
# AUS-SPEC

# Infrastructure Specifications

# 0222 Earthwork

# 0222 EARTHWORK

IMPORTANT: This document has been adapted from the NATSPEC suite of specification templates for use in the Cessnock City Council area by both Council and industry. NATSPEC regularly updates the base templates (currently in April and October each year), and Council may incorporate changes into its version of AUS-SPEC from time to time. To assist in highlighting any changes made by Council to the NATSPEC templates, the following conventions are used.

- See ANNEXURE M at the end of this document which contains (where practical) Cessnock City Council customisations (also known as 'office master' text). References to the Annexure are to also be inserted at relevant clauses in the main body of the document.
- Where content is added to the main body of the document, it is to be shown in brown text like this.
- Where content is deleted or excluded from the main body of the document, it is to be shown ~~struck through like this~~. Such clauses are to have no effect.

Where there is a conflict between main body text and Cessnock City Council specific clauses, Council's specific clauses shall prevail.

## 1 GENERAL

### 1.1 RESPONSIBILITIES

**General**

Requirement: Provide earthworks to the dimensions and tolerances, as documented.

### 1.2 DESIGN

**General**

Designer: Refer to *0010 Quality requirements for design* worksection.

Geotechnical and environmental reports provided: as per any DA consent conditions.

**Requirements**

General: To DESIGN in *0171 General requirements*.

Design of footing or pier depths: If not documented, to be designed by a professional engineer in accordance with *0010 Quality requirements for design* worksection.

~~Contract depths: The footing or pier depths shown on the drawings are provisional.~~

Authority requirements: as per any DA consent conditions.

### 1.3 CROSS REFERENCES

**General**

Requirement: Conform to the following:

- 0010 Quality requirements for design.
- 0136 General requirements (Construction).
- ~~*0171 General requirements*.~~
- *0172 Environmental management*.

**Limitations**

Exclusion: This worksection is not intended to apply to works within the scope of the following:

- *1112 Earthworks (Road reserve)*. That worksection also applies to earthworks within future public roads, for example as part of subdivision works.

### 1.4 STANDARDS

**General**

Earthworks: Conform to the recommendations of those parts of AS 3798 (2007) that are referenced in this worksection.

Description and classification of soils: To AS 1726 (2017).

Reference: Note that AS 3798 (2007) is a guide standard. See AS 3798 (2007) clause 1.1 on its limitations.

## 1.5 INTERPRETATION

### Abbreviations

General: For the purposes of this worksection, the following abbreviations apply:

- GITA: Geotechnical inspection and testing authority.
- GTA: Geotechnical testing authority.

### Definitions

General: For the purposes of this worksection, the definitions given in AS 3798 (2007) and the following apply:

- Bad ground: Ground unsuitable for the works, including fill liable to subsidence, ground containing cavities, faults or fissures, ground contaminated by harmful substances and ground that is, or becomes, soft, wet or unstable.
- Rock: Monolithic material with volume greater than 0.3 $m^3$ that cannot be removed until broken up by rippers or percussion tools.
- Site topsoil: Natural soil, excavated from the site, that contains organic matter, supports plant life, conforms generally to the fine-to-medium texture classification to AS 4419 (2018) and is free from the following:
  - . Stones more than 25 mm diameter.
  - . Clay lumps more than 50 mm diameter.
  - . Weeds and tree roots.
  - . Sticks and rubbish.
  - . Material toxic to plants.
- Subgrade: The trimmed or prepared earth material on which the pavement, footing or slab is constructed. Generally taken to relate to the upper line of the earth material.
- Zone of influence: A foundation zone bounded by planes extending downward and outward from the bottom edge of a footing, slab or pavement and defining the extent of foundation material having influence on the stability or support of the footings, slab or pavement.

## 1.6 TOLERANCES

### General

Finish: Finish the surface to the required level, grade and shape within the following tolerances:

- Under building slabs and load bearing elements: +0, -25 mm.
- Pavement subgrades: +0, -40 mm.
- Batters: No steeper than the slope shown on the drawings. Make sure flatter slopes do not impact on boundaries or required clearances to buildings, pavements or landscaping.
- Other ground surfaces: ±50 mm, provided the area remains free draining and matches adjacent construction where required. Provide smoothness as normally produced by a scraper blade.

Note: AS 3798 (2007) clause 3.3(a)(v) refers to standard of surface trim. State any other tolerances on levels or dimensions. Particular tolerances may be required for work prepared for separate or future contracts.

## 1.7 SUBMISSIONS

### Design documentation

Calculations: Submit calculations by a professional engineer showing the stability and safety of proposed excavations and temporary supports, including supports required for adjacent structures.

### Execution details

Report: Submit a time-based schedule detailing the methods and equipment proposed for the earthworks, including the following:

- Dewatering and groundwater control and disposal of surface water.
- Excavation methods, stages, clearances, batters and temporary supports.
- Stockpiles and borrow pits.
- Placing and compaction methods and stages.

Geotechnical site investigations: Provide a geotechnical report supporting the methods proposed for excavation.

Disposal location: Submit details of the locations and evidence of compliance with the appropriate authority requirements for the disposal of material requiring removal from site.

Temporary shoring: Submit a proposal for any temporary shoring required, including the progressive removal.

Proof rolling: Submit details of proposed method and equipment for proof rolling.

Records of measurement: Submit a certified copy of the agreed records of measurement.

Site records: Submit the following to AS 3798 (2007) clause 3.4 and Appendix B:

- Geotechnical site visit record.
- ~~Earthworks summary report or daily geotechnical reports.~~

**Products and materials**

Imported fill: Submit certification or test results by a GTA registered laboratory of the imported fill as evidence of conformity with the contract, including the source.

**Tests**

Compaction: Submit certification and/or test results in conformance with the documented level of inspection and testing to AS 3798 (2007).

### 1.8 INSPECTION

**Notice**

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

- Witness Point: Items to be measured as listed in **RECORDS OF MEASUREMENT**.
- Witness Point: Areas to be cleared and/or stripped of topsoil.
- Witness Point: Areas stripped of topsoil.
- Hold Point: Excavation completed to contract levels or founding material.
- Hold Point: Proof rolled subgrade before placing fill.
- Witness Point: Filling completed to contract levels.
- Witness Point: Stockpiled topsoil before spreading.

## 2 PRODUCTS

### 2.1 FILL MATERIALS

**General**

Suitable material: To AS 3798 (2007) clause 4.4 including inorganic, non-perishable material suitably graded and capable of compaction to the documented density.

Unsuitable materials: Do not use fill defined as unsuitable by AS 3798 (2007) clause 4.3.

Reference: See AS 3798 (2007) clause 3.3(a)(iv).

Sulfur content: Do not provide material with sulfur content exceeding 0.5% within 500 mm of cement bound elements (for example concrete structures or masonry) unless the elements are protected by impermeable membranes or equivalent means.

Re-use of excavated material: Only re-use suitable material to AS 3798 (2007) clause 4.4.

**Stockpiles**

General: Segregate the earth and rock material and stockpile for re-use in backfilling operations.

Location: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along drainage channels.

### 2.2 BORROW OR IMPORTED FILL

**General**

Borrow or imported material: Use only when suitable excavated material from site is not available.

- Suitable material: To AS 3798 (2007) clause 4.4.

Material conforming to the following: As documented (e.g. on the Drawings).

Borrow pits:

- Locate more than ~~3000 mm~~ 3.0m from any fence line, boundary, edge of excavation or embankment.
- Strip and stockpile topsoil.
- Provide erosion protection during winning operations of material and make sure drainage is maintained.
- On completion of winning operations grade abrupt changes of slope, respread topsoil, and apply and maintain hydroseeded grassing.

Borrow and imported fill additional testing: As documented.

### 2.3 GEOTEXTILE

**General**

Material: UV stabilised, permeable, polymeric, woven or non-woven textile material used in contact with soil/rock material.

Identification and marking: To AS 3705 (2012).

Product: As documented.

Properties: As documented.

## 3 EXECUTION

### 3.1 SITE PREPARATION

**Erosion and sedimentation control**

Requirement: To ~~*0172*~~ *0173 Environmental management*.

### 3.2 GEOTECHNICAL

**As found site conditions**

General: If the following are encountered, give notice and obtain instructions before carrying out any further work in the affected area:

- Bad ground.
- Discrepancy in expected conditions.
- Rock.
- Springs, seepages.
- Topsoil more than 100 mm deep.

**Inspection and testing**

Level of inspection and testing: Level 2 sampling and testing to AS 3798 (2007) clause 8.3 by a GTA, except where documented otherwise on the Drawings.

Frequency of testing: To AS 3798 (2007) Table 8.1.

### 3.3 RECORDS OF MEASUREMENT

Over-excavation: The contractor is not entitled to a contract variation or extension of time for excavation in excess of that required by the contract, including excavation below required depths, or additional excavation that the contractor may elect to undertake to permit the use of certain construction plant, and any consequent additional backfilling, compacting or testing.

**Excavation and backfilling**

Agreed quantities: If a schedule of rates applies, provisional quantities are documented, or there are variations to the contract levels or dimensions of excavations, do not backfill or place permanent works in the excavation until the following have been agreed and recorded:

- Depths of excavations related to the datum.
- Final plan dimensions of excavations.
- Quantities of excavations in rock.

Method of measurement: By registered surveyor.

**Rock**

Level and class: If rock is measured for payment purposes, either as extra over excavation of material other than rock or for adjustment of provisional measurements, do not remove the rock until the commencing levels and the classes of rock have been determined.

## 3.4 REMOVAL OF TOPSOIL

**General**

Reference: See AS 3798 (2007) clause 6.1.5.

Extent: Areas of cut or fill and areas occupied by structures, pavements and embankments.

Maximum depth: As documented, or if not specified, 200 mm.

Disposal: Remove topsoil unsuitable for re-use from the site to AS 3798 (2007) clause 6.1.8.

**Topsoil stockpiles**

General: Stockpile site topsoil intended for re-use.

Stockpile maximum height: 1.5 m.

Identification: Mark and label stockpiles of different soil types.

Vegetation: Do not burn off or remove plant growth that occurs during storage.

Protection: Conform to the following:

- Provide drainage and erosion protection.
- Do not allow traffic on stockpiles.
- If a stockpile is to remain for more than four weeks, sow with temporary grass.
- Protect the topsoil stockpiles from contamination by other excavated material, weeds and building debris.

## 3.5 EXCAVATION

**Extent**

Site surface: Excavate the site to the levels and profiles required for the documented structures, pavements, filling and landscaping. Make allowance for compaction, settlement or heaving.

Footings, pits, wells and shafts: Excavate to the required sizes and depths. Confirm that the foundation conditions meet the design bearing capacity.

**Bearing surfaces**

Requirement: Provide even plane bearing surfaces for loadbearing elements including footings. Step to accommodate level changes. If supporting masonry, make the steps appropriate to the courses.

**Rock**

General: Do not use explosives.

**Existing footings**

Requirement: If excavation is required within the zone of influence of an existing footing, provide supports to the footing sufficient to prevent damage arising from the works. Use methods including temporary shoring or underpinning.

**Existing services**

Location: Before starting earthworks, locate and mark existing underground services in the areas that will be affected by the earthworks operations including clearing, excavating and trenching.

Utility services: Contact BEFORE YOU DIG AUSTRALIA to identify location of underground utility services pipes and cables.

Excavation: Do not excavate by machine within ~~1000 mm~~ 1.0m of existing services.

**Proof rolling**

Extent: Proof roll excavations for pavements, filling and non-spanning slabs on ground to determine the presence of bad ground.

Proof rolling method and equipment: To AS 3798 (2007) clause 5.5.

Requirement: If excessive settlement, rebound or heaving is encountered, provide test pits or trenching to determine the extent of bad ground.

**Disposal of excess excavated material**

General: Remove excess excavated material from site not required or unsuitable for fill.

Standard: To AS 3798 (2007) clause 6.1.8.

## 3.6 REINSTATEMENT

**Deterioration of bearing surfaces**

Requirement: If the bearing surface deteriorates because of water or other cause, excavate to a sound surface before placing the loadbearing element.

**Subgrades affected by moisture**
Requirement: If, due to high moisture content, the subgrade cannot support construction equipment or the overlying pavement cannot be compacted, perform one or more of the following:

- Allow the subgrade to dry until it provides support for equipment and allows compaction.
- Scarify the subgrade to a depth of 150 mm, work as necessary to accelerate drying, and recompact when the moisture content is satisfactory.
- Excavate the wet material and remove to spoil, and backfill excavated areas.

**Over excavation**
Requirement: If excavation exceeds the required depths, reinstate to the correct depths, levels and bearing capacity.

Zone of influence: Within the zone of influence of footings, beams, or other structural elements, use concrete of strength equal to the structural element, minimum 15 MPa. Make sure that remedial concrete does not create differential bearing conditions.

Below slabs or pavements: Rectify the over excavation as follows:

- Generally: Provide selected fill compacted to the documented density.
- Less than 100 mm: Do not backfill. Increase the thickness of the layer above.

Rock depressions and subsoil drains: Backfill rock depressions and over excavation of subsoil drains using coarse subsoil filter.

## 3.7 SUPPORTING EXCAVATIONS

**Removal of supports**
General: Remove temporary supports progressively as backfilling proceeds.

**Voids**
General: If voids occur outside sheeting or sheet piling, fill and compact voids to a dry density similar to that of the surrounding material.

## 3.8 ADJACENT STRUCTURES

**Temporary supports**
General: If required, provide supports to adjacent structures, sufficient to prevent damage arising from the works.

Lateral supports: Provide lateral support with shoring.

Vertical supports: If required, provide vertical support with piling or underpinning or both.

**Permanent supports**
General: If permanent supports for adjacent structures are required and are not documented, give notice and obtain instructions.

**Encroachments**
General: If encroachments from adjacent structures are encountered and are not documented give notice and obtain instructions.

**Zone of influence**
Angle from horizontal: As per any geotechnical engineer's report issued as part of the Contract documents, or if not documented, the Contractor is to obtain its own advice.

## 3.9 ROCK BOLTING

**General**
Requirement: For temporary or permanent support of rock faces, provide proprietary high strength steel bars or tubes anchored into holes drilled in the rock and tensioned against plates bearing on the rock face. Schedule the installation to conform to systematic bolting or calculated relief, as documented.

Standard: To AS 4678 (2002).

**Protection**
General: Protect permanent rock bolts by grouting the drilled hole with cement grout after tensioning the rock bolt. Protect the bearing plate and the exposed portion of rock bolt and anchorage with a protective coating or by embedment in concrete.

## 3.10 GEOTEXTILE

**General**

Preparation: Trim the ground to a smooth surface free from cavities, ~~and~~ projecting rocks, branches and tree roots..

Installation: Lay the fabric flat, not stretched tight, and secure with anchor pins. Overlap joints 300 mm minimum.

## 3.11 PREPARATION FOR FILLING

**Preparation**

Stripping: Prepare the ground surface before placing fill (including topsoil fill), ground slabs or load bearing elements to AS 3798 (2007) clause 6.1.5. Remove material that inhibits or prevents satisfactory placement of fill layers, loose material, debris and organic matter.

Foundation preparation: To AS 3798 (2007) clause 6.1.7.

Compaction: Compact the ground exposed after stripping or excavation, to a minimum depth of 150 mm, to the minimum relative compaction in AS 3798 (2007) Table 5.1.

Reference: From AS 3798 (2007) Table 5.1 Note 7.

Ground treatment or improvement methods:

- Scarify method: Loosen exposed excavation by scarifying to a minimum of 150 mm, moisture-condition and compact to AS 3798 (2007) Section 5.

~~Impact roller and impact compaction: Use an approved method.~~

Slope preparation: If fill is placed on a surface steeper than 4:1 (horizontal:vertical), bench the surface to form a key for the fill. As each layer of fill is placed, cut the existing ground surface progressively to form a series of horizontal steps more than 1 m in width and more than 100 mm deep. Recompact the excavated material as part of the filling. Shape to provide free drainage.

Reference: See AS 3798 (2007) clause 6.1.6, recommends slopes less than 8:1 (horizontal:vertical) do not require benching. Check if the 4:1 (horizontal:vertical) slope applies to your design, and edit as appropriate. AS 3798 (2007) clause 6.1.6 also recommends minimum depth of 300 mm bench.

Working platform: Not Used

**Under earth mounds**

General: Cultivate the ground to a depth of 200 mm before mound formation.

**Under slabs, paving and embankments**

General: If required, loosen the ground to a depth of more than 200 mm and adjust the moisture content before compaction to a density consistent with subsequent filling.

**Rock ledges**

General: Remove overhanging rock ledges.

## 3.12 PLACING FILL

**General**

Extent: Place fill to the documented dimensions, levels, grades, and cross-sections so that the surface is always self-draining.

Layers: Place fill in near-horizontal layers of uniform thickness no greater than 150 mm after compaction, deposited systematically across the fill area.

Edges: At junctions of fill and existing surfaces, do not feather the edges.

Mix: Place fill in a uniform mixture.

Previous fill: Before placing subsequent fill layers, make sure that previously accepted layers still conform to requirements, including moisture content.

Protection: Protect the works from damage due to compaction operations. If required, limit the size of compaction equipment or compact by hand.

Protective covering to membranes: Do not disturb or damage during backfilling.

**Placing at structures**

Fill adjacent structures and trenches: To AS 3798 (2007) clause 6.2.6.

Requirement: Place and compact fill in layers simultaneously on both sides of structures, culverts and pipelines to avoid differential loading. Commence compacting each layer at the structure and proceed away from structure.

Over the top of structures: Carefully place first layers of fill.

Retaining walls: Do not place fill against concrete retaining walls until the concrete has been in place for 28 days unless the structure is supported by struts.

**Compaction**

General: Compact the subgrade and each layer of fill to the required depth and density, as a systematic construction operation. Shape surface to provide drainage and prevent ponding.

Maximum rock and lump size in layer after compaction: To AS 3798 (2007) clause 6.2.2.

Fill batter faces: Either compact separately, or overfill and cut back. Form roughened surfaces to the faces.

Minimum relative compaction: To AS 3798 (2007) Table 5.1.

## 3.13 PLACING TOPSOIL

**Stockpiled topsoil**

Cultivation: Rip subgrade to a depth of 100 mm or to the depth of rippable subgrade if less. Cultivate around services and tree roots by hand. Trim to allow for the required topsoil depth.

Herbicide: Apply before placing topsoil.

Herbicide product: Not Used

Placing: Spread and grade evenly.

Compaction: Lightly compact topsoil so that the finished surface is smooth, free from lumps of soil, at the required level, ready for cultivation and planting.

Edges: Finish topsoil flush with abutting kerbs, mowing strips and paved surfaces. Feather edges into adjoining undisturbed ground.

**Disposal of excess topsoil**

On-site: Dispose of surplus topsoil as documented, and then any remaining on site as directed by the Superintendent by spreading evenly over the areas already placed.

~~Off-site: Remove excess topsoil from the site and dispose of legally.~~

## 3.14 FILL MOISTURE CONTROL

**General**

Moisture content: Adjust the moisture content of fill during compaction to meet documented requirements, or if not documented, within the range of 85% to 115% of the optimum moisture content determined by AS 1289.5.1.1 (2017) or AS 1289.5.2.1 (2017), as appropriate, to achieve the required density.

Reference: See AS 3798 (2007) clause 6.2.3. Add water or aerate as required.

## 3.15 TESTING

**Site tests**

Compaction control tests: To AS 1289.5.4.1 (2007) or AS 1289.5.7.1 (2006).

Reference: Refer to SA HB 160 (2006) for additional information on soil testing.

See AS 3798 (2007) Section 5 for guidelines on compaction criteria for commercial and residential developments.

If the use of course material or ripped rock is proposed, see AS 3798 (2007) clauses 5.4 and seek geotechnical advice. With such material, testing to the relevant parts of AS 1289 is not applicable.

Test frequency: To AS 3798 (2007) Table 8.1.

Note: If frequency of testing depends on location, state the different requirements for each location. The required frequency may need adjustment on large scale or concentrated operations, e.g. filling of gullies, farm dams. Where specific recommendations for test frequency are given in the geotechnical report for the site, these should replace the AS 3798 (2007) requirements.

## 3.16 COMPLETION

**Geotechnical report**

Inspection and testing report: For Level 2 sampling and testing, submit a statement with results from each visit to site.

**Grading**

External areas: Grade to give falls away from buildings, minimum 1:100.

Subfloor areas: Grade the ground surface under suspended floors to drain ground or surface water away from buildings without ponding.

**Site restoration**

Requirement: If 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.

## 4 ANNEXURE A – REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

| | | |
|---|---|---|
| AS 1289 | | Methods of testing soils for engineering purposes |
| AS 1289.5.1.1 | 2017 | Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort |
| AS 1289.5.2.1 | 2017 | Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified 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 1289.5.7.1 | 2006 | Soil compaction and density tests - Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method) |
| AS 1726 | 2017 | Geotechnical site investigations |
| AS 3705 | 2012 | Geotextiles - Identification, marking, and general data |
| AS 3798 | 2007 | Guidelines on earthworks for commercial and residential developments |
| AS 4419 | 2018 | Soils for landscaping and garden use |
| AS 4678 | 2002 | Earth-retaining structures |
| EN 15804 | 2012 | Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products |
| ISO 14025 | 2006 | Environmental labels and declarations - Type III environmental declarations - Principles and procedures |
| ISO 21930 | 2017 | Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services |
| SA HB 160 | 2006 | Soils testing |
| Cessnock City Council | | Development Engineering Handbook |

## 5 ANNEXURE M – CESSNOCK CITY COUNCIL SPECIFIC CLAUSES

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|---|---|---|
| M1. | Variations to or non-conformances with Council's AUS-SPEC are to be evaluated with reference to the procedure in Council's *Development Engineering Handbook*. Acceptance is to be obtained in writing from:<br>a) an authorised representative of Council's Director of Infrastructure and Engineering Services. | **Variation procedure** |
| M2. | This specification applies in addition to any development consent (DA) conditions. If there is any inconsistency, the conditions of consent shall prevail. | **DA Conditions** |
| M3. | Refer to the Cessnock City Council Development Engineering Handbook for final inspection, works-as-executed and handover requirements. | **Completion** |

## 6 AMENDMENT HISTORY

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| 0 | 15/01/2024 | First Published |