Specifications for soils and landscaping of constructed Melbourne Water assets.

Scope

These specifications of topsoil for horticultural purposes are to be adopted for the construction of Melbourne Water assets requiring the utilisation of on-site won topsoil (natural, ameliorated natural soils and/or blended soil products) and/or importation of topsoil.

The intent of the specifications is to ensure that site soils are tested and ameliorated, and imported soils meet requirements, to ensure fitness-for-purpose for the specified use. Melbourne Water recognises that topsoil is a valuable resource and needs to be protected, retained and reused whenever possible.

Local soils must be considered in interpreting the soil test results to ensure soil conditions support the local flora to ensure flora diversity is supported.

Compliance

Topsoil utilised on Melbourne Water assets (aquatic, ephemeral, terrestrial and turf zones) must:

- Comply with the specifications detailed in Appendix A of this document and be rated as clean fill under EPA-VIC IWRG621.
- Be free of building debris.
- Contain no more than 5% by weight of particles >20mm and no particles sized >50mm.
- Imported topsoil must be free of viable plant propagules (weed seeds, rhizomes etc.) as per Appendix L of *AS 4419-2018*.
- Site won topsoil can have plant propagules within it. Therefore, a weed control program, to reduce the weed risks, must be established. Site won material must not contain any State Prohibited Weed seed or plant fragments (refer Appendix B).

These specifications refer to *AS 4419-2018 Soils for landscaping and garden use* and utilise technical items from that standard.

Sampling and Analysis

- Sampling of soils must ensure representativeness. Topsoil and / or subsoil sampling shall follow the requirements of *AS 4419-2018.*
- Testing of topsoils must analyse the parameters specified in Appendix A of this document. Methods for analysis are specified in *AS 4419-2018*. Topsoils must be tested at a NATA accredited laboratory and results interpreted by a Certified Professional Soil Scientist (CPSS) to determine compliance with specifications in Appendix A of this document. The CPSS will determine the significance of any non-compliance and may deem a property substantively compliant if fitness-for-purpose will not be compromised.
- Prior to importing topsoil, a certificate from a suitably qualified CPSS must be provided to and accepted by Melbourne Water stating that the material meets the relevant specification(s) in Appendix A of this document and EPA-VIC IWRG621. CPSS Register - *Soil Science Australia.org.au*
- The CPSS report assessing both the in-situ soils (to be retained or stripped for stockpiling/reuse) and/or imported material must address all properties detailed in the specifications in Appendix A of this document & EPA-VIC IWRG621. The report must specify any ameliorants to be applied to the topsoil to enable compliance with the specification.

Stripping and Stockpiling

- A soil survey should be undertaken in advance of stripping to determine maximum stripping depths of topsoil and to provide guidance on appropriate soil handling and stockpiling. A CPSS should be used for this purpose.

- Stripping of in-situ topsoil for reuse must only be to the depth specified by the CPSS. Contamination of topsoils by subsoil clays must be avoided. Topsoil stockpiles shall be labelled with the date of construction and detail of its provenance. Subsoils shall be stockpiled separately to avoid cross contamination.

- Stockpiles must not be trafficked during or after construction.

- If stockpiles are in place for greater than one month, the entire stockpile shall be sown with a sterile rye grass or suitable pasture grasses. Neither Kikuyu nor Couch grasses shall be used for this purpose. See EPA guidelines for major construction sites for more detail.

- Site won and/or imported topsoil must not be stockpiled in excess of 1.5m in height. Any material stockpiled in excess of 1.5m in height or for longer than 12 weeks will require an additional topsoil assessment in advance of being spread. This is to evaluate the impact of depth and long-term stockpiling to ensure the material is still fit for purpose.

Preparation, Amelioration and Placement

- Site won material may have viable exotic and native propagules except if they are State Prohibited Weeds (refer Appendix B). A weed control program must be prepared and implemented to reduce the weed risk from using site won topsoil.

- Propagule exclusion and weed control must result in planting areas with <2% weed cover with turf areas to be free of broadleaf weeds. State Prohibited and Regionally Prohibited weeds must not be present on the site at handover (Victorian invasive plant classifications).

- Unless otherwise accepted by Melbourne Water, the Civil contractor is to deliver the preplacement weed control, topsoil placement/amelioration (where required) and erosion matting works.

- Application of ameliorants for topsoil and subsoil is best achieved either in-situ or following placement, depending on the amelioration required. The CPSS will advise on the most appropriate amelioration methods as some ameliorants (such as organic matter/compost) are best added prior to placement.

- Site preparation and soil placement must be carried out in line with the following:

    - In situ subsoil (outside wetland clay liner areas) is to be ripped to a minimum depth of 250mm. Ripping shall occur with the subsoil in a dry state to enable shattering of the profile. Areas of shallow or surface rock can be excluded from ripping on approval by Melbourne Water;

    - Necessary amelioration of the subsoil as required by soil testing shall be applied following ripping and prior to topsoil placement;

    - Roughening (20 to 50mm disturbance) of the top layer of ripped sub soil or clay liner is to be undertaken to ensure bonding between the topsoil and the upper layer of sub soil or clay liner.

    - Amelioration of stockpiled subsoil shall be carried out following placement. Respread subsoil will not require ripping;

- Topsoil must be spread at a minimum thickness of 200mm across the entire planting zones. Once the 200mm depth is reached, ameliorants shall be applied and worked into the soil if not applied to the stockpile. The soil surface shall be groomed to final contours and left in a friable tilth for seeding / planting;

- **Note:** The clay liner (inundation zone) depth is in addition to the 200mm topsoil layer and serves a different purpose.

General

- The developer and their associated consultants and contractors are responsible for the timing of stripping and stockpiling of any site won material, and as such, wear the risk if they choose to strip the site prematurely. Gaining advice and direction from a CPSS regarding the staging of the stripping and the footprint required for stockpiling should be strongly considered prior to any works commencing.

- Timing of any jute matting should be strongly considered. If the planting program commences in excess of 3 months after civil works completes the topsoiling any jute matting (or other topsoil stabilisation measures) may be viewed as temporary by Melbourne Water. The planting contractor may need to replace the existing jute mat or spray out the sterile rye grass which will be at the developer's cost. Any jute matting installed must have a minimum 12-month life span following plant installation.

- This specification and those in Appendix A of this document are to be adhered to by both civil and landscaping consultants and the appointed contractors.

- Adhering to the required values within Appendix A is vital for good plant establishment and will provide fit-for-purpose growing media that minimise soil dispersion and consequent turbidity in the water column.

Appendix A: Required Soil Parameters

A1 - TOPSOIL SPECIFICATION FOR AQUATIC AND EPHEMERAL INUNDATION ZONES

The aquatic and ephemeral inundation zone soils must provide resistance to compaction, have reasonable wet strength, suitable drainage capacity and good water holding capacity. This specification therefore describes a soil that optimises permeability and water holding capacity to enable plant growth and sustain plant life during extended dry periods.

The optimum soil to achieve both good water holding capacity and reasonable wet strength is in the fine sandy loam to fine sand texture range. To achieve the required chemical properties, a fertiliser and/or appropriate organic component is/are typically needed.

A wide range of site soils may be suitable for aquatic and ephemerally inundated plantings, including naturally occurring silts and clays. The optimum soil to achieve both good water-holding capacity and reasonable wet strength is in the fine sandy loam to fine sand texture range. However, finer textured soils may be suitable provided they comply with performance specifications below. To achieve the required chemical and physical properties, a fertiliser and/or appropriate organic component is/are typically needed.

All aquatic and ephemeral inundation zone soils must meet the requirements as set out in tables 1a & 1b. Certification of compliance by a Certified Professional Soil Scientist (CPSS) is required.

Physical properties for aquatic and ephemeral inundation zones

Property	Units	Acceptable Range
Texture, preferred range	n/a	Clay Loam to loamy sand
Permeability (@ 16 drops by McIntyre Jakobsen)	mm/h	> 30
Bulk Density	kg/L	1.1–1.5
Dispersibility in water	Category	1 or 2 (AS 4419) Category
Water repellence (AS4419-2018)	seconds	<60
Particle size distribution		
Large Particles	% by mass	2-20mm = <2% > 20mm = 0%
> 2.0 mm (fine gravel)	% w/w	< 10
1.0–2.0 mm (very coarse sand)	% w/w	< 10
0.5–1.0 mm (coarse sand)	% w/w	10–30
0.25–0.5 mm (medium sand)	% w/w	20–40
0.1–0.25mm (fine sand)	% w/w	10–30
0.05–0.1mm (very fine sand)	% w/w	5–20*
0.002–0.05 (silt)	% w/w	<15**
<0.002 (clay)	% w/w	<20**

Table 1a. Physical properties for aquatic and ephemeral inundation zones.

* max 40% combined very fine sand, silts and clay.

** max 12% silt and clay combined.

Chemical properties for aquatic and ephemeral inundation zones

Property	Units	Acceptable range
pH (1:5 in water)	pH units	5.7–8.0
pH (1:5 in $CaCl_2$)	pH units	5.0–7.3
Electrical conductivity (1:5)	dS/m	< 0.5
Exchangeable Na %	% of ECEC	<7
Exchangeable Ca %	% of ECEC	60–80
Exchangeable Mg %	% of ECEC	15–25
Exchangeable K %	% of ECEC	3–10
Exchangeable Al %	% of ECEC	< 2
Exchangeable Ca:Mg ratio	Ratio	3–7
Organic matter	% w/w	2–5
Available Phosphorus (Colwell)	mg/kg	<40
Available Nitrogen (as nitrate)	mg/kg	<30

Table 1b. Chemical properties for aquatic and ephemeral inundation zones.

A2 - TOPSOIL SPECIFICATION FOR DRYLAND TERRESTRIAL NATIVE PLANTING AREAS

A sandy loam to clay loam topsoil designed for mass planting of grasses, woody and herbaceous perennials and is not subject to compaction by pedestrian or other traffic is ideal for dryland terrestrial native plantings. In some locations to local soils may support important indigenous vegetation communities. Consideration of local soils in interpreting the soil test results to ensure soil conditions support the local flora is critical to ensure flora diversity is supported. Planting methods may vary and include direct seeding, tube and potted specimens.

The soil must be free of 'unwanted material' and must meet all the requirements of tables 2a and 2b below. Certification of compliance by a Certified Professional Soil Scientist (CPSS) is required.

Physical properties for dryland terrestrial native planting areas

Property	Units	Acceptable Range
Texture, preferred range	n/a	Sandy loam to clay loam
Permeability (@ 16 drops by McIntyre Jakobsen)	mm/h	> 20
Bulk Density	kg/L	1.2-1.6
Dispersibility in water	Category	1 or 2 (AS 4419) Category
Water repellence (AS4419-2018)	seconds	<60
Visible contaminants > 2 mm (glass, plastic and metal)	%w/w	< 0.5
Particle size distribution		
Large Particles	% by mass	2-20mm = <10 > 20mm = <2

Table 2a. Physical properties for dryland terrestrial native planting soils.

Chemical properties for dryland terrestrial native planting areas

Property	Units	Acceptable range
pH (1:5 in water)	pH units	5.5–8.0
pH (1:5 in $CaCl_2$)	pH units	4.8–7.3
Electrical conductivity (1:5)	dS/m	< 0.5
Exchangeable Na %	% of ECEC	<7
Exchangeable Ca %	% of ECEC	60–80
Exchangeable Mg %	% of ECEC	15–25
Exchangeable K %	% of ECEC	3–10
Exchangeable Al %	% of ECEC	< 2
Exchangeable Ca:Mg ratio	Ratio	3–7
Organic matter	% w/w	2–8
Available Phosphorus (for P-sensitive plants) (Colwell)	mg/kg	<10
Available Phosphorus (for P-tolerant/standard plants) (Colwell)	mg/kg	30-70
Available nitrogen	mg/kg	>20
Available iron	mg/kg	100–400
Available manganese	mg/kg	15–75
Available zinc	mg/kg	5–30
Available copper	mg/kg	1–15
Available boron	mg/kg	0.5–5

Table 2b. Chemical properties for dryland terrestrial native planting soils.

A3 - TOPSOIL SPECIFICATION FOR DRYLAND TERRESTRIAL TURF AREAS

Generally, this requires a sandy loam to loam topsoil designed to provide moderate resistance to compaction in public and other amenity turf areas subject to moderate levels of pedestrian and vehicular traffic. The specification is not suitable for active recreational areas and is not considered suitable for construction of playing fields, even with specific turf management practices to prevent compaction.

The soil must be free of 'unwanted material' and meet all the requirements of tables 3a and 3b. Certification of compliance by a Certified Professional Soil Scientist (CPSS)[1] is required.

Physical properties for dryland terrestrial turf areas

Property	Units	Acceptable Range
Texture, preferred range	n/a	Sandy Loam to Loam
Permeability (@ 16 drops by McIntyre Jakobsen)	mm/h	> 30
Bulk Density	kg/L	1.2-1.6
Dispersibility in water	Category	1 or 2 (AS 4419) Category
Water repellence (AS4419-2018)	seconds	<60
Visible contaminants > 2 mm (glass, plastic and metal)	%w/w	< 0.5
Particle size distribution		
Large Particles	% by mass	2-20mm = <10 > 20mm = 0

Table 3a. Physical properties for dryland terrestrial turf soils.

Chemical properties for dryland terrestrial turf areas

Property	Units	Acceptable range
pH (1:5 in water)	pH units	5.5–8.0
pH (1:5 in $CaCl_2$)	pH units	4.8–7.3
Electrical conductivity (1:5)	dS/m	< 0.5
Exchangeable Na %	% of ECEC	<7
Exchangeable Ca %	% of ECEC	60–80
Exchangeable Mg %	% of ECEC	15–25
Exchangeable K %	% of ECEC	3–10
Exchangeable Al %	% of ECEC	< 5
Exchangeable Ca:Mg ratio	Ratio	3–7
Organic matter	% w/w	2–8
Available Phosphorus (Colwell)	mg/kg	30–70
Available Nitrogen	mg/kg	30–50

Table 3b. Chemical properties for dryland terrestrial turf soils.

A4 - SPECIFICATION FOR SUBSOILS

This specification aims to provide direction and guidance with regard to site subsoils encountered in and around Melbourne. Imported subsoils must also comply with this specification. Subsoils shall provide anchorage for plants and storage of deep water. They shall be stable (i.e. non-dispersive) and not prone to erosion.

This specification aims to provide general guidelines for the improved management of subsoils but given the range of subsoils likely to be encountered across greater Melbourne, and potential non-compliances with the specification below, results will need to be interpreted by an accredited Certified Professional Soil Scientist to determine if and how soils can be made fit-for-purpose.

Subsoils must be free of 'unwanted material' as defined by rubbish, rubble and other physical contaminants of human origin and meet the requirements of tables 4a and 4b.

The sampling will apply to the first 250mm of subsoil below topsoil.

Physical properties for subsoils

Property	Units	Acceptable Range
Texture, preferred range	n/a	Sandy Loam to Medium Clay
Permeability (@ 16 drops by McIntyre Jakobsen)	mm/h	> 5
Bulk Density	kg/L	1.2-1.6
Dispersibility in water	Category	1 or 2 (AS 4419)
Visible contaminants > 2 mm (glass, plastic and metal)	%w/w	< 0.5

Table 4a. Physical properties for subsoils.

Chemical properties for subsoils

Property	Units	Acceptable range
pH (1:5 in water)	pH units	5.5–8
pH (1:5 in $CaCl_2$)	pH units	4.8–7.3
Electrical conductivity (1:5)	dS/m	< 0.75
Chloride	mg/kg	<200
Exchangeable Na %	% of ECEC	<10
Exchangeable Ca %	% of ECEC	50–80
Exchangeable Mg %	% of ECEC	15–30
Exchangeable K %	% of ECEC	3–10
Exchangeable Al %	% of ECEC	< 2
Exchangeable Ca:Mg ratio	Ratio	2-–7
Organic matter	% w/w	>1

Table 4b. Chemical properties of subsoils.

Testing of subsoils must use the methodology set out by AS 4419 (2018) or equivalent Material must be tested at a NATA accredited laboratory and results interpreted by a Certified Professional Soil Scientist (CPSS) to determine compliance with this specification - as set out in tables 4a & 4b. The CPSS will determine the significance of any non-compliance and may deem a property substantively compliant if performance will not be compromised.

Appendix B: WEED MANAGEMENT

Construction of sites involving the disturbance to and laying of topsoil will require a weed management program to ensure the design outcomes are achieved. When laying topsoil a weed management program addressing a period of no less than 24 months must be developed. The plan will nominate; priority species, locations/zones for control, timing and methods for weed control and ongoing maintenance - until a satisfactory level of plant establishment is achieved.

The plan needs to address the different phases of the project especially; before and after site disturbance, during plant installation and the maintenance period. It needs to recognise that the weed threats will change over the phases of the project and must be responsive to threatening species as they emerge. The plan should also allow natural regeneration of desirable species to be enabled where they support the design objective.

The weed management plan will deliver a site:

- Supportive of the design species
- With <2% weed cover in planted areas
- With <1% broadleaf weeds in turf areas
- Free of Regionally Controlled and Prohibited weeds (as declared under the Victorian CaLP Act). If State Prohibited weeds are identified on the site, the contractor must inform Melbourne Water and DELWP for appropriate controls to be undertaken.
- Free of priority weeds for the project as identified by Melbourne Water (eg *Salix* sp – Willows)

References:

DEWLP (2007) - Victorian - Catchment and Land Protection Act 1994

DEWLP (2018) - Victorian invasive plant classifications).

Environmental Protection Authority (EPA) – Victoria - EPA guidelines for major construction sites.

Environmental Protection Authority (EPA) – Victoria - EPA-VIC IWRG621: Soil hazard categorisation and managementEPA-VIC IWRG621

SAI Global - AS 4419-2018 Soils for landscaping and garden use

Soil Science Australia (2019) – Certified Practicing Soil Scientists (CPSS) register *Soil Science Australia.org.au*