for formation reinforcement to reduce subgrade deformations and structural/general fill layer thicknesses shall be determined by the Designer and installed by the Contractor in accordance with manufacturer recommendations and the Drawings.

11.2 Geotextiles

11.2.1 Applications

Geotextiles for separation and filtration shall comply with the Earthworks Materials Specification and be installed at locations specified on the Drawings or where directed by the Superintendent.

Where a Strength Class and Filtration Class is not specified in the documentation for a specific installation, a geotextile shall be selected and used in accordance with Table 12.

The nominated strength class shall be considered appropriate for where the drop height of fill is less than or equal to 1.5 m. Where the height of drop of the fill is greater than 1.5 m, the Contractor is to sought specialist advice and be given approval by the Superintendent prior to ordering and placement of the geotextile.

Geotextiles used as filter or separation layers under or within embankments may be a woven or a non-woven type, except that, where the geotextiles are used under rockfill embankments or placed over rockfill or other uneven surfaces, they shall have an elongation greater than 30%.

Table 12 Geotextile Applications – Unsaturated Conditions

Application	Function	Strength Class ³ Requirements ^{1, 2}	Filtration Class Requirements ³	
			D ₁₅ ≤ 0.075 mm (Cohesive Soils)	D ₁₅ > 0.075 mm (Granular Soils)
Separation under or within embankments (unsaturated conditions)	To prevent mixing of dissimilar soil types during construction for unsaturated soils where CBR > 3	Strength Class stated in Table 14 for CBR > 3 and the D ₈₅ of the fill	VII	VIII

Application	Function	Strength Class ³ Requirements ^{1, 2}	Filtration Class Requirements ³	
			D ₁₅ ≤ 0.075 mm (Cohesive Soils)	D ₁₅ > 0.075 mm (Granular Soils)
Working platform or bridging layer	To prevent mixing of dissimilar soil types in saturated conditions in working platform / bridging layer applications for soils where CBR ≤ 3 and where filtration is not a critical function	Strength Class stated in Table 14 for CBR ≤ 3 and the D ₈₅ of the fill	VI	IV
Drainage and separation behind retaining structures including rock filled mattresses and joints of pipes and arches	To provide the combined functions of separation and filtration	Strength Class stated in Table 16 for the specific type of structure	III	II
Under rock armour revetment layer in embankments	For cushioning layer requirements to minimise damage to geotextile due to excess drop height refer to Note 3 in Table 14	Strength Class stated in Table 14	III	II

Notes:

- 1 Requirements for strength class for installation damage protection are based on a 1.5 m drop height of material for the corresponding maximum nominal stone size.
- 2 Geotextile Strength Class to ensure survivability for the given application. Geotextile survivability refers to the ability of the geotextile to withstand the installation stresses during construction. It is related to construction method, subgrade condition, backfill material including stone size and other factors.
- 3 Strength and Filtration Class in accordance with the Earthworks Materials Specification.

Table 13 Geotextile Applications – Saturated Conditions

Application	Strength Class ³ Requirements ^{1, 2}	Filtration Class ³ Requirements		
		D ₅₀ ≤ 0.075 mm (Predominantly silt and clay soils)	D ₅₀ > 0.075 mm and D ₁₅ ≤ 0.075 mm (Predominantly granular soils with low permeability)	D ₁₅ ≤ 0.075 mm (Predominantly pervious granular soils)
Separation under or within embankments (saturated conditions)	Strength Class stated in Table 14 for CBR ≤ 3	V	IV	II

Application	Strength Class ³ Requirements ^{1, 2}	Filtration Class ³ Requirements		
		$D_{50} \leq 0.075 \text{ mm}$ (Predominantly silt and clay soils)	$D_{50} > 0.075 \text{ mm}$ and $D_{15} \leq 0.075 \text{ mm}$ (Predominantly granular soils with low permeability)	$D_{15} \leq 0.075 \text{ mm}$ (Predominantly pervious granular soils)
To prevent mixing of dissimilar soil types in saturated conditions for soils where $\text{CBR} \leq 3$	and the D_{85} of the fill			
Drains Trench drains, edge drains, drainage blankets, counterfort and cut-off drains	Strength Class stated in Table 15 for the specific trench depth and the D_{85} of the fill	V	IV	II

Notes:

- 1 Requirements for strength class for installation damage protection are based on a 1.5 m drop height of material for the corresponding maximum nominal stone size.
- 2 Geotextile Strength Class to ensure survivability for the given application. Geotextile survivability refers to the ability of the geotextile to withstand the installation stresses during construction. It is related to construction method, subgrade condition, backfill material including stone size and other factors.
- 3 Strength and Filtration Class in accordance with the Earthworks Materials Specification.

Table 14 Selection of Strength Class for Mechanical Separation of Soil Layers

D_{85} of Material ¹ (mm)	Strength Class ^{2, 3}	
	$\text{CBR} \leq 3$	$\text{CBR} > 3$
≤ 37.5	C	A
≤ 75	C	B
≤ 200	D	C
$\leq 400^4$	E	D
$\leq 600^4$	E	E

Notes:

- 1 Applies to the layer to be placed over geotextile.
- 2 Applies to the material on which the geotextile is placed.
- 3 Strength Class in accordance with the Earthworks Materials Specification.
- 4 For cushioning purposes a minimum thickness of 150 mm of material with a $D_{85} < 75 \text{ mm}$ shall be used for the initial lift to protect the geotextile

Table 15 Selection of Strength Class for Trench Drain Applications

D ₈₅ of Material ¹ (mm)	Strength Class ²	
	Trench Depth < 2 m	Trench Depth < 2 m
≤ 37.5	A	B
≤ 75	B	C
≤ 200	C	D

Notes:

1 Applies to the layer to be placed over geotextile.

2 Strength Class in accordance with the Earthworks Materials Specification.

Table 16 Selection of Strength Class for Drainage and Separation Behind Structures

Type of Structure	Strength Class ¹
Concrete retaining walls Segmental block walls Reinforced soil concrete panel walls	B
Gabion walls Crib walls Rock filled mattresses	C

Notes:

1 Strength Class in accordance with the Earthworks Materials Specification.

11.2.2 Ordering and Delivery

Prior to ordering geotextile, the Contractor must submit to the Superintendent documentation which demonstrates that the geotextile complies with the requirements of this Specification and that specified on the Drawings. The Contractor shall not order material prior to acceptance of the proposed geotextile by the Superintendent.

With each batch of geotextile delivered to the Site, quality records shall be provided which include a certificate of compliance demonstrating that the geotextile complies with all the requirements of this Specification for its specified use, together with test results reported on NATA endorsed test documents. The certificate shall not be more than 12 months old.

[16] HOLD POINT

Process Held: Ordering of geotextile

Submission Details: Documentation, including a certificate of compliance from the supplier, which demonstrates that the proposed geotextile meets

	the requirements of this Specification and nominates where each strength and filtration class will be used.
Release of Hold Point:	The Superintendent will consider the submitted documents and may inspect the geotextile or direct further action prior to release of the Hold Point, such as site sampling and testing in accordance with this Specification.
Identifiable Record:	Report approved by Superintendent and signed ITP

11.2.3 Storage

Geotextiles shall be stored under protective cover or wrapped with a waterproof, opaque UV protective sheeting to avoid any damage prior to installation.

Geotextiles shall not be stored directly on the ground or in any manner in which they may be affected by heat. The method of storage shall be in accordance with all other recommendations set by the manufacturer.

The protected geotextile rolls must be clearly labelled showing manufacturer, type of geotextile and batch identification number.

11.2.4 Placing Geotextiles

The area on which the geotextile is to be placed shall be prepared by clearing and grading unless specified otherwise on the Drawings. All sharp objects, including cut trees, shrubs and large stones, shall be removed or cut flush with the ground surface.

Where necessary, localised excavations shall be carried out to permit installation of geotextiles.

Geotextiles shall be covered by relevant construction materials or suitable protective sheeting within 48 hours of being placed.

Geotextiles used in trenches shall be placed so as to conform loosely to the shape of the trenches.

Joints in geotextiles shall be as recommended by the manufacturer.

Where geotextiles are used to line subsoil drainage trenches, the textiles shall fully envelop the drainage material in the trench and be folded over that material with a minimum 300 mm overlap at the top of the trench.

[2] WITNESS POINT

Process Witnessed:	Placement of geotextile.
Submission Details:	Notification of the geotextile type, location, date and time of placement.
Identifiable Record:	Signed ITP

11.2.5 Working Over Geotextiles

No construction equipment shall stand or travel directly on the laid geotextile until the initial lift of fill material is placed over the geotextile (in accordance with manufacturers recommendations).

Unrestricted movement of plant and equipment over the placed geotextile is permitted only after the cover material has been compacted and is stable. Vibratory and heavy compaction plant is not to be used on the initial lifts of fill materials.

The procedure for filling over subsoil drainage trenches shall be such as to ensure that the 300 mm overlap at the top of the trench remains intact.

At the Superintendent's discretion, a site trial may be required to evaluate the suitability of the Contractor's nominated construction process and compaction methods as to assess any potential damaging effects on geotextiles.

12 Embankment Widening

12.1 General

Embankments are typically widened to:

- Provide for additional tracks.
- Provide access to the track side
- Provide width for structures.
- Improve the existing embankment's stability.
- Dispose of spoil from other works.

Although embankments are often widened as a spoil disposal measure, the widened section becomes part of the embankment structure. Hence it is necessary for the work to be done in accordance with proper earthworks practice.

All earthworks, including survey, stripping, and foundation preparations, are to be in accordance with requirements of this Specification.

Sites for embankment widening are to be specified by the Superintendent.

[17] HOLD POINT

Process Held:	Embankment widening.
Submission Details:	Inspection of the existing embankment by the Contractor to assess its condition, including identification of areas of vegetation removal and marginal/past stability, and potential impacts to adjacent track(s). May include a stability assessment by a Geotechnical Engineer.
Release of Hold Point:	The Superintendent may recommend further action prior to authorising the release of the Hold Point.
Identifiable Record:	Inspection report, photos, stability assessment, vegetation removal plan. Signed ITP by the Superintendent

12.2 Existing Drainage Structures

Existing culverts and drains are to be located, extended and cleared by hydroblasting or similar to ensure satisfactory flow of watercourses. Care is to be taken to ensure that moisture is not trapped between the existing and the widened embankment, and water does not pond against the toe of the embankment.

The condition of the existing culverts shall be inspected after cleaning and may comprise use of a camera.

[3] WITNESS POINT

Process Witnessed:	Extension of existing drainage structures.
Submission Details:	Condition assessment report for existing drainage structures to be retained.
Identifiable Record:	Condition assessment report

12.3 Drainage Blankets

Drainage blankets at locations of widened embankments are to be installed in accordance with the Drawings or where directed by the Superintendent. Unless directed or approved otherwise by the Superintendent, the procedure for placing drainage blankets at a widened embankment is as follows:

- 1) Excavate into the existing embankment toe to give a 1 m scarp;
- 2) The Contractor shall prepare the base of the drainage blanket to ensure the drainage blanket can drain after it is placed. A clear drainage path is to be maintained throughout the layer, particularly at the outer edges of the widened embankment.
- 3) Place a geotextile complying with Section 11 of this Specification.
- 4) Construct a drainage blanket layer with a minimum compacted thickness of 300 mm. The drainage blanket material must be spread and placed in such a way as to avoid segregation and to ensure that it is not contaminated with foreign materials. The drainage blanket material must meet the properties shown in the Earthworks Materials Specification, be compacted in accordance with Section 13 of this Specification and conform to level tolerances stated in Section 8.4.2.
- 5) Place a geotextile, complying with Section 11, at the interface of the drainage blanket material and the overlying embankment fill, thus fully encapsulating the drainage blanket material.
- 6) Provide outlets at the ends of the drainage blanket layer as shown on the Drawings or directed by the Superintendent.

The grading of the drainage blanket material shall be adjusted, within the limits specified in the Earthworks Materials Specification, as to ensure that it provides a stable foundation for compaction of the overlying embankment.

The geotextile is to be covered with a layer of general fill or structural fill material (meeting the requirements of the Earthworks Materials Specification) consistent with the embankment material design.

Protection for exposed granular material shall be considered at the outside of the drainage blanket to prevent slumping of the drainage material and undermining of the overlying fill.

12.4 Construction of Widened Embankment

The general embankment widening sequence is:

- Unless stated otherwise on the Drawings, excavate into the existing embankment to form terraces as defined in Section 6.5.
- The exposed material at each terrace shall be inspected by a Geotechnical Engineer, prior to proceeding with the next terrace, to determine the embankment construction configuration, material composition, slope stability, seepage, drainage structures and compliance to the Drawings.
- If a free draining material is exposed during excavation, this layer must be connected to a drainage blanket, or an additional drainage layer may be constructed in accordance with Section 6.2.6. The geofabric shall be wrapped to encapsulate the drainage layer with an appropriately sized rock protection facing.
- Place and compact embankment materials in layers in accordance with the Drawings, the Earthworks Materials Specification and this Specification (including all relevant Hold Points).

[18] HOLD POINT

Process Held:	Placement of fill for widening of an embankment.
Submission Details:	Inspection of the exposed embankment by the Geotechnical Engineer and assessment of material classification in accordance with the Earthworks Materials Specification. May include results of tests to confirm material classification criteria. The Contractor shall also document locations of any compromised free draining material, including within adjacent track.
Release of Hold Point:	The Geotechnical Engineer will inspect the exposed surfaces and may recommend further action prior to the Superintendent authorising the release of the Hold Point. Further action may include compaction, further terracing, foundation treatments or stabilisation works, prior to or concurrent with any further work within the embankment widening.
Identifiable Record:	Survey report, inspection report, photos, details of any drainage installed, Signed ITP by the Superintendent

13 Compaction of Fill

13.1 General

Compaction shall be either Method Compaction, Project Specific or Compacted Layer Method, as required for the class of fill in Table 17, using plant appropriate to the Class of fill and the site conditions.

Each layer of material placed in embankments, material backfilled in cuttings and material replacing Unsuitable Material shall be trimmed as construction proceeds, shall be uniformly compacted to the required moisture and density over the full area and depth of the layer, and each Lot confirmed as complying with requirements of this Specification before the next covering layer/Lot is commenced. Coarse and fine particles should be evenly distributed throughout the whole layer.

The Contractor proceeds at their own risk if they place material over a Lot whose compliance requirements have not been met. The time and costs for all works associated with rectifying a non-conformance, including the removal and replacement of any conforming overlying layers, shall be borne by the Contractor.

Complete the compaction promptly to ensure that moisture content remains conforming and uniform and to minimise the possibility of rain damage.

The Contractor shall manage its hauling equipment over fill already in place to prevent damage to the conforming fill and to prevent localised over compaction below haul routes.

Inspection, sampling and testing of the earthworks for acceptance shall be carried out by the Contractor to the satisfaction of the Superintendent. The Contractor shall undertake all reasonable additional testing at no cost to the Principal if in the Superintendent's opinion the tests carried out are inadequate or unsatisfactory, or the Contractor supplied materials do not conform to the requirements of this Contract.

At all times during the course of the Contractor's normal shifts, the work associated with compaction of embankment fill, backfill around structures, formation and capping shall be planned to allow reasonable access for the Superintendent to carry out inspections and review of testing methods and results.

The operation of compaction equipment, excavation plant or other activities that have an influence on the compaction testing shall be suspended or directed elsewhere whilst testing is in progress. Delays or inconvenience to the Contractor, due to compaction or other testing required for controlling the attainment of the specified standards of compaction or other placed performance requirement shall not entitle the Contractor to any monetary recompense or extensions of time.

At all times the Superintendent will be guided in the field by the results of the compaction testing in their determination of the actual compaction achieved by the Contractor. Notwithstanding the results of the insitu tests, the Superintendent may direct, that any area that in their opinion has not been compacted to the required standard, additional passes of compaction equipment to be undertaken.

13.2 Moisture Content

The Contractor shall maintain the moisture content of materials at the time of compaction, within the range specified in Table 21 of this Specification, at all locations within the Lot. The moisture content shall be adjusted within that range to enable the specified compaction to be achieved.

Do not compact material that has been placed with a moisture content greater than or less than that specified in Table 21, or has become wetted-up or dried out after placement, until it has achieved the specified moisture content range. The drying process may be assisted by aeration or other methods where approved by the Superintendent. Alternatively, the Contractor may remove the wet material to a stockpile site for drying out and later use as fill material. All costs of removal to stockpile, for drying out and later use is deemed to be included in the rates generally.

If there is insufficient moisture in the material for it to be compacted as specified, add water. The added water must be applied uniformly and thoroughly mixed with the material until a homogeneous mixture is obtained. The cost of such wetting of the material must be borne by the Contractor.

13.3 Method Compaction

13.3.1 General

Method compaction shall be undertaken in accordance with Section 13.3.3 of this Specification.

Plant and methods not specified shall only be used providing the Contractor demonstrates at site trials that a state of compaction is achieved by the alternative method equivalent to that obtained using the specified method.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account when assessing the amount of compaction required for any layer.

If more than one type of material is being used in such a way that it is not practical to define the areas in which each material occurs, the Contractor shall compact with plant operating as if only the material which requires the greater compactive effort is being compacted.

Compaction shall be carried out for the full width of the layer.

13.3.2 Testing and Surveillance

The Contractor shall perform nuclear densometer testing in each lot at locations and frequencies determined using the compacted layer method. The fill shall comply with the field density, field moisture and homogeneity criteria for the compacted layer method. Laboratory testing is not required.

Alternative test methods to show compliance to maximum dry density and homogeneity requirements may be proposed by the Contractor.

The Superintendent may direct the Contractor to carry out laboratory dry density tests on material compacted to method requirements at a frequency defined in contract specific documents. If the results of field tests show densities which indicate the state of compaction to be inadequate, then if this is due to failure of the Contractor to comply with the requirements of the Contract, the Contractor shall carry out such further work as is required to comply with the contract.

Full time surveillance of Method Compaction shall be provided in accordance with the requirements for Level 1 earthworks certification defined in Australian Standard AS3798-2007.

13.3.3 Compaction Requirements

Method compaction shall be undertaken using the plant and methods in Table 18 appropriate to the required compaction method as listed in Table 17 for the class of material being compacted.

Table 17 Earthworks Materials Compaction Requirements

Material Description	Typical Use	Compaction Method
High plasticity cohesive	Homogenous, Type C and Type D general fill	Method 1 ¹ or Compacted Layer
Low plasticity cohesive	Type A and B general fill	Method 2 or Compacted Layer
Well graded granular	Structural fill	Method 2 or Compacted Layer
Uniformly graded granular	General fill, bedding sand, trench backfill	Method 3 or Compacted Layer
Coarse granular	Rockfill	Method 4
Selected granular	Blinding layer	Method 5
Selected well graded granular	Rockfill bridging	No compaction
Selected granular	Capping	Compacted Layer

Notes:

1. *Except for materials with liquid limit greater than 50 only deadweight tamping or vibratory tamping rollers shall be used.*

Table 18 Method Compaction for Earthworks Materials: Plant and Methods

Type of Compaction Plan	Ref No.	Category	Method 1		Method 2		Method 3		Method 4		Method 5
			D	N [#]	D	N [#]	D	N [#]	D	N	N for D ≤ 250 mm
Smoothed wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll:										
	1	over 2100 kg up to 2700 kg	125	8	125	10	125	10*	U	U	
	2	over 2700 kg up to 5400 kg	125	6	125	8	125	8*	U	U	
	3	over 5400 kg	150	4	150	8	U	U	U	U	
Deadweight tamping roller	Mass per metre width of roll:										
	1	over 4000 kg up to 6000 kg	225	4	150	12	250	4	U	U	
	2	over 6000 kg	300	5	200	12	300	3	U	20	
Pneumatic-tyred roller	Mass per wheel:										
	1	over 1000 kg up to 1500 kg	125	6	U		150	10*	U	U	
	2	over 1500 kg up to 2000 kg	150	5	U		U		U	U	
	3	over 2000 kg up to 2500 kg	175	4	125	12	U		U	U	
	4	over 2500 kg up to 4000 kg	225	4	125	10	U		U	U	
	5	over 4000 kg up to 6000 kg	300	4	125	10	U		U	U	
	6	over 6000 kg up to 8000 kg	350	4	150	8	U		U	U	
	7	over 8000 kg up to 12000 kg	400	4	150	8	U		U	U	
	8	over 12000 kg	450	4	175	6	U		U	U	
Vibratory tamping roller	Mass per metre width of a vibrating roll:										
	1	over 700 kg up to 1300 kg	100	12	100	12	150	12	U	U	
	2	over 1300 kg up to 1800 kg	125	12	125	12	175	12*	U	U	

Compaction of Fill

Type of Compaction Plan	Ref No.	Category	Method 1		Method 2		Method 3		Method 4		Method 5
			D	N#	D	N#	D	N#	D	N	N for D ≤ 250 mm
	3	over 1800 kg up to 2300 kg	150	12	150	12	200	12*	U		U
	4	over 2300 kg up to 2900 kg	150	9	150	9	250	12*	400	5	U
	5	over 2900 kg up to 3600 kg	200	9	200	9	275	12*	500	6	U
	6	over 3600 kg up to 4300 kg	225	9	225	9	300	12*	600	6	U
	7	over 4300 kg up to 5000 kg	250	9	250	9	300	9*	700	6	12
	8	over 5000 kg	275	9	275	9	300	7*	800	6	10
Vibratory roller	Mass per metre width of a vibratory roll:										
	1	over 270 kg up to 450 kg	U		75	16	150	16	U		U
	2	over 450 kg up to 700 kg	U		75	12	150	12	U		U
	3	over 700 kg up to 1300 kg	100	12	125	10	150	6	U		U
	4	over 1300 kg up to 1800 kg	125	8	150	8	200	10*	U		U
	5	over 1800 kg up to 2300 kg	150	4	150	4	225	12*	U		12
	6	over 2300 kg up to 2900 kg	175	4	175	4	250	10*	400	5	11
	7	over 2900 kg up to 3600 kg	200	4	200	4	275	8*	500	5	10
	8	over 3600 kg up to 4300 kg	225	4	225	4	300	8*	600	5	8
	9	over 4300 kg up to 5000 kg	250	4	250	4	300	6*	700	5	7
	10	over 5000 kg	275	4	275	4	300	4*	800	5	6
Vibrating plate compactor	Mass per m ² of base plate:										
	1	over 880 kg up to 1100 kg	U		U		75	6	U		U
	2	over 1100 kg up to 1200 kg	U		75	10	100	6	U		U

Compaction of Fill

Type of Compaction Plan	Ref No.	Category	Method 1		Method 2		Method 3		Method 4		Method 5
			D	N [#]	D	N [#]	D	N [#]	D	N	N for D ≤ 250 mm
	3	Over 1200 kg up to 1400 kg	U		75	6	150	6	U		U
	4	over 1400 g up to 1800 kg	100	6	125	6	150	4	U		U
	5	over 1800 kg up to 2100 kg	150	6	150	5	200	4	U		U
	6	over 2100 kg	200	6	200	5	250	4	U		12
Vibro-tamper	Mass:										
	1	over 50 kg up to 65 kg	100	3	100	3	150	3	U		U
	2	over 65 kg up to 75 kg	125	3	125	3	200	3	U		12
	3	over 75 kg up to 100 kg	150	3	150	3	225	3	U		10
	4	over 100 kg	225	3	200	3	225	3	U		10
Power rammer	Mass:										
	1	100 kg up to 500 kg	150	4	150	6	U		U		U
	2	over 500 kg	275	8	275	12	U		U		14
Dropping-weight compactor	Mass of rammer over 500 kg weight drop:										
	1	over 1 m up to 2 m	600	4	600	8	450	8	U		U
	2	over 2 m	600	2	600	8	U		U		U
Crawler Dozer	1	Operating Weight over 45 tonnes	U		U		U		800	4	U

Notes:

1. The minimum number of passes '**N**' is the minimum number of times that each point on the surface of the layer being compacted shall be traversed by the item of compaction plant in its operating mode, or struck by power rammers or falling weight compactors. '**D**' is the maximum depth of the compacted layer. '**U**' identifies that method compaction is unsuitable for the given scenario.
2. In column headed **N[#]**, the number of passes shown is to be doubled for structural fill. Such extra compaction shall be carried out for the full width of the embankment.

Compaction of Fill

3. *The compaction plant is categorised in terms of static mass. The mass per metre width of roll is the total mass on the roll divided by the total roll width. Where a smooth wheeled roller has more than one axle the category of the machine shall be determined on the basis of the axle giving the highest value of mass per metre width.*
4. *A deadweight tamping roller is a machine with a roll or rolls from which 'feet' project and where the projected end area of each 'foot' exceeds 0.01 m² and the sum of the areas of the feet exceeds 15% of the area of the cylinder swept by the ends of the feet. The requirements for tamping rollers apply to machines that have 2 rolls in tandem. If only one tamping roll traverses each point on the surface of the layer on any one pass of the machine, the minimum number of passes shall be twice the number given plus any further doubling required to satisfy **Note 2** above.*
5. *For pneumatic-tyred rollers the mass per wheel is the total mass of the roller divided by the number of wheels. In assessing the number of passes of pneumatic-tyred rollers the effective width shall be the sum of the widths of the individual wheel tracks together with the sum of the spacings between the wheel tracks provided that each spacing does not exceed 230 mm. Where the spacings exceed 230 mm the effective width shall be the sum of the widths of the individual wheel tracks only.*
6. *A vibratory tamping roller, which may be self-propelled or towed, is a machine having a means of applying mechanical vibration to one or more rolls. The roll or rolls have projecting feet where the height of each foot exceeds 10% of the radius of the roll drum, the projected end area of each foot exceeds 0.1% of the roll drum surface area, and the sum of the areas of the feet exceeds 10% of the area of the cylinder swept by the ends of the feet.*

*The requirements for the operation of vibratory tamping rollers shall be the same as those stated for vibratory rollers in **Note 7** except that vibratory tamping rollers operating without vibration will be classified as deadweight tamping rollers.*

7. *Vibratory rollers are self-propelled or towed smooth-wheeled rollers having means of applying mechanical vibration to one or more rolls except that vibratory rollers employed for Method 4 compaction shall be single roll types.*

Vibratory rollers operating without vibration will be classified as smooth-wheeled rollers.

The requirements for vibratory rollers are based on the use of the lowest gear on a self-propelled machine with mechanical transmission and a speed of 1.5 to 2.5 km/h for a towed machine, or a self-propelled machine with hydrostatic transmission. If higher gears or speeds are used an increased number of passes shall be provided in proportion to the increase in speed of travel.

Where the mechanical vibration is applied to two rolls in tandem, the minimum number of passes shall be half the number given for the appropriate mass per metre width of one vibrating roll but if one roll differs in mass per metre width from the other the number of passes shall be calculated as for the roll with the smallest value. Alternatively, the minimum number of passes may be determined by treating the machine as having a single vibrating roll with a mass per metre width equal to that of the roll with the higher value.

Compaction of Fill

Vibratory rollers shall be operated with their vibratory mechanism operating only at the frequency of vibration recommended by the manufacturers. Where more than one amplitude setting is available and/ or a range of frequencies is recommended, the machine shall be operated at the maximum amplitude setting and at the maximum recommended frequency for that setting.

Vibratory rollers shall be equipped or provided with devices indicating the frequency at which the mechanism is operating and the speed of travel. Both devices shall be capable of being read by an inspector alongside the machine.

8. *Vibrating-plate compactors are machines having a base-plate to which is attached a source of vibration consisting of one or two eccentrically weighted shafts and:
 - a) *the mass per square metre of the base-plate of a vibrating-plate compactor is calculated by dividing the total mass of the machine in its working condition by its area in contact with compacted material;*
 - b) *vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturers. They shall normally be operated at travelling speeds of less than 1 km/h but if higher speeds are necessary the number of passes shall be increased in proportion to the increase in speed of travel.**
9. *Vibro-tampers are machines in which an engine-driven reciprocating mechanism acts on a spring system through which oscillations are set up in a base-plate.*
10. *Power rammers are machines which are actuated by explosions in an internal combustion cylinder, each explosion being controlled manually by the operator.*
11. *Dropping weight compactors are machines in which a dead weight is dropped from a controlled height using a hoist mechanism and they include self-propelled machines with mechanical traversing mechanisms capable of compacting soil in trenches and close to structures.*
12. *In the case of power rammers and dropping-weight compactors one pass will be considered as made when the compacting shoe has made one strike on the area in question.*
13. *For items marked * in the Method 3 column, the roller shall be towed by track-laying tractors. Self-propelled rollers are unsuitable.*
14. *Where combinations of different types or categories of plant are used, the following shall apply:
 - a) *the depth of layer shall be that for the type of plant requiring the least depth of layer; and*
 - b) *the number of passes shall be that for the type of plant requiring the greatest number of passes.**

[19] HOLD POINT

Process Held:	Construction of rock fill embankments
Submission Details:	<p>Notification of the place, date and time of construction of the trial section, at least 3 working days prior to commencement, with details of:</p> <ul style="list-style-type: none">a) Test results of all previous trial sections;b) Material type(s) and specifications, including moisture conditioning prior to and during rolling;c) Plant types and specifications;d) Number of passes;e) Visual inspection by the Superintendent to confirm that there is no remaining internal settlement and that embankment stability exists.
Release of Hold Point:	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.
Identifiable Record:	Signed ITP by the Superintendent

[20] HOLD POINT

Process Held:	Acceptance of trial section of rock fill.
Submission Details:	Verification, including test results, of conformity of each trial section including details of the proposed compaction procedure, any test results and survey reports.
Release of Hold Point:	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.
Identifiable Record:	Trial section report including test results. Signed ITP by the Superintendent

13.4 Compacted Layer Method

13.4.1 Compliance Requirements

Compaction conformity of materials placed by the compacted layer method is based on the characteristic value of relative compaction and relative moisture in accordance with requirements of

the Table 19 below. Round off the relative compaction value and the characteristic relative compaction and moisture values to the nearest 0.1%.

Conformity of a Lot is achieved if the lower limit of the characteristic value of relative compaction of that Lot is not less than that determined in accordance with the Programme Quality Plan.

Variations to test frequencies and alternative test methods can be adopted in accordance with the Programme Quality Plan.

Table 19 Placement and Compaction Compliance Requirements for Compacted Layer Method

Criteria	Test Method ⁴	Compliance				
General Earth Fill		Homogenous Embankment	Zoned Embankment			
			A	B	C	D
Closest depth below Formation Level (m) ³		0.35	0.35	1.0	1.5	2.0
Equivalent Compaction level ¹	AS1289.5.1.1	Min. 95% SMDD @ 60-90% MR				
Compaction test frequency ⁴	AS1289.5.8.1	1 test per 1500 m ² /layer		1 test per 3000 m ² /layer		
Indirect test methods		Indirect test methods described in the Programme Quality Plan may be used to reduce the compaction test frequency and confirm design parameters				
Maximum loose lift thickness ²		300 mm	300 mm	300 mm	300 mm	300 mm
Minimum compacted lift thickness ²		150 mm	150 mm	150 mm	150 mm	150 mm
Structural Fill						
Compaction level ⁵	AS1289.5.1.1	Min. 100% SMDD @ 60–90% MR				
Compaction test frequency ⁴	AS1289.5.8.1	1 test per 1000 m ² , min. 1 test per lot				
Indirect test methods		Indirect test methods described in the Programme Quality Plan may be used to reduce the compaction test frequency and confirm design parameters				
Maximum loose lift thickness		300 mm				
Minimum compacted lift thickness		150 mm				
Capping						
Compaction level	AS1289.5.1.1	Min. 102% SMDD at 70–110% OMC				
Compaction test frequency ⁴	AS1289.5.8.1	1 test per 1000 m ² , min. 1 test per layer				
Indirect test methods		Indirect test methods described in the Programme Quality Plan may be used to reduce the compaction test frequency and confirm design parameters				
Maximum loose lift thickness		300 mm				
Minimum compacted lift thickness		150 mm				

Criteria	Test Method ⁴	Compliance
Select Fill Adjacent to Structures		
Compaction level	AS1289.5.1.1	Min. 100% SMDD @ $\pm 2\%$ OMC
Compaction test frequency ⁴	AS1289.5.8.1	1 test per 100 m ² , min. 1 test per layer
Maximum loose lift thickness		100 mm for lightweight compaction 300 mm for other compaction methods
Bedding Sand		
Maximum loose lift thickness		150 mm
Rockfill		
Maximum loose lift thickness		1000 mm

Notes:

- 1 *Equivalent Compaction Level is provided as coarse materials may not be able to be tested using standard test methods, alternative test methods are to be nominated to demonstrate general compliance to these compaction levels.*
- 2 *May be varied as per Earthworks Materials Specification with prior approval from Superintendent subject to demonstration of thicker lifts can achieve compaction requirements to the full depth of each lift.*
- 3 *Closest depth below Formation Level may be varied by geotechnical design and supporting documentation.*
- 4 *Refer to Section 13.4.2 for variations to test frequencies and methods.*
- 5 *Compaction requirements on the lowest structural fill lift may, where approved by the Superintendent, be completed in accordance with Section 13.3.*

13.4.2 Alternative Test Frequencies and Methods

If consistent test results can be demonstrated, the Contractor may apply to the Superintendent for a reduction in test frequency for that particular quality control test method. The frequency of testing may be increased at the discretion of the Superintendent if the test results demonstrate a high degree of variability which could affect the design assumptions or the quality of the completed construction. Statistical analysis and criteria for reducing compliance testing must be in accordance with the Programme Quality Plan.

Alternative test methods may be proposed by the Contractor to confirm the compaction of the earthworks materials during construction. The Contractor must seek approval from the Superintendent prior to using any alternative test methods, providing a detailed report on trials conducted using the alternative test methods and correlation factors to the compliance test requirements of Table 19. The report must also include statistical analysis and criteria for reducing compliance testing, in accordance with the Programme Quality Plan. The Contractor must document the alternative test methods in a Project Specific Specification and append to this Specification. The Project Specific Specification must be approved by the Superintendent.

Increased cost of testing will not be paid for by the Superintendent unless prior approval is obtained from the Superintendent.

13.5 Proof Rolling

At the discretion of the Superintendent, proof rolling may be required at the following levels:

- Foundation Level in cuttings for foundation treatments Type C2, Type C4 and Type C6
- Subgrade Level
- Base of the capping layer
- Formation Level.

All fill Lots must be capable of withstanding proof rolling to verify their stability.

Where directed by the Superintendent, the Contractor shall complete proof rolling immediately following the excavation or placement and compaction of materials to be tested. The moisture content of the compacted material being proof rolled must be within the range specified in Table 19 of this Specification.

Proof rolling shall be undertaken on a path parallel to the track centreline and along the full width and length of each Lot. The rolling pattern must cover the area or Lot to be assessed, with successive passes of the equipment offset laterally by 40 to 50%. A pass is defined as one traverse over a single point. Each pass shall be undertaken with the equipment operating at a speed in the range of 3-10 km/h, as determined by and in the presence of the Superintendent.

Non-conformance of a proof roll is nominated as natural or compacted placed material that, in the opinion of the Superintendent, exhibits visible deformation, rutting, yielding or shows signs of distress or instability under a pass of either a:

- a) Static smooth wheeled roller with mass greater than 12 t; or
- b) Highway truck with rear axle(s) loaded to greater than 8 t each and tyre pressures of 600 kPa.

The Contractor may nominate other equipment for the proof rolling and acceptance criteria, which is to be included in the PQP and approved by the Superintendent.

[21] HOLD POINT

Process Held:	Proof roll acceptance.
Submission Details:	At least 1 working day prior to the proof rolling, notify the Superintendent and provide verification by all relevant testing certificates that the subject layer or surface conforms in all respects except proof rolling. Proof roll details.
Release of Hold Point:	The Superintendent will consider the submitted documents and visual observations made during the proof roll prior to authorising release of the Hold Point.
Identifiable Record:	Signed ITP by the Superintendent. Report indicating the Lot number, location, date and time of the proof roll and the type, model, gross mass and tyre pressures (if applicable) of the test equipment.

Fill Lots failing the proof rolling shall be deemed as non-conforming and treated in accordance with non-conforming materials in this Specification.

If further proof rolling is required at a later date, the layer must be re-conditioned such that the moisture content is within the range specified in Table 19 of this Specification, re-verified as conforming for density, moisture and survey requirements of this Specification, and given not less than eight (8) passes with the roller to be subsequently used for the proof rolling operation.

13.6 Inspection and Test Plans

The Contractor shall provide the testing laboratory with all information, including relevant parts of the Contract, Specifications, Inspection and Test Plans (ITP's), and ensure that laboratory performs sampling and testing in accordance with the Contract, this Specification and the Earthworks Materials Specification.

Project Testing laboratories that provide on-site testing services must independently review the Contractors Inspection and Test Plans to confirm that:

- a) All conformity tests are identified.
- b) Sampling and test methods, acceptance criteria and frequency of testing conform to the Contract and Specifications.

Any discrepancies must be resolved between the Contractor and the Project Testing laboratory and amended Inspection and Test Plans issued, where appropriate.

14 Earthworks During a Short Possession

14.1 General

A Short Possession is defined as period of time under possession where the Hold Point requirements of Sections 1 to 13 of this specification cannot be fully implemented due to time constraints. The Superintendent shall declare whether or not a possession is deemed to be 'short'. The Contractors shall satisfy Section 14 when a Short Possession is declared.

The Contractor shall provide sufficient plant, materials and spare equipment in order to complete the works during the possession.

14.2 Roles and Responsibilities

14.2.1 Experienced Staff

The Contractor shall provide staff who have experience utilising the materials imported to site. In particular staff shall have the following experience:

- The ability to visually assess stockpiled material for moisture content and recommend requirements for moisture conditioning;
- Assessment of number of passes to compact material in accordance with specification to suit the available plant; and
- Earthworks supervisor/tester shall understand how compaction may breakdown the material if it is overworked.

14.2.2 Use of Additional Materials

Excavation deeper than Foundation Level shall be agreed by the Superintendent in accordance with the procedures outlined in Section 5.9.

The Contractor shall advise the Superintendent where utilisation materials in addition to design expectations is proposed. Utilisation of additional materials shall be at the sole discretion of the Superintendent.

Surplus materials not utilised during the possession shall be stockpiled at a location directed by the Superintendent for use elsewhere in the corridor.

14.2.3 Certification of Earthworks

Full time surveillance of the works shall be provided in accordance with the requirements for Level 1 earthworks certification defined in Australian Standard AS3798-2007. The nominated Level 1 person shall certify that the earthworks have been constructed in accordance with this Specification and the Earthworks Materials Specification, except for any non-conformances approved by the Superintendent.

The Superintendent shall be notified of any non-conformances to this Specification or the Earthworks Materials Specification that are identified during construction. Acceptance of any non-conformances during construction shall be at the sole discretion of the Superintendent.

All non-conformances shall be recorded as construction occurs and shall be reported in a Non-Conformance Report after construction is completed.

14.3 Materials

Earthworks materials shall be sourced from established suppliers to ARTC who can demonstrate they produce a consistent product via laboratory material test reports.

Earthworks materials shall be tested at source prior to transportation to site. Upper and lower bound reference values for stockpile moisture content, optimum moisture content and maximum dry density at the specified degree of compaction shall be established based on statistical analysis using k values (method described in the Programme Quality Plan) associated with the number of tests nominated in the PQP.

The Contractor and earthworks supervisor/tester shall make themselves aware of the latest reference values for all the materials being used. The reference values used for a particular site and project shall be documented as these may change as more test results are added to a database being maintained for each material source.

For each material source, reference values shall be updated as new testing comes to hand. For each material source the material properties shall be provided to ARTC to incorporate into their database, if applicable.

Earthworks materials shall be moisture conditioned at source prior to transportation to site to ensure that drying back of the materials is not required prior to compaction. Materials stockpiled on site shall be covered to protect stockpiles from drying out or wetting up.

[22] HOLD POINT

Process Held:	Commencement of works
Submission Details:	At least 2 working days prior to the works, notify the Superintendent that stockpile inspection will occur.
Release of Hold Point:	Joint inspection of stockpiles for moisture condition by the Contractor and the Superintendent 1 day prior to the works. Hold Point released at the sole discretion of the Superintendent.
Identifiable Record:	Signed ITP by the Superintendent. Report indicating the stockpile number, material type, date and time of the inspection

14.4 Compaction

Method compaction shall be utilised in accordance with Section 13.3.

Field testing shall be performed in accordance with Section 13.3.2. The results of the field tests shall be used as a guide for acceptance of the works. Results of the field tests shall be interpreted using the statistical method in the Project Quality Plan and shall comply with the requirements of the Earthworks Materials Specification.

Samples of earthworks materials shall be taken for laboratory testing in accordance with Section 13.4. Results of these tests shall not be used for acceptance of the works. Results of these tests shall be used to detect trends in materials to inform future works where the source of these materials will be used again.

14.5 Commissioning Track

Documentation provided in Hold Point 23 shall be provided before commissioning track.

[23] HOLD POINT

Process Held:	Commissioning track
Submission Details:	Completion of earthworks
Release of Hold Point:	Acceptance of Works by the Superintendent
Identifiable Record:	<ul style="list-style-type: none">• Signed ITP by the Superintendent, Contractor and Level 1 representative stating that works have been constructed in accordance with the design and any non-conformances have been accepted by the Superintendent• Marked up drawings showing the extent of excavation, type and extent of materials placed;• Photographic record of the work• Non-conformance reports closed out by the Superintendent;• Certification of earthworks and track.

Appendix A – Changes to ARTC Standards Relating to this Specification

Appendix B – Earthworks Foundation Treatment Schematic

To be Issued

Appendix C – Schedule of Records

C1. Schedule of Hold Points

Table C1.1 Schedule of Hold Points

Number	Clause	Process	Submission Details	Release of Hold Point	Identifiable Records
1	5.7	Clearing and grubbing.	a) Plans showing extent of clearing and grubbing; and b) All the necessary approvals and consents, including environmental approvals.	The Superintendent will approve work prior to authorising the release of the Hold Point.	Approved plans signed by Superintendent and Contractor.
2	5.7	All works, after completion of clearing and grubbing, which will alter the ground surface as surveyed.	a) Survey Report of the existing surface levels of the section of Works, in accordance with the Contractor's PQP, submitted at least 3 working days before the proposed date for altering the surfaces. b) For the section of Works, notification that: <ul style="list-style-type: none"> i. The survey set out has been carried out, including set out of the cut to fill intersection point and extent of the Transition Zone as specified in Section 6.4. ii. Erosion and sedimentation controls have been implemented; and iii. Clearing, grubbing and removal of cleared materials for that section of the Works has been completed. 	The Superintendent will inspect the surfaces and set out, and may direct further action prior to authorising the release of the Hold Point. Further action may include altering the limits of the cut/fill transition.	a) Hold point release record; b) Survey report; and c) Approved plans signed by the Superintendent and Contractor.
3	5.9.1	Earthworks after Unsuitable Material is	Identification and classification of Unsuitable Material, proposed actions to record the volumes, manage stockpiling,	The Superintendent will inspect the surfaces and the encountered materials, and may direct further action prior to authorising the	a) Hold point release record; and b) Survey or agreed

Appendix C – Schedule of Records

Number	Clause	Process	Submission Details	Release of Hold Point	Identifiable Records
		identified.	spoiling or treatment of the Unsuitable Material.	release of the Hold Point.	volume approved by the Superintendent before and after management of Unsuitable materials.
4	6.2.1	Type and Extent of each Embankment Foundation Treatment Lot.	<ul style="list-style-type: none"> a) Survey report; b) Notification of completion of clearing operations; and c) Notification that topsoil has been removed in accordance with Section 5.8 (unless treatment Type E4, Type E5 or Type E6 are specified). 	<p>The Superintendent:</p> <ul style="list-style-type: none"> a) Will consider the submitted documents; b) Will inspect the embankment foundation area and may seek advice from the designer's geotechnical representative to confirm the type and extent of treatment; and c) May direct further action prior to authorising the release of the Hold Point. Further action may include removal of Unsuitable Material in accordance with Section 5.9, or treatment in accordance with Section 5.10. 	Survey report, Signed ITP by the Superintendent and record of all advice received.
5	6.3.1	Type and Extent of each Cutting Foundation Treatment Lot.	<ul style="list-style-type: none"> a) Survey report; b) Notification of completion of clearing operations; c) Notification that Subgrade Level has been achieved; d) Type of cutting foundation treatment being adopted; and e) Any relevant test records. 	<p>The Superintendent:</p> <ul style="list-style-type: none"> a) Will consider the submitted documents; b) Will inspect the excavated floor of the cut; and c) May direct further action prior to authorising the release of the Hold Point. Further action may include removal of Unsuitable Material in accordance with Section 5.9, or treatment in accordance with Section 5.10. 	Survey report, Signed ITP by the Superintendent and record of any third party advice.
6	6.4	Type and Extent of each Transition Lot.	<ul style="list-style-type: none"> a) Survey report; b) Notification of completion of clearing operations; c) Notification that Subgrade Level has 	<p>The Superintendent:</p> <ul style="list-style-type: none"> a) Will consider the submitted documents; b) Will inspect the excavated base of the transition; and 	Survey report, Signed ITP by the Superintendent and record of any third party advice.

Appendix C – Schedule of Records

Number	Clause	Process	Submission Details	Release of Hold Point	Identifiable Records
			<ul style="list-style-type: none"> been achieved; d) Type of transition treatment being adopted; and e) Any relevant test records. 	c) May direct further action prior to authorising the release of the Hold Point. Further action may include removal of Unsuitable Material in accordance with Section 5.9, or treatment in accordance with Section 5.10.	
7	7.2.1	Excavation of non-rippable Material.	Ripping test witnessed by the Superintendent to determine the production rate, as per Table 5.	The Superintendent will consider the ripping test and determine rock excavation conditions, prior to authorising the release of the Hold Point.	Report approved by Superintendent and signed ITP.
8	7.4	Excavation of a rock cutting.	<ul style="list-style-type: none"> a) Relevant survey reports; and b) Plan for reuse of excavated material. 	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.	Relevant survey reports and signed ITP.
9	7.4	Excavation in rock below the top of cutting and below bench level.	Presentation of cleaned batter and bench/floor surfaces for geotechnical inspection.	The Superintendent or Geotechnical Engineer will inspect the cleaned surfaces and may direct further action prior to authorising the release of the Hold Point. Further action may include additional cleaning (if the condition of the faces cannot, in the opinion of the Superintendent or Geotechnical Engineer, be adequately assessed), and stabilisation works, prior to or concurrent with any further work within the cutting.	ITP signed by Geotechnical Engineer or Superintendent.
10	7.7.1	Start of each blast.	<p>At least a week prior, submit details of Blasting Management Plan:</p> <ul style="list-style-type: none"> a) Proposed blasting design and estimated vibration and air blast at sensitive receivers; and b) Measures to limit noise and to ensure that vibration from blasting does not adversely affect nearby structures. 	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.	Superintendent signed Blast Management Plan.
11	9.2	Covering of structural fill	Verification of conformity of each Lot of structural fill placed, with relevant test and	The Superintendent will consider the submitted documents, prior to authorising the	Lot conformity records.

Appendix C – Schedule of Records

Number	Clause	Process	Submission Details	Release of Hold Point	Identifiable Records
		layer.	survey reports.	release of the Hold Point.	
12	9.3	Placement of each Lot of Capping.	Test reports verifying conformity of each Lot of material for use in Capping Layer.	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.	Material Lot conformity record.
13	9.3	Covering of each Lot of Capping.	Verification of conformity of each Lot of Capping placed, with relevant test and survey reports.	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.	Lot conformity record.
14	10.1	Use of stabilised material in the subgrade, embankment fill and formation.	Provision of a stabilised material design by the Designer and Project Specific Specification for stabilised material, including results and details of laboratory testing, stabilisation method, stabilisation trial section, stabilisation quality control and stabilisation quality assurance details.	The Superintendent will consider the submitted document, prior to authorising the release of the Hold Point.	Approved Project Specific Specification for the stabilised material and the stabilisation quality plan.
15	10.3	Stabilised fill trial section in the embankment and formation open for inspection and testing as required by the Designer.	<ul style="list-style-type: none"> a) Provision of a stabilised material test results which demonstrate compliance with design criteria and specification requirements; and b) The Contractor's Project Specific Specification for stabilised materials inclusive of the results of the trial. 	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.	Stabilised material test results, approved revisions of the Contractor's Project Specific Specification for stabilised materials.
16	11.2.2	Ordering of geotextile.	Documentation, including a certificate of compliance from the supplier, which demonstrates that the proposed geotextile meets the requirements of this Specification and nominates where each strength and filtration class will be used.	The Superintendent will consider the submitted documents and may inspect the geotextile or direct further action prior to release of the Hold Point, such as site sampling and testing in accordance with this Specification.	Report approved by Superintendent and signed ITP.
17	12.1	Embankment widening.	Inspection of the existing embankment by the Contractor to assess its condition, including identification of areas of	The Superintendent may recommend further action prior to authorising the release of the	Inspection report, photos, stability assessment, vegetation removal plan.

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Number	Clause	Process	Submission Details	Release of Hold Point	Identifiable Records
			vegetation removal and marginal/past stability, and potential impacts to adjacent track(s). May include a stability assessment by a Geotechnical Engineer.	Hold Point.	Signed ITP by the Superintendent.
18	12.4	Placement of fill for widening of an embankment.	Inspection of the exposed embankment by the Geotechnical Engineer and assessment of material classification in accordance with the Earthworks Materials Specification. May include results of tests to confirm material classification criteria. The Contractor shall also document locations of any compromised free draining material, including within adjacent track.	The Geotechnical Engineer will inspect the exposed surfaces and may recommend further action prior to the Superintendent authorising the release of the Hold Point. Further action may include compaction, further terracing, foundation treatments or stabilisation works, prior to or concurrent with any further work within the embankment widening.	Survey report, inspection report, photos, details of any drainage installed, Signed ITP by the Superintendent.
19	13.3.3	Construction of rock fill embankments.	Notification of the place, date and time of construction of the trial section, at least 3 working days prior to commencement, with details of: <ul style="list-style-type: none"> a) Test results of all previous trial sections; b) Material type(s) and specifications, including moisture conditioning prior to and during rolling; c) Plant types and specifications; d) Number of passes; and e) Visual inspection by the Superintendent to confirm that there is no remaining internal settlement and that embankment stability exists. 	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.	Signed ITP by the Superintendent.
20	13.3.3	Acceptance of trial section of rock fill.	Verification, including test results, of conformity of each trial section including details of the proposed compaction procedure, any test results and survey	The Superintendent will consider the submitted documents, prior to authorising the release of the Hold Point.	Trial section report including test results. Signed ITP by the Superintendent.

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Number	Clause	Process	Submission Details	Release of Hold Point	Identifiable Records
			reports.		
21	13.5	Proof roll acceptance.	a) At least 1 working day prior to the proof rolling, notify the Superintendent and provide verification by all relevant testing certificates that the subject layer or surface conforms in all respects except proof rolling; and b) Proof roll details.	The Superintendent will consider the submitted documents and visual observations made during the proof roll prior to authorising release of the Hold Point.	Signed ITP by the Superintendent. Report indicating the Lot number, location, date and time of the proof roll and the type, model, gross mass and tyre pressures (if applicable) of the test equipment.
22	14.3	Commencement of works.	At least 2 working days prior to the works, notify the Superintendent that stockpile inspection will occur.	Joint inspection of stockpiles for moisture condition by the Contractor and the Superintendent 1 day prior to the works. Hold Point released at the sole discretion of the Superintendent.	Signed ITP by the Superintendent. Report indicating the stockpile number, material type, date and time of the inspection.
23	14.5	Commissioning track.	Completion of earthworks.	Acceptance of Works by the Superintendent.	<ul style="list-style-type: none"> Signed ITP by the Superintendent, Contractor and Level 1 representative stating that works have been constructed in accordance with the design and any non-conformances have been accepted by the Superintendent; Marked up drawings showing the extent of excavation, type and extent of materials placed; Photographic record of the work; Non-conformance reports closed out by the

Appendix C – Schedule of Records

Number	Clause	Process	Submission Details	Release of Hold Point	Identifiable Records
					Superintendent; and <ul style="list-style-type: none"> • Certification of earthworks and track.

C2. Schedule of Witness Points

Table C2.1 Schedule of Witness Points

Number	Clause	Process	Submission Details	Identifiable Records
1	5.5	Construction of permanent drainage.	Grade conforms to design, no cracks or open joints present, no soil, rock or other material are present inside of pipes and culverts.	Signed ITP.
2	11.2.4	Placement of geotextile.	Notification of the geotextile type, location, date and time of placement.	Signed ITP.
3	12.2	Extension of existing drainage structures.	Condition assessment report for existing drainage structures to be retained.	Condition assessment report.