

**SES**  
**AUSTRALIA**  
Environment & Soil Sciences

# Tallawong Green

## Soil Landscape Specifications




**Prepared for:**

**Deicorp projects (Tallawong Station) Pty Ltd**

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## TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION.....</b>	<b>5</b>
<b>2</b>	<b>SPECIFICATION 1: ACTIVE TURF STANDARD WEIGHT A-HORIZON ('TYPE 1').....</b>	<b>8</b>
2.1	PART A. 'FIT-FOR-PURPOSE' PERFORMANCE DESCRIPTION .....	8
2.2	PART B. TECHNICAL PARAMETERS .....	9
2.3	METHOD REFERENCES .....	10
2.4	PART C. EXAMPLE COMPONENTS FOR THE SOIL SUPPLIER .....	10
<b>3</b>	<b>SPECIFICATION 2: ACTIVE TURF STANDARD WEIGHT B-HORIZON ('TYPE 2').....</b>	<b>12</b>
3.1	PART A. 'FIT-FOR-PURPOSE' PERFORMANCE DESCRIPTION .....	12
3.2	PART B. TECHNICAL PARAMETERS .....	13
3.3	METHOD REFERENCES .....	13
3.4	PART C. EXAMPLE COMPONENTS FOR THE SOIL SUPPLIER .....	13
3.5	MANUFACTURING SOILS FROM SITE-WON SUBSOIL – PROCESS AND VALIDATION.....	14
3.6	WORK METHOD STATEMENT FOR INCORPORATING SITE SUBSOIL INTO MANUFACTURED SOILS FOR LANDSCAPING .....	14
3.7	WORK METHOD STATEMENT .....	15
<b>4</b>	<b>SPECIFICATION 3: GENERAL PLANTING A-HORIZON SOIL MIX – STANDARD WEIGHT ('TYPE 3').....</b>	<b>16</b>
4.1	PART A. 'FIT-FOR-PURPOSE' PERFORMANCE DESCRIPTION .....	16
4.2	ORGANIC MULCH (OPTIONAL) .....	17
4.3	PART B. TECHNICAL PARAMETERS.....	18
4.4	METHOD REFERENCES .....	19
4.5	PART C. EXAMPLE COMPONENTS FOR THE SOIL SUPPLIER .....	19
<b>5</b>	<b>SPECIFICATION 4: GENERAL PLANTING SUBSOIL B-HORIZON – STANDARD WEIGHT ('TYPE 4' SOIL MIX).....</b>	<b>21</b>
5.1	PART A. 'FIT-FOR-PURPOSE' PERFORMANCE DESCRIPTION .....	21
5.2	PART B. PRODUCT SPECIFICATION (TECHNICAL PARAMETERS) .....	22
5.3	METHOD REFERENCES .....	23
5.4	PART C. EXAMPLE COMPONENTS FOR THE SOIL SUPPLIER .....	23
5.5	MANUFACTURING SOILS FROM SITE-WON SUBSOIL – PROCESS AND VALIDATION.....	23
5.6	WORK METHOD STATEMENT FOR INCORPORATING SITE SUBSOIL INTO MANUFACTURED SOILS FOR LANDSCAPING .....	24
5.7	WORK METHOD STATEMENT .....	24
<b>6</b>	<b>SPECIFICATION 5 &amp; 6: GENERAL GARDEN AREAS - LIGHTWEIGHT ('TYPE 5' A-HORIZON SOIL MIX AND 'TYPE 6' B-HORIZON SOIL MIX) .....</b>	<b>25</b>
6.1	PART A. 'FIT-FOR-PURPOSE' PERFORMANCE DESCRIPTION .....	25
6.2	TECHNICAL PARAMETERS .....	26

6.3	METHOD REFERENCES .....	27
6.4	PART C. EXAMPLE COMPONENTS FOR THE SOIL SUPPLIER .....	28
<b>7</b>	<b>TREE PLANTINGS WITHIN ACTIVE TURF AREA .....</b>	<b>29</b>
<b>8</b>	<b>Q1 QUALITY ASSURANCE AND CONTROL .....</b>	<b>30</b>
8.1	INITIAL COMPLIANCE CERTIFICATION .....	30
8.2	RECORD KEEPING .....	30
8.3	QUALITY CONTROL: COMPLIANCE DURING CONSTRUCTION .....	31
8.4	HOLD POINT TEMPLATE .....	33
<b>9</b>	<b>LIMITATIONS .....</b>	<b>34</b>

## DOCUMENT TABLES IN TEXT

Table 1. Proposed on-slab soil landscape areas for Tallawong Green. ....	6
Table 2. Specification 1: Standard Weight Active Turf A-Horizon 'Type 1' – Physical Properties. ....	9
Table 3. Specification 1: Standard Weight Active Turf A-Horizon 'Type 1' – Chemical Properties. ....	10
Table 4. Specification 1: Standard Weight Active Turf A-Horizon 'Type 1' (On-Slab) – Physical Properties. ....	13
Table 5. Specification 1: Standard Weight Active Turf A-Horizon 'Type 1' (On-Slab) – Chemical Properties. ....	13
Table 6. Specification 3: General Planting 'Type 3' physical properties. ....	18
Table 7. Specification 3: General Planting 'Type 3' chemical properties. ....	18
Table 8. Specification 4: B-Horizon Standard Weight 'Type 4' physical properties. ....	22
Table 9. Specification 4: B-Horizon Standard Weight 'Type 4' physical properties. ....	22
Table 10. Specification 5 & 6: Lightweight A-Horizon 'Type 5' and B-Horizon 'Type 6' physical properties. ....	26
Table 11. Specification 5 & 6: Lightweight A-Horizon 'Type 5' and B-Horizon 'Type 6' chemical properties. ....	27
Table 12. Example components (likely to meet the physical Target ranges of this specification) .....	28
Table 13. Outline of the required testing frequency to achieve compliance testing. Samples must be tested to the performance criteria indicated in the product specification. ....	31



# 1 Introduction

SESL Australia (SESL) has been engaged by Deicorp projects (Tallawong Station) Pty Ltd (the Client) to provide professional soil science landscape specifications, advice and assessment for the design and construction phase of the centrepiece Tallawong Green (the Project).

The site area covers 70,424 m<sup>2</sup> and is located at two sites:

- (1) Site 1: 2 - 12 Conferta Ave, Rouse Hill Legally known as Lot 294 / DP1213279
- (2) Site 2: 1 - 15 Conferta Ave, Rouse Hill Legally known as Lot 293 / DP1213279.

Tallawong Green will be constructed upon an underground carpark and will comprise of a turf grass area with large trees (i.e. Figs and Eucalyptus) planted along the perimeter. Play areas, footpaths and amenity areas will be also constructed on the green. The specifications in this report relate to green-scape areas only and do not relate to importation of select fill for engineering requirements. SESL understands that the green will also receive compaction from pedestrian traffic and occasional maintenance and emergency vehicles.



Figure 1. Tallawong Green schematic. (Source: Deicorp projects (Tallawong Station) Pty Ltd. February 2020).

SESL's purpose for this project is to provide soil specifications to ensure a suitable medium is constructed to 1.5m depth using imported and recovered materials from site for successful plant growth. There will be a balance between developing a soil profile that can support vegetative growth as well as tolerate compaction. At this stage in the design process the engineering weight bearing load requirements are not known, therefore SESL has provided a lightweight and standard weight specifications and incorporated other strategies such as reducing soil depth to minimise soil weight loading.

There is an opportunity to retain and reuse on-site resources in the subsoil (B-Horizon). SESL understands that the site topsoil (A-Horizon) has already been stripped however the B-Horizon is part of the Blacktown Landscape and has potential for reuse. Blacktown subsoils are strongly aggregated red-brown, light to medium clays or grey silty clays to heavy clays. Chemical and physical analysis will allow for characterisation of the site materials to determine the exact proportion of the soil could be blended with imported materials to achieve desired soil properties. The resource recovery strategy outlined will allow for an environmental and economical process.

SESL has provided soil specifications as outlined in Table 1. Each landscape has been assigned a soil type code for reference.

Table 1. Proposed on-slab soil landscape areas for Tallawong Green.

Weight Loading	Landscape Area	SESLs Soil Type Code
<b>Standard Weight</b>	On-Slab Active Turf A-Horizon	'Type 1' A-Horizon Soil Mix
	On-Slab Active Turf B-Horizon	'Type 2' B-Horizon Soil Mix
	On-Slab A-Horizon - Ground Cover, Shrubs and Trees Specification	'Type 3' A-Horizon Soil Mix
	On-Slab B-Horizon	'Type 4' B-Horizon Soil Mix
<b>Lightweight</b>	On-Slab A-Horizon - Ground Cover, Shrubs and Trees Specification	'Type 5' A-Horizon Soil Mix
	On-Slab B-Horizon	'Type 6' A-Horizon Soil Mix
<b>n/a</b>	Quality assurance & control / Hold Points	n/a

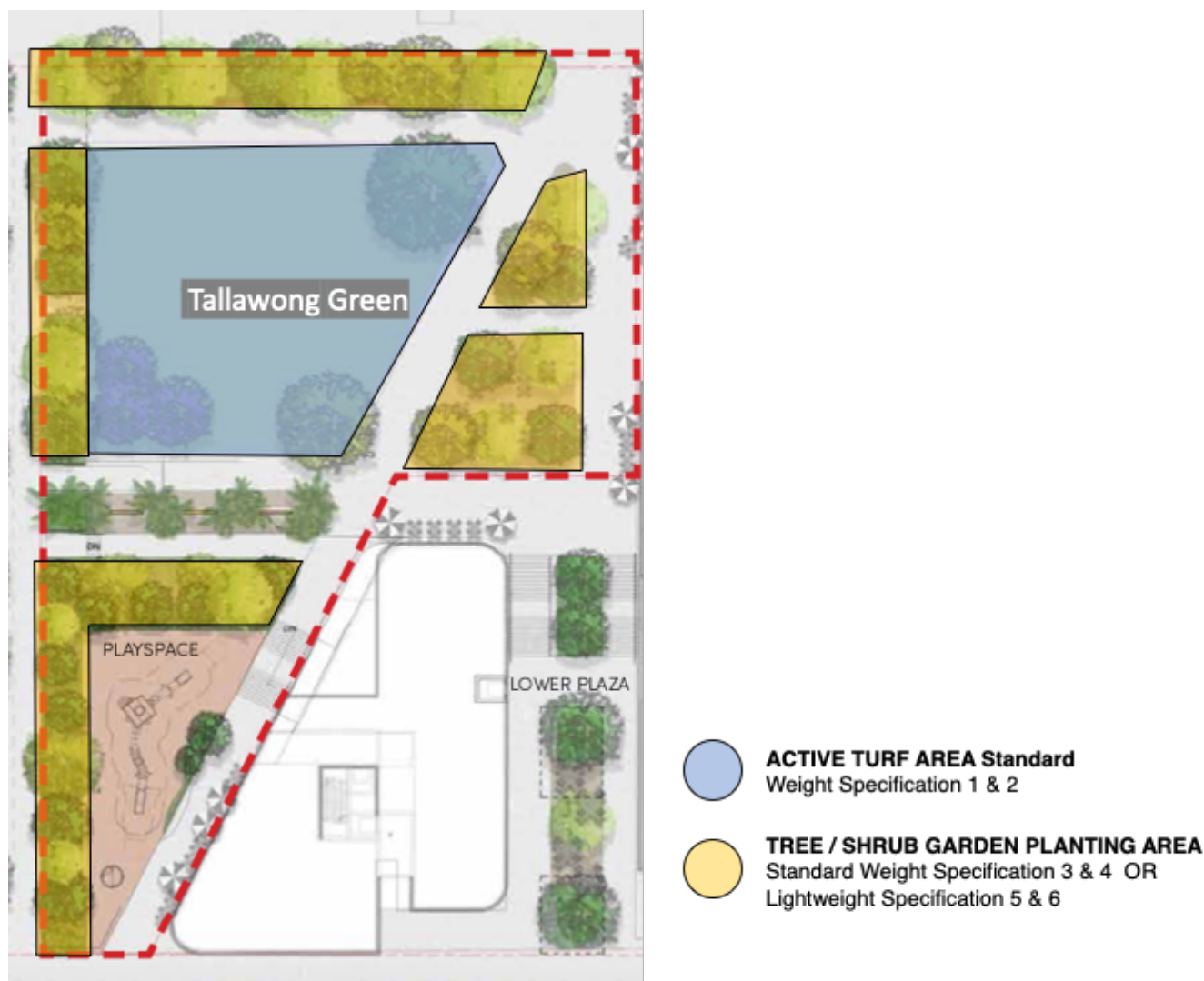


Figure 2. Tallawong Green with two different soil types. The active turf soil is in blue and areas in yellow are the garden and tree planting areas.

## 2 Specification 1: Active Turf Standard Weight A-Horizon ('Type 1')

### 2.1 Part A. 'Fit-for-purpose' performance description

Soil 'Type 1' is for recreational use and is intended for moderate to high levels of use from pedestrian traffic and the occasional maintenance and emergency vehicles. This soil will also support building structures such as playgrounds and amenity buildings. This soil will be compacted to meet engineering requirements however will still need to sustain turf planting.

Soil 'Type 1', is a loamy sand to sandy loam (80/20 blend), well-drained 'turf underlay' topsoil mix designed to provide resistance to compaction, rapid drainage but with adequate water-holding capacity to sustain turf growth. The narrow fines specifications is considered important in meeting the shear strength target range without risking undue compaction, but precedence will be given to meeting the shear strength and permeability test Target ranges. The recommended depth of Soil 'Type 1' is 300mm.

Soil 'Type 1' A-Horizon should have a minimum of 300mm depth overlying a Soil 'Type 2' B-Horizon consisting of a 60/40 blend. In the instance of tree plantings within the turf area refer to 'Tree Plantings within Active Turf Area'.

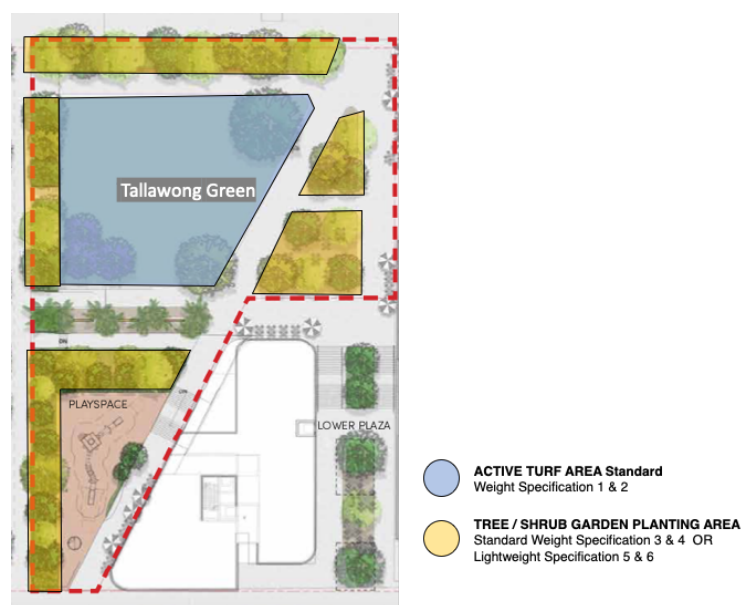


Figure 3. Specification 1 is to be used in the active turf areas that are highlighted in blue.



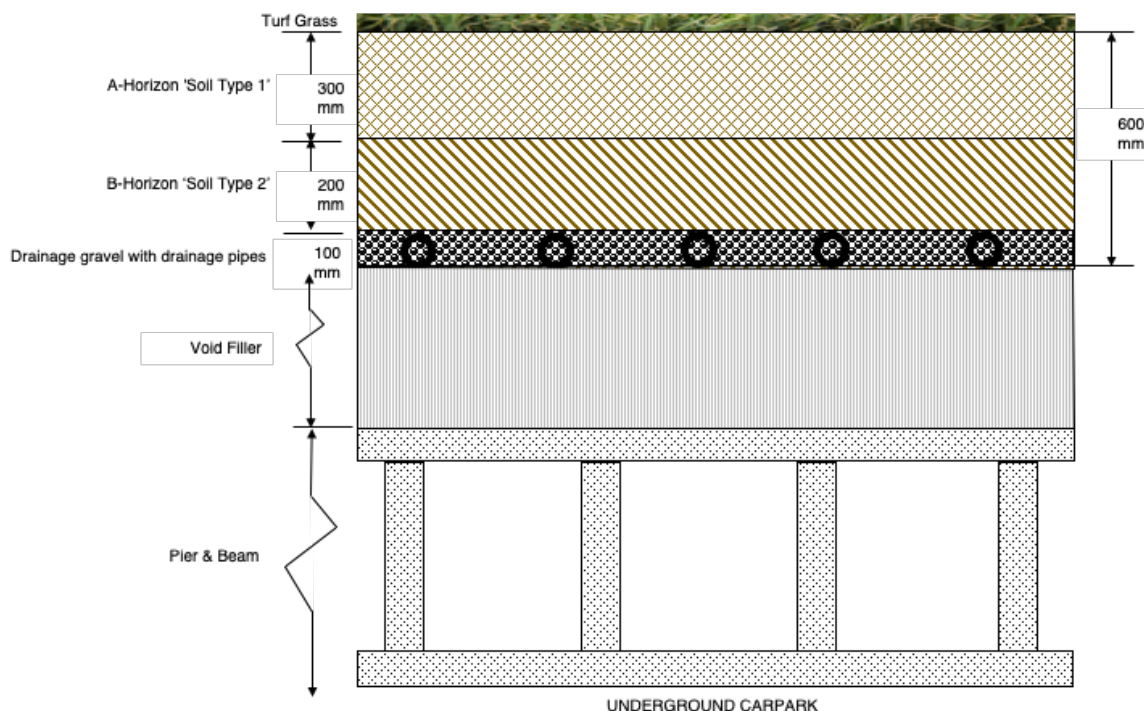


Figure 4. Standard Weight Active Turf A-Horizon 'Type 1' (On-Slab)

## 2.2 Part B. Technical parameters

Generally, the soil must be free of 'unwanted material' and must meet all the Target ranges of Table 2 and Table 3. Where variations from these Target ranges occur refer to Specification Q1.

Table 2. Specification 1: Standard Weight Active Turf A-Horizon 'Type 1'– Physical Properties.

Property	Units	A-Horizon Target range	
2.0 mm (fine gravel) <sup>1</sup>	% retained by	< 3	
1.0 mm (very coarse sand)	mass	< 10	
0.5 mm (coarse sand)		10–30	40–70
0.25 mm (medium sand)		20–40	
0.1 mm (fine sand)		20–30	
0.05 (very fine sand)		< 15 (max 20% combined vfs, Si +Cl)	
0.002 mm (silt)		< 8 (Si + Clay combined 5–8%)	
< 0.002 mm (clay)		2–6	

Large particles <sup>2</sup>		2–10 mm < 2% > 10 mm 0%
Organic matter content <sup>4</sup>	% w/w	2 to 5
Permeability <sup>3</sup>	mm/hour	50–200 (@ 16 drops by McIntyre Jakobsen)
Wettability (AS 4419) <sup>2</sup>	mm/hour	> 5
Dispersibility in water <sup>2</sup>		1 or 2 (AS4419) Category

Table 3. Specification 1: Standard Weight Active Turf A-Horizon 'Type 1'– Chemical Properties.

Property	Units	A-Horizon Target range
pH in water (1:5) <sup>5</sup>	pH units	5.4–8.0
pH in CaCl <sub>2</sub> (1:5) <sup>5</sup>	pH units	5.2–7.5
Electrical conductivity (1:5) <sup>5</sup>	dS/m	< 0.5
Exchangeable Na percentage <sup>5</sup>	% of ECEC	< 7
Exchangeable Ca/Mg ratio <sup>5</sup>	Ratio	3–9
Available phosphorus Mehlich 3 <sup>5</sup> Olsen	mg/kg	50–150 20–50
Available nitrogen (nitrate N + ammonium N)	mg/kg	30–100

## 2.3 Method references

1. AS1289 1632 - 2003
2. AS4419
3. McIntyre & Jakobsen-1998
4. Rayment & Lyons – 6B2
5. Rayment & Lyons (2011)

## 2.4 Part C. Example components for the soil supplier

The following table outlines suggested components that may likely meet the physical Target ranges of this specification. This is **not** part of the product specification. It is an example for the edification of the soil supplier

of what might meet the product specification. For the purposes of tendering, the contractor must allow for the inclusion of the above soil amendments, but the specific amendments required must be verified by laboratory testing and agronomist recommendations.

Example components (likely to meet the physical Target ranges of this specification)		
Medium grade clean sand	60–80% by volume	e.g. 7-parts washed sand/ 2-part sandy loam/1 part AS4454 compost.
Sandy loam soil	10–30% by volume	
Composted soil conditioner conforming with Australian Standard AS 4454	10% by volume	
Base level Target ranges for fertilisers (to be verified by laboratory testing and per agronomist's report)		
Lime and/or dolomite	2 kg/m³ at mixing	
Balanced compound NPK turf starter fertiliser	2.9 kg/100m² after placement	
Minor and trace elements	300 g/m³ at mixing	

See also **Specification Q1 Quality assurance and control and Hold-Points.**

### 3 Specification 2: Active Turf Standard Weight B-Horizon ('Type 2')

#### 3.1 Part A. 'Fit-for-purpose' performance description

Soil 'Type 2' is the subsoil B-Horizon that is to be installed beneath Soil 'Type 1' at a depth of 200mm. The overlying topsoil (Type 1) will be used for recreational use and is intended for moderate to high levels of use from pedestrian traffic and the occasional maintenance and emergency vehicle.

This B-Horizon subsoil will be compacted to no more than 80% proctor to meet engineering requirements as this soil will still need to sustain turf planting and provide adequate drainage.

Soil 'Type 2' can be comprised of 60% imported media blended with 40% site subsoil clay. The depth can be constructed to a minimum of 200mm giving a total soil profile of 500mm.

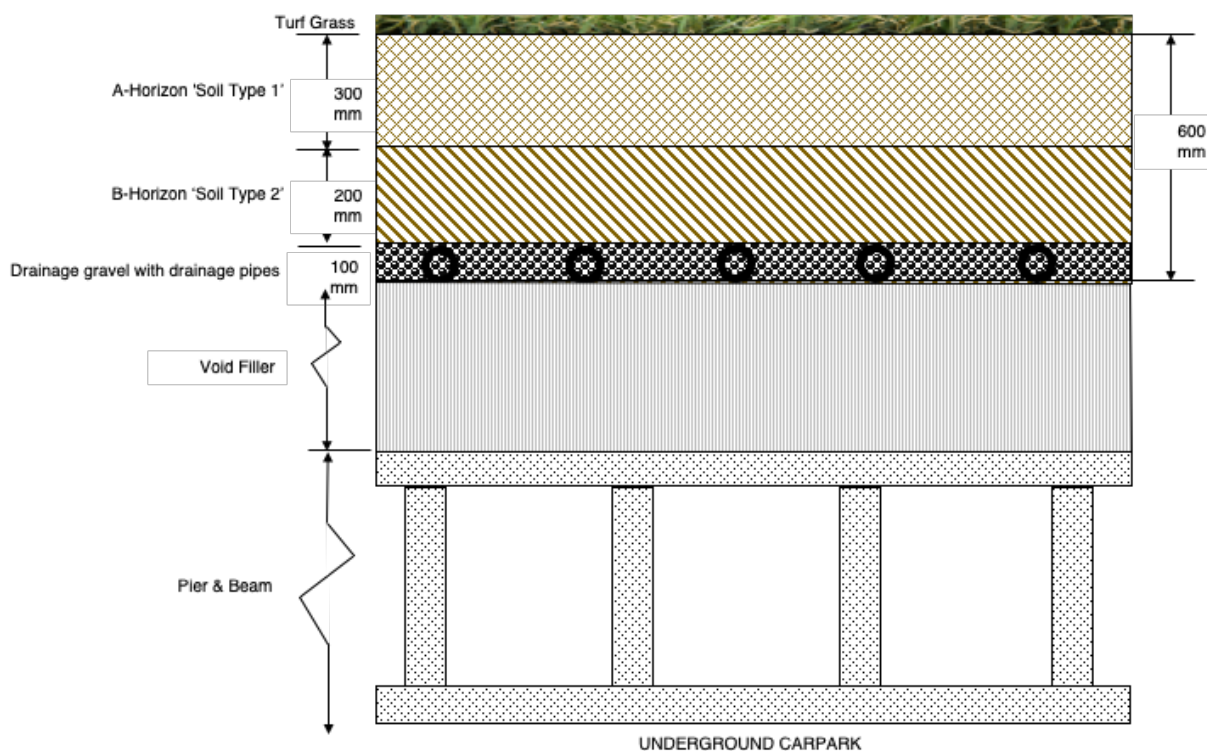


Figure 5. Standard Weight Active Turf B-Horizon 'Type 2' (On-Slab)



## 3.2 Part B. Technical parameters

Generally, the soil must be free of 'unwanted material' and must meet all the Target ranges of Table 4 and Table 5. Where variations from these Target ranges occur refer to Specification Q1.

Table 4. Specification 1: Standard Weight Active Turf A-Horizon 'Type 1' (On-Slab) – Physical Properties.

Property	Units	A-Horizon Target range
Large particles <sup>1</sup>		100% < 50 mm
Organic matter content <sup>2</sup>	% w/w	2 to 5

Table 5. Specification 1: Standard Weight Active Turf A-Horizon 'Type 1' (On-Slab) – Chemical Properties.

Property	Units	A-Horizon Target range
pH in water (1:5) <sup>3</sup>	pH units	5.4–8.0
pH in CaCl <sub>2</sub> (1:5) <sup>3</sup>	pH units	5.2–7.5
Electrical conductivity (1:5) <sup>3</sup>	dS/m	< 0.5
Exchangeable Na percentage <sup>3</sup>	% of ECEC	< 7
Exchangeable Ca/Mg ratio <sup>3</sup>	Ratio	3–9

## 3.3 Method references

1. AS4419
2. Rayment & Lyons – 6B2
3. Rayment & Lyons (2011)

## 3.4 Part C. Example components for the soil supplier

The following table outlines suggested components that may likely meet the physical Target ranges of this specification. This is **not** part of the product specification. It is an example for the edification of the soil supplier of what might meet the product specification. For the purposes of tendering, the contractor must allow for the inclusion of the above soil amendments, but the specific amendments required must be verified by laboratory testing and agronomist recommendations.

Example components (likely to meet the physical Target ranges of this specification)		
Medium grade sand	60 – 70% by volume	e.g. 6-parts sand/ 4-part site-won clay
Sandy loam soil	30 - 40% by volume	
Base level Target ranges for fertilisers (to be verified by laboratory testing and per agronomist's report)		
Lime and/or dolomite	2 kg/m³ at mixing	
Balanced compound NPK turf starter fertiliser	2.9 kg/100m² after placement	
Minor and trace elements	300 g/m³ at mixing	

### 3.5 Manufacturing soils from site-won subsoil – process and validation

Site-won subsoil shall be screened prior to use in manufactured soil blends. After screening, the subsoil shall be characterised to determine the chemical and physical parameters. Properties for assessment are:

- Physical properties: large particles.
- Chemical properties: pH and salinity, cation exchange capacity and the organic matter content.
- Analysis shall be undertaken by a NATA-registered laboratory (SESL Australia or equivalent).

An allowance should be made for the addition of sand (to improve the particle size distribution), the addition of gypsum (to improve the exchangeable calcium).

Sampling frequency for characterisation shall be 1: 1000 m<sup>3</sup>.

### 3.6 Work method statement for incorporating site subsoil into manufactured soils for landscaping

It is understood that subsoil is an available resource for the creation of the soil blends. Once characterised, recommendations will be delivered with approximate blending rates of soil components (sand) and soil ameliorants (gypsum, lime, fertilisers) to manufacture small batches of landscaping soils. These landscaping soils will then be assessed against the criteria set out in the performance specification for approval for bulk blending, prior to installation.

### 3.7 Work method statement

1. Screen and breakdown the site-won excavated subsoil to < 50mm
2. Characterise the subsoil using a NATA-registered laboratory (SES Australia or equivalent) for large particles, pH, EC, cations and organic matter to ensure it meets the requirements of the specification above.
3. Engage a soil scientist to determine the rates of sand and gypsum required to meet the desired specification, as well as any other materials needed (sand, topsoil, fertilisers, other soil ameliorants)
4. Blend the ratios as specified by the soil scientist by mixing small batches. Take a representative sub-sample from the small-mix batch and submit for analysis against the desired specification to a NATA-registered laboratory (SES Australia or equivalent).
5. Upon approval of meeting the specification from a soil scientist, mix large batches at the prescribed ratios and validate as per the requirements of the specification.

See also **Specification Q1 Quality assurance and control and Hold-Points.**

## 4 Specification 3: General Planting A-Horizon Soil Mix – Standard Weight ('Type 3')

### 4.1 Part A. 'Fit-for-purpose' performance description

'Type 3' topsoil is specified as a sandy loam to clay loam topsoil mix to be installed to a minimum depth of 300mm over the top of 'Soil Type 4' to ensure enough rooting volume for large trees such as Figs and Eucalyptus. Soil 'Type 3' and 'Type 4' are not to be compacted.

'Type 3' topsoil is designed for general purpose, landscape garden bed planting of grasses, woody and herbaceous annuals and perennials that have a high nutrient target range for sustained optimum growth and are not subject to compaction by pedestrian or other traffic.

The heavier textured soils in this specification may require the use of engineered solutions (drainage techniques) where excessive wetness is anticipated. Note that the Organic soil variant should not be chosen for low P plantings and should not be used below 300 mm. Planting methods may vary and include direct seeding, tube and potted specimens up to 45 L.

'Type 1' A-Horizon soil will be installed over 'Type 2' B-Horizon subsoil as illustrated in Figure 7.

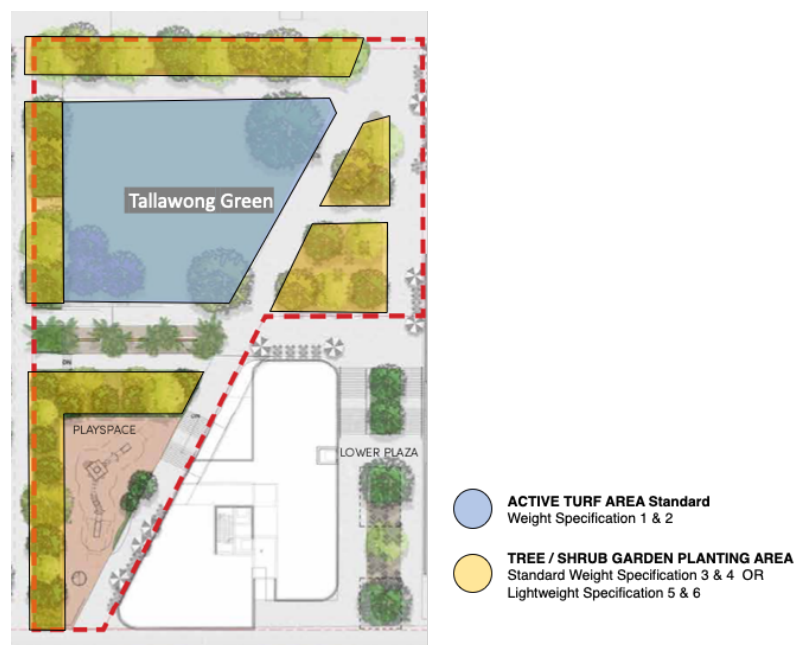


Figure 6. Specification 3 is to be used in the general garden areas that are highlighted in yellow.



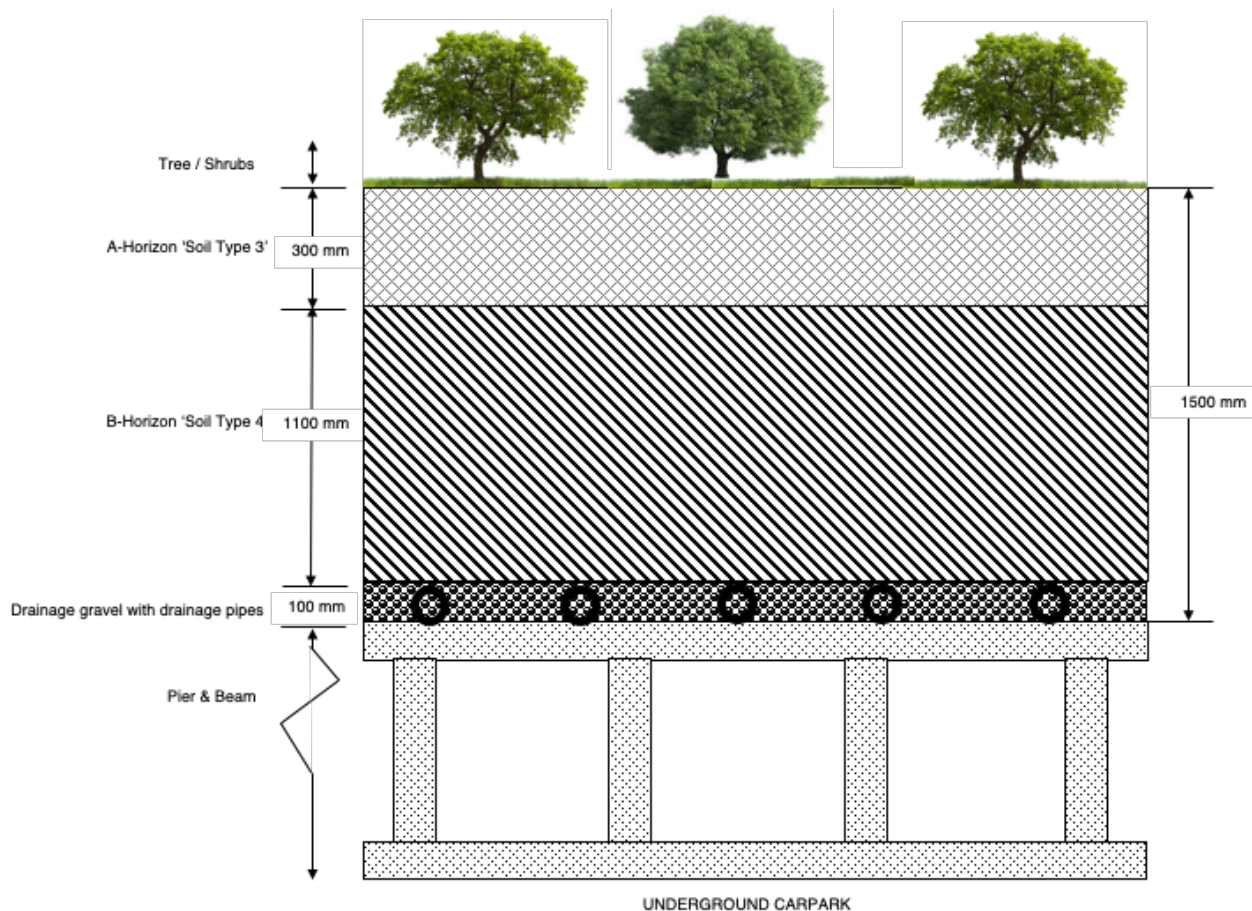


Figure 7. General Planting Standard Weight 'Type 3' Soil. An optional imported mulch layer could be applied at a depth of 50 – 75mm to the surface of the imported A Horizon.

## 4.2 Organic Mulch (optional)

If mulch is to be applied to the surface of 'Soil Type 1' it should comply with Australian Standard 4454 and be installed at a thickness of 50 – 75mm. Do not apply mulch greater than 75mm thick. A composted forest mulch would suffice. Alternatively, decorative mulch such as pine chip and pine bark could be used.

An application of urea at 20g/m<sup>2</sup> or 200g/m<sup>3</sup> will assist with any nitrogen drawdown effect.

## 4.3 Part B. Technical Parameters

Generally, the soil must be free of 'unwanted material' and must meet all the Target ranges of Table 6 and Table 7. Where variations from these Target ranges occur refer to **Specification Q1 Quality assurance and control**.

Table 6. Specification 3: General Planting 'Type 3' physical properties.

Property	Units	Target range
Texture, preferred range <sup>1</sup>	n/a	Sandy loam to clay loam
Organic matter <sup>2</sup>	% dwb	3 - 6
Permeability (@ 16 drops by McIntyre Jakobsen) <sup>3</sup>	mm/h	> 30
Wettability <sup>4</sup>	mm/h	> 5
Dispersibility in water <sup>4</sup>	Category	1 or 2 (AS4419)
Large particles (naturally occurring) <sup>4</sup>		
2–20 mm	% w/w	< 20
> 20 mm	% w/w	< 10
Visible contaminants > 2 mm (glass, plastic and metal) <sup>5</sup>	%w/w	< 0.5

Table 7. Specification 3: General Planting 'Type 3' chemical properties.

Property	Units	Target range
pH in water (1:5) standard range <sup>6</sup>	pH units	5.4–6.8
pH in CaCl <sub>2</sub> (1:5) standard range <sup>6</sup>	pH units	5.2–6.5
pH in water (1:5) alkaline range <sup>6</sup>	pH units	6.8–8.0
pH in CaCl <sub>2</sub> (1:5) alkaline range <sup>6</sup>	pH units	6.5–7.5
Electrical conductivity (1:5) <sup>6</sup>	dS/m	< 0.65
Phosphorus – P-tolerant /standard plants. Acid soils method <sup>6</sup>	mg/kg	50–100
Phosphorus – P sensitive. Acid soils method <sup>6</sup>	Mg/kg	30 - 60
Sodium (Na) <sup>6</sup>	% of ECEC	< 7%

Potassium (K) <sup>6</sup>	% of ECEC	5–10%
Calcium (Ca) <sup>6</sup>	% of ECEC	60–80
Exchangeable magnesium (Mg) <sup>6</sup>	% of CEC	15–25
Exchangeable aluminium (Al) <sup>6</sup>	% of CEC	< 2
Exchangeable Ca/Mg ratio <sup>6</sup>	w/w	3 – 9
Available iron (Fe) <sup>6</sup>	mg/kg	100–400
Available manganese (Mn) <sup>6</sup>	mg/kg	25–100
Available zinc (Zn) <sup>6</sup>	mg/kg	5 – 30
Available Copper (Cu) <sup>6</sup>	mg/kg	1 – 15
Available boron (B) <sup>6</sup>	mg/kg	0.5 – 5
Available N (ammonium-N + nitrate-N) <sup>6</sup>	mg/kg	> 50

## 4.4 Method references

1. Texture (SESL Method)
2. Rayment and Lyons 6B2
3. McIntyre & Jakobsen-1998
4. AS4419
5. AS4454-2012 Appendix I
6. Rayment & Lyons (2011)

## 4.5 Part C. Example components for the soil supplier

The following table outlines suggested components that may likely meet the physical target ranges of this specification. This is **not** part of the product specification. It is an example for the edification of the soil supplier of what might meet the product specification.

Example components (likely to meet the physical Target ranges of this specification)		
Sandy loam soil	70–100% by volume	e.g. 7 parts washed sand/2 parts sandy loam/1 part AS4454 compost.
Composted soil conditioner conforming with Australian Standard AS 4454	0–30% by volume	

**Base level Target ranges for fertilisers (to be verified by laboratory testing and per agronomist's report)**

Balanced compound NPK turf starter fertiliser	0.5 kg/100 m <sup>2</sup> after placement
Minor and trace elements	300 g/m <sup>3</sup> at mixing

For the purposes of tendering the contractor must allow for the inclusion of the above soil amendments but the specific amendments required must be verified by laboratory testing and agronomist recommendations.



## 5 Specification 4: General Planting Subsoil B-Horizon – Standard Weight ('Type 4' Soil Mix)

### 5.1 Part A. 'Fit-for-purpose' performance description

Soil 'Type 4' can be used as a B-Horizon subsoil under Soil 'Type 3' General Planting Topsoil (standard weight).

Soil 'Type 4' is generally, a low organic matter material that is well balanced chemically, is not saline or sodic or excessively acidic or calcium deficient and not dispersive. It is designed to provide improved rooting depth for larger plantings and reduce the likelihood of waterlogging. It may be made up using site subsoil or fill materials or a blend of both. It is not generally considered to require the application of fertiliser to subsoil but must be low in P if used for P-sensitive plantings.

Soil 'Type 4' can be comprised of 50% imported media blended with 50% site subsoil clay. The depth can be constructed to a minimum of 200mm giving a total soil profile of 500mm.

Soil 'Type 3' A-Horizon soil (300mm) will be installed over 'Type 4' B-Horizon subsoil (1100mm) as illustrated in Figure 7. The overall soil profile total including the Soil Type 3 topsoil is 1500mm.

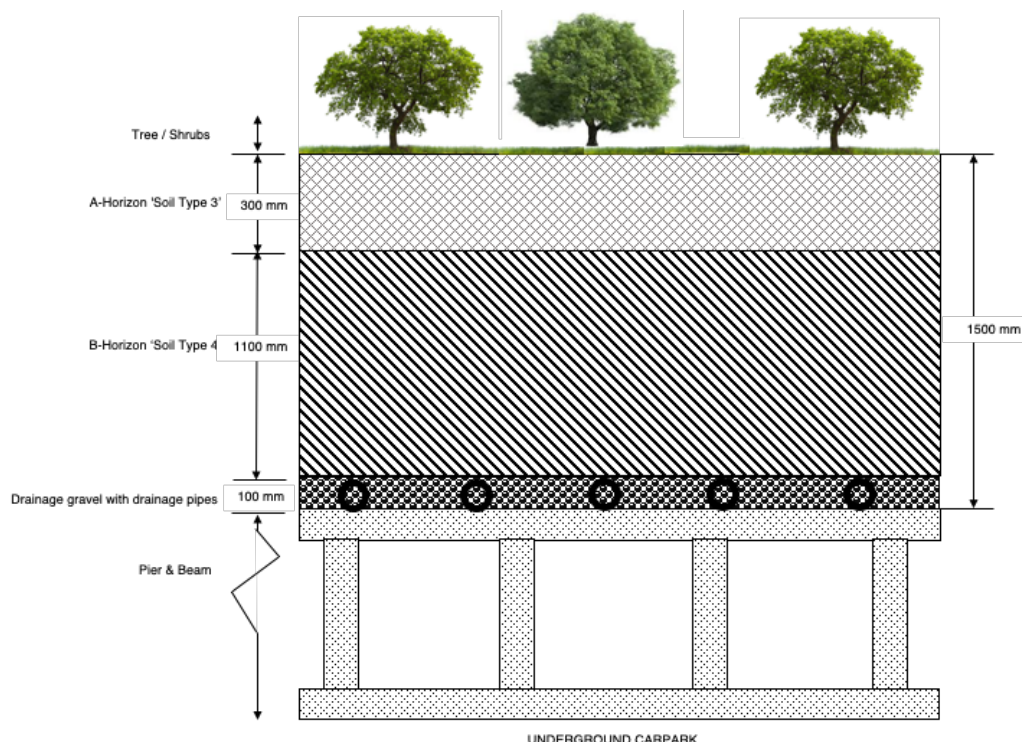


Figure 8. 'Type 3' & Type 4 general planting standard weight soil profile.

## 5.2 Part B. Product specification (technical parameters)

Soil 'Type 4' soil must be free of 'unwanted material' and must meet all the Target ranges of Table 8 and

Table 9. Where variations from these Target ranges occur refer to Specification Q1 Quality Assurance and Control and Hold Points.

Table 8. Specification 4: B-Horizon Standard Weight 'Type 4' physical properties.

Property	Units	Target range
Texture, preferred range <sup>1</sup>	n/a	sandy loam to sandy clay loam
Large particles <sup>4</sup>	% w/w	100% < 50 mm

Table 9. Specification 4: B-Horizon Standard Weight 'Type 4' physical properties.

Property	Units	Target range
pH in water (1:5) Standard range <sup>6</sup>	pH units	5.4–6.8
pH in CaCl <sub>2</sub> (1:5) Standard range <sup>6</sup>	pH units	5.2–6.5
pH in water (1:5) Alkaline range <sup>3</sup>	pH units	6.8–8.0
pH in CaCl <sub>2</sub> (1:5) Alkaline range <sup>3</sup>	pH units	6.5–7.5
Electrical conductivity (1:5) <sup>6</sup>	dS/m	< 0.5
Chloride <sup>6</sup>	mg/kg	< 200
Phosphorus – P (P-tolerant or standard plants) – acid soils method <sup>6</sup>		< 30 mg/kg
Phosphorus – P (P-sensitive plants) – alkaline soils method <sup>3</sup>		< 20 mg/kg
Sodium (Na) <sup>6</sup>	% of ECEC	< 7%
Potassium (K). <sup>6</sup>	% of ECEC	3–10%
Calcium (Ca) method 18F1 or 15A1 in alkaline soils <sup>3</sup>	% of ECEC	60–80
Magnesium (Mg) <sup>6</sup>	% of ECEC	15–25%
Ca:Mg ratio <sup>6</sup>	-	1.5 - 8

## 5.3 Method references

1. Texture (SESL Method)
2. AS 1289.3.8.1-2006 & P.E.V. Charman & B.W. Murphy-1991 Chapter 10: Craze & Hamilton
3. Rayment & Lyons 15A1-2011
4. AS4419
5. AS4454-2012 Appendix I
6. Rayment & Lyons (2011)

## 5.4 Part C. Example components for the soil supplier

The following table outlines suggested components that may likely meet the physical Target ranges of this specification. This is not part of the product specification. It is an example for the edification of the soil supplier of what might meet the product specification.

Example components (likely to meet the physical Target ranges of this specification)	
Sandy or sandy loam soil	50 % v/v
On-site clay subsoil	50 % v/v
Base level Target ranges for fertilisers (to be verified by laboratory testing and per agronomist's report)	

For the purposes of tendering, the contractor must allow for the inclusion of the above soil amendments, but the specific amendments required must be verified by laboratory testing and agronomist recommendations.

## 5.5 Manufacturing soils from site-won subsoil – process and validation

Site-won subsoil shall be screened prior to use in manufactured soil blends. After screening, the subsoil shall be characterised to determine the chemical and physical parameters. Properties for assessment are:

- Physical properties: large particles.
- Chemical properties: pH and salinity, cation exchange capacity and the organic matter content.
- Analysis shall be undertaken by a NATA-registered laboratory (SESL Australia or equivalent).

An allowance should be made for the addition of sand (to improve the particle size distribution), the addition of gypsum (to improve the exchangeable calcium).

Sampling frequency for characterisation shall be 1: 1000 m<sup>3</sup>.

## 5.6 Work method statement for incorporating site subsoil into manufactured soils for landscaping

It is understood that subsoil is an available resource for the creation of the soil blends. Once characterised, recommendations will be delivered with approximate blending rates of soil components (sand) and soil ameliorants (gypsum, lime, fertilisers) to manufacture small batches of landscaping soils. These landscaping soils will then be assessed against the criteria set out in the performance specification for approval for bulk blending, prior to installation.

## 5.7 Work method statement

1. Screen and breakdown the site-won excavated subsoil to < 50mm
2. Characterise the subsoil using a NATA-registered laboratory (SESL Australia or equivalent) for large particles, pH, EC, cations and organic matter to ensure it meets the requirements of the specification above.
3. Engage a soil scientist to determine the rates of sand and gypsum required to meet the desired specification, as well as any other materials needed (sand, topsoil, fertilisers, other soil ameliorants)
4. Blend the ratios as specified by the soil scientist by mixing small batches. Take a representative sub-sample from the small-mix batch and submit for analysis against the desired specification to a NATA-registered laboratory (SESL Australia or equivalent).
5. Upon approval of meeting the specification from a soil scientist, mix large batches at the prescribed ratios and validate as per the requirements of the specification.

See also **Specification Q1 Quality assurance and control and Hold-Points.**



## 6 Specification 5 & 6: General Garden Areas - Lightweight ('Type 5' A-Horizon Soil Mix and 'Type 6' B-Horizon Soil Mix)

### 6.1 Part A. 'Fit-for-purpose' performance description

Soil 'Type 5' and Soil 'Type 6' are lightweight soils that are to be used in the general garden areas in the instance where engineers weight bearing loads are enforced. Soil 'Type 5' and 'Type 6' are not to be compacted. The A-Horizon & B-Horizon Soil Mix specifications describes the formulation of an open granular well-drained growing media with a saturated density of less than 2200 kg/m<sup>3</sup> (< 2.2 kg/L) for use in on-slab applications with an expectation of longevity.

'Type 5' topsoil formulation to be used in the surface 300 mm and 'Type 4' B Horizon should be used in profiles deeper than 300mm. A lower percentage of organic components (< 5 % w/w) is prescribed in the B horizon due to susceptibility to slumping over time and prevention of the soil becoming anaerobic.

In order to maintain structure and porosity over extended periods, and to avoid slumping and volume loss over time, the formulation must employ low density mineral components such as ash, perlite, scoria, pumice and diatomaceous earth, or artificial components such as urea formaldehyde and styrofoam. Physically, the media has the properties of a potting media and is assessed using the methodology of AS 3743 Potting mixes.

It is unlikely that manufactured soils containing site-won material will be suitable for on-structure applications due to the weight restrictions.

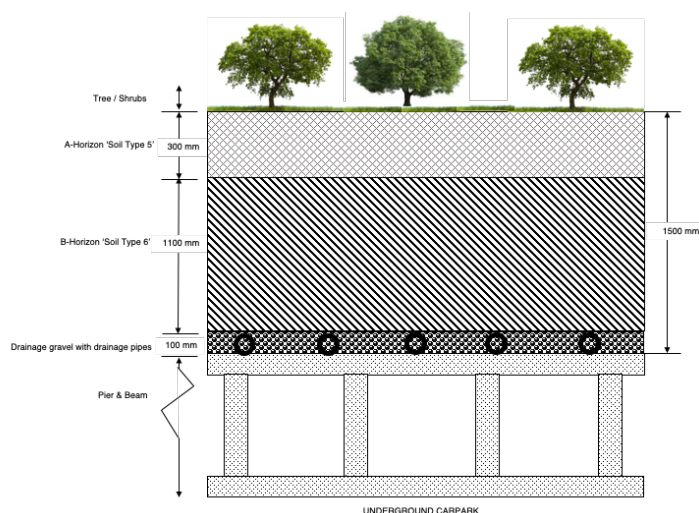


Figure 9. Lightweight A-Horizon 'Type 5' and B-Horizon 'Type 6' soil profile for general garden plantings.

## 6.2 Technical Parameters

Generally, the soil must be free of 'unwanted material' and must meet all the Target ranges of **AS 3743 Potting mixes** and the specified Target ranges of **Australian Standard AS 4419 Landscape soils**. However, compliance with AS 3743 does not demonstrate compliance with this specification. Where the Target ranges of this specification and AS3743 conflict, properties specified here must take precedence.

Table 10. Specification 5 & 6: Lightweight A-Horizon 'Type 5' and B-Horizon 'Type 6' physical properties.

Property	Units	A-Horizon Target range	B-Horizon Target range
Texture, preferred range <sup>1</sup>	n/a	Gravelly loamy sand to organic sandy loam	Gravelly loamy sand to organic sandy loam
Air-filled porosity <sup>2</sup>	%	≥ 10	≥ 10
Water-holding capacity <sup>2</sup>	%	≥ 40	≥ 40
Saturated density <sup>2</sup>	kg/m <sup>3</sup>	< 2200	< 2200
Permeability (@ 16 drops by McIntyre Jakobsen) <sup>3</sup>	mm/h	> 100	> 100
Organic matter <sup>4</sup>	% w/w	< 15	< 5
Wettability <sup>2</sup>	min	≤ 5	≤ 5
<b>Large particles in the largest dimension <sup>5</sup></b>			
< 2 mm	% w/w	30–70	30–70
2–10 mm	% w/w	10–20	10–20
10–20 mm	% w/w	5–10	5–10
20–50 mm	% w/w	< 5	< 5
> 50 mm	% w/w	0	0

Table 11. Specification 5 &amp; 6: Lightweight A-Horizon 'Type 5' and B-Horizon 'Type 6' chemical properties.

Chemical properties	Units	A-Horizon Target range	B-Horizon Target range
pH in water (1:5) Standard range <sup>2</sup>	pH units	5.4–6.8	5.4–6.8
Electrical Conductivity (1:1.5) <sup>2</sup>	dS/m	< 2.2	< 2.2
Chloride <sup>2</sup>	mg/L	≤ 200	≤ 200
Ammonium-N (NH <sub>4</sub> ) <sup>2</sup>	mg/L	≤ 100	≤ 100
Ammonium-N + nitrate-N (NH <sub>4</sub> + NO <sub>3</sub> ) <sup>2</sup>	mg/L	≥ 50	≥ 50
Nitrogen draw-down index <sup>2</sup>	-	≥ 0.7	≥ 0.7
Toxicity index <sup>2</sup>	mm	≥ 70	≥ 70
Phosphorus – P standard range <sup>2</sup>	mg/L	8–40	8–40
Low phosphorus – P (P-sensitive plants) <sup>2</sup>	mg/L	< 3	< 3
Potassium (K) <sup>2</sup>	mg/L	50–250	50–250
Sulphate (SO <sub>4</sub> ) <sup>2</sup>	mg/L	≥ 40	≥ 40
Calcium (Ca) <sup>2</sup>	mg/L	≥ 80	≥ 80
Magnesium (Mg) <sup>2</sup>	mg/L	≥ 15	≥ 15
Ca:Mg ratio <sup>2</sup>	–	1.5–10	1.5–10
K:Mg ratio <sup>2</sup>	–	1–7	1–7
Sodium (Na) <sup>2</sup>	mg/L	≤ 130	≤ 130
Iron (Fe) <sup>2</sup>	mg/L	≥ 35	≥ 35
Copper (Cu) <sup>2</sup>	mg/L	0.4–15	0.4–15
Zinc (Zn) <sup>2</sup>	mg/L	0.3–10	0.3–10
Manganese (Mn) <sup>2</sup>	mg/L	1–15	1–15
Boron (B) <sup>2</sup>	mg/L	0.02–0.65	0.02–0.65

## 6.3 Method references

1. Texture (SESL Method)
2. AS3743
3. McIntyre & Jakobsen-1998
4. Rayment & Lyons 6G1-2011
5. AS4419

## 6.4 Part C. Example components for the soil supplier

The following table outlines suggested components that may likely meet the physical Target ranges of this specification. This is **not** part of the product specification. It is an example for the edification of the soil supplier of what might meet the product specification.

Table 12. Example components (likely to meet the physical Target ranges of this specification)

Components	A-Horizon Components	B-Horizon Components
Sandy loam soil or site won topsoil	20–40% by volume	10–30% by volume
Horticultural ash, perlite, or similar lightweight low-density mineral matter or mixtures of these	30–60% by volume	30–50% by volume
Composted soil conditioner conforming with AS4454	20–30% by volume	< 20% by volume
Composted 10mm pine bark	-	20-40%
Base level Target ranges for fertilisers (to be verified by laboratory testing and per agronomist's report)		
Lime and/or dolomite	2 kg/m <sup>3</sup> at mixing	2 kg/m <sup>3</sup> at mixing
Balanced compound NPK turf starter fertiliser	3.0 kg/100 m <sup>2</sup> after placement	3.0 kg/100 m <sup>2</sup> after placement
Minor and trace elements	300 g/m <sup>3</sup> at mixing	300 g/m <sup>3</sup> at mixing

For the purposes of tendering, the contractor must allow for the inclusion of the above soil amendments, but the specific amendments required must be verified by laboratory testing and agronomist recommendations.

The suggested **fertilisers are expected to last 3–6 months** of sustained growth. A suitable fertiliser (e.g. controlled slow release) and organic matter maintenance program may be required after this period, depending on the design intent.

See also **Specification Q1 Quality assurance and control and Hold-Points.**

## 7 Tree Plantings within Active Turf Area

SESL understands that trees (Figs, Eucalyptus) will be planted within the turf active area. The tree species are not known yet and are likely to affect:

1. Soil Type - Type 1 soil may need to be excavated and replaced with Type 3 soil to allow for a soil that has higher nutrient and water holding properties.
2. Soil Depth – The 500mm deep soil profile is likely to be inadequate for large trees.
3. Subsoil areas with the active turf area may need to be excavated to 1500mm to allow for adequate root space for large areas.

Figure 10 illustrates the complete soil profile combining both the Active Turf and General Garden planting areas. Client feedback regarding the underground construction is required in order for SESL to update this illustration.

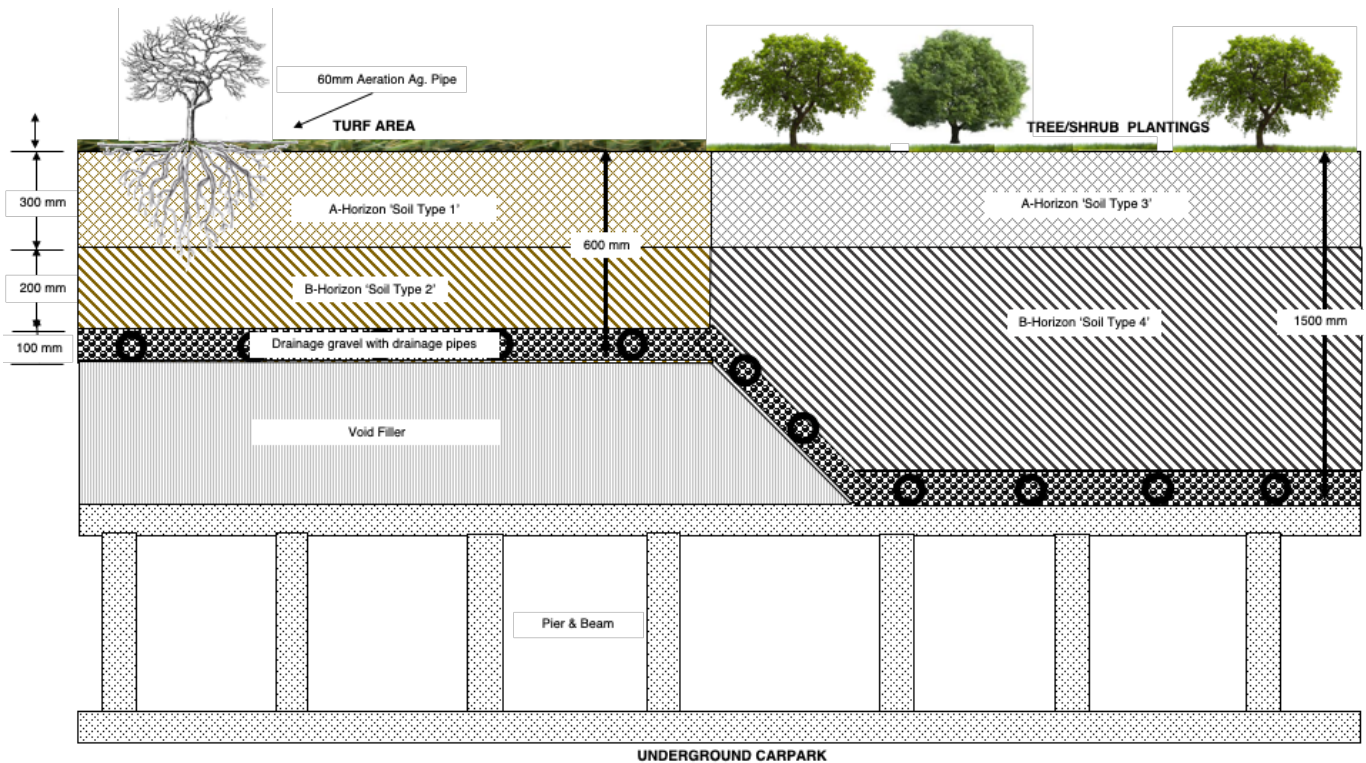


Figure 10. Illustration of complete soil profile with Active Turf and General Garden Areas. Tree plantings within Active Turf areas



## 8 Q1 Quality Assurance and Control

The contractor must use analytical testing to verify compliance with the Product Specification. This will be done in two parts: initial compliance certification and quality control, described below.

### 8.1 Initial compliance certification

**Before any soil installation**, the contractor or soil manufacturer will submit samples of trial blends likely to meet the performance specifications (see suggested formulations) to a NATA-registered testing laboratory (SESL Australia or equivalent). The trial blend must be based on available test information on components and, if necessary, employ a soil scientist for advice.

**Submit trial samples** to the NATA-registered testing laboratory (SESL Australia or equivalent), allowing sufficient time for testing and re-formulation in the case of failure to satisfy the performance criteria. Once compliant, a test certificate clearly stating compliance with the applicable criteria must be presented to the site supervisor or quality officer.

Note that alternative test methodologies may be accepted and certified as compliant by an independent Certified Professional Soil Scientist (CPSS).

**Non-compliance** will automatically generate the first **Hold point 1**. No soil will be installed until initial compliance certification has been demonstrated.

**Manufacturer's product representation:** For imported soils from manufacturers, a 'product representation' document produced by the supplier may be accepted as a compliance certificate if:

- It is an off-the-shelf product line, not a custom mix;
- A representative test certificate is available and is acceptably recent (within 3 months);
- The testing covers all those criteria in the performance specification; and
- The manufacturer's quality assurance system is externally certified.

### 8.2 Record keeping

Growing media initial compliance certification records must be kept in an easily retrievable manner that provides for traceability of purchase and location on site. Each compliance certification for all the product specifications used on site must be identified by date, quantity to be supplied and a copy of the formulation used to reach compliance.

## 8.3 Quality control: compliance during construction

The contractor must submit samples of blended soils or imported soil mixes at regular intervals during construction for the purposes of demonstrating continued compliance as part of quality control.

### 8.3.1 Test submissions

For Hold Point 1, contractor or supplier is to submit representative samples of ~ 5 kg of each product specification, packed and labelled to indicate the source and the specification to be met. The samples must be taken in a representative manner.

For Hold Point 2 and 3, representative samples should be collected by a qualified soil scientist in accordance to *Section 9 Landscape: Standard Specification for Urban Infrastructure Works (TAMS 2002)*.

The contractor must refer to the testing frequencies indicated in Table 13. Variations to the frequencies in this table are permitted on the submission to the superintendent of an alternative testing program that clearly achieves the desired outcome of quality control. Materials supplied from operations that have a third-party-endorsed quality assurance program may be acceptable pending submission of the relevant documentation.

Table 13. Outline of the required testing frequency to achieve compliance testing. Samples must be tested to the performance criteria indicated in the product specification.

Specification	Material	Minimum QC test frequency
Soil Type 1	Standard Weight Active Turf A-Horizon	1 per 1,000 m <sup>3</sup> .
Soil Type 2	Standard Weight Active Turf A-Horizon B-Horizon	1 per 500 m <sup>3</sup> .
Soil Type 3	Standard Weight General Garden A-Horizon	1 per 500 m <sup>3</sup> .
Soil Type 4	Standard Weight General Garden B-Horizon	1 per 500 m <sup>3</sup> .
Soil Type 5	Lightweight General Garden A-Horizon	1 per 100 m <sup>3</sup> .
Soil Type 6	Lightweight General Garden B-Horizon	1 per 100 m <sup>3</sup> .

Note: Where the delivery is less than the stated QC testing frequency, the initial compliance certificate must be deemed to demonstrate compliance.

### 8.3.2 Analysis

All testing as required by the product specifications must be arranged by the contractor, and carried out by NATA-registered testing laboratory (SESL Australia or equivalent). All test results records will be made available to the superintendent or quality officer.

**Hold point 1.** The test certificate will be accompanied by a statement of compliance from a soil scientist.

Compliance certificates will be in the form of a report clearly stating the material is compliant, with an attachment showing the test result relied upon. In the case of minor non-compliance or substantial compliance, a clear statement must be obtained from a soil scientist waiving the compliance and certifying the sample is compliant or fit for purpose, with or without conditions.

### 8.3.3 Non-compliance

In the case of substantive non-compliance, **Hold Points 2 and Hold Point 3** will occur – one to correct soil already installed and another to ensure new deliveries are compliant. In the case of minor non-compliance or substantial compliance, a clear statement must be obtained from an independent CPSS report certifying the corrective procedure has resulted in compliance or fit for purpose including acceptance of any non-compliance with or without conditions and certifying the sample is fit for purpose. The superintendent will examine the submitted documentation prior to authorising the release of the Hold Point.

**Hold point 2.** The contractor will need to make corrective procedures to bring any soil that has been placed with substance compliance in accordance with the CPSS Soil Scientist advice.

**Hold point 3.** In the event that quality control samples show substantial non-compliance from the approved performance Target ranges, the supplier must demonstrate compliance of any future loads. This may require re-formulation or alteration to existing formulations and may require the advice of an independent CPSS to meet correct analysis, making adjustments to mixing ratios, additives and procedures to achieve compliance.

### 8.3.4 Record keeping

Growing media construction and QC compliance records must be kept in an easily retrievable manner that provides for traceability of purchase and location on site. Each batch of soil must be identified by date of manufacture, quantity and a corresponding test result and must link into when the material was delivered and where the material was placed.

## 8.4 Hold Point Template

<b>HOLD POINT 1</b>	
Process Held:	Completion of <i>insert specification</i> initial compliance certification. .
Submission Details:	Initial soil analysis with sample provided by supplier or contractor demonstrated soil results compliance with the <i>insert specification</i> . Sample analysed must include subsoil improvement as recommended in specification. .
Release of Hold Point:	Submission of laboratory test certificates to superintendent together with suppliers, contractors or independent soil scientist report certifying compliance or fit for purpose including acceptance of any non-compliance with or without conditions. .
<b>HOLD POINT 2</b>	
Process Held:	Supply of <i>insert specification</i>
Submission Details:	At least (3) working days prior to supply for <i>insert specification</i> , the Contractor shall provide certificate(s) from a NATA-registered or approved non NATA-registered laboratory for physical and chemical analysis. Certificates are to be certified compliant or fit for purpose by a soil scientist, including acceptance of any non-compliance with or without conditions.
Release of Hold Point:	The superintendent will examine the submitted documentation prior to authorising the release of the Hold Point.
<b>HOLD POINT 3</b>	
Process Held:	Compliance failure of <i>insert specification</i> during ongoing compliance certification
Submission Details:	Corrective procedures specification from a Certified Professional Soil Scientist (CPSS) for soil corrective amendments likely to result in compliance with the <i>insert specification</i>
Release of Hold Point:	Submission of laboratory test certificates to superintendent together with an independent CPSS report certifying the corrective procedure has resulted in compliance or fit for purpose including acceptance of any non-compliance with or without conditions. The superintendent will examine the submitted documentation prior to authorising the release of the Hold Point.

## 9 LIMITATIONS

### *Limitations of This Report:*

SESL has provided consulting services for this project as outlined in our discussions and in accordance with current professional and industry standards for soil site assessment. The findings of this report are the result of discrete/specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of this site and do not represent the actual state of the site at all points. Should materials or conditions be encountered other than those which have been described these will require additional assessment.

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