

Engineering Construction Specification C06 Earthworks (Road reserve)

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1 General

1.1 Responsibilities

1.1.1 Objectives

General: The work to be executed under this Specification consists of:-

Removal of topsoil

All activities and quality requirements associated with site regrading, the excavation of cuttings, the haulage of material and the construction of embankments to the extent defined in the Drawings and Specification.

Removal and replacement of any unsuitable material,

Any spoil or borrow activities associated with earthworks, and

Any additional processing of selected material for the selected material zone.

1.1.2 Performance

Requirements: Conform to this worksection, the Drawings and Standards as directed and approved.

1.2 Cross references

1.2.1 General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- *C01 General requirements (Construction)*
- *C02 Quality management (Construction)*
- *C03 Control of traffic*
- *C04 Control of erosion and sedimentation (Construction)*
- *C05 Clearing and grubbing*
- *C07 Stabilisation*
- *C14 Subsurface drainage (Construction)*
- *C15 Subsoil and formation drains (Construction)*
- *C23 Stormwater drainage (Construction)*
- *C25 Pipe drainage*
- *C26 Precast box culverts*
- *C27 Drainage structures*
- *C29 Landscape - road reserve and street trees*

1.3 Standards

1.3.1 General

Soil testing: To AS 1289 (Various).

1.4 Interpretation

1.4.1 Abbreviations

General: For the purposes of this worksection the following abbreviation applies:

- CBR: California Bearing Ratio.

1.4.2 Definitions

General: For the purposes of this worksection the following definitions apply:

- Open drains: All drains other than pipe and box culverts and include catch drains, channels (gutters) and kerbs and channels (gutters).
- Rock (AUS-SPEC): Monolithic material with volume greater than 0.5 m³ in sites which cannot be removed until broken up by explosives, rippers or percussion tools. For support purposes material hardness on the Mohr scale not less than 3 and not deteriorate on exposure to the atmosphere.
- Selected material zone: The top part of the upper zone of formation in which material of a specified higher quality is required.
- Shallow embankments: Embankments less than 1.5 metres depth from the top of pavement to natural surface.
- Spoil: Surplus excavated material.
- Unsuitable material: Material not suitable for support of pavement or layer of fill including:
 - Material showing deformation, rutting, softness, yielding, distress or instability under proofrolling or the loading from construction machinery.
 - Topsoil, peat or any organic material.
 - Soluble material, e.g. gypsum or salt rock.
 - Susceptible to scouring or classified as Emerson Class number 1 or 2.

1.5 Tolerances

1.5.1 General

Measurement: At right angles to the slope line.

(+): Means toward the roadway surface.

(-): Means away from the roadway surface.

1.5.2 Batter slopes

Excavation: Conform to the following:

- At toe of batter and level of table drain:
 - ≤ 1:1 slopes: + 0 mm, - 150 mm from the documented slope line.
 - > 1:1 slopes: + 0 mm, - 200 mm from the documented slope line.
- ≥ 2 m above table drain:
 - ≤ 1:1 slopes: ± 300 mm.
 - > 1:1 slopes: 300 mm, - 600 mm.

Embankment: Conform to the following:

- 1 m below shoulder: ± 150 mm.
- > 1 m below shoulder: ± 300 mm.

Median areas: Conform to the following:

- ≤ 2 m measured horizontally from edge of shoulder: ± 35 mm from documented slope line, measured at right angles to the slope line within 24 hrs of compaction.
- > 2 m measured horizontally from edge of shoulder: ± 75 mm from documented slope line, measured at right angles to the slope line within 24 hrs of compaction.

1.5.3 Floors

Floor of cutting: To **ANNEXURE - EARTHWORKS INFORMATION**.

1.5.4 Tops of embankments

At completion of embankment construction: Conform to the following:

- Parallel to the designed grade line.
- + 10 mm or - 40 mm of the levels specified.

1.5.5 Selected material

Completed layer: To ANNEXURE - EARTHWORKS INFORMATION

1.5.6 Selected backfill

Plasticity Index: > 2, < 12 adjacent to structures.

1.6 Submissions

1.6.1 Authority approvals

Requirement: Submit details of all authority approvals before commencing the works for which the approval is granted, including the following:

- Spoil and borrow:
 - Planning approval.
 - Permits for access to locations.
 - Permits for the introduction of imported material,

1.6.2 Calculations

- Survey records.
- Cut and fill calculations.

1.6.3 Design documentation

General: Submit the following:

- Survey: Submit site survey verifying existing ground profile within 14 days of site possession.

1.6.4 Execution details

Survey system: Submit details of the proposed survey system for approval within 14 days of possession of site before commencement of clearing and grubbing or earthworks.

Ground model discrepancies: If discrepancies in the model are identified, submit plans 7 days, before commencement of Works and state the maximum dimensions of the proposed stockpile.

Unsuitable material: Submit details of any areas of the foundation or layer which ruts excessively, yield or shows signs of instability.

Cuttings in rock: Submit detailed procedures to maintain accurate dimensions and uniform batters in rock.

Excavation method statement: Submit including details of excavation procedures based on geotechnical information, as documented.

Excavation beyond batter line: Submit details of alternative corrective measures.

Embankment treatment type: If either loosen and compact, bridging layer, working platform, geotextile/geogrid layer, drainage layer or other treatment is proposed, submit details.

Contaminated material: Notify and submit details of proposed method and disposal location, 24 hours before disposal.

1.6.5 Records

Drawings: Work-as-executed drawings.

Records of any imported material.

1.6.6 Tests

General:

CBR tests.

Proof rolling and deflection monitoring.

Compaction tests.

Materials:

Select materials.

Synthetic membrane.

Results: Submit results of testing to **ANNEXURE – MAXIMUM LOT SIZE AND MINIMUM TEST FREQUENCIES**.

1.7 Inspections

1.7.1 Notice

General: Give notice so that inspection may be made of the following:

- Unsuitable material: Material deemed unsuitable for embankment or pavement support in its present position.
- Unsuitable material: Determine that sufficient depth of unsuitable material has been removed.
- Cuttings in rock: Stability of batter.
- Ripping floors of cuttings: Ripped or loosened material.
- Compacting floors of cuttings: Completed cutting floor.
- Transition from cut to fill: Position of intersection line between cutting and embankment.
- Bridging layer treatment: Seepage water causing movement under roll test. Remove wet material to spoil or construct subsoil drainage or drainage blanket, or all three solutions based on site conditions.
- Foundations: Embankment foundation area following removal of topsoil.
- Trimming tops of embankment: Trimmed and compacted embankment.
- Selected material zone: Completed surface before placing any subsequent pavement layers over the completed select material zone surface.
- Deflection monitoring and proof rolling: Any visible deformation, rutting, yielding and or showing signs of distress or instability.

2 Pre-construction planning

2.1 General

All waste management is the responsibility of the applicant and their contractor. There may be opportunities to reuse some excavated material within a site. Any waste not suitable for reuse shall be disposed of by the Contractor to a suitably NSW EPA licenced Landfill. Council's Resource

Recovery Centre may be able to accept waste from a site as would many other nearby licenced landfills.

Council does not operate stockpile sites and is unable to accept waste material generated from road reserves or private land.

2.1.1 Planning approval

Spoil haulage disposal: If handling of spoil is involved.

Borrow: If proposed, obtain approval and any permits required for entry on land.

2.1.2 Program

Timing: Program the work so that material conforming to **PLACING FILL FOR EMBANKMENT CONSTRUCTION** and **SELECTED MATERIAL ZONE** for the upper zones of the formation, is available when required.

Rock supply: Adjust working methods and program the work to obtain hard and durable rock to the documented dimensions, as required.

2.2 Survey

2.2.1 Ground models

Verification: The contractor may receive ground models before commencement of Contract, in the form of computer generated road design data files in the format of the approved software.

Verification alternative: The Contractor may verify the accuracy of the model by field surveys.

Shallow embankments: Survey and calculate the area of shallow embankments after removal of topsoil.

3 Materials

3.1 Material characteristics

3.1.1 Items to be clarified on site

Quality and quantity: Confirm the following factors for determining material quality and quantity:

- Nature and types of the materials encountered in excavations.
- The bulking and compaction characteristics of materials incorporated in embankments.
- The estimated quantity for general earthworks at any cutting includes all types of materials which may be encountered in the cutting.

3.1.2 Embankment material

Source: Obtain the material for embankment construction from the cuttings within the Works conforming to **CUTTINGS, Cuttings in rock**, supplement by borrow in conformance with **BORROW**.

Description: Free of tree stumps and roots, clay, topsoil, steel, organic material and other contaminants and suitable for compaction to **COMPACTION AND MOISTURE REQUIREMENTS**.

Excavated material: Use for constructing embankments if it conforms to documented requirements.

Deficient embankment material: Rectify deficiency conforming to **Benching in cuttings**.

3.1.3 Drainage layer material properties table

Property	Requirement
Maximum dimension	125 mm
Percentage passing: <ul style="list-style-type: none"> • 19.0 AS sieve • 1.18 AS sieve • 75 µm AS sieve 	0-15% 0-5% < 0.5%
Percentage of + 19.0 mm fraction with Is ⁽⁵⁰⁾	Maximum 10%
Wet/dry strength variation	ANNEXURE - EARTHWORKS INFORMATION
Is ⁽⁵⁰⁾ = Point lead strength	

4 Execution

4.1 Establishment

4.1.1 Protection of earthworks

General: The Contractor's responsibility for care of the Works shall include the protection of earthworks.

Erosion and sedimentation control: Install effective erosion and sedimentation control measures to *C04 Control of erosion and sedimentation* prior to commencing earthworks and maintain these control measures for the duration of the contract.

Drainage of working areas: Maintain drainage of all working areas throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of an approved erosion and sedimentation control system.

Salinity prevention: In salt affected areas, take adequate precautions to minimise ingress of surface water into the groundwater table.

Wet weather precautions: If rain is likely or if work is not proposed to continue in a working area on the following day, take precautions to minimise ingress of any excess water into earthworks material.

Loose material: Seal off ripped material remaining in cuttings and material placed on embankments by compaction to provide a smooth tight surface.

Wet material: If in-situ or stockpiled material becomes excessively wet as a result of the Contractor not providing adequate protection of earthworks, replace and/or dry out the material to minimise any consequent delays to the operations. This is a HOLD POINT.

4.1.2 Setting out of earthworks

Timing: Establish batter indicator boards and pegs before earthworks operations commence and after survey controls are in place.

Indicators: Locate indicators as follows:

- Horizontal: Generally 25 m intervals.
- Verified interval: Not more than 5 m height.

Information on the indicator and pegs: Clearly mark the chainage/station, offset from control line and slope distance to the finished surface level.

Retention and removal of pegs: Maintain all pegs and batter indicators in their correct positions. Remove them on completion of the contract or separable part.

Additional pegs: Place additional pegs and indicators as required to suit. Do not paint these the same colours as setting out pegs and stakes.

Transitions cuttings/embankments: Mark the position and extent of all transitions from cuttings to embankments and foundations for shallow embankments with clearly labelled stakes.

4.2 Removal of topsoil

Program Timing:

Remove Topsoil only after implementation of erosion and sedimentation controls and completion of clearing, grubbing and disposal of materials for that section of the works.

This is a WITNESS POINT

4.2.1 Extent of work

General: Remove topsoil throughout the length of the Work and stockpile separately clear of the work. Avoid contamination by other materials.

Cuttings: Remove topsoil to a depth documented in **ANNEXURE - EARTHWORKS INFORMATION**.

Embankments: Remove topsoil over the base of embankments to the depth below the natural surface documented in **ANNEXURE - EARTHWORKS INFORMATION**.

Shallow embankments: If the height of embankment from natural surface to underside of pavement is less than 2 m, remove topsoil which is deeper than the depth documented in **ANNEXURE - EARTHWORKS INFORMATION** to its full depth.

4.2.2 Erosion control

Stabilisation: Track roll or stabilise stockpile batters to minimise erosion.

Seeding of stockpiles: If required to encourage vegetation, conform to **Grassing** in the *C29 Landscape - road reserve and street trees* worksection.

Survey

Earthwork volumes: Provide earthwork volumes if payment is on a 'Schedule of Rates' basis unless alternative arrangements have been made. After removing the topsoil, determine the surface levels in each cutting and embankment at sufficient locations to calculate the volume of excavation for general earthworks and the volume of compacted fill.

This is a HOLD POINT.

Stockpiles

Height and batter: Conform to the following:

Maximum height: 2.5 m.

Maximum batter slope: 2 H:1.

Trim: To a simple shape.

Removal of Topsoil

Prohibited: No topsoil is to be removed from the site unless approved in writing by the Superintendent.

Erosion control

Stabilisation: Track roll or stabilise by other approved means to minimise erosion.

Seeding: Where seeding of stockpiles is recommended, conform to *C29 Landscape – roadways and street trees*.

4.3 Unsuitable material

4.3.1 General

Requirement: Identify unsuitable materials conforming to AS 3798 clause 4.3. Excavate, remove and replace unsuitable material.

Removal: Dispose of unsuitable material as permitted by local authorities.

4.3.2 Replacement material

Material property: Replace unsuitable material with material from cuttings, or with material borrowed in conformance with **EMBANKMENTS, Embankment material** or **BORROW**.

Compaction: Before replacing material, compact the excavated surface to conform to **Compaction and moisture requirements**.

Placing: Replacement material is deemed to form part of embankment construction. Conform to **PLACING FILL FOR EMBANKMENT CONSTRUCTION** and to **COMPACTION AND MOISTURE REQUIREMENTS**.

Resultant unsuitable material: Rework or replace any unsuitable material resulting from inappropriate construction activities.

4.4 Cuttings

4.4.1 General

Requirement: Excavate material including benching, treatment of cutting floors and transition from cut to fill, as documented.

Excavated materials: Loosen and break down material excavated from cuttings to conform to **EMBANKMENTS, Embankment construction** and **Embankment material**.

Cleaning: Clean cut batters in rock with slopes of 1H:1V or steeper with compressed air until loose rock and soil is removed. Do not use water jets or air-water jets.

4.4.2 Benching in cuttings

Benches: Bench cut batters at locations and widths, as documented, to provide drainage and erosion control to **BATTERS, Excavation tolerances for batters table**.

Bench maintenance: Remove loose stones and boulders regularly throughout the Contract period.

4.4.3 Variable material

Excavation methods: If material of variable quality or moisture content is found after removal of topsoil, adjust excavation methods to allow blending of the materials and to obtain material in conformance with **EMBANKMENTS, Embankment material**.

4.4.4 Tops of cuttings

General: Neatly rounded, as documented.

4.4.5 Floors of cuttings

Excavation level: Excavate the floors of cuttings, parallel to the designed grade line, to a designed floor level at the underside of the selected material zone, or where there is no selected material zone, to the underside of the pavement subbase.

Trimming: Trim the floors to documented tolerance.

CBR testing: Before ripping the cutting floor, determine the CBR of the various materials which may exist in the cutting floor.

Ripping floors of cuttings: Rip material in the floor to a minimum depth of 150 mm below the designed floor level for the width of the selected material zone (or subbase layer, where no selected material zone).

Particles in the ripped or loosened zones: Maximum 150 mm.

Consider the need for subsoil drainage in the floor of a cutting.

4.4.6 Compacting floors of cuttings

Compaction: Re-compact ripped or loosened material to conform to **COMPACTION AND MOISTURE REQUIREMENTS**.

Maximum compacted material particle dimension: 200 mm.

After re-compaction: Re-trim the floors of cuttings parallel with the finished wearing surface.

Tolerances: Conform to **ANNEXURE - EARTHWORKS INFORMATION**.

4.4.7 Batter slopes

Profile: Construct batter slopes, as documented.

Tops of cuttings: Neatly round tops of cutting to the documented dimensions and, re-setout, remove additional material and re-trim, if required.

Batters for cuttings: Even and without undulations in the general plane of the batter except that batters may require progressive flattening at the ends of cuttings due to the presence of less stable material.

Unstable material: Clean cut faces of loose or unstable material progressively as the excavation proceeds.

4.4.8 Excavation beyond batter line

Minor over excavation: Minor change in the general slope of the batter, beyond slope line and the tolerance applicable may be approved, however, this does not constitute a variation for batter slopes.

Alternative corrective measures: Provide details of the material and/or methods proposed to restore the required slope and stability of the batter.

Batters steeper than 1H:1V: If any section of the batter, up to a height of 3 m above the table drain level, has been over excavated beyond the tolerance limit documented, restore batter to the average batter slope using randomly mortared stone.

Restoration material: Conform to the following:

- Stone: Similar to sound rock in the cutting.
- Mortar: Coloured to match the rock.

4.5 Transition from cut to fill

4.5.1 Intersection line

Survey: After removing the topsoil and before excavating any cutting, mark the position of the intersection line between cutting and embankment occurring at the underside of the selected material zone or pavement subbase.

4.5.2 Terrace construction

General: Following excavation to the cutting floor, excavate a terrace for the width of the selected material zone (or subbase layer, where no selected material zone) to a depth of 900 mm below and parallel to the cutting floor, as shown in **ANNEXURE - TRANSITION FROM CUT TO FILL**.

Extent of terrace: Extend the cut to the point where the cutting floor is 900 mm below the original stripped surface, or a distance of 20 metres, whichever is the lesser.

Excavated material: Incorporate the material excavated into the embankments or dispose of as permitted by local authorities.

Material placed above the terrace: Conform to **EMBANKMENTS, Embankment material** and compact to **COMPACTION AND MOISTURE REQUIREMENTS**.

Free drainage: Provide 1% minimum grade towards the nearest exit of the cutting or install a subsurface drain at the lower end.

4.6 Embankments

4.6.1 Foundations

Unsuitable material: If any underlying material is determined unsuitable, remove and replace the material conforming to **UNSUITABLE MATERIAL**.

Preparation for shallow embankments: Loosen material exposed by the removal of topsoil and unsuitable material to a depth of 150 mm, adjust moisture content of loosened material and compact to **COMPACTION AND MOISTURE REQUIREMENTS**.

Preparation for other embankments: Grade and level to general area, adjust the moisture content and compact the top 200 mm to **COMPACTION AND MOISTURE REQUIREMENTS**.

Foundation damage: Use suitable equipment and techniques to minimise surface heaving or other foundation damage.

4.6.2 Bridging layer treatment

Ground water seepage: A bridging layer may be used with approval, if ground water seepage is encountered in foundation area or it is demonstrated that it is impracticable to achieve compaction of the foundation to **COMPACTION AND MOISTURE REQUIREMENTS**. A bridging layer is unacceptable where the proximity of the bridging layer to the pavement is likely to affect the pavement design.

Material: Free-draining granular material with strong mechanical interlock and low sensitivity to moisture.

Method: End-dump the granular material and spread in a single layer, in sufficient depth to allow the passage of earthmoving equipment with minimal surface heaving. The compaction requirements of **COMPACTION AND MOISTURE REQUIREMENTS** do not apply to the bridging layer.

4.6.3 Working platform treatment

An alternative to a bridging layer: A working platform created by the chemical stabilisation of in situ material conforming to the *C07 Stabilisation* worksection.

4.6.4 Geotextile/geogrid layer

Requirement: If approved, to **MATERIALS, GEOTEXTILE** in the C14 Subsurface drainage worksection and **EXECUTION, GEOTEXTILE** in the C15 Subsoil and formation drains worksection.

4.6.5 Drainage layer treatment

General: Install drainage layer of rock enclosed with geotextile over embankment foundations.

Drainage: Shape and trim embankment foundation to provide drainage of the embankment. After, construction, maintain a clear drainage path, especially at the outer edges of the embankment.

4.6.6 Hillside embankments

Requirement: If embankments are constructed on or against any natural slopes or the batters of existing embankments, and if the existing slope or batter is steeper than 10H:1V in any direction, cut horizontal terraces as follows:

- Step the existing slope or batter in successive terraces, minimum 1 m in width, and cut terraces progressively as the embankment is placed.
- Depth: Conform to the following:
 - Minimum 300 mm at the steps.
 - If existing slope is 4H:1V: Minimum 600 mm at the steps.
- To coincide with natural discontinuities wherever possible.
- Provide subsoil drainage, if required.
- Compact excavated material as part of the new embankment material.

4.6.7 Batter slopes

Design criteria: The batter slopes, as documented represent the estimated requirements for the expected types of materials.

Redetermination: Batter slopes may be changed following further assessment of the materials found on site.

Average planes of embankment batter: As documented when completed.

Slope undulations: Avoid undulations in the general plane of the batter.

4.6.8 Batter slope for median areas

Free draining: Grade medians so there is no ponding.

4.6.9 Rock facing of embankments

Requirement: Provide a facing of clean, hard, durable rock to embankment batters, including embankments at bridge abutments.

Location: As documented.

Rock placement: Exercise extreme caution whilst placing the rock facing as follows:

- Where embankment material is placed above other roads in use, place the outer rock layer to prevent movement down the batter or onto the roadway.
- Make sure that, no rock can be dislodged and roll onto any adjacent roadway or track in use.

Mechanical interlock: Build up the rock facing in layers before each layer of filling. Place rock by hand or plant so that its least dimension is vertical and mechanical interlock between the larger stones occurs.

Excess fine material: Remove excess fine material surrounding rock. Replace rocks, if required.

Graded filter: Fill space between larger batter rocks with progressively smaller rocks to form a graded filter which prevents the leaching out of fines from the fill material but does not overfill the voids between larger rocks, or cause the larger rocks to lose contact with one another. Remove fine material from the outside of the rocks on the face of the batter.

Geotextile: Use an appropriate geotextile for embankment construction to prevent the leaching out of fines from the fill material, as documented.

4.7 Placing fill for embankment construction

4.7.1 General

Uniformity of material: Select the methods of excavation, transport, depositing and spreading of the fill material so as to ensure that the placed material is uniformly mixed.

Embankment stability: Construct the embankment and stabilise by compaction of the fine material embedding the rock pieces. Compact fine material to meet the requirements of **Compaction and moisture requirements**.

Sources of material and processing: Determine suitable sources of material and any processing to satisfy these quality requirements. Fill material shall be obtained from cuttings within the work, supplemented by borrow if the material source has been certified.

Placing: Place fill in layers parallel to the grade line and compact in conformance with **COMPACTION AND MOISTURE REQUIREMENTS**.

4.7.2 Layer thickness

Requirement: Uniform, compacted layers not more than 200 mm thickness.

Large rock: If more than 25% by volume of the filling consists of rock with any dimension larger than 150 mm, seek approval to increase thickness to 300 mm. Relative compaction to conform to **COMPACTION AND MOISTURE REQUIREMENTS**.

4.7.3 Maximum layer thickness and material properties of rock in earth fill embankments table

Maximum layer thickness (mm)	Minimum quantity rock (by volume)	Maximum rock size (mm)	% Passing 37.5 mm AS Sieve (by mass)
300	–	200	> 60%
500	25% > 200 mm	300	> 60%

4.7.4 Rock pieces

Grading of fill material: Break down rock material and evenly distribute it through the fill material, and place sufficient fine material around the larger material as it is deposited to fill voids and produce a dense, compact embankment.

Insufficient fine material: If there is insufficient fine material to fill the voids, obtain additional fine material from other places in the work or change the method of winning fill material.

Stony patches: Rework stony patches having insufficient fine material, with additional fine material to achieve a dense, compact layer.

4.7.5 Equipment

General: Use suitable equipment and techniques to avoid surface heaving or other damage to the foundations and underlying embankment layers.

4.7.6 CBR value

Requirement: CBR of compacted embankment material below selected material zone (or subbase layer, where no selected material zone) to **ANNEXURE - EARTHWORKS INFORMATION**.

4.7.7 Trimming tops of embankments

Top of embankments: Trim parallel to the design grade line at levels equal to the finished surface level, less the thicknesses of pavement courses and the selected material zone, if applicable.

Compaction: Compact the tops of embankments in conformance with **COMPACTION AND MOISTURE REQUIREMENTS**.

4.8 Selected material zone and verges

4.8.1 Site won selected material

Requirement: Conform to the following:

- Stone size: Maximum 100 mm and have no less than 50% passing the 19 mm sieve.
- CBR value: To ANNEXURE - EARTHWORKS INFORMATION.
- Maximum Plasticity Index: 15.

4.8.2 Site won verge material

Requirement: Conform to the following:

- Size: Maximum 50 mm and no less than 50% passing the 19 mm sieve
- Have a CBR value not less than specified in ANNEXURE -
- **EARTHWORKS INFORMATION**
- Maximum Plasticity Index: 15.

4.8.3 Spill through bridge abutment fill material

Material at waterway crossings and at overbridges: Conform to the following:

- Grading: 100% passing the 53 mm AS Sieve.
- Waterway crossings:
- CBR value: To ANNEXURE - EARTHWORKS INFORMATION.
- Plasticity Index: 6 to 15.
- Overbridges:
 - CBR value: To ANNEXURE - EARTHWORKS INFORMATION.
 - Maximum Plasticity Index: 25.

Stabilisation: If chemical stabilisation is required, the requirements of this clause apply to the selected material immediately before incorporating the stabilising agent.

Winning material: Obtain the selected material from cuttings excavated under the Contract or from borrow areas in conformance with **BORROW**.

Work methods: If required, use work methods to yield material by breaking down oversize rock, including processing through a crusher so that resulting material conforms to documented requirements.

4.8.4 Conservation of material

Stockpiles: If the material is not placed directly in the selected material zone, stockpile it at approved locations for future use until sufficient material is reserved to complete the selected material zone over the whole work and make sure stockpiles do not exceed 4000 tonnes.

Extra material: If suitable available material has not been conserved, provide material of equivalent quality.

4.8.5 Placing and compaction

Layers: Place and compact in layers in conformance with **COMPACTION AND MOISTURE REQUIREMENTS**.

Compacted layer thickness: < 150 mm.

Composition of layers: Homogeneous and free from patches containing segregated stone or excess fines.

Non-conforming material: Exclude all non-complying material from all areas.

Top of the selected material zone: Compact and trim parallel with the design grade line at a level equal to the finished surface level minus the thickness of pavement layers adopted. The tolerances for the trimmed levels are given in ANNEXURE - EARTHWORKS INFORMATION.

4.9 Fill adjacent to structures

4.9.1 General

Structure types: Structures include bridges, precast and cast-in-place box culverts and retaining walls.

Fill adjacent to other culverts and drainage structures: Conform to **BEDDING AND SUPPORT MATERIAL** and **BEDDING AND BACKFILLING** in the *C23 Stormwater drainage (Construction)* worksection.

Time of placement: Do not place fill against structures, headwalls or wing walls within 21 days after placing of the concrete, unless the walls are effectively supported by struts as approved or it can be demonstrated that 85% of the design strength of the concrete has been achieved.

4.9.2 Treatment at weepholes

Gravel: Provide drainage adjacent to weepholes by a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50 mm to 10 mm as follows:

- Particle dimension: < 50 mm.
- < 5 % mass to pass the 9.5 mm AS sieve.

Extent: Extend broken stone or river gravel continuously in the line of the weepholes, at least 300 mm horizontally into the fill and from 200 below to at least 450 mm vertically above the level of the weepholes.

Geotextile membrane: Alternatively, provide a geotextile membrane of equivalent drainage characteristics. Store and install to the manufacturer's recommendations.

4.9.3 Backfill

Location: Place backfill adjacent to structures, as documented.

Backfill material: Conform to the following:

- Granular material.
- Size: < 50 mm.
- Plasticity Index: Between 2 and 12.

Placement: Place backfill in layers, with a maximum compacted thickness of 150 mm simultaneously on both sides of box culverts and other drainage structures to avoid differential loading. Start compaction at the wall and proceed away from it, in conformance with **COMPACTION AND MOISTURE REQUIREMENTS**.

Horizontal terraces: Cut the existing embankment slope behind the structure in the form of successive horizontal terraces, minimum 1 m wide, and place backfill to **PLACING FILL FOR EMBANKMENT CONSTRUCTION**.

Spill through abutments: Do not dump rocks against columns or retaining walls, build up evenly around or against structures.

Framed structures: For embankments at both ends of the structure, bring up backfill at both ends simultaneously, keeping the difference between the levels of the embankments less than 500 mm.

4.9.4 Backfill width and height table

Structure type	Backfill	
	Width	Height
Bridge abutments	2 m	H
Cast-in-place box culverts	H/3	H + 300 mm
Corrugated steel pipes and arches	0.5 m	H + 500 mm
Retaining walls	H/3	H
Note: H = Height of structure		

4.10 Spoil

4.10.1 General

- All waste management is the responsibility of the applicant and their Contractor. There may be opportunities to reuse some excavated material within the works. Any waste not suitable for reuse shall be disposed of by the Contractor to a suitably NSW EPA licenced Landfill. Council's Resource Recovery Centre may be able to accept waste from the site as would many other nearby licenced landfills.
- Council does not operate stockpile sites and is unable to accept waste material generated from road reserves or private land.

4.10.2 Non-contaminated materials

Embankments: If flatter batter slopes are required on embankments or if excess material is to be used in the uniform widening of embankments, shape the surface to provide a tidy appearance and effective drainage.

Surplus material: Spread and compact the surplus material in conformance with, **PLACING FILL FOR EMBANKMENT CONSTRUCTION** and **COMPACTION AND MOISTURE REQUIREMENTS** for material in embankments.

Disposal: Dispose of spoil at approved locations. Compact spoil in conformance with **COMPACTION AND MOISTURE REQUIREMENTS** for material in embankments.

4.10.3 Contaminated material

Requirement: Stockpile and/or remove from the site in an approved manner and location.

Method: Excavate and dispose of all contaminated material in an environmentally responsible manner including the following:

- Test material uncovered on-site before disposal. If putrescibles wastes are included, analyse leachate and landfill gases.
- Excavate material without creating off-site environmental problems.
- Seal remaining contaminated material or wastes, where only part of the tip has been excavated, so there is no off-site effect now or in the future.
- Transport odorous wastes in covered vehicles.
- Dispose of contaminated material in a landfill licensed to take the type of contaminated material or wastes uncovered.

Haulage disposal

Planning approval: Spoil Removal and disposal is to conform with Council's conditions of development consent and relevant legislation. This is a WITNESS POINT.

Method: Dispose of spoil in a manner and at locations approved by the Superintendent. Compact spoil as specified in Compaction and moisture requirements for material in embankments. Chain of Responsibility legislation and other relevant legislation applies.

4.11 Borrow

4.11.1 General

Criteria: Unless provided by the Contract, borrow will only be authorised for the following:

- Constructing cuttings and embankments to the batter slopes.
- Providing materials of the quality specified.
- When there is an overall deficiency in either the quantity or the quality of material required to complete the works.

Wastage: Borrow will not be authorised for excess widening of embankments or wastage of quality material by the Contractor.

Material: Conform to **EMBANKMENTS, Embankment material and Rock facing of embankments, or FILL ADJACENT TO STRUCTURES.**

Authorities: Conform to the requirements of Council and relevant environmental planning legislation, as appropriate.

4.11.2 Borrow sites

Location: Make sure the edges are no closer than 3 m from any fence line, road reserve boundary or edge of excavation or embankment and provide adequate clearance for the construction of catch drains.

Borrow site location: As approved.

Drainage: Provide drainage outlets, as documented.

Batter slopes: Conform to the following:

- Not steeper than 4H:1V.
- To be left in a tidy and safe condition.

Site preparation and restoration: For borrow within the defined working area for the Works, prepare site in conformance with the *C05 Clearing and grubbing* worksection and **REMOVAL OF TOPSOIL.**

Widening of cutting: If borrow material is obtained by uniformly widening a cutting, conform to **CUTTINGS, BATTERS,** for the redetermination of batter slopes, compaction of floors of cuttings respectively and the trimming of batters

4.12 Compaction and moisture requirements

4.12.1 Trimming and compaction

Requirement: Compact all layers uniformly, as documented before the next layer is commenced.

Trimming: Trim each layer of material before and during compaction to avoid bridging over low areas and to present a smooth surface at the top of each layer.

4.12.2 Shallow cutting

Floor of shallow cutting: To **CUTTINGS, Floors of cuttings** and **TRANSITION FROM CUT TO FILL** and compact to provide a relative compaction of not less than 97% for a depth of 300 mm for modified compactive effort.

4.12.3 Cut-fill transition

Requirement: If shallow cutting conditions occur, the requirements of **TRANSITION FROM CUT TO FILL** may be modified so that the depth of terrace excavation at the transition from cut to fill is reduced from 900 mm to 250 mm.

4.12.4 Proof rolling

General: Conform to, **ANNEXURE – MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

Requirement: Proof roll, if required to **ANNEXURE - EARTHWORKS INFORMATION** and where ripping or loosening of the cutting floor is not required.

4.12.5 Moisture content

Compaction timing: Adjust the moisture content of the material at the time of compaction to allow the required compaction to be attained, at a moisture content which is within the range set out in **ANNEXURE - EARTHWORKS INFORMATION** and as follows:

- Wet material: Do not compact material that has become wet after placement until it has dried out so that the moisture content is within this range.
- Aeration: The drying process may be assisted by aeration or by the use of hydrated or quick lime.
- Drying: Alternatively, transport the wet material to a stockpile site for drying out and later use as fill material.
- Dry material: If the material is too dry for required compaction, add water. Apply water uniformly and thoroughly, mix with the material until a homogeneous mixture is obtained.

4.12.6 Compaction

Extent: Compact the material to obtain the required relative compaction for the full depth of each layer in embankments and for the full width of the formation over the entire length of the work.

Rain damage: Complete compaction promptly to minimise the possibility of rain damage and conform to the following:

- If material that has achieved relative compaction becomes wet and moisture content is greater than the optimum level, determined by AS 1289.5.1.1, dry out and uniformly recompact to the required relative compaction before next layer is placed. Alternatively, remove wet layer of material to a stockpile site for future use.

Repair: Loosen, recondition and recompact rain damaged surfaces before placing another layer of material.

4.13 Furniture and services

4.13.1 Widening of formation

General: Widen road shoulders and formation to accommodate footpaths, guard fence, streetlight plinths, emergency telephone bays and vehicle standing areas, as documented.

4.14 Testing

4.14.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

4.14.2 Deflection monitoring or proof rolling tests

Preparation: Present the work available in lots, to carry out deflection monitoring or proof rolling.

Minimum Lot size: 300 m continuous length of formation, or lesser length as approved, and a single carriageway width with homogeneous material and appearance.

Boundaries: Identify the boundaries of each lot with clearly labelled stakes.

Timing: Test within 3 days of compaction. Following completion of the formation to the underside of the selected material zone and completion of the selected material zone.

4.14.3 Compaction and moisture tests

Preparation: Prepare the area at sampling locations for required compaction and moisture tests.

Moisture content: Before testing, work the lot, make sure moisture content and compaction of all material is uniform within the lot.

Test representation: Test/s taken are considered to represent the total volume of material placed within the lot.

Further testing: Undertake further testing if the material which is present has not achieved required uniformity to **PLACING FILL FOR EMBANKMENT CONSTRUCTION**. Nominate the area to be represented by the additional testing.

Non-conforming material: If such testing confirms non-conformance, perform remedial work as necessary to achieve conformance to **COMPACTION AND MOISTURE REQUIREMENTS**.

Deflection monitoring or proof rolling test results: Conform to the following:

- If required characteristic deflection is less than 1.2 mm, make sure the standard deviation of the lot does not exceed 0.2 mm.
- If required characteristic deflection exceeds 1.2 mm, make sure the coefficient of variation of the lot does not exceed 25%.

Further proof rolling: If required, at a later date, re-condition the layer so that the moisture content conforms to **COMPACTION AND MOISTURE REQUIREMENTS**. Pass the roller no less than 8 times.

4.15 Completion

4.15.1 Temporary works at completion

Tree enclosures: Remove temporary tree enclosures.

Tree marking: Remove temporary marks and tags.

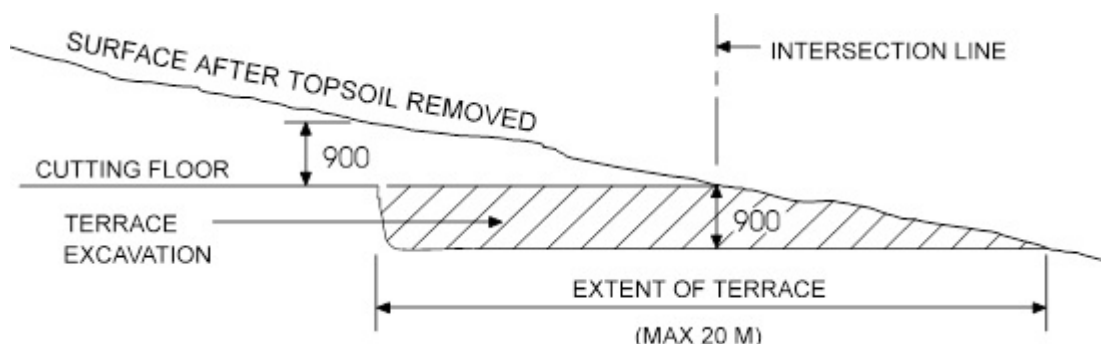
Temporary supports: Remove temporary supports to adjacent structures.

4.15.2 Site restoration

Requirement: Where variation of existing ground surfaces is not required as part of the works, restore surfaces to the condition existing at the commencement of the contract or to the *C29 Landscape - road reserve and street trees* worksection.

5 Annexures

5.1 Annexure - Transition from cut to fill



5.2 Annexure - Summary of hold and witness points

Reference No:	Clause/Description	Type	Submission/ Inspection	Submission/ Notice details	Process held
C06-WP01	INSPECTIONS Notice Unsuitable material	W	Material deemed unsuitable for embankment or pavement support in its present position.	3 days before replacement of unsuitable material	Replacement of unsuitable material
C06-HP02	INSPECTIONS Notice Unsuitable material	H	Determine sufficient depth of unsuitable material has been removed	3 days before backfilling with replacement material	Backfilling with replacement material, For development inspections book through "MyInspect"
C06-WP03	SUBMISSIONS Evidence of material disposal.	W	Evidence that the disposal of unsuitable material is in accordance with the approved water management plan.	3 days after disposal of unsuitable material	Disposal of material.
C06-HP04	INSPECTIONS Bridging layer treatment identified by roll test.	H	Subgrade or pavement movement observed under roll test	Wet material removed and subsoil treatment applied.	Subgrade or pavement layer acceptance prior to further pavement construction. For development inspections book through "MyInspect".
C06-WP05	INSPECTIONS Notice Cuttings in rock	W	Stability of batter	3 days before excavation	Excavation below bench level for slopes of 1H:1V or steeper
C06-WP06	INSPECTIONS Notice Ripping floors of cuttings	W	Ripped or loosened material	3 days before re-compaction	Re-compaction
C06-WP07	CUTTINGS, Compacting floors of cuttings	W	Compacted cut floor	3 days before placing subsequent layers	Placing subsequent layers
C06-WP08	INSPECTIONS Notice Transition from cut to fill	W	Position of intersection line between cutting and embankment.	3 days before excavation on cutting	Excavation cutting

Reference No:	Clause/Description	Type	Submission/ Inspection	Submission/ Notice details	Process held
C06-HP09	INSPECTIONS Notice Foundations	H	Embankment foundation area following removal of topsoil.	3 days before treatment of each Lot of embankment foundation	Treatment of each Lot of embankment foundation, For development inspections book through "MyInspect".
C06-HP10	SUBMISSIONS Execution details Embankment treatment type	H	If either loosen and compact, bridging layer, working platform, geotextile/geogrid layer, drainage layer or other treatment is proposed, submit details.	3 days before additional treatments	Additional treatments; loosen and compact, bridging layer, working platform or geotextile/geogrid layer, drainage layer
C06-HP11	INSPECTIONS Notice Trimming tops of embankment	H	Trimmed and compacted embankment	3 days before placing any subsequent pavement layers	Placing any subsequent pavement layers, For development inspections book through "MyInspect".
C06-HP12	INSPECTIONS Notice Selected material zone	H	Completed surface	3 days before placing any subsequent pavement layers	Placing any subsequent pavement layers, For development inspections book through "MyInspect".
C06-WP13	INSPECTIONS Notice Deflection monitoring and proof rolling	W	Any visible deformation, rutting, yielding and or showing signs of distress or instability.	3 days before completion	Completion

5.3 Annexure - Maximum lot sizes and minimum test frequencies

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Stripping topsoil	Surface levels	10,000 m ²	1 cross section per 25 m	Survey
Excavation	Geometry	10,000 m ²	1 cross section per 25 m	Survey
Floor of cuttings	Cuttings and placing fill for embankment construction: • CBR test	5,000 m ²	1 per 1,000 m ² *	AS 1289.6.1.1
	Compaction	10,000 m ²	1 per 500 m ²	AS 1289.5.4.1
Foundation for Embankments	Compaction	5,000 m ²	1 per 500 m ²	AS 1289.5.4.1
Embankments • General	Geometry	1 layer 10,000 m ²	1 cross section per 25 m	Survey
	Material quality: • CBR	1 layer 5,000 m ²	1 per 800 m ³	AS 1289.6.1.1
	Compaction/moisture content/optimum moisture content	1 layer 5,000 m ²	1 per 250 m ³	AS 1289.5.1.1 AS 1289.5.4.1
Embankments • Select zone	Geometry	1 layer 10,000 m ²	1 cross section per 25 m	Survey
	Material quality: • Particle size distribution • CBR	10,000 m ² 10,000 m ²	1 per 1,000 m ³ * 1 per 500 m ³ *	AS 1289.6.1.1
	Compaction/moisture content/optimum moisture content	1 layer 5,000 m ²	1 per 250 m ³ *	AS 1289.5.1.1 AS 1289.5.4.1
Selected material zone and fill adjacent to bridges, wingwalls, retaining walls and culverts	Material quality: • Particle size distribution • Plasticity index	1 Structure 1 Structure	1 per 200 m ³ * 1 per 200 m ³ *	AS 1289.3.3.1
	Compaction/moisture content	1 Structure	1 per layer	AS 1289.5.1.1 AS 1289.5.4.1
Compaction and moisture tests	Proof rolling	1 layer 5,000 m ²	1 per lot	RMS T198
	Deflection monitoring: • Benkelman beam method	1 layer 5,000 m ²	1 per lot	RMS T199
* Note: or part thereof, per lot.				

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Lot size: A continuous length of formation at least 300 m, or lesser length, and a single carriageway width with homogeneous material and appearance.				

5.4 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS 1289		Methods of testing soils for engineering purposes
AS 1289.3.3.1	2009	Soil classification tests - Calculation of the plasticity index of a soil
AS 1289.5.1.1	2017	Soil compaction and density tests- Determination of dry density/moisture content relation of a soil using standard compactive effort
AS 1289.5.4.1	2007	Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio
AS 1289.6.1.1	2014	Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen
AS 3798	2007	Guidelines on earthworks for commercial and residential developments
RMS T198	2013	Proof rolling test
RMS T199	2014	Deflection monitoring test
Wingecarribee Shire Council		Standard DA condition for waste management