WINDIMURRA VANADIUM PROJECT
PROTEUS ENGINEERS

STANDARD SPECIFICATION

FOR

GENERAL EARTHWORKS

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1.0 SCOPE

This specification defines the requirements for site clearance, grubbing, excavation, filling, compaction and finishing of earthworks.

2.0 APPLICABLE CODES AND STANDARDS

The works shall comply with all current Australian Standards and statutory regulations where applicable and related specifications as applicable.

2.1 Australian Standards

AS 1141 Methods for sampling and testing aggregates

AS 1152 Specification for test sieves

AS 1289 Methods of testing soils for engineering purposes

AS 1348 Glossary of terms – road and traffic engineering

AS 1470 Health and safety at work - principles and practices

AS 3600 Concrete structures

AS 1726 Geotechnical site investigations

AS 2187 Explosives - storage, transport and use

AS 3660 Termite management

AS 3798 Guidelines on earthworks for commercial and residential developments.

3.0 SETTING OUT

The earthworks shall be set out in accordance with the drawings.

The Contractor shall examine the site and verify all existing levels and survey control points, and the set out points shown on the drawings, before commencing the earthworks.

The Contractor shall ascertain the position of all underground services and structures in the vicinity of the work. The Contractor shall ensure that the existing services are not damaged.

All concrete bases and posts, pipes or other erections used for temporary bench marks shall be removed on completion of work. Temporary bench marks shall be designed and placed so as not to be a potential source of danger.

4.0 SITE CLEARING AND GRUBBING

In the interests of minimising the environmental impact, unnecessary clearing of trees and other vegetation will not be tolerated. Uncontrolled practices shall not take place and all activities, including equipment movements, shall be restricted to the designated work areas and construction areas. Trees and vegetation within designated work areas and

construction areas which are not to be disturbed will be identified on site prior to clearing works commencing.

The Contractor shall obtain environmental clearance from the Engineer and then give at least 24 hours notice of his intention to commence site clearing. Within certain areas for clearing and grubbing, the Engineer may nominate areas for partial clearing and grubbing or clearing only.

Notwithstanding these limitations, clearing and grubbing shall be carried out over the areas comprising the full extent of the works, including borrow pit areas, stockpile sites, access roads, drain alignments, fence lines, fire breaks, areas set aside for the Contractor's establishment on the site and any other areas specified which are necessary for the completion of the works.

The Contractor shall not commence clearing any borrow or stockpile area until The Engineer has jointly agreed with the Contractor the extent of the area to be cleared.

All cleared areas shall be kept clear of re-growth for the duration of the works.

Clearing and grubbing of the site shall include the removal of all vegetation, deleterious matter such as tree stumps, roots, rubbish, building rubble and other debris within the area of the work. It shall include the grubbing out of all stumps and roots larger than 50 mm diameter to a depth of 600 mm and all other roots, vegetation and boulders to a depth of 300 mm below either the natural surface or the finished subgrade surface, whichever is the lower. The waste matter shall be removed from the site and disposed of as specified. The preferred method of disposal of vegetation shall be by chipping into mulch and spreading over topsoil stockpiles unless noted otherwise.

All burning shall be subject to the agreement of the Engineer. All timber, brush, rotten wood and other refuse from the clearing or grubbing operations to be disposed of by burning, shall only be burned in areas designated by the Engineer. Burning shall be carried out in a workmanlike manner to minimise hazards such as bush fires, damage to other properties or existing structures, and delays to construction progress.

All laws, regulations and ordinances relating to the building of fires shall be complied with. Disposal by burning shall be kept under constant attendance until the fires have burned out or have been extinguished.

The top layer of organic topsoil, to a depth of 100mm or as shown on the drawings, shall be stripped from the area of the works and stored for reuse or disposed of as directed by the Engineer. Topsoil dumps shall not be more than two metres in height.

5.0 EXCAVATIONS

5.1 General

Before commencing any excavations or penetrations of the ground, a permit shall be applied for on a written form (eg. Permit to Dig). Excavation shall not commence until written agreement is obtained.

5.2 Safety

The Contractor shall take the necessary action to ensure the safety of each excavation with regard to people, equipment, existing services, nearby buildings, structures etc. The Contractor shall also comply with all current WORKSAFE regulations.

The sides of all excavations shall conform to the following minimum requirements:

- every face of any excavation that exceeds a depth of 1.5 m shall be supported or contained by shoring unless the face is cut back to a safe slope or there is no danger to persons in the vicinity of the work
- the shoring of the excavation is braced as the excavation progresses and, where a mechanical digger is used, the shoring is kept as close as practicable to the digger
- the shoring extends at least 200 mm above the surrounding ground level or a similar protection is provided at the edges of the excavation by a fender board.

Buildings, structures, footings, pipelines, ducts, tunnels, culverts, slabs, conduits etc., shall be supported to the satisfaction of the Engineer in all situations where excavations undercut, are next to, or reduce the support.

All necessary measures shall be taken to ensure that excavations are in a safe condition at all times, including the erection of suitable safety barricades, warning signs and hazard lights.

5.3 Water

The Contractor shall take appropriate action and supply all equipment necessary to divert any surface and sub-soil water from the work. Trenches, sumps, pumps, spears and other dewatering equipment shall be utilised as required.

The de-watering method and procedures shall not result in damage to or have any detrimental effect on adjacent structures and services or on adjoining land. The Contractor shall be responsible for all damages or detrimental effects caused by de-watering.

5.4 Depth of Excavation

All excavations shall be made to the depth or extent as shown on the drawings with proper allowance for fill, blinding concrete and formwork. The excavations shall be kept free and clean of loose materials, water and rubbish. Should excavation to the nominated depth reveal unstable or unsuitable ground, the Contractor shall immediately inform the Engineer.

5.5 Spoil

Excavated material that is unsuitable for backfilling or other filling requirements, or is otherwise not required for re-use in the works, shall be removed from the site and disposed of at the specified area or as directed by the Engineer.

5.6 Over-Excavation

Unauthorised over-excavation shall be reinstated to a condition at least equivalent to the original ground by using either compacted approved backfill or lean mix (15 MPa) concrete. Over-excavation shall be reported to the Engineer before any corrective measures are undertaken.

5.7 Fill and Embankment Slopes

The slope of compacted fills or excavated embankment surfaces shall not be steeper than the slopes specified on the drawings.

5.8 Rock Excavation

5.8.1 Bulk Rock Excavation

Bulk rock excavation is that which would normally be carried out using a bulldozer and loader or scraper.

Bulk rock excavation shall be deemed to be material which cannot be ripped at 100 bm3/h by a bulldozer with a motor power of 300 kW (equivalent to a Caterpillar D10N). The bulldozer is assumed to be in good condition, fitted with good tracks and a single hydraulic ripper with a sharp ripper shoe.

5.8.2 Detailed Rock Excavation

Detailed rock excavation is that excavation which would normally be carried out using a backhoe or hydraulic excavator.

Detailed rock excavation shall be deemed to be material which cannot be excavated at a rate of 20 bm3/h using a 110 kW flywheel power hydraulic excavator (equivalent to a Caterpillar E240C). The excavator is assumed to be in good condition and fitted with a 500 mm wide rock bucket with sharp tines.

5.8.3 Test Machine

The test machine for rock classification shall be provided together with a competent operator to demonstrate to the satisfaction of the Engineer that any material warrants classification as rock.

5.8.4 Blasting

5.8.4.1 Regulations

All drilling and blasting shall be performed strictly in accordance with the requirements of the Engineer, the Mines Regulations and other statutory requirements as applicable.

5.8.4.2 Safety

All necessary measures are to be taken to ensure the protection of persons, the work, adjacent plant, vehicles and property. To ensure protection from flying rock, blasting nets shall be used where required for each blasting operation.

5.8.4.3 Site Blasting

If explosives will be needed for the work on site, the Contractor shall submit a written request to the Engineer.

This request shall include the following information:

- the details and location of the work where explosives are proposed to be used
- the maximum quantity and types of explosives to be stored on site
- the details of the explosives magazine and its proposed location
- copies of current shotfirer's licenses and permits.

Only after written permission has been given by the Engineer shall the Contractor bring explosives on to the site. Explosives shall only be stored in an accepted magazine.

A 'Permit to Blast' shall be obtained from the Engineer prior to the Contractor carrying out any blasting.

The 'Permit to Blast' application shall contain the following:

- the size, type and location of charges
- the method of protection
- the method of firing
- the time of firing requested
- details of warning signals.

The excavation profile resulting from the blasting shall have a minimum of overbreak.

The Engineer shall be immediately notified of any blasting misfire, the location of the misfire and the remedial action to be taken.

All unused explosives shall be returned to the magazine immediately the charge has been placed.

6.0 FILLING

6.1 General

Unless notified otherwise, all the required filling materials shall be won, transported, placed, compacted and tested by the Contractor. Where imported fill is required or specified, the fill shall be supplied by the Contractor.

6.2 Borrow Pits

The establishment of the borrow areas shall include clearing and grubbing the borrow pit site, removing and stockpiling topsoil, stripping and stockpiling any excess or unsuitable overburden, drainage control and, if required, a single access road or track. The winning of borrow material shall include excavating and processing of selected material.

When processing of materials is required, it shall include combining with other materials, the addition of water and any other operation needed to produce the required material.

The Contractor shall obtain material from borrow pits which are always subject to any specified environmental limitations and restrictions and safety regulations. Borrow areas shall be kept free of large accumulations of water. Dust control shall be suitably managed to the satisfaction of the Engineer.

On completion of all operations at the borrow pit, the Contractor shall leave the area in a safe condition. Batters and floor shall be evenly graded and drainage shall fall to a common point.

When the borrow pit is to be restored, the overburden and material in stockpile taken from the borrow area and not considered suitable for use in the works shall be spread evenly over the borrow pit area. Batter slopes shall not be steeper than one (1) vertical to two (2) horizontal. The finished profiles over the borrow area shall complement the natural contours and surface slopes of the surrounding ground and shall be to the satisfaction of The Engineer.

The flow of water into the borrow pit shall be prevented by the construction of earth banks and interceptor drains.

Borrow pits shall be progressively established and rehabilitated in stages.

6.3 Fill Material

The suitability of material for fill or backfill shall be in accordance with this specification. Allowance shall be made for the re-use of excavated material where possible.

Fill material shall be granular and fit for purpose, clean and free from roots, wood, masonry, plastic, rubbish, building rubble, organic matter and large stones. Materials containing clay/silt exceeding 15% by weight shall not be used.

Structural select fill material shall be well graded between the limits shown below:

Sieve Size (mm)	% Passing by Mass
75	100
37.5	70-100
19	50-100
9.5	40-100
4.75	30-100
2.36	17-73
1.18	14-63
0.6	12-50
0.425	10-45
0.3	8-35
0.15	5-20
0.075	0-15

Excavated material unsuitable for use as fill shall be removed to spoil and replaced with approved fill material.

6.4 Inspection

Filling operations shall not commence until the Engineer has been formally notified and given approval.

6.5 Moisture Conditioning

Prior to the compaction of fill, all fill material shall be moisture conditioned to achieve a moisture content within +2,-1% of the optimum moisture content for the material. The moisture shall be uniformly distributed throughout the fill and there shall be no clods of soil.

6.6 Placement of Earth Fill

Earth fill shall be placed in a systematic manner in horizontal layers of approximately equal thickness. The depth of each layer shall not exceed 300mm loose, unless specified otherwise, and in any case shall not exceed the depth for which satisfactory compaction can be guaranteed using the proposed plant.

No stone within the fill layer shall exceed 150 mm in maximum dimension. Where select fill is nominated this shall be free of material greater than 25mm in size. Screening or otherwise sorting of the material prior to placement may be required.

At the edges of filled ground, the embankment shall be overfilled and cut back on completion to ensure batters are compacted.

Where existing soil surfaces are to be covered with less than 300 mm of fill, the surface shall be scarified then mixed with the imported fill to give a minimum compacted layer thickness of 150 mm and re-compacted to the same density as that specified for fill.

6.7 Compaction of Earth Fill

6.7.1 Compacted Soil Density

The degree of fill compaction shall comply with that specified.

At a minimum the level of compaction under structures and roads shall not be less than 95% Modified Maximum Dry Density (MMDD) and in all other areas shall not be less than 90% MMDD.

6.7.2 Proof Rolling

Where specified, proof rolling shall be carried out using a 12 tonne drum roller travelling at a speed not exceeding 7 km/hr. At least 4 passes of the roller shall be made. Any soft or loose soil spots in the foundation after rolling shall be brought to the attention of the Engineer.

6.7.3 Backfill Compaction

Backfill around concrete shall be compacted to the minimum density specified.

Special care shall be taken when backfilling near retaining walls. Fill material shall not be placed behind the retaining wall until material on the low side has been compacted or shoring is in place. Heavy vibrating compaction equipment shall not be operated closer to the retaining wall than the height of the backfill on which it is operating. However, the compaction of the total fill volume must still comply with this specification.

Fill to trenches shall be compacted to a density at least equal to that of the surrounding in-situ material.

6.8 Finishing and Tolerances

The surface of all gravel areas, roadways and embankments newly constructed or disturbed shall be graded to a smooth surface.

Topsoil shall be spread on areas to be restored as directed by the Engineer or as shown on the drawings. The average slope of batters shall not exceed the specified slope.

The surface of the subgrade under concrete or paving at any point shall not be higher than the design level shown on the drawings. Unless noted otherwise on the drawings, all levels shall be finished to the tolerances shown in Table 1.

Table 1: Finished Profile Tolerances

Subgrade for slabs and hardstand areas	+ 0 mm - 20 mm
Detailed excavation Deviation from the design level	± 20 mm
Deviation from a 3 m straight edge laid along the finished surface	< 10 mm
Bulk earthworks levels	± 50 mm
Deviation of batter line from the design batter at any point along the batter	<150 mm

6.9 Dust Suppression

The Contractor shall take all necessary measures to ensure that dust from the operations does not constitute a hazard or nuisance on the works or adjacent areas to the satisfaction of the Engineer. The Contractor shall comply with the requirements of statutory regulations and the mine environmental management plan (EMP).

7.0 INSPECTION AND TESTING

7.1 General

A suitably qualified soils technician shall be engaged by the Contractor to perform sampling, insitu density testing of fill material, sub-grade and graded area, and such other soil tests as specified. Testing shall be carried out in accordance with AS 1289. Density tests shall be carried out not later than 24 hours after compaction has been completed. Test results shall be issued to the Engineer for approval.

The Contractor shall provide access at all times during construction to the site for the Engineer to undertake their own testing if directed.

Standard penetrometer tests (SPT) may be used on subgrades for footings and slabs where the material is suitable for their use, i.e. an absence of stony material. They shall be calibrated to the percent MDD specified. In the absence of a specified figure, 95% shall be used. They may also be used as an assistance to determine compaction in general bulk filling, but shall not replace the tests specified.

7.2 Frequency of Testing

Table 2 shall represent the minimum number of tests to be performed.

TABLE 2: Frequency Of Testing

Description	Test	Minimum Testing Frequency
Bulk Earthworks Foundation	Compaction Moisture Content	1 test per 1,000 m2 1 test per 1,000 m2
Embankment Construction- General	Compaction Moisture Content	1 test per layer per 1,000 m2 1 test per layer per 1,000 m2
Backfill of trenches - General Under roads and buildings	Compaction (SPT) Compaction (SPT)	1 test per 10 m3 or 20 Lm (whichever is less) 1 test per 10 Lm
Under Footings (<4 m2)	Compaction (SPT)	1 test per footing
Under Footings (>4 m2)	Compaction (SPT)	1 test per 3 m2 (minimum of 2 per footing)
Over Footings	Compaction (SPT)	1 test per 20 m3 (minimum of 1 per 4 footings)
Slab (on grade)	Compaction (SPT)	1 test per 30 m2

Random tests shall be carried out in all areas where compaction limits have been specified.

Amongst others, the following stages of the work will be inspected:

- completion of stripping before placing any fill material
- completion of excavation work before compacting the natural sub-grade
- completion of general fill before placing sub-grade material and final layers
- completion of compacted sub-grade fill material before placement of final layers
- at the stage when sub-grade material is completed beneath future concrete structures.

At the completion of each stage, test results shall be given to the Engineer.

7.3 Unsatisfactory Results

Where the field density of the compacted layer as determined by test is less than the specified percentage compaction, the layer shall be re-worked and re-tested until the specified compaction is achieved. Unsatisfactory material shall be excavated and replaced with satisfactory material and compacted as specified