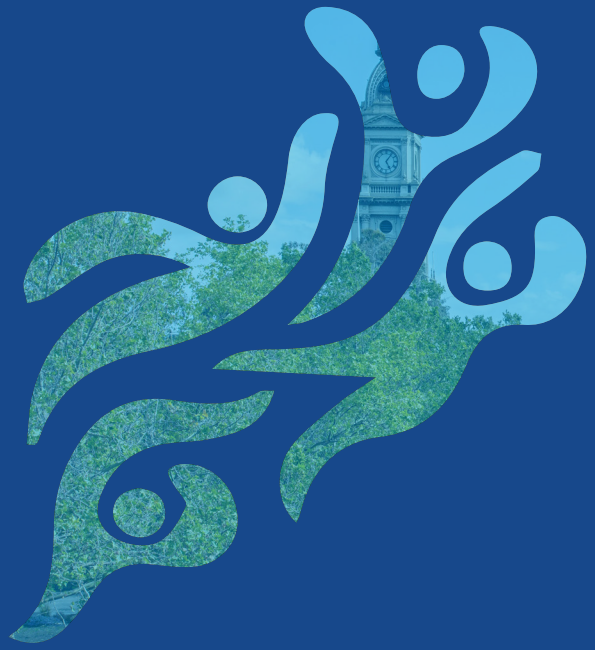
City of Yarra

Embedding Green Infrastructure Guidelines - Appendix

November 2018



ECOLOGY
ENGINEERING
DESIGN

E2DESIGNLAB

CITY OF YaRRA

CONTENTS

Prepared for the City of Yarra by E2Designlab

APPENDIX A
Technical Drawing Catalogue

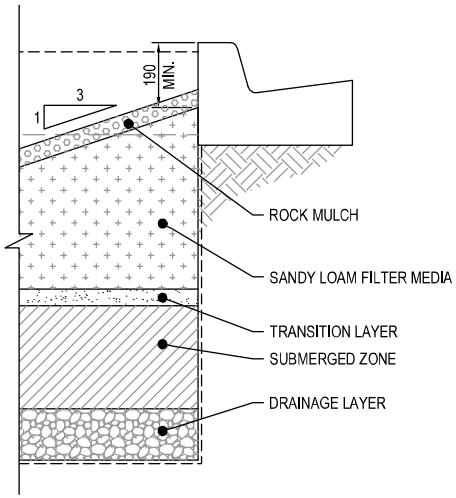
Provides a catalogue of Green Infrastructure design drawings,

separated into various design elements

All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

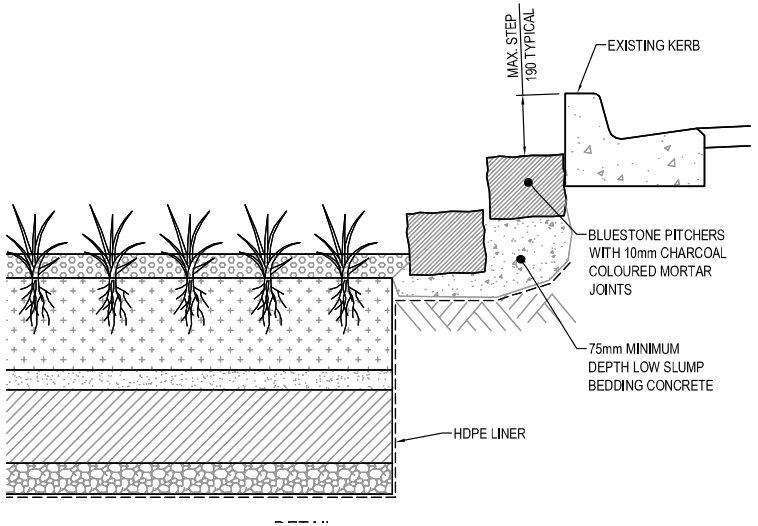
CONCRETE KERB EDGE

Source: Moreland WSUD Guidelines - SK006



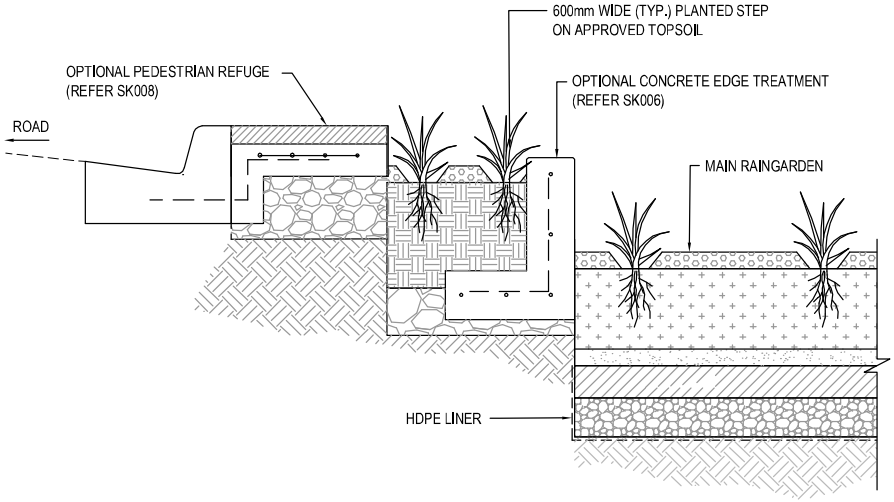
BLUESTONE STEPPED EDGE

Source: Moreland WSUD Guidelines - SK008



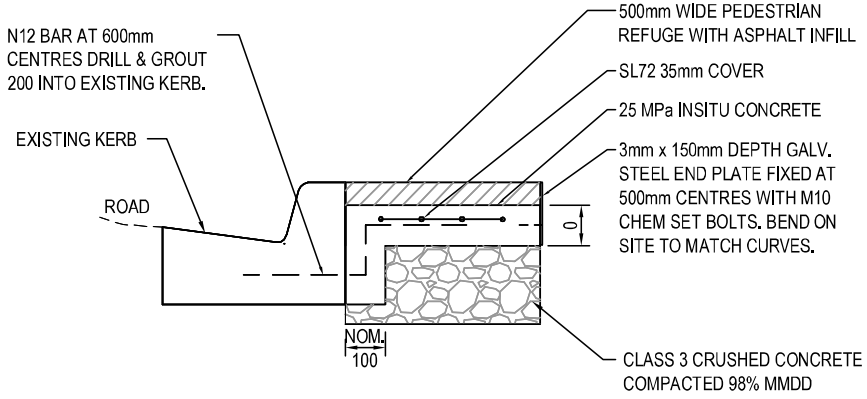
PLANTED BUFFER EDGE

Source: Moreland WSUD Guidelines - SK013



PEDESTRIAN REFUGE EDGE

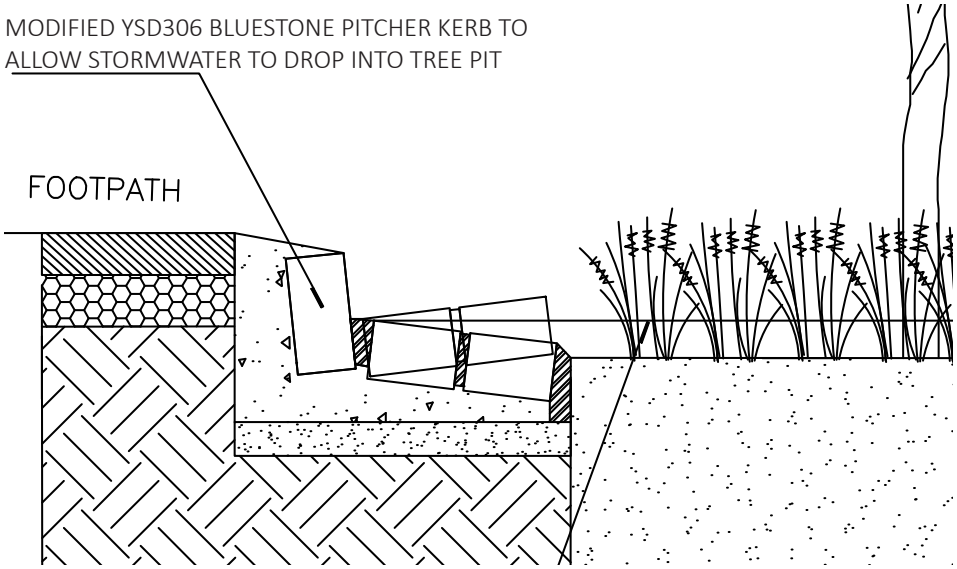
Source: Moreland WSUD Guidelines - SK008

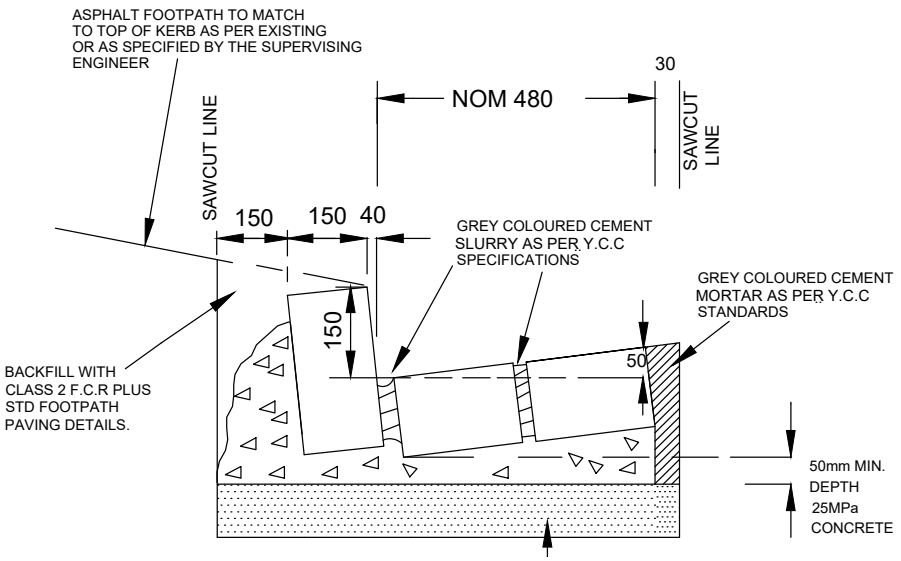


All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

BLUESTONE CHANNEL INLET

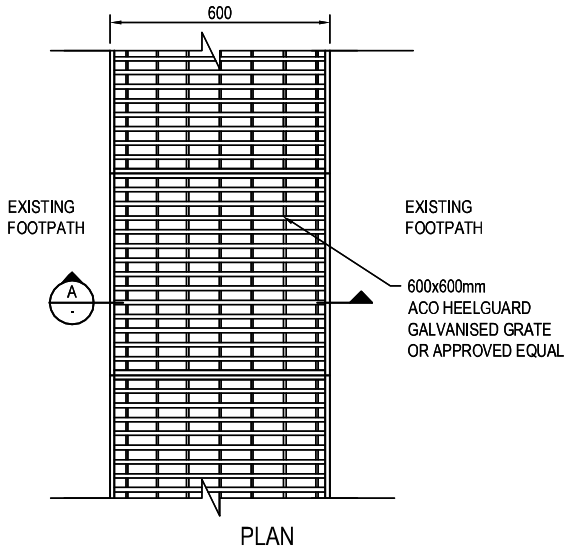
Source: E2Designlab for City of Yarra Green Infrastructure Guidelines (YSD306 shown on right)



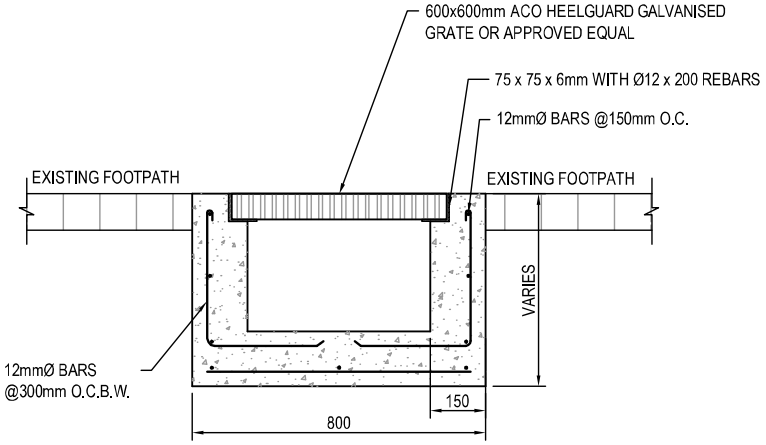


GRATED INLET CHANNEL

Source: Moreland WSUD Guidelines - SK



PLAN

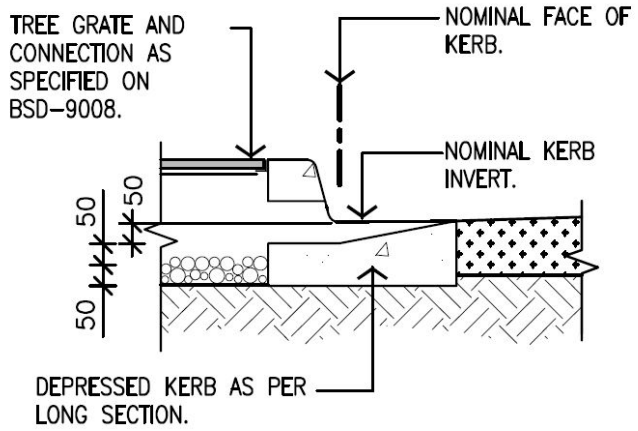


GRATED CONCRETE CHANNEL

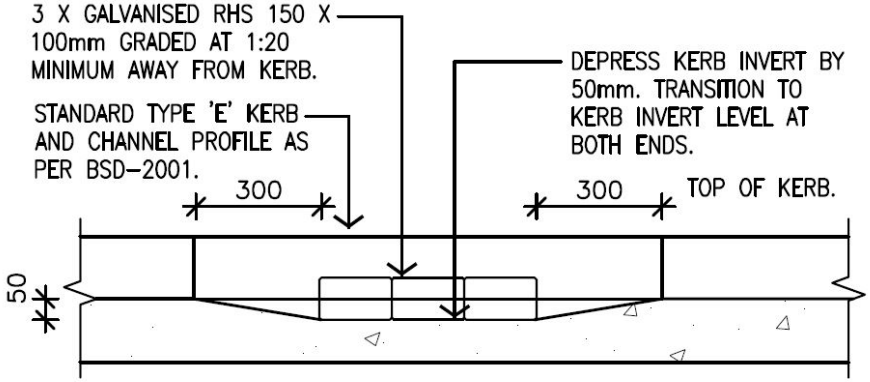
IMAGE

KERB INLET TO GRATED TREE PIT

Source: Brisbane City Council Standard Drawings - BSD-9061



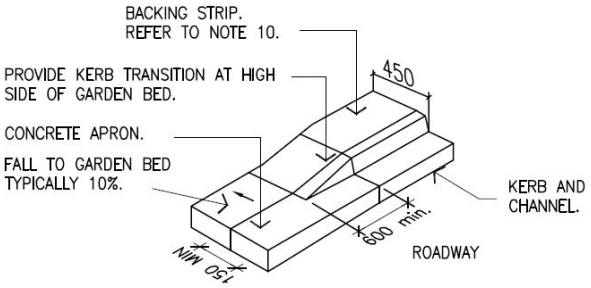
WSUD KERB INLET CROSS SECTION



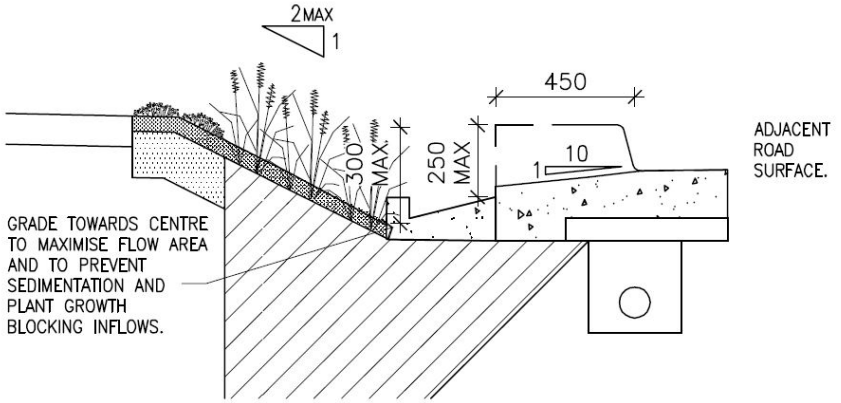
WSUD KERB INLET LONG SECTION

CONCRETE KERB BREAKOUT

Source: Brisbane City Council Standard Drawings - BSD-8331



KERB TRANSITION DETAIL



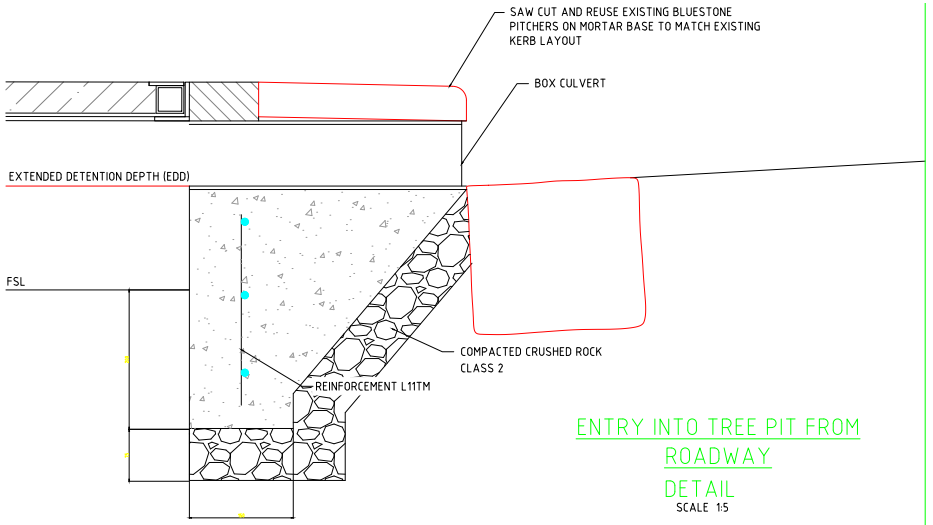
B 8331 STREETSCAPE BIORETENTION (VERGE TYPE) – KERB INLET DETAILS

All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

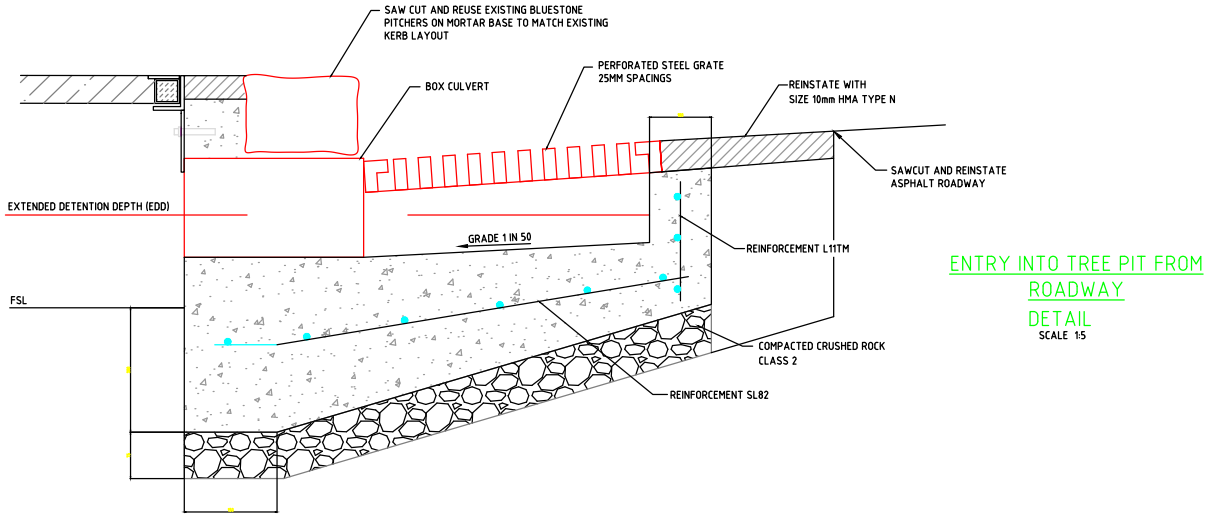
KERB INLET TO GRATED TREE PIT

Source: City of Yarra



CHANNEL INLET TO GRATED TREE PIT

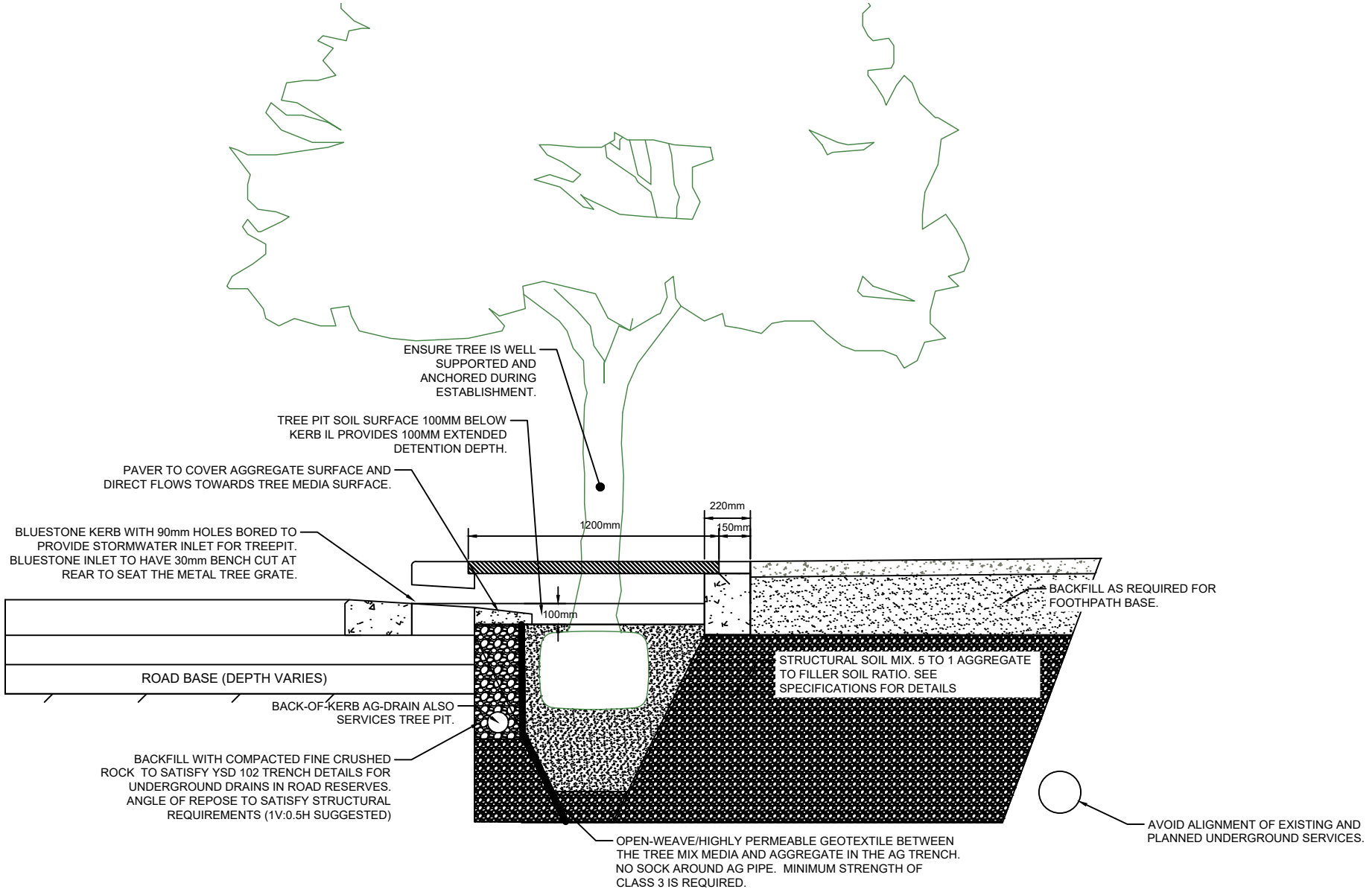
Source: City of Melbourne



All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

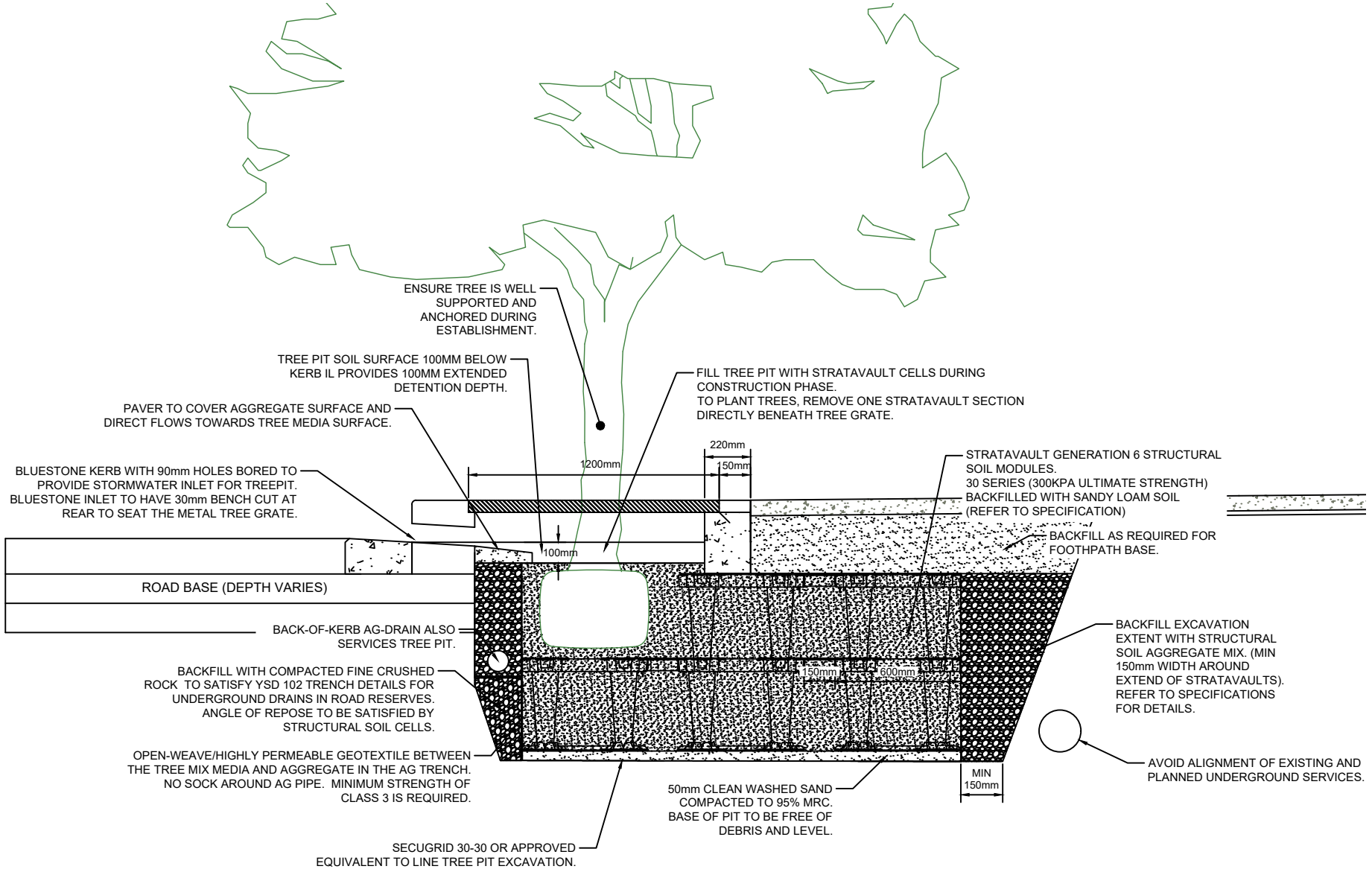
GRATED TREE PIT BEHIND KERB WITH STRUCTURAL SOILS

Source: E2DesignLab



GRATED TREE PIT BEHIND KERB WITH STRATAVAULT

Source: E2DesignLab

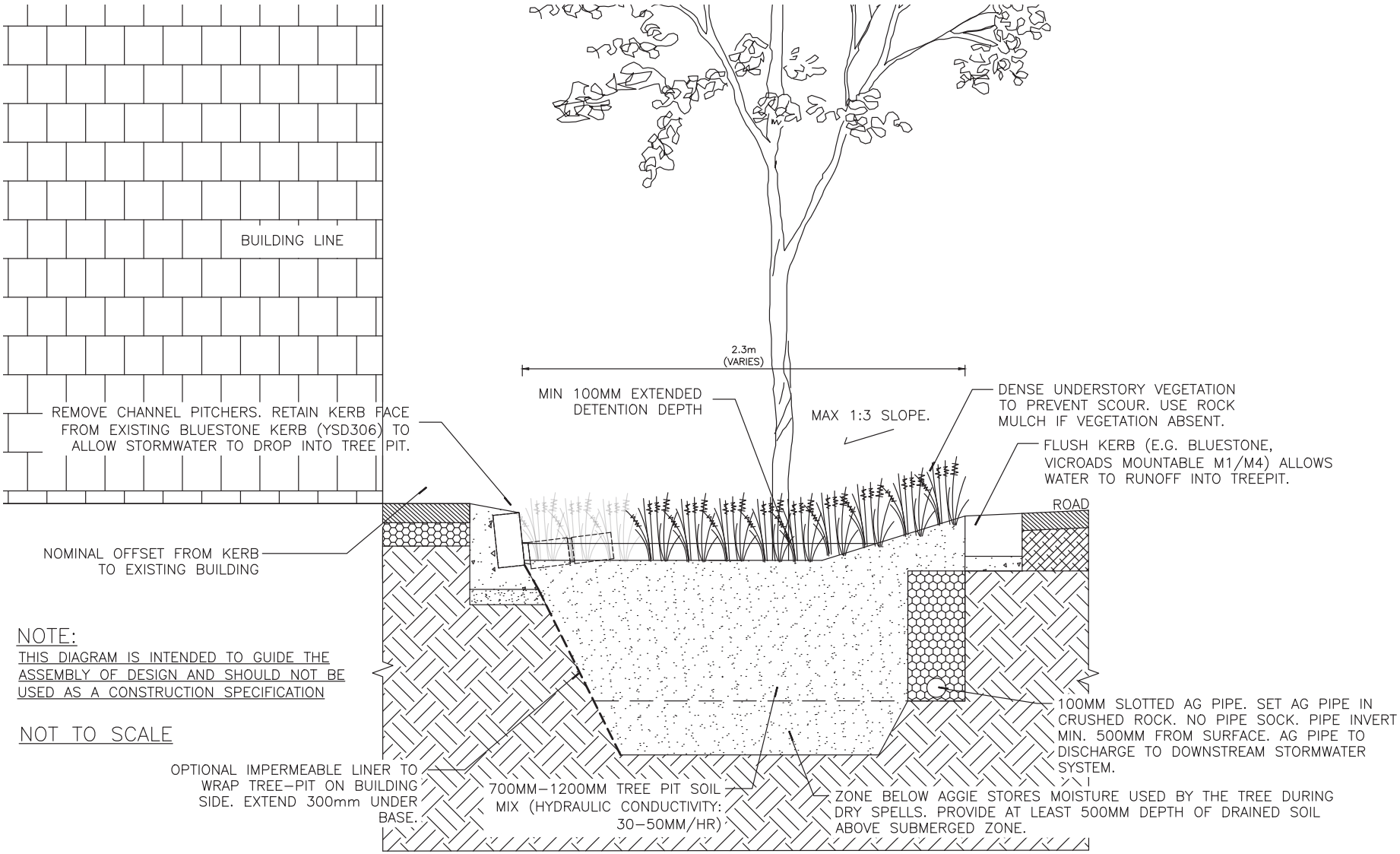


All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

ON-ROAD OPEN TREE PIT WITH BLUESTONE KERB INLET

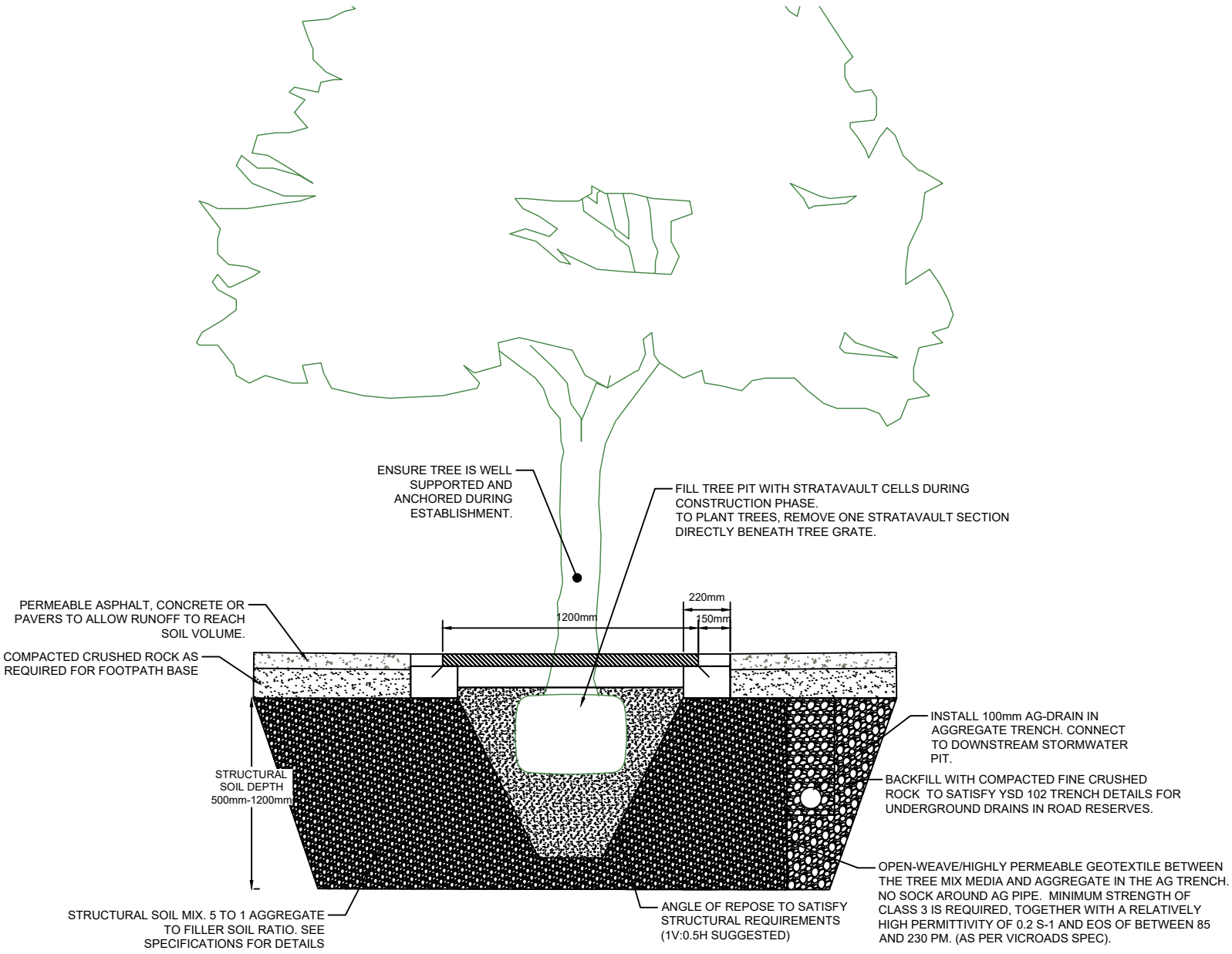
Source: E2DesignLab



All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

ON-ROAD PERMEABLE PAVEMENT WITH STRUCTURAL SOILS

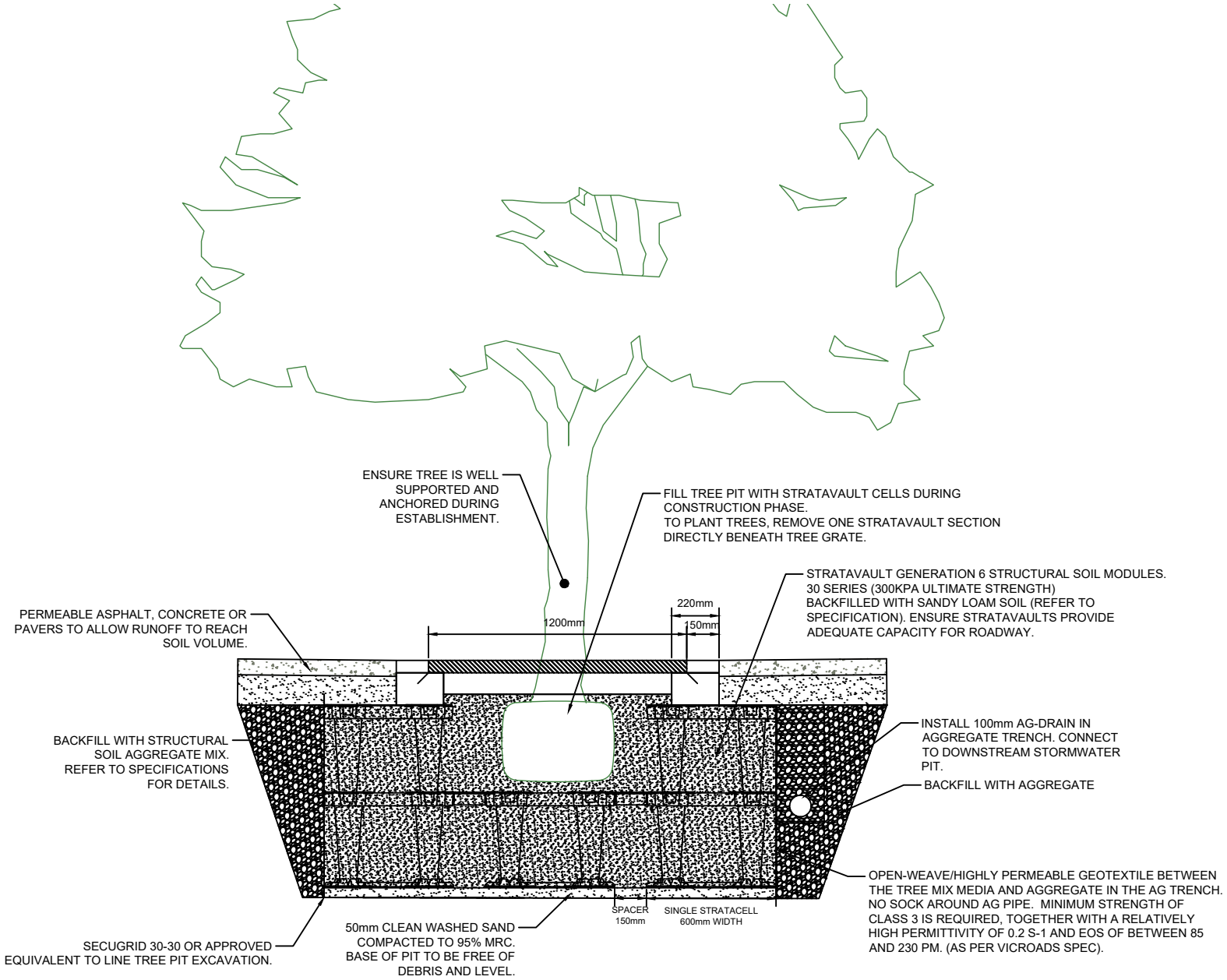
Source: E2DesignLab



All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

ON-ROAD PERMEABLE PAVEMENT WITH STRATAVAULT

Source: E2DesignLab

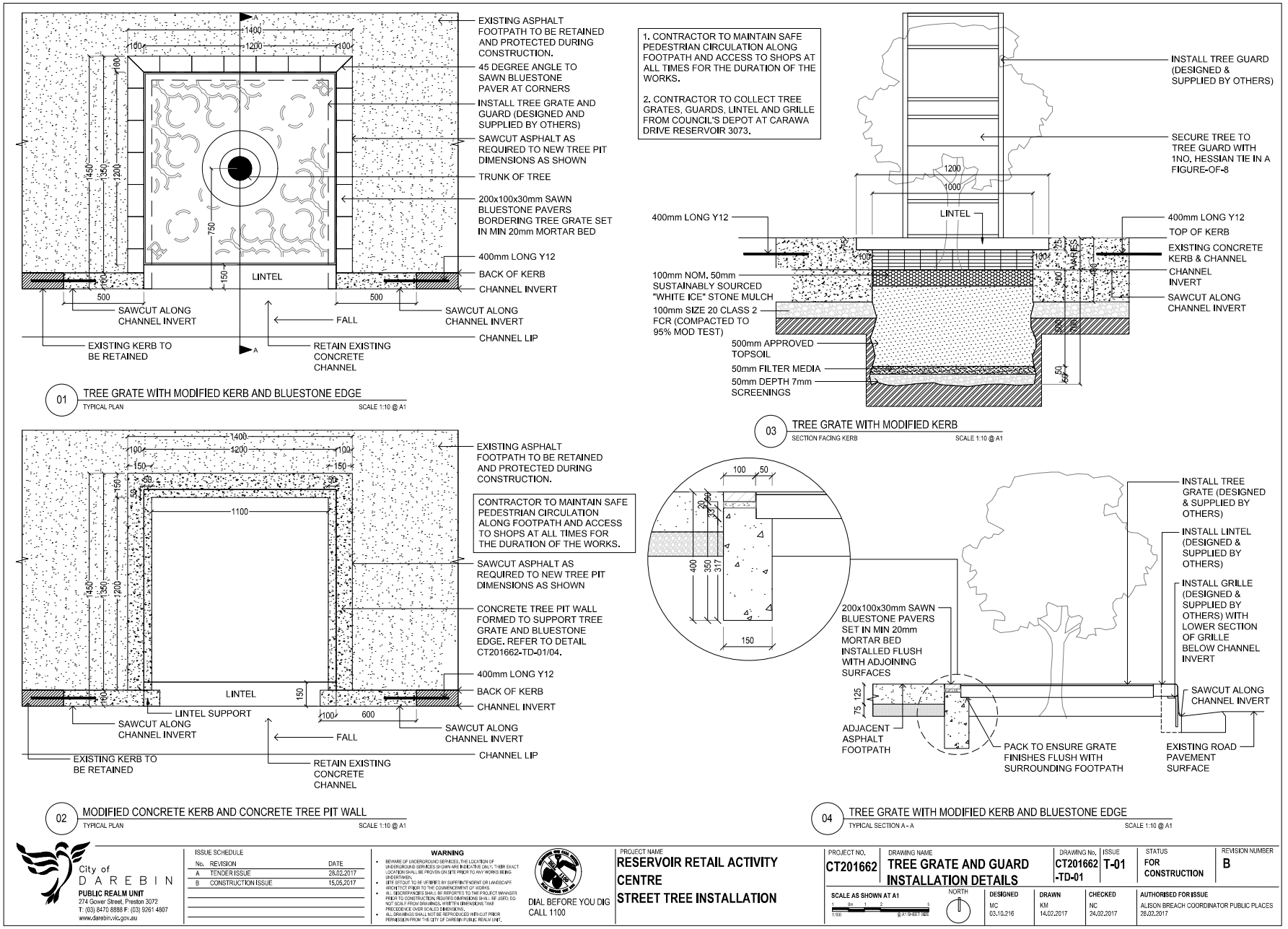


TREE GRATE AND GUARD INSTALLATION DETAILS

Source: City of Darebin Reservoir Retail Activity Centre

TREE GRATE DETAILS

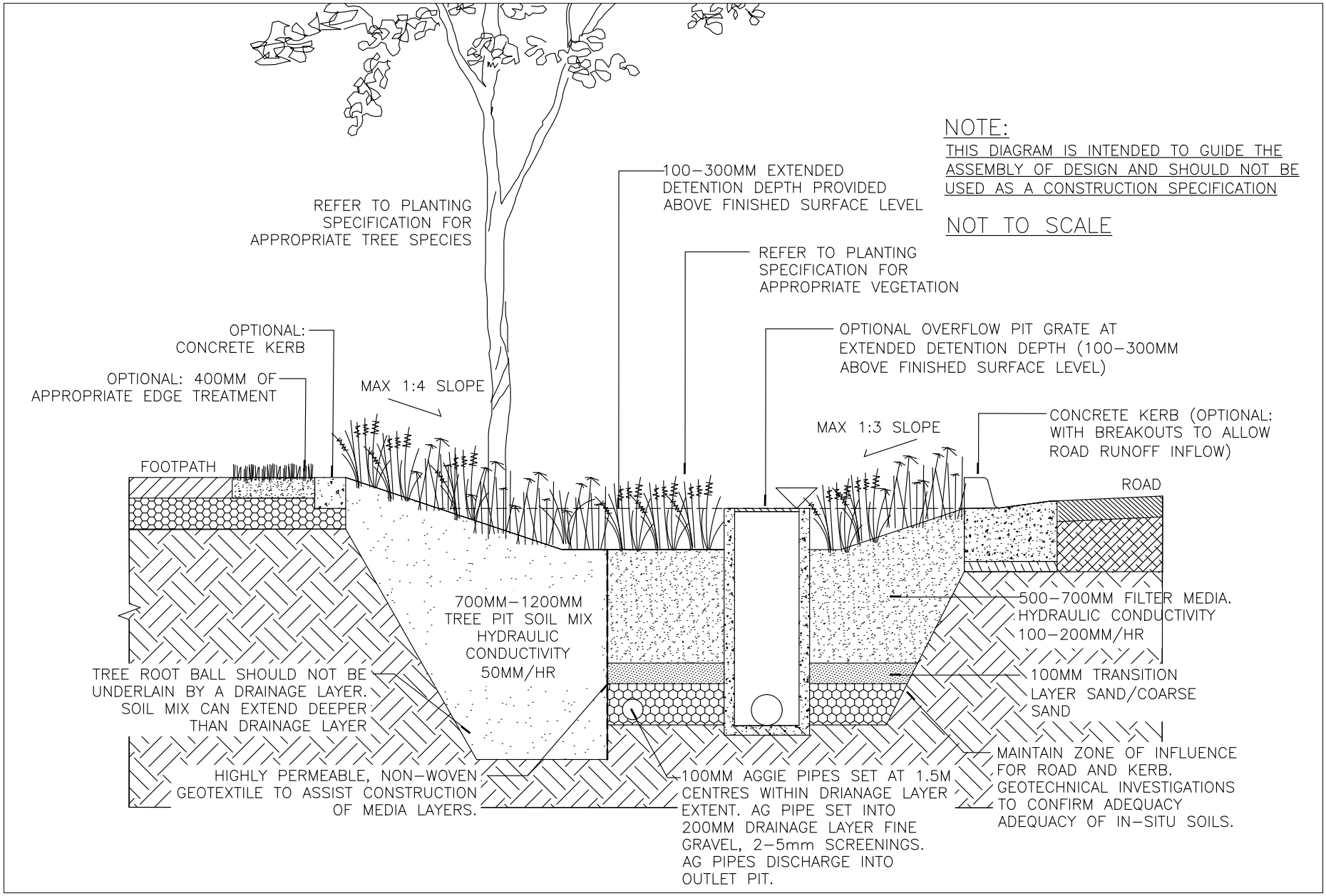
All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.



All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

‘GREEN-BLUE’ RAINGARDEN SECTION

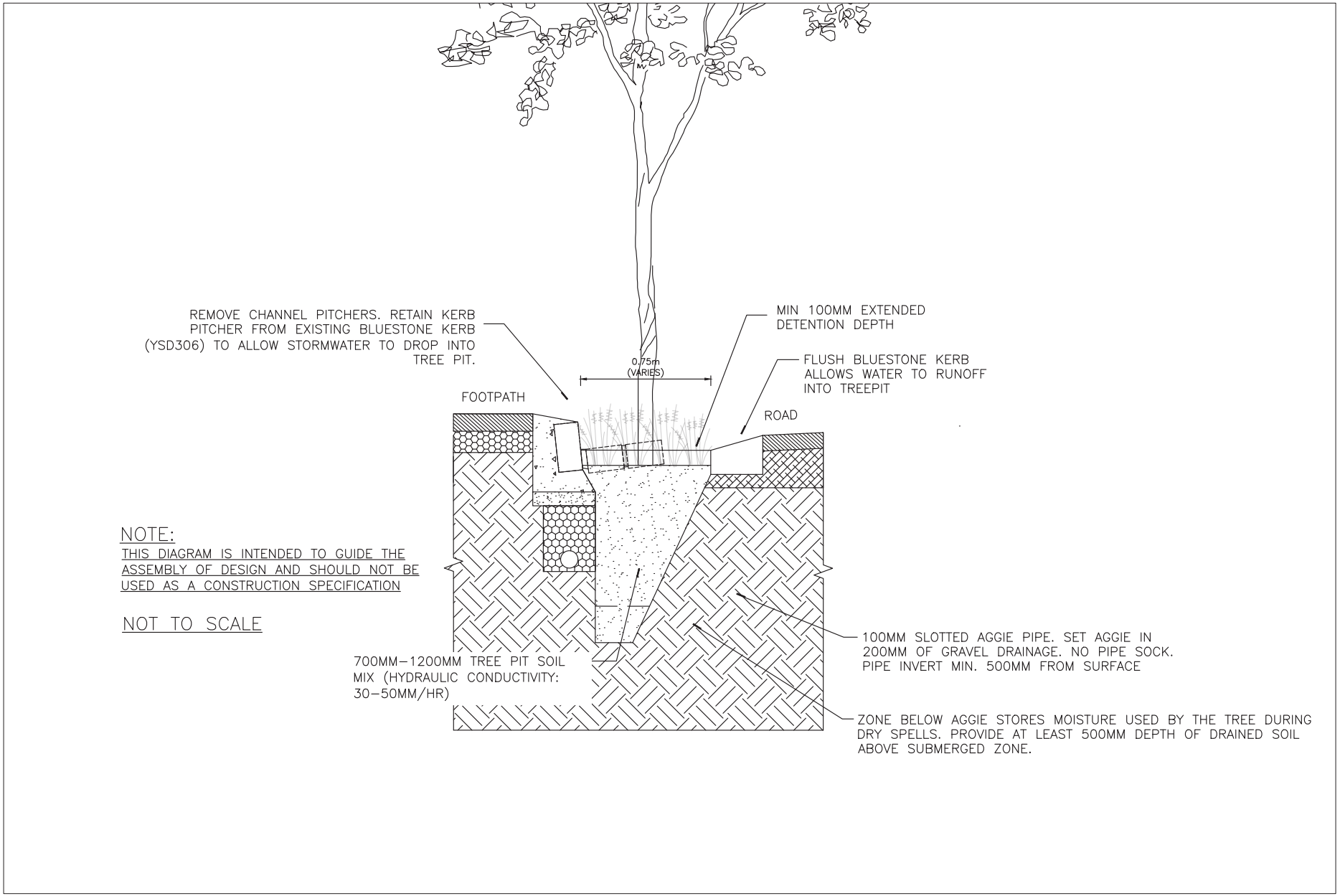
Source: E2DesignLab



All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

GREEN-BLUE KERB AND CHANNEL TREE PIT

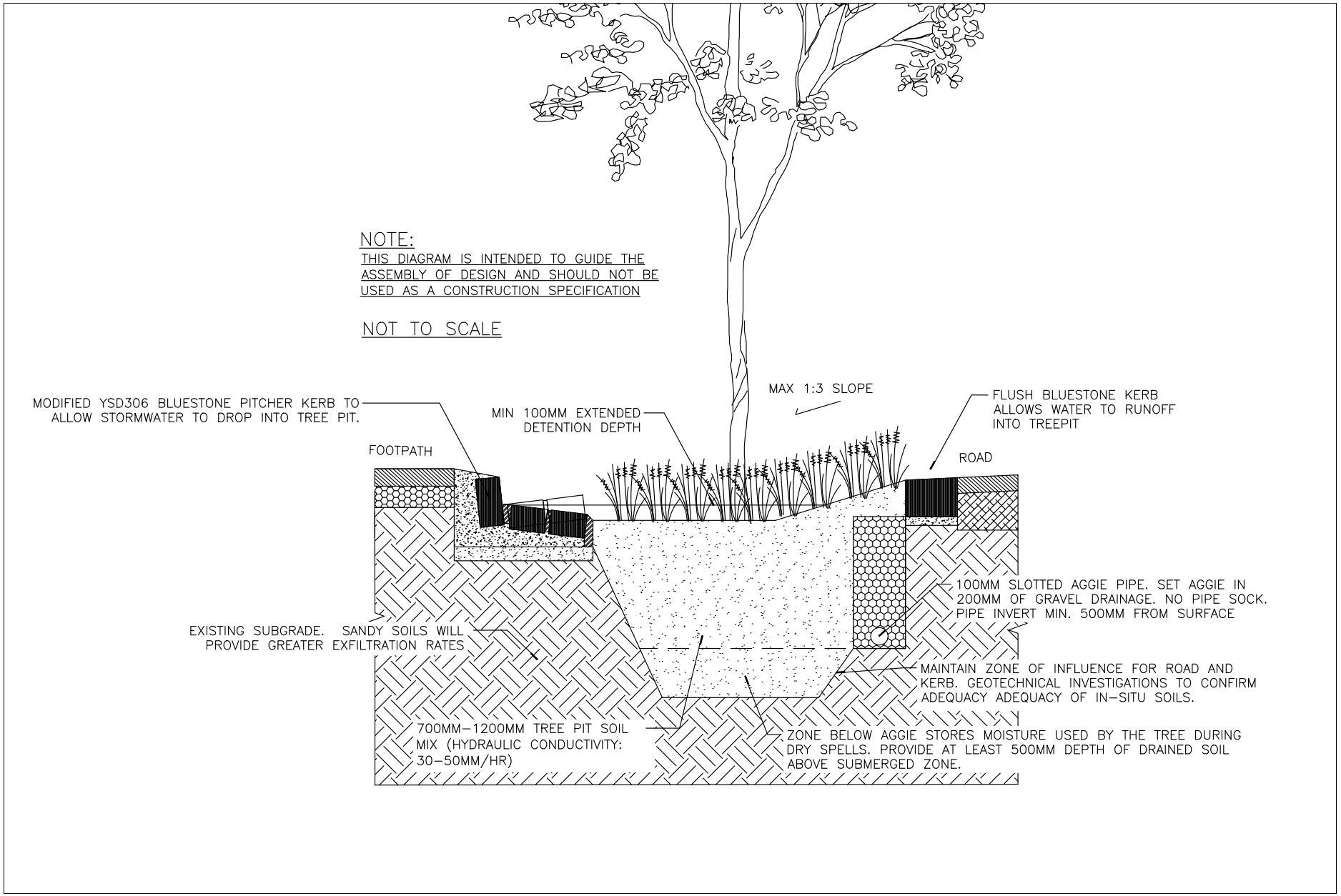
Source: E2DesignLab



All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

GREEN-BLUE BUMP OUT TREE PIT

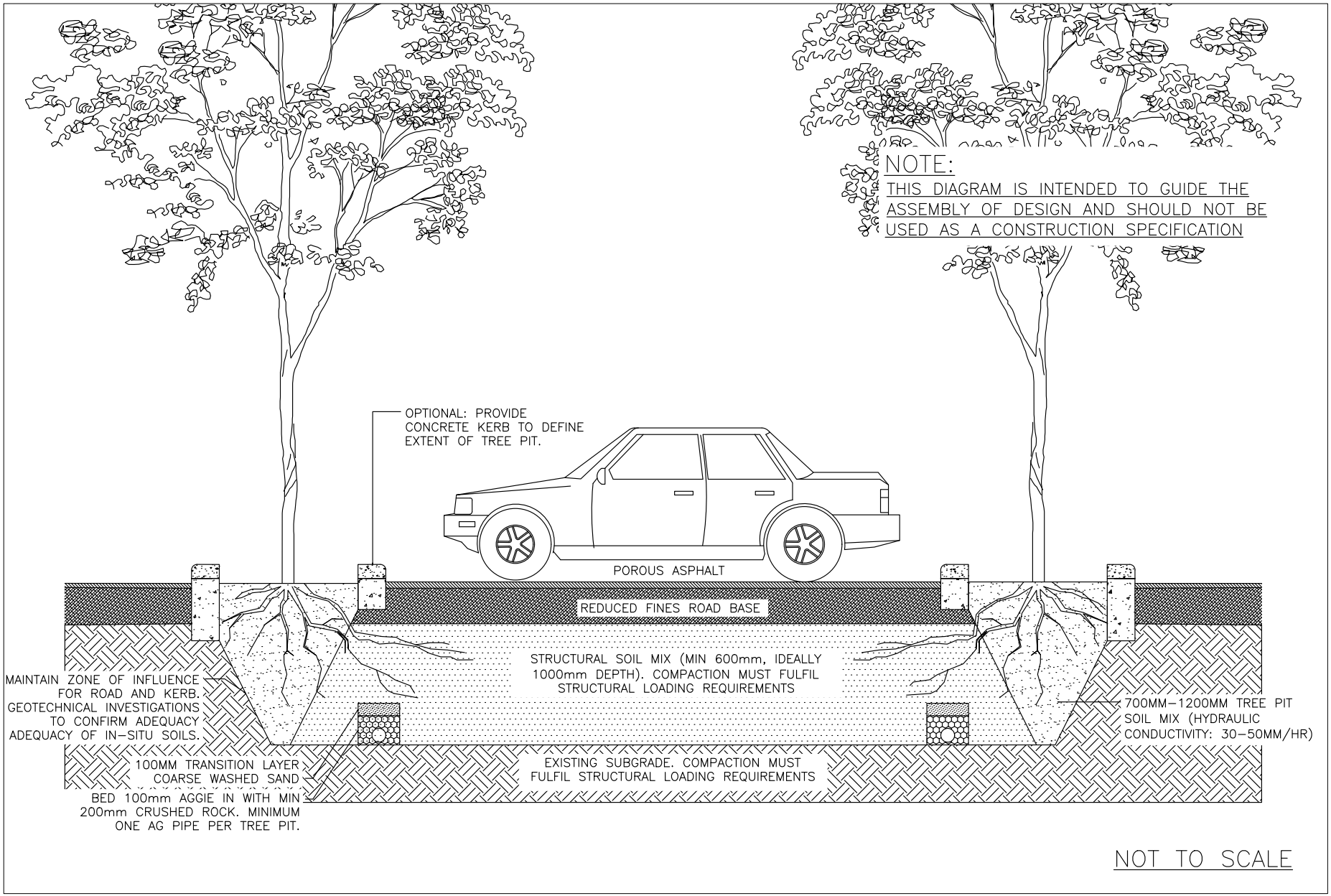
Source: E2DesignLab



All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

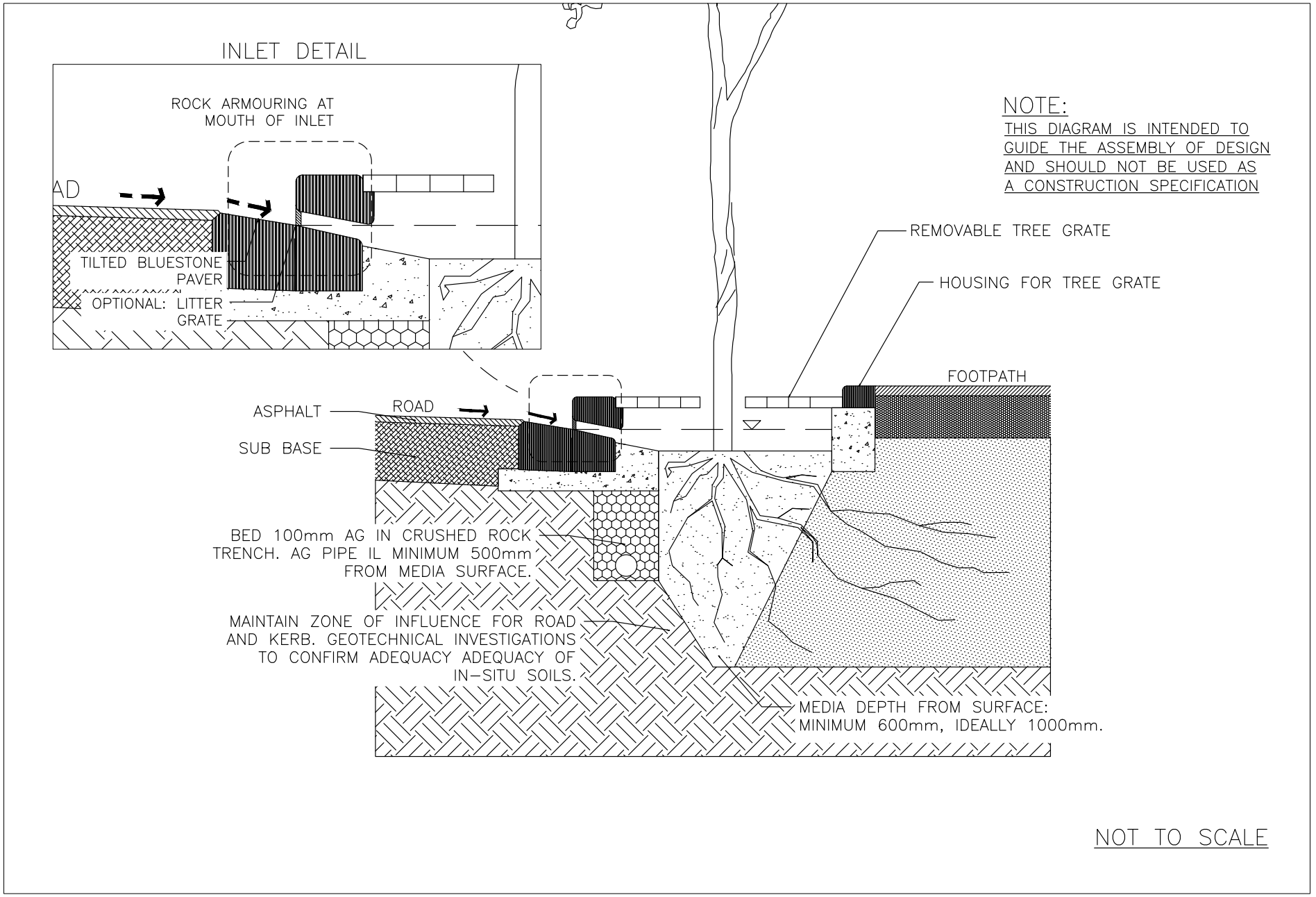
PERMEABLE PAVEMENTS AND STRUCTRUAL SOILS WITH TREE PITS

Source: E2DesignLab



GRATED TREE PIT WITH STRUCTURAL SOILS

Source: E2DesignLab

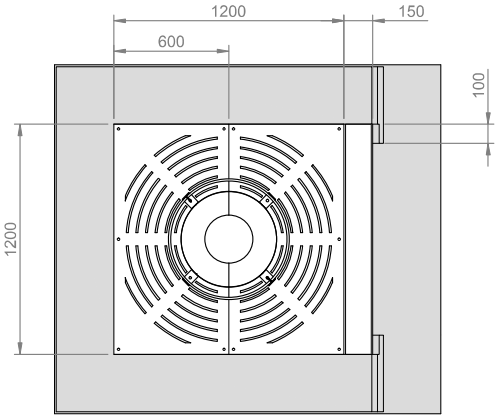


All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

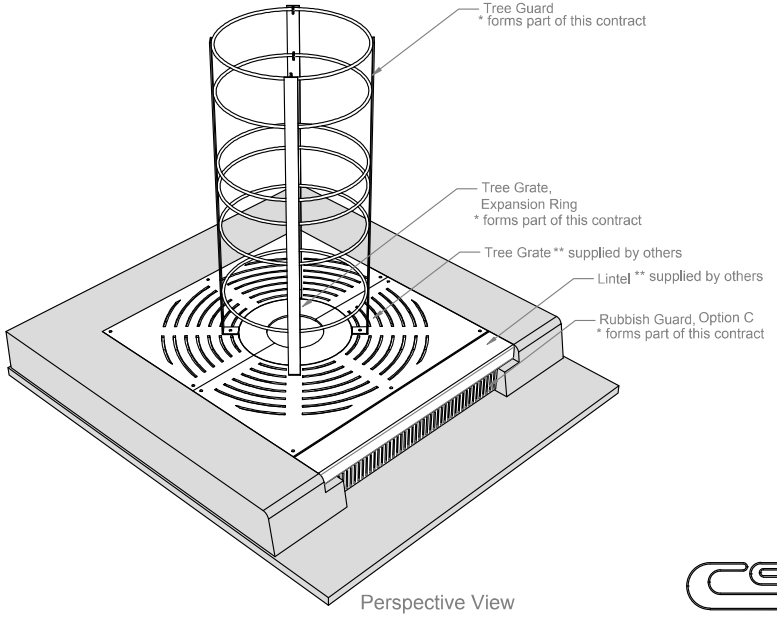
TREE GRATE AND GUARD INSTALLATION DETAILS

Source: City of Darebin Standard Details - 04/DD02

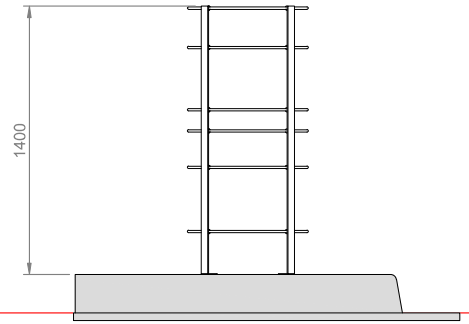
*all steel work to be hot dip galvanised



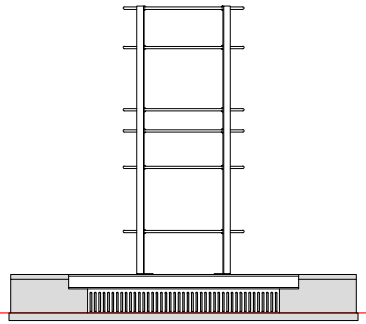
Top View



Perspective View



Front View



Right View

Road Level

Commercial Systems *Australia Pty. Ltd.*
49-51 Vinter Avenue, Croydon, VIC
phone: (03) 9725 9344
fax: (03) 9725 9744
email: design@commercialsystems.com.au

Manufacturing Instructions

Installation Assembly
K1065
Darebin Tree Guard

Drawing #CS1565

Drawn By: C.Artemiou
Date Drawn: 15.05.2014
Revision: 0

SHEET 1 of 7

ALL DIMENSIONS IN MILLIMETERS
UNLESS OTHERWISE STATED

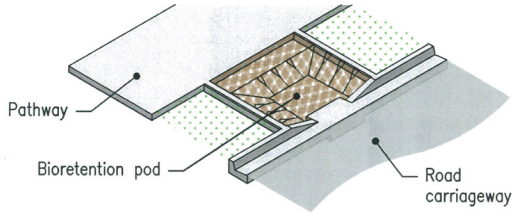
ALL DIMENSIONS TO BE +/- 1mm
UNLESS OTHERWISE STATED

All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

All drawings re-scaled to fit for display purposes. Original source material may contain standard scale drawings for use.

OPEN TREE PIT WITH KERB OPENING

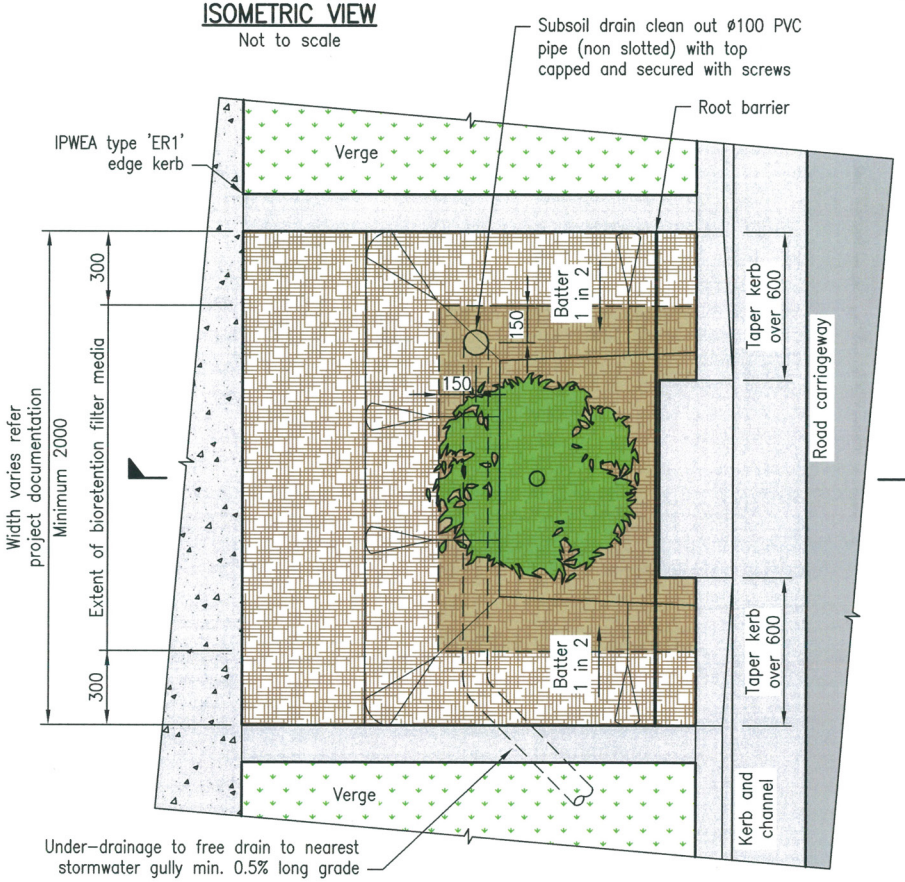
Source: Moreton Bay Regional Council Standard Drawings - SL-1015



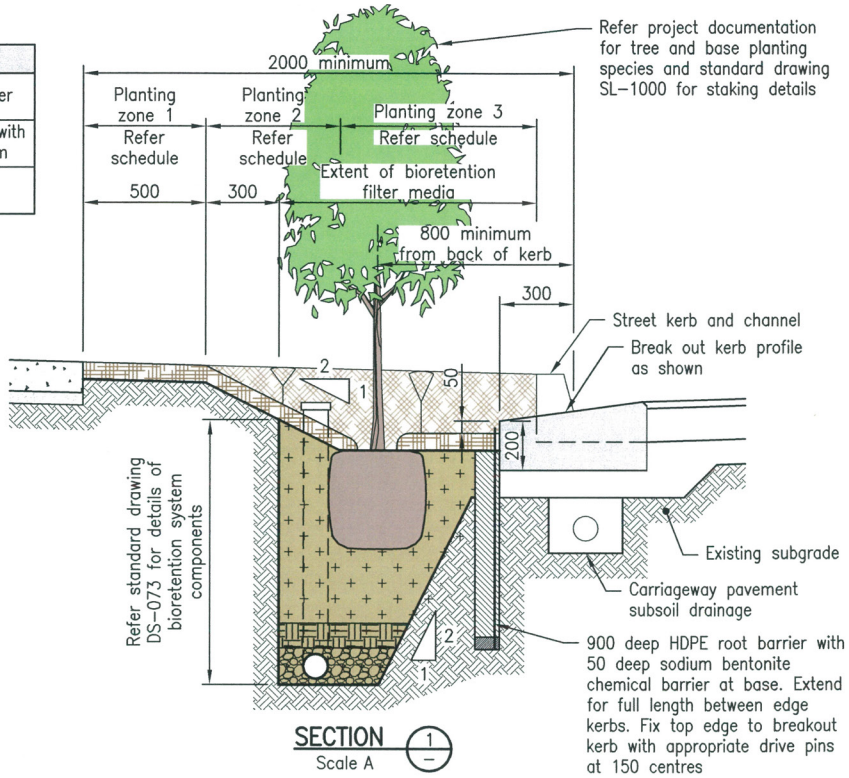
ISOMETRIC VIEW
Not to scale

PLANTING ZONE SCHEDULE

ZONE	DESCRIPTION	REQUIREMENT
1	0.5m wide strip adjacent pathway	Low growing ground cover
2	Batter slope adjacent pathway	Shrubs and small plants with maximum height 800mm
3	Base planting species	General WSUD planting



TREE WITH BREAK OUT KERB PLAN
Scale A



SECTION 1
Scale A

NOTES:

1. Detail to be incorporated in developments where services/permits/grades enable the construction of the tree pit and where the under-drain can be connected to gully.
2. Refer to standard drawing DS-073 for notes on filter media, vegetation, under-drains, filter cloth, slotted pipe, general construction and services.
3. The WSUD kerb shown is only suitable for street tree pits and small rain gardens. Larger systems (e.g tree trenches) may need specific inlet design or multiple inlets.
4. Tree pits are to be located upstream of gully pits.
5. If a service (ie gas) will cross the WSUD tree pit, provide a conduit for future use. service size to be confirmed with service provider.
6. If there is a grade up from the road to the footpath, a retaining wall and fence may be required and a tree pit in the verge may be less feasible.
7. Provision of safety and other users shall be in accordance with Austroads requirements such as limiting depth of vertical drops.
8. Maintain 50–100mm radius separation between mulch and stem of tree.
9. Ensure services have been located prior to excavation. Consult with service providers if tree location conflicts with service.
10. Where trees are arranged in sequence provide subsoil drainage clean out at every fifth tree.

APPENDIX B
Standard Specifications

Provides standard specifications for the following design elements:

- Tree Pit Soil Mix
- Filter Media
- Treatment Vegetation
- Tree Species
- Permeable Pavement
- Structural Soil Systems
- Safety Edge Considerations

B.

1. Tree Pit Soil Mix

The soil mix for Green-Blue tree pits has been designed to balance the need for permeability and moisture holding capacity. The hydraulic conductivity is less than that of raingarden filter media and designed to promote optimal tree growth conditions.

Tree pit soil shall be sourced by the Contractor from an approved supplier. Approval shall be obtained from the Principal prior to purchase.

Saturated hydraulic conductivity

In the range of 30 - 50 mm/hr. If the hydraulic conductivity exceeds 100 mm/hr it should be amended to increase the soil moisture retention capacity and reduce hydraulic conductivity to within the range by mixing with fine sand or loamy sand with low nutrient content.

Particle size distribution (PSD) - composition (w/w) requirements

The material shall preferably meet the following particle size distribution shown in Table 3, however this should be treated as a guide and meeting the hydraulic conductivity, nutrient and soil moisture requirements are of greater importance.

Particle Size Distribution

Description	Proportion	Grading
Clay & Silt	<10%	<0.05 mm
Very Fine Sand	10-30%	0.05-0.15 mm
Fine Sand	10-30%	0.15-0.25 mm
Medium to Coarse Sand	20-40%	0.25-1.0 mm
Coarse Sand	4-10%	1.0-2.0 mm
Fine Gravel	<3%	2.0-3.4 mm

Soil nutrition

The tree pit soil mix shall comply with the following specifications as defined by AS4419 – 2003 (Soils for Landscaping and Garden Use);

- Organic Matter Content – 4-8% (w/w). An organic content higher than 5% is likely to result in leaching of nutrients.
- pH 5.5 – 7.5 before delivery to site, add dolomite as required.
- Electrical Conductivity (EC) <1.2 dS/m.
- Orthophosphate content <50 mg/kg.
- Total nitrogen content < 800 mg/kg.

Potential tree pit soil mix shall be assessed by an arborist to ensure it is capable of supporting a healthy vegetation community. This assessment should take into consideration delivery of nutrients by stormwater. Any component or soil with high levels of salt (as determined by EC measurements), high levels of clay or silt particles (exceeding the particle size limits set above), or any other extremes which may retard tree growth should be rejected.

Soil moisture storage capacity

The soil should have a volumetric water content of >=20% and preferably >=25% at the optimum root zone depth.

1. Tree Pit Soil Mix (cont.)

Testing requirements

Tests are to be undertaken on tree pit soil mix prior to delivery and again from the onsite stockpile to confirm soil suitability and conformance with the above described requirements. Testing shall be conducted by a NATA approved laboratory, and a copy of the test results sent to the project superintendent for approval, prior to the soil installation.

The submission shall include the following test results to determine whether a soil is suitable:

- Saturated hydraulic conductivity (HC) in accordance with AS 4419, ASTM F1815-06.
- Particle size distribution in accordance with ASTM 1289.3.6.1 – 2009.
- Soil moisture release curve.
- pH, salts and nutrients

The F1815-06 test uses a compaction method that best represents field conditions. The Contractor shall allow for the testing of three (3) delivered samples taken from the stockpile prior to placement. The Contractor shall allow for a minimum of 3 working days for the testing and reporting of filter media. All costs associated with testing should be included in the Contractors price for supply. Recommendations for suitable testing labs can be made by the Principal if required.

The Contractor must provide testing of the filter media and submit testing results to the superintendent. Any unsatisfactory media will need to be removed from site and replaced with specified and approved media.

B.

2. Filter Media

The filter material shall preferably be based on a ‘washed sand’ of siliceous or calcareous origin, one that has been mined and processed. Topsoils are not usually suitable. ‘Burdettes Turf 200’ or ‘Daisy’s garden supplies bio-drain’ or similar may be suitable as a base with amendment or addition of sandy loam soil to increase soil moisture retention, reduce hydraulic conductivity and meet the particle size distribution requirements.

Filter media shall be sourced by the Contractor from an approved supplier. Approval shall be obtained from the Principal prior to purchase.

Filter media properties

Saturated hydraulic conductivity

In the range of 100 - 200 mm/hr. If the hydraulic conductivity exceeds 200 mm/hr it should be amended to increase the soil moisture retention capacity and reduce hydraulic conductivity to within the range by mixing with fine sand or loamy sand with low nutrient content.

Particle size distribution (PSD) - composition (w/w) requirements

The material shall preferably meet the following particle size distribution shown in Table 2, however this should be treated as a guide and meeting the hydraulic conductivity, nutrient and soil moisture requirements are of greater importance.

Table 2. Particle Size distribution

Description	Proportion	Grading
Clay & Silt	<3%	<0.05 mm
Very Fine Sand	5-30%	0.05-0.15 mm
Fine Sand	10-30%	0.15-0.25 mm
Medium to Coarse Sand	40-60%	0.25-1.0 mm
Coarse Sand	7-10%	1.0-2.0 mm
Fine Gravel	<3%	2.0-3.4 mm

The total clay and silt mix should be less than 3% (w/w) to reduce the likelihood of structural collapse. The filter media should be well-graded i.e., it should have all particle size ranges present from the 0.075 mm to the 4.75 mm sieve (as defined by AS1289.3.6.1 - 1995). There should be no gap in the particle size grading, and the composition should not be dominated by a narrow particle size range.

Soil nutrition

The filter media shall comply with the following specifications as defined by AS4419 – 2003 (Soils for Landscaping and Garden Use);

- Organic Matter Content – less than 5% (w/w). An organic content higher than 5% is likely to result in leaching of nutrients
- pH 6.2 – 6.8 before delivery to site, add dolomite as required
- Electrical Conductivity (EC) <1.2 dS/m
- Orthophosphate content <50 mg/kg
- Total nitrogen content < 800 mg/kg

Potential filter media shall be assessed by a horticulturalist to ensure it is capable of supporting a healthy vegetation community. This assessment should take into consideration delivery of nutrients by stormwater. Any component or soil with high levels of salt (as determined by EC measurements), high levels of clay or silt particles (exceeding the particle size limits set above), or any other extremes which may retard plant growth should be rejected.

Soil moisture storage capacity

The soil should have a volumetric water content of >=15% and preferably >=20% at the optimum root zone depth.

2. Filter Media (cont.)

Testing requirements

Tests are to be undertaken on all filter media prior to delivery and again from the on-site stockpile to confirm soil suitability and conformance with the above described requirements. Testing shall be conducted by a NATA approved laboratory, and a copy of the test results sent to the project superintendent for approval, prior to the filter soil installation.

The submission shall include the following test results to determine whether a soil is suitable:

- Saturated hydraulic conductivity (HC) in accordance with AS 4419, ASTM F1815-06
- Particle size distribution in accordance with ASTM 1289.3.6.1 – 2009
- Soil moisture release curve
- pH, salts and nutrients

The F1815-06 test uses a compaction method that best represents field conditions. The Contractor shall allow for the testing of three (3) delivered samples taken from the stockpile prior to placement. The Contractor shall allow for a minimum of 3 working days for the testing and reporting of filter media. All costs associated with testing should be included in the Contractors price for supply. Recommendations for suitable testing labs can be made by the Principal if required.

The Contractor must provide testing of the filter media and submit testing results to the superintendent. Any unsatisfactory media will need to be removed from site and replaced with specified and approved media.

Amelioration of top 150 mm of filter media

The top 150 mm of the filter medium should be ameliorated with appropriate organic matter, fertiliser and trace elements with the constituents and quantities as recommended by the soil assessor or detailed in Table 3.

Amelioration to top 150mm of Filter Media

Constituent	Quantity (kg/100m^2 Filter Area)
Granulated Poultry Manure Fines	50
Superphosphate	2
Magnesium Sulphate	3
Potassium Sulphate	2
Trace Element Mix	1
Fertilizer NPK (16.4.14)	4
Lime	20

2. Filter Media (cont.)

Transition and submerged zone layers

In a standard raingarden system a transition layer is included. In a submerged zone system the transition layer also functions as a submerged zone layer. To prevent the filter media from washing into the drainage layer, a transition layer is required between the filter media and fine gravel drainage layer. The transition layer should be a clean, well graded coarse sand material containing <2% fines.

The transition layer must meet 'bridging' criteria as follows based on engineering principles that rely on the largest 15% of the overlying layer particles 'bridging' with the smallest 15% of the underlying layer particles. This results in smaller voids, which prevent the migration of filter media particles into the sand.

The particle size distribution of the transition layer shall be assessed to ensure it meets the following criteria:

D15 (transition layer) is less than or equal to 5 x D85 (filter media) where:

- D15 (transition layer) is the 15th percentile particle size in the transition layer material, and
- D85 (filter media) is the 85th percentile particle size in the filter media.

AND

D15 (drainage layer) is less than or equal to 5 x D85 (transition layer) where:

- D15 (drainage layer) is the 15th percentile particle size in the drainage layer material, and
- D85 (transition layer) is the 85th percentile particle size in the transition layer.

A suitable product is washed A3 filter sand (Vicroads) with 90% particles retained above 0.25 mm. The transition layer shall be tested to determine its particle size distribution to ensure it meets the required grading and 'bridging' criteria. The superintendent may also require testing of hydraulic conductivity.

Where the transition layer is also required to function as a submerged zone, it should be constructed using transition layer material as described above with addition of carbon sources and mixed as follows (per 100 L):

- 98 Litres of Transition Layer Material.
- 500 g biodegradable sugar cane mulch.
- 1.5 kg recycled, untreated hardwood chips or plantation hardwood chips.

The purpose of the submerged zone is to temporarily hold water for plants for a longer period of time and allow anaerobic (no air) processes to break down nutrients to occur below the aerobic root zone.

Drainage layer

The purpose of the drainage layer is to convey infiltrated flows horizontally across the base of the system into the slotted underdrainage pipes. The slotted underdrainage pipes that convey the treated stormwater are to be 100 mm in diameter and surrounded by the gravel drainage layer.

The drainage layer shall have a uniform thickness of 200 mm. Suitable materials include coarse sand (coarser than transition layer) or washed fine gravel in the range 2 mm - 7 mm. Scoria and unwashed gravels with a significant quantity of fine particles are not acceptable.

The transition layer shall be tested to determine its particle size distribution to ensure it meets the required grading and 'bridging' criteria. The superintendent may also require testing of hydraulic conductivity.

Installation of filter media

The filter media shall be lightly compacted during installation to prevent migration of fine particles. A single pass for each lift with a drum lawn roller should be performed. Under no circumstance should heavy compaction or multiple-passes be made. Filter media should be installed and compacted in two lifts to achieve the finished compacted depth.

Hold points

The contractor shall seek approval from the superintendent before proceeding to the next stage at the following inspection hold points and allow 24 hours' notice for a council representative to attend site inspections:

- Provision of samples and specified test results for all materials (filter media, submerged zone (transition layer media) and drainage media).
- At completion of drainage connections associated with raingarden and before backfill with soil material including gravel, sand, soil or filter media. Under-drainage must not be installed with filter socks.
- Placement of any soil material within raingarden including drainage layer, transition/submerged zone layer and filter media.
- Practical completion of raingarden including plants and rock work.

B.

3. Stormwater Treatment Vegetation

Stormwater treatment vegetation shall planted with an average finished density of approximately 8 plants/m2. Individual species for each mix will be distributed within the area so that the final layout is a well-mixed assortment of different plant types. The plants shall cover the entire base of the raingarden.

The subsoils (filtration media or in-situ soil) shall be well saturated the previous day prior to the planting of vegetation. Plants are to be supplied as 50 mm tubes. All waste is to be disposed of by the Contractor. An inspection shall be made by the Superintendent or their representative following completion of planting to ensure that vegetation has been planted in such a manner as to ensure successful establishment and as per the intended design. Any plants deemed to be unsatisfactorily planted shall either be replanted or replaced at the Contractors expense.

At least 50% of raingarden plant species must be selected for effective stormwater treatment. Arborists and/or a water sensitive urban design expert should be consulted before the specification of plantings to ensure they suit the context and conditions.

B.

4. Tree Species for Green Infrastructure

The choice of tree species in Green infrastructure is influenced by a range of factors that include available overhead space, leaf fall, infrastructure risk, native/ exotics and aesthetic considerations. Available overhead space for tree canopy must be considered to avoid issues with streetscape infrastructure (powerlines, street awnings etc.). Full mature canopy and future infrastructure works must be considered when assessing appropriate tree species for a site. Tree species with small canopies are recommended for sites with overhead constraints.

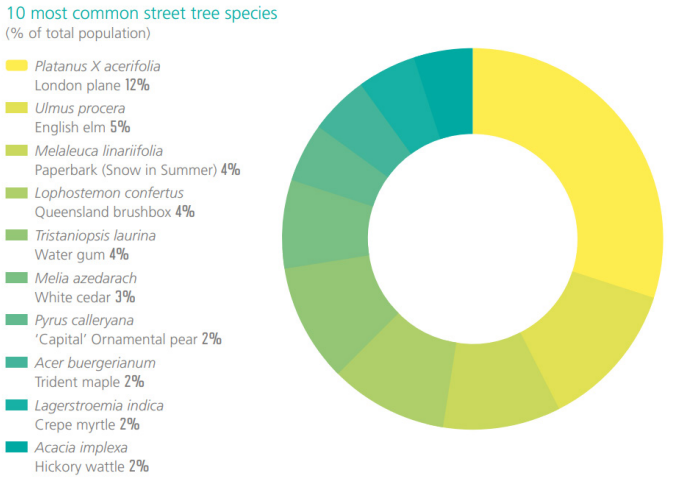
Both native and exotic trees can be implemented in Green infrastructure. Native species tend to be non-deciduous and therefore lend themselves to more successful implementation within open tree pits and permeable pavement systems. Native species are also generally better suited to Australian conditions and can be hardier through dry periods.

Deciduous trees can have a large impact on the performance of permeable pavements and other infiltration systems. Autumn leaf litter can block inlets and the high concentration of organic material can hamper the ability of water to soak into the system. Permeable pavements are susceptible to blockage as leaves decompose. Where possible, avoid planting deciduous species in or around open tree pits or permeable pavements. When deciduous species must be near these systems, ensure that maintenance schedules are increased throughout autumn to intercept leaf fall.

Certain species have aggressive root systems that actively seek out underground water, and can cause problems for nearby underground infrastructure. Care must be taken when planning Green infrastructure near underground services. Arborists should be consulted before the specification of plantings to ensure they suit the context and conditions.

City of Yarra Urban Forest

The City of Yarra has 20,854 public street trees and a great many more park and private trees in the City of Yarra. Together, they provide a 17% tree canopy cover over the municipality. The figure below provides a breakdown of the 10 most common street tree species in Yarra. Six of the top ten species are exotic deciduous species, meaning they drop their leaves for winter. The other four species are natives, though not indigenous to the Yarra region.



10 public tree species found in City of Yarra. The Snow in Summer paperbark and Acacia implexa are no longer being planted as urban street trees (City of Yarra, 2017).

Data collected for the 2017 Urban Forest Strategy has identified the potential loss of 10% of Yarra's street tree population in 10 years, and a further 24% in 11-20 years. If left unmanaged this will greatly impact the liveability of the city and expand areas susceptible to excessive heat generation and retention. Council aims to increase canopy cover in Yarra by 25% (from 2014 levels) by 2040. This represents an increase from 17% to 21.25% total canopy (City of Yarra, 2017).

4. Tree Species for Green Infrastructure (cont.)

Street Tree Selection Criteria

Environmental factors

- Climate: Consider that in addition to the prevailing climate of the inner-city, there are micro-climatic conditions that exist within the built environment, such as wind tunnels, reduced solar amenity, radiated heat from surrounding buildings and pavements.
- Soils: Consider that the soils may be highly modified or disturbed and in poor condition. Compacted soils and paved areas will also reduce the amount of oxygen that is available to the roots.
- Contribution towards micro-climate: Chose species that can improve the micro-climate of the street, for example by providing shade and reducing glare and ultra-violet light in summer, and/or winter deciduous trees that will allow sun through in the colder months.
- Minimal water requirements: In order to reduce reliance on potable water use, species selected must be able to survive without further watering beyond early establishment.
- Tolerance of pests and diseases: Consider use of a diversity of tree species to reduce the impact of a particular pest or disease on any single species.
- Wildlife habitat: Preference the use of locally native and indigenous tree and plant species adjacent to waterways.
- Low risk of becoming an environmental weed: – species that pose a risk of becoming an environmental weed are generally not considered suitable. This is particularly important given proximity to the Yarra River environs.

Management Requirements

- High performing species: Preference trees that establish quickly and those that have consistently performed well in local conditions.
- Litter (leaf, fruit) at acceptable levels: Preference species (or cultivars of species) with low levels of leaf and fruit drop where this is likely to be an issue.
- Minimal disturbance by roots to pavements, kerbing and roads: Plant appropriately sized trees to ensure there is sufficient space above and below ground to allow the tree to grow undisturbed to prevent damage of surrounding hardscape by vigorous tree roots.
- Low maintenance requirements: Chose appropriate species that once established, should not require additional watering, fertilising and pruning beyond that of routine maintenance

Streetscape Aesthetics

- Unity: Establish strong and consistent planting theme with regularly spaced, single species planting on each side of the street. Where street conditions vary along the length, create a coherent streetscape character by restricting the number of tree species used in each street to a maximum of two.
- Scale: Create the desired scale within the streetscape through use of the largest possible tree in each planting location, whilst ensuring that the tree height and width are appropriate for the street width and urban form of the streetscape.
- Obstructions: Ensure there is sufficient space for the above and below ground parts of each tree to grow undisturbed and to contribute the character of the streetscape.

4. Tree Species for Green Infrastructure (cont.)

Sourcing and Purchasing Street Trees

- All trees supplied are predominately in 45-100 litre stock and must all be Approved by the Supervisor prior to delivery. Pricing is to include delivery to the planting site or an intermediate storage facility. Trees shall be delivered to site in such a manner to prevent damage during transit and the dehydration of the root balls.
- Standard size trees for planting are 1.5 -3.0 metres high with 45-100 litre root balls in pots, bags or burlapped.
- Larger size trees are usually planted in main thoroughfares where vandalism maybe high.
- Where stock cannot be sourced at the required size or quality the Supervisor must be informed and may approve alternative size trees or species or postpone planting until appropriate sized stock is available.
- Once the Supervisor has Approved the stock for purchase the Contractor will immediately order the stock from the Approved supplier and provide a purchase order number for the supplier to secure the stock. The supplier must hold stock until ready to be planted.
- Tree stock shall not be stored at depot locations within the Municipality for periods longer than two weeks.
- The Contractor must initiate a detailed auditing process for the acceptance of trees and plants upon delivery to ensure stock meets the criteria (see right). Tree material that is of low quality or does not fulfil one of the criteria will be rejected, unless specifically Approved by the Supervisor.
- Any damage sustained during transport or planting that results any of the tree quality criteria (see right) not being achieved will be rejected and replaced at the expense of the Contractor.
- Any costs associated with the return or replacement of stock will be at the expense of the Contractor.

- It is preferred that all trees stock conform to AS 2303-15 ‘Tree Stock for Landscape Use’. At a minimum all stock shall meet the following criteria:

  - o be true to form and species;
  - o be healthy, of typical growth, free of pest and diseases;
  - o consist of a single straight central Leader, with even radial symmetrical branching habit that can easily be pruned to uplift the canopy without removing substantial portions of the Tree, that will affect Tree structure or aesthetics.
  - o be free of structural and root defects
  - o have established root systems in the container, preventing no more than 10% of the soil to fall away.
  - o have an even trunk taper, which is proportionate to tree size;
  - o be able to stand erect without the assistance of supportive staking
  - o not have been pruned to encourage bushiness, especially the central Leader; and
  - o be hardened off and acclimatised to local conditions.

Timing of Planting

- Plant numbers and species must be determined by August. Nurseries typically source seed and orders in spring and grow a little extra stock on speculation through January. Orders will not be met if they are not placed by January.
- The optimal time for planting is in Autumn (April-May) when the soil is still warm and wet weather is on the horizon. Plantings should not be conducted between October – March to due to a lack of soil moisture and summer heat.

4. Tree Species for Green Infrastructure (cont.)

Street Tree Positioning Criteria

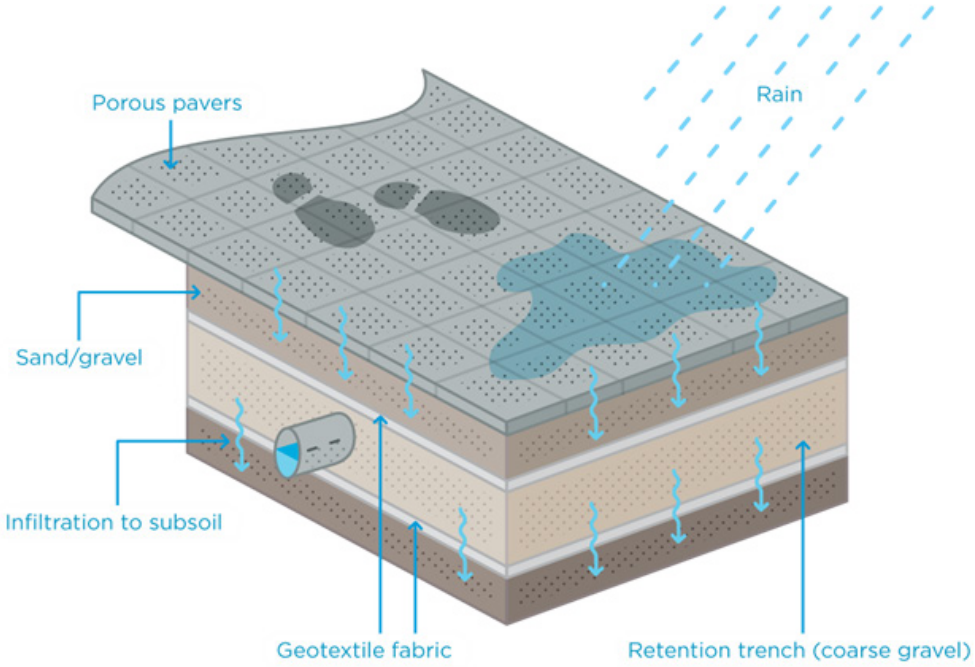
Trees are not recommended in the following locations:

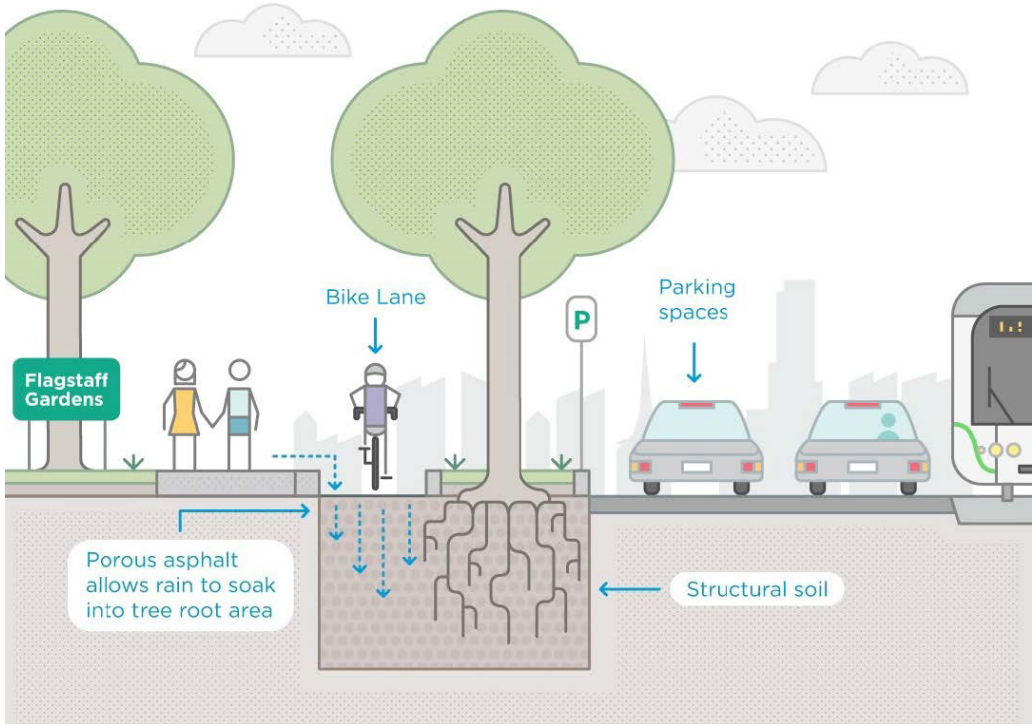
- where an existing tree will significantly affect the health, vigour and shape of a new tree;
- within 5m of an existing nature strip tree unless: it is proposed to remove the existing tree in the short to medium term or close plantings are consistent with the character of the streetscape;
- within 1m of a vehicle crossover;
- within 1m of a stormwater drain;
- within 1m of a residential water/gas service or ferule connection to water mains;
- within 2m of a fire hydrant or drainage pit;
- within 1m of an inspection pit;
- within 3m of an electricity pole (includes Yarra Tram Poles, light poles etc.);
- within 1.5m directly beneath overhead service wires to properties;
- where it will inhibit visibility of an intersection or pedestrian crossing (consult with Traffic Engineers regarding possible locations);
- directly in front of pedestrian access to properties;
- where the planting will interfere with the flow of pedestrian, bicycle or motor vehicles. (Cut outs are not to extend into bicycle lanes).
- over incoming gas and water services;

5. Permeable Surfaces with structural soils

Permeable Surfaces with structural soils

Permeable surfaces allow water to pass through and infiltrate into structural soils below. These structural soils are generally a mix of aggregate and soil material that allow tree roots to access infiltrated water. Permeable pavements and structural soils can be used in footpaths, bike lanes and in the roadway. Structural soils also serve to increase the soil volume available for trees in constrained urban environments, where raingardens and other Green Infrastructure responses are not appropriate.





5. Permeable Surfaces with structural soils (cont.)

Permeable surface The surface layer must be a porous material that allows the infiltration of water into the subsurface layers. This can comprise of open graded asphalt (with air voids between 20-25%), permeable pavers or interlocking paver arrangements with voids between pavers.

Base course

Permeable pavements that allow water to infiltrate require a modified base course that allows water to pass into the surrounding soil. To allow water to move through the base course, fine particles of the material are removed to increase void space. While it is desirable to maximise the void ratio of a base material to maximise for stormwater purposes, uniform materials with very high void ratios (40%) are unsuitable for carrying trucks and other significant traffic.

It is recommended to use a standard road base (e.g. 20 mm crushed rocks) to underlie permeable pavements, with fine particles of a certain size scalped out. Scalping fine particles increases permeability, while reducing the structural capacity of the material. This is a necessary compromise that can be controlled by the size of particles scalped out of the material.

This gives designers the ability to preference the permeability or structural capacity requirements of the pavement, depending on the situation. For example, the removal of material smaller than 0.600mm from a sample of 20mm crushed rock resulted in a forty-fold increase in permeability and a reduction of the Resilient Modulus (indicator of structural capacity) between 20% and 45%. Removing material smaller than 1.18mm provided a 100 times increase in permeability, but also a 30% to 55% reduction in resilient modulus1. Given concerns regarding the compaction and structural integrity of structural soils it is recommended to adopt the conservative case to remove fine particles smaller than 0.600mm. For design purposes it is recommended to assume a resilient moduli of saturated, scalped base materials to be about half those normally used in pavement design[1]. Scalped base courses generally exhibit void ratios of around 15%, meaning their capacity for retaining water is much less than materials with uniform particle size.

1 *Shackel, B., Beecham, S. & David Pezzaniti, B. M., 2008. Design of Permeable Pavements for Australian Conditions. Adelaide, 23rd ARRB Conference.*

Permeable Pavement and Structural Soil Specifications

Permeable pavement The surface layer must be a porous material that allows the infiltration of water into the subsurface layers. This can comprise of open graded asphalt (with air voids between 20-25%), permeable pavers or interlocking paver arrangements with voids between pavers.

Aggregate Layer

The permeable pavement is directly underlain by a washed aggregate layer. The aggregate layer is to be a minimum of 75mm thick, compacted to 95% modified compaction.

Structural Soil Layer

Structural soils are a weight-bearing substrate made largely of crushed stone (basalt) and a small amount of filler soil mix (loam to clay loam with nutrient additives) at a ratio of 5:1 of volume (assuming void space of 40%). A minimum depth of 600mm is required2. Structural soil layers should be compacted to 95% modified compaction. Under compaction, structural soils form a uniform, rigid, stone “lattice” with dispersed spaces (pores or voids) that allows for the controlled passage of oxygen, water and tree roots deep beneath concreted pavements and roads. These voids also provide room for an uncompacted soil mix rich in nutrients and trace elements for plant growth and water retention.

The crushed stone is the primary component of the soil system and must be uniformly sized and highly angular to create an open “lattice” structure when compacted. The properties of the soil filler material should have a high stability and longevity, high cation exchange capacity, high water holding ability, low potential for downward migration, and high pH buffer capacity. To avoid the separation of filler soil and aggregate during transport, the structural soil mix should be kept moist during mixing and transportation to avoid separation of materials. Structural soil should be installed in 150mm lifts, with compaction of each lift, to ensure consistent compaction of the entire layer.

Subgrade

Subgrade underlying structural soils should be compacted as per standard road construction.

5. Permeable Surfaces with structural soils (cont.)

Structural Soil Component Composition[2]

Structural Soils (Typically 600-1,000 mm deep)

Structural soil mix is to be a thoroughly combined mix of aggregate and filler soil mix in a ratio of 5:1 (by weight) to the structural requirements of the project civil

Aggregate (City of Melbourne, 2017)

SHALL BE 40MM CRUSHED BASALT. GRAVEL SHALL BE CLEAN AND FREE FROM CLAY AND OTHER MATTER. SUBMIT SAMPLE FOR APPROVAL. THE AGGREGATE SHALL BE OF THE FOLLOWING PARTICLE SIZE DISTRIBUTION:

A.S. SIEVE	PERCENT PASSING
53.0	100
37.5	90-100
26.5	0-75
19.0	<15
13.2	<2
9.5	<2
6.7	<2
4.75	<2
2.36	0

TRANSPORTING: SOIL MIXES MUST BE DELIVERED TO SITE PRE-BLENDED. THE SOIL MIX MUST BE TRANSPORTED IN A MOIST CONDITION TO PREVENT SEGREGATION OF COMPONENTS.

Filler Soil Mix (City of Melbourne, 2017)

FILLER SOIL SHALL BE A THOROUGHLY COMBINED MIX OF A CLAY LOAM OR SIMILAR SOIL (BURDETT'S MOUNTAIN SOIL BLEND MAY BE SUITABLE) AND 5% BY VOLUME OF COMPOSTED GREEN WASTE, SCREENED TO LESS THAN 12MM, WITH THE FOLLOWING PROPERTIES.

SUBMIT SAMPLE FOR APPROVAL.

ORGANIC MATTER	<1% BY WEIGHT
PH IN WATER	5.5 - 6.5
ELECTRICAL CONDUCTIVITY	<1.2 DS/M
AMMONIUM	20-200MG/KG
PHOSPHOROUS	10-50MG/KG

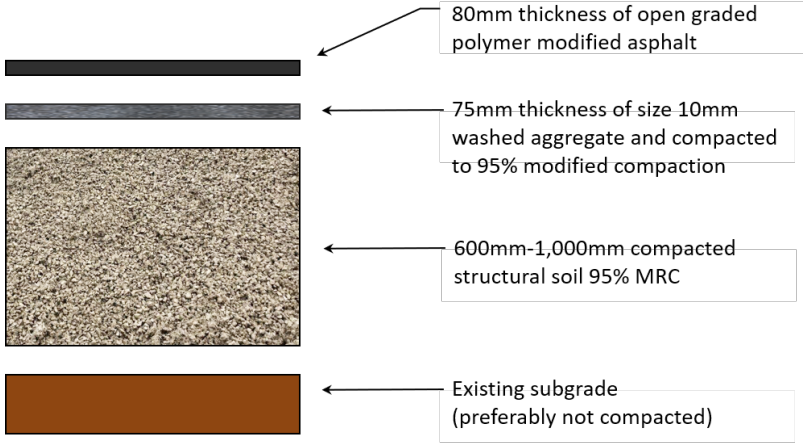
Nutrient Additives (City of Melbourne, 2017)

...NG

TESTING OF SAMPLES FOR APPROVAL).

MAGRILIME OR A 50/50 LIME/DOLOMITE MIX	TO BRING PH TO 5.5 - 6.5
TRACE ELEMENT MIX	100G/ CUBIC METRE
POTASSIUM NITRATE	300G/ CUBIC METRE
NITRAM (AMMONIUM NITRATE)	300G/ CUBIC METRE
SUPERPHOSPHATE	300G/ CUBIC METRE
IRON SULPHATE	500G/ CUBIC METRE
CONTROLLED RELEASE FERTILISER (8-9 MONTH OSMOCOTE)	1.5KG/ CUBIC METRE
GYPSUM	300G/ CUBIC METRE
MAGNESIUM SULPHATE (EPSOM SALTS)	150G/ CUBIC METRE

THESE ADDITIVES MUST BE MIXED WITH THE FILLER SOIL AND TESTED FOR COMPLIANCE WITH THE SPECIFICATION. FILLER SOIL MIX SHALL BE INSTALLED AS DETAILED.



[2] City of Melbourne (2017). *Structural soil composition guide.*
URL: http://www.melbourne.vic.gov.au/sitecollectiondocuments/porous-asphalt-pavement-

5. Permeable Surfaces with structural soil cells

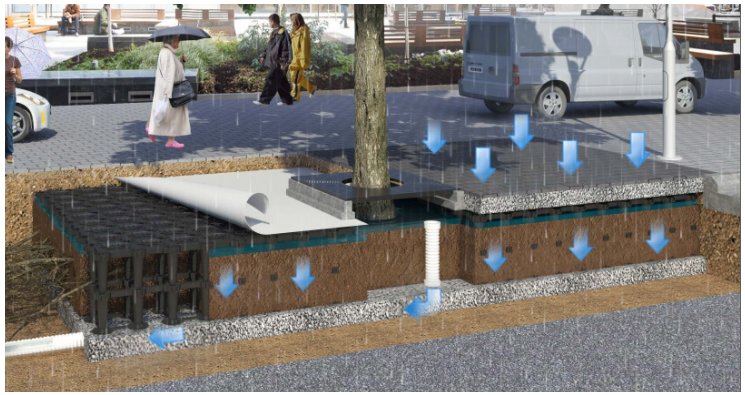
Citygreen Strataflow Systems

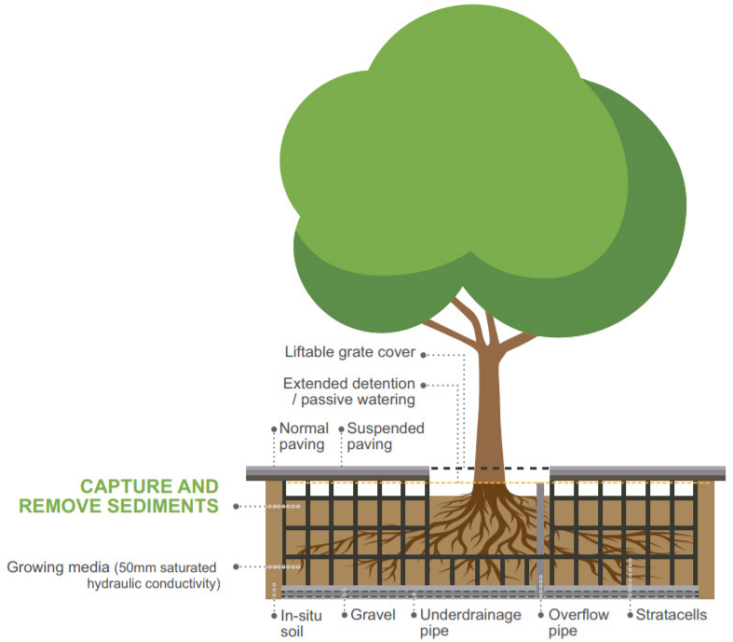
Citygreen's Strataflow systems use structural tree pit systems to create soil volume and allow surrounding stormwater to infiltrate the system, providing passive irrigation for street trees. Strataflow systems provide a similar benefit to structural soils, instead using proprietary structural cells to support overlying pavements. The voids inside the structural system contain soil and growing media, providing trees with extensive soil volume to develop roots.

Water is delivered to the system from the surrounding impervious surfaces (e.g. roads, footpaths etc.). Suspended pavements allow for extended detention on the soil surface, capturing and infiltrating stormwater. Pre-treatment of inflows is required to prevent the build-up of sediments and litter on the soil surface.

Structural soil modules are required where pavements are to be supported above uncompacted soils. Modules must be founded on well compacted earth with adequate bearing capacity to support anticipated loads. Locations of existing infrastructure must be identified to ensure the modules do not clash. Some services may be located within conduits within the treepit subject to utility approval. Care should be taken adjacent to live pressure mains (ie water) to ensure joints and thrust blocks are adequately supported.

The location of the modules should ensure they are not within the zone of influence of any adjacent infrastructure or buildings.





B.

6. Safety Edge Considerations

Notable considerations

- A planted, gravel or otherwise differentiated strip with a slope of no more than 1 in 10 and width of at least 300 mm should be provided between paths and Green Infrastructure as a tactile indication of the edge of the pedestrian area.
- Where depths are greater than 190 mm, the use of terraced steps is preferred. Other physical barriers such as fencing, handrails and seating may also be considered although these must be balanced with amenity considerations.
- A pedestrian refuge is an important safety consideration, particularly for larger Green Infrastructure assets at street corners to allow pedestrians crossing the road to move out of the way of oncoming traffic. A strip of at least 400 mm and preferably 500 mm should be provided where practical.
- The design of Green Infrastructure adjacent to parallel parking should provide for safe step-down and egress from vehicles. A minimum 400 mm and preferably 600 mm wide stable surface (grass or pavement) is recommended to be provided parallel to the kerb line.
- Dense planting can be used around the edges to deter pedestrian ingress and cushion the level difference. Temporary barriers can be used during plant establishment.

Where to learn more

Moreland WSUD Design package

http://www.moreland.vic.gov.au/globalassets/areas/esd/moreland-water-sensitive-urban-design-package.pdf

[1] Moreland City Council (2013). *Moreland's streetscape raingarden and tree pit design package*. URL: http://www.moreland.vic.gov.au/environment-bins/environment/water/wsud-design-package/

APPENDIX C
Inspection & Maintenance

Provides inspection and maintenance checklists for vegetated and grated tree pits

C.

Green Infrastructure Inspection Checklist

Date		Site address	
Weather		Site ID	
Date of last rainfall		Asset name	
WSUD Type		Asset ID	
Inspected by			

Task Item	Performance target	Good condition	Moderate condition	Poor condition	Score	Condition summary
		(1 point)	(2 points)	(3 points)		
		No works	*Maintenance*	*Rectification*		
Surrounds and other infrastructure						
Damage or removal of structures	No damage, erosion or issues / removal of structures	Stable structures No vandalism impacting amenity No safety risks	Minor damage Does not pose risk to structural integrity or asset function	Major damage Poses risk to structural integrity, public safety or asset function		
Rubbish	No litter present	No litter present	Some litter present Diminished aesthetics and /or causing some visible blockage	Large amount of litter present Heavily impacting aesthetics and/or blocking flows		
Inlet						
Erosion	Minor erosion that doesn't pose public safety risk and would not worsen if left unattended	No erosion	Minor erosion Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows)	Major erosion Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows)		
Blockage	No blockage	No blockage	Partial blockage of inlet causing some bypass of flows or restricted inflows	Blockage of inlet causing significant bypass or restriction of inflows		
Damage or removal of structures	No damage, erosion or issues / removal of structures	Stable structures No vandalism impacting amenity No safety risks	Minor damage Does not pose risk to structural integrity or asset function No safety risks	Major damage, poses risk to structural integrity, public safety or asset function		
Batters						
Erosion	Minor erosion that doesn't pose public safety risk and would not worsen if left unattended	No erosion	Minor erosion Does not pose risk to structural integrity, public safety or asset function (limited short circuiting of flows)	Major erosion Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows)		
Vehicle or pedestrian damage	No compaction, plant loss, vandalism impacting system function	No compaction, plant loss, vandalism impacting system function	Minor compaction, plant loss Does not pose risk to structural integrity or asset function	Significant compaction, plant loss Poses risk to structural integrity, public safety or asset function		

C.

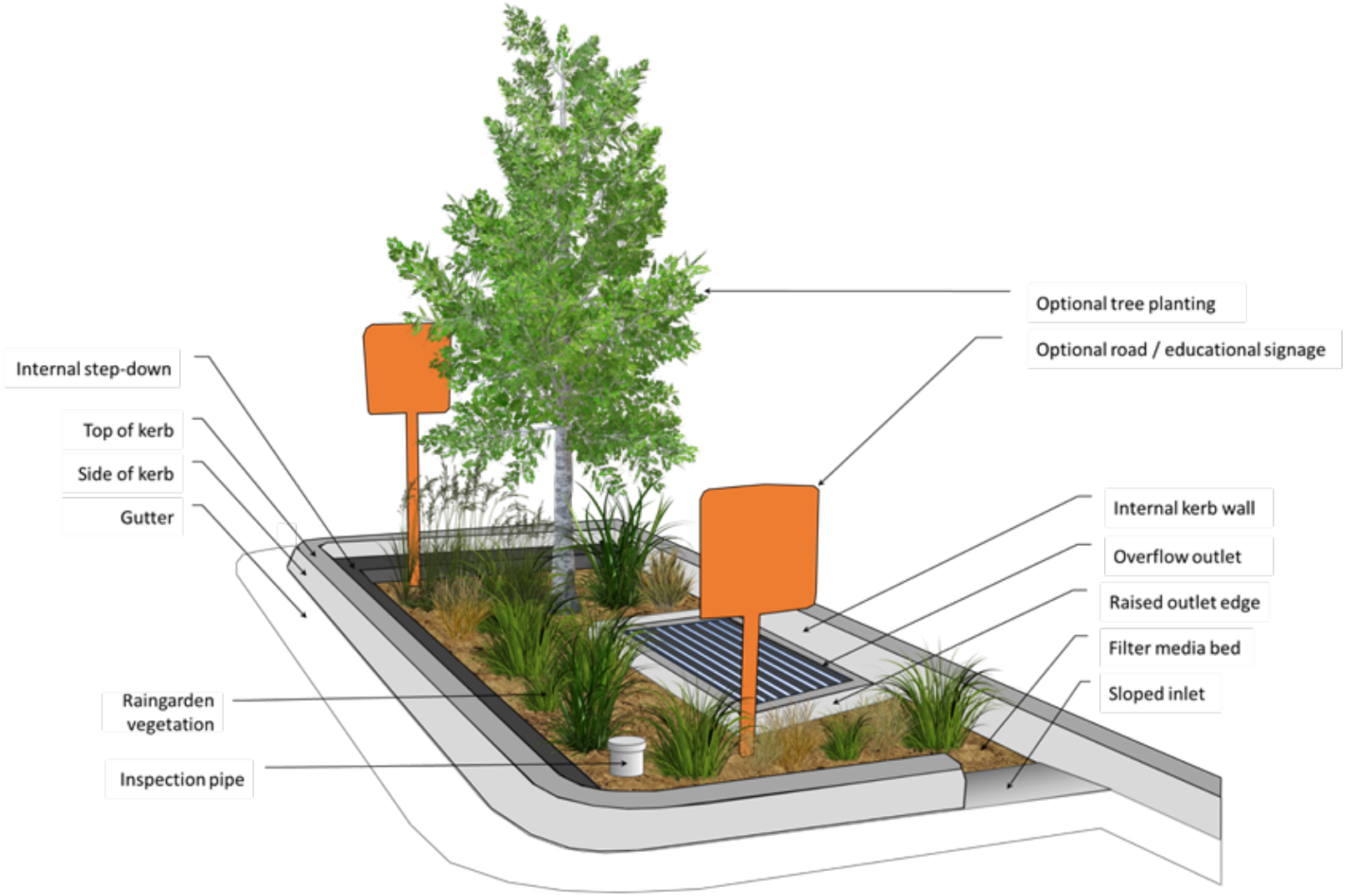
Green Infrastructure Inspection Checklist (cont.)

Surface levels	Even surface with no depressions or mounds	Even surface with no depressions or mounds. Base is flat with flows evenlydistributed across asset surface.	Some small depressions or mounds present or preferential flow paths. Base is mostly flat with flows evenlydistributed across most of asset.	Significant depressions or mounds present or defined preferential flow paths. Surface levels are impacting flows through the asset (e.g. short circuiting flows, blocking flows, limited flow distribution).		
Extended detention depth	Designed extended detention depth provided	Design extended detention depth provided	At least 50% of design extended detention provided	Less than 50% of design extended detention depth provided		
Rubbish	No litter present	No litter present	Some litter present Diminished aesthetics and /or causing some visible blockage	Large amount of litter present Heavilyimpacting aesthetics and/or blocking flows		
Leaf litter	No accumulated leaf litter causing blockages or impeding flows or vegetation growth	Minimal leaf litter present or covers less than 20% of surface	Some wet and decaying leafmatter present (covering 20-50% of surface) Aesthetic issue Some obstruction of flow paths	Large amount wet and decaying leaf matter present (covering >50% of the surface) Impacting vegetation growth Obstructing flow paths and blocking inlets or outlets		
Plant health	Good vegetation health	Healthy vegetation	Vegetation is stressed Poor health (signs of disease, pests) in less than 20% of plants	Vegetation is dying back Poor health (signs of disease, pests) in more than 20% of plants		
Plant cover	Tree present	Tree present	Tree not present, replacement only required	Tree not present and other functional issues		
Weeds	Limited weed cover with no declared noxious weed species	Limited weed cover (<10%) and no declared noxious weed species	Low/Moderate weed cover (10-50%) and no declared noxious weed species	High weed cover (>50%) and/or declared noxious weed species present		
Nuisance fauna	No nuisance fauna	No nuisance fauna	Some nuisance fauna but limited impact on aesthetics, water qualityand/or vegetation growth	Significant nuisance fauna issues Heavilyimpacting aesthetics, vegetation growth and/or water quality		
Outlet, overflow and inspection pipes						
Erosion	Minor erosion that doesn't pose public safetyrisk and would not worsen if left unattended	No erosion	Minor erosion Does not pose risk to structural integrity, public safetyor asset function (e.g. limited short circuiting of flows)	Major erosion Posing risk to structural integrity, public safetyor asset function (e.g. short circuiting of the majorityof flows)		
Blockage	No blockage	No blockage	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal	Blockage of outlet or overflow preventing or significantlyobstructing outflows		
Damage or removal of structures	No damage, erosion or issues / removal of structures	Stable structures No vandalism impacting amenity No safetyrisks	Minor damage Does not pose risk to structural integrityor asset function	Major erosion Poses risk to structural integrity, public safetyor asset function		

Green Infrastructure Maintenance (cont.)

Vegetated Tree Pit Schematic

Example kerb outstand



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Green Infrastructure Maintenance Checklist

Form instructions - vegetated tree pit

Step 1.

Fill out the inspection form in Table 1.

Step 2.

For each tree pit item in Table 2, complete the following:

i. Identify the item's location within the asset. If the tree pit item is not relevant to the asset, place an 'N/A' in the three shaded columns.

ii. If the item is present, assess the item's condition with the listed inspection item questions. Reference photos for each item (1-8) are provided in Table 3 to aid the condition assessment.

iii. Place a number 1-3 in the condition column for the condition observed.

- 1 = Good - the item is functioning as designed and no works are required
- 2 = Maintenance needed – the item requires some cleaning and general upkeep
- 3 = Rectification needed – the functionality of the item is heavily limited and special attention/works is required.

iv. Review the Typical maintenance response/s if the item receives either a 2 or 3 condition assessment.

v. Apply the Typical maintenance response (or an alternative action) if it will improve the item's condition without negatively impacting other asset items. Place a 'Y' in the Action Taken column if a repair was undertaken or place a 'N' if not.

vi. Place a 'Y' in the Repaired column if the condition of the item was restored to a 'Good' condition status by the action. If further works need to be undertaken to achieve this, place a 'N' instead.

vii.For items that receive an 'N' in the Repaired column, please provide a comment in the Notes area of Table 1 on what further works/actions that need to be undertaken so that the item can be restored to a 'Good' condition. Accompany all notes with the item number it refers to.

Table 1. Vegetated Tree pit inspection register

Inspection Register	
Date	
Location	
Asset name	
Asset ID	
Inspected by (name)	
Date	
Notes / Further Works Required	

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Green Infrastructure Inspection Checklist

Table 2. Vegetated tree pit inspection and maintenance form

Item	Tree pit item	Inspection item	Condition (1,2,3)	Typical maintenance response	Action Taken (Y/N)	Repaired (Y/N)
1	**Inlet blockage**	Is there scour or erosion where water enters the asset?		Re-profile with hand tools. Place gravel or stones at the inlet to absorb inflow energy.		
		Is there rubbish, leaf litter or sediment blocking the inlet?		Remove by hand and dispose responsibly.		
2	**Surface level**	Is the level of the surface sitting less than 50 mm below the kerb invert at the inlet and the outlet pit?		Remove mulch and sediment from the surface so it sits 50-100 mm below inlet and outlet.		
3	**Surface condition**	Is the surface covered with sediment, leaf litter, and/or rubbish?		Remove debris from the top of the surface and check water will drain through exposed media.		
		Are there areas which appear higher and not getting wet during rain events?		Smooth out surface so it is flat and even with hand tools.		
		Are there areas which have been eroded away or scoured? Are inflows being concentrated to a particular area?		Smooth out surface so it is flat and even with hand tools.		
4	**Plants**	Are the plants looking unhealthy or dying?		Prune diseased sections, irrigate as needed, replace dead plants. If plants die repeatedly, replace with a different type of plant which is doing well in similar conditions. Avoid or minimise fertilizer use as this will pollute downstream waterways.		
		Are there bare patches between plants?				
		Are there weeds present?		Remove weeds by hand and dispose responsibly.		
5	**Filter media**	Is the asset holding water for more than a couple of hours after the rain and inflows have stopped?		Remove accumulated sediment and gravel mulch. Remove and replace up to top 100 mm of filter media (loamy sand) as needed. Dispose responsibly.		
6	**Overflow pit and pipe**	Is there anything blocking flows entering the top of the overflow pit or pipe or preventing water flowing into the stormwater drain?		Remove blockages and dispose responsibly.		
7	**Underdrainage**	Is there water in the inspection pipe?		Flush the underdrain or uncover it to check for blockages. Replace cap cover if missing.		
8	**Associated infrastructure**	Is there any damage to other structures associated with the asset (signage, fences, kerbs, drainage pits etc)? Are there any safety concerns for residents or general public?		Repairs for structural issues to be undertaken immediately.		

Green Infrastructure Inspection Checklist

Table 3. Raingarden item reference photos

Item	Good Condition – Example	Poor Condition - Example 1	Poor Condition - Example 2
1. Inlet blockage			
2. Surface level			

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Green Infrastructure Inspection Checklist

Item	Good Condition – Example	Poor Condition - Example 1	Poor Condition - Example 2
3. Surface condition e			
4. Plants			

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Item	Good Condition – Example	Poor Condition - Example 1	Poor Condition - Example 2
5. Filter media			
6. Overflow pit and pipe			

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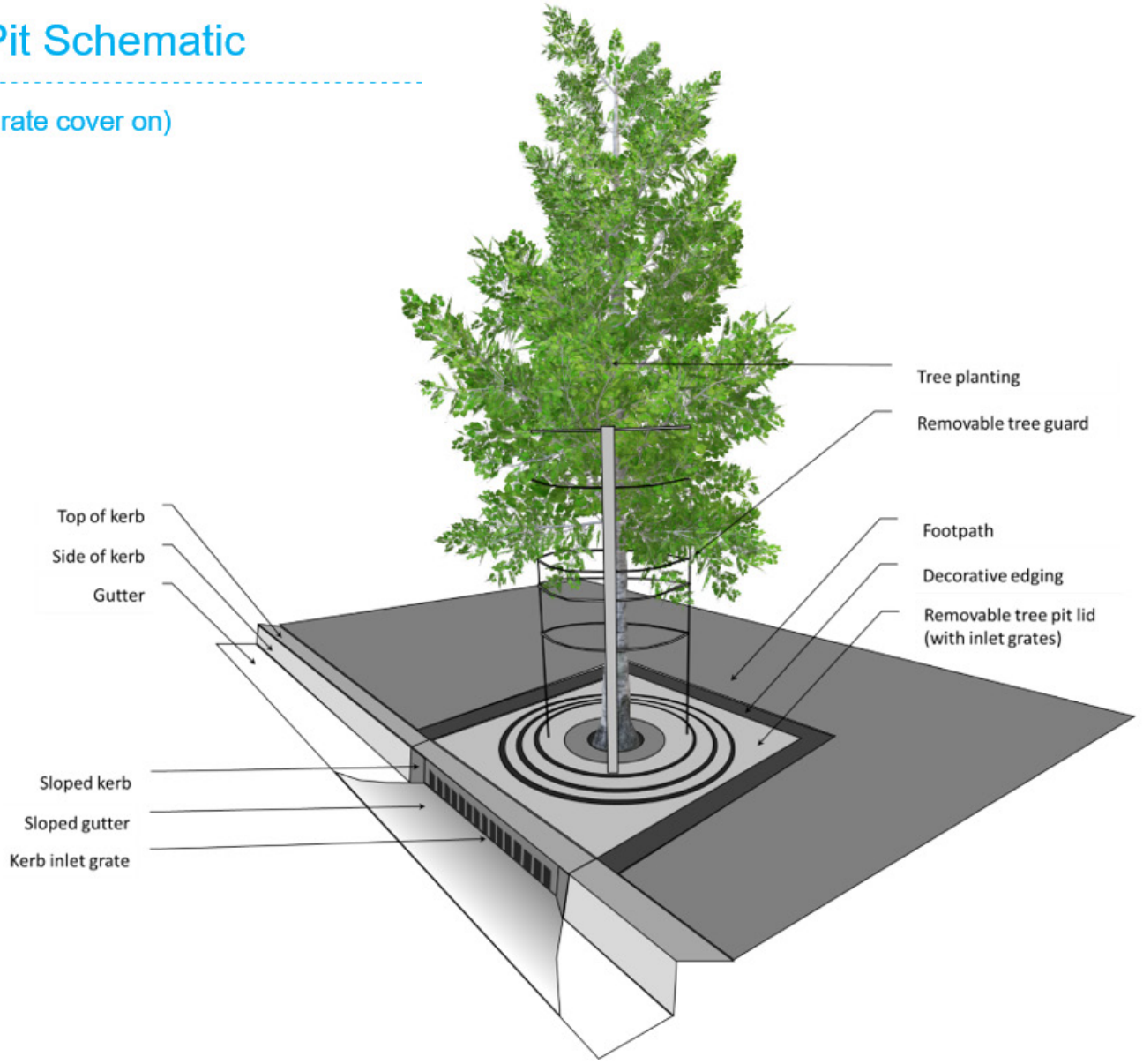
Green Infrastructure Inspection Checklist

Item	Good Condition – Example	Poor Condition - Example 1	Poor Condition - Example 2
7. Underdrainage			
8. Associated infrastructure			

Green Infrastructure Maintenance Checklist

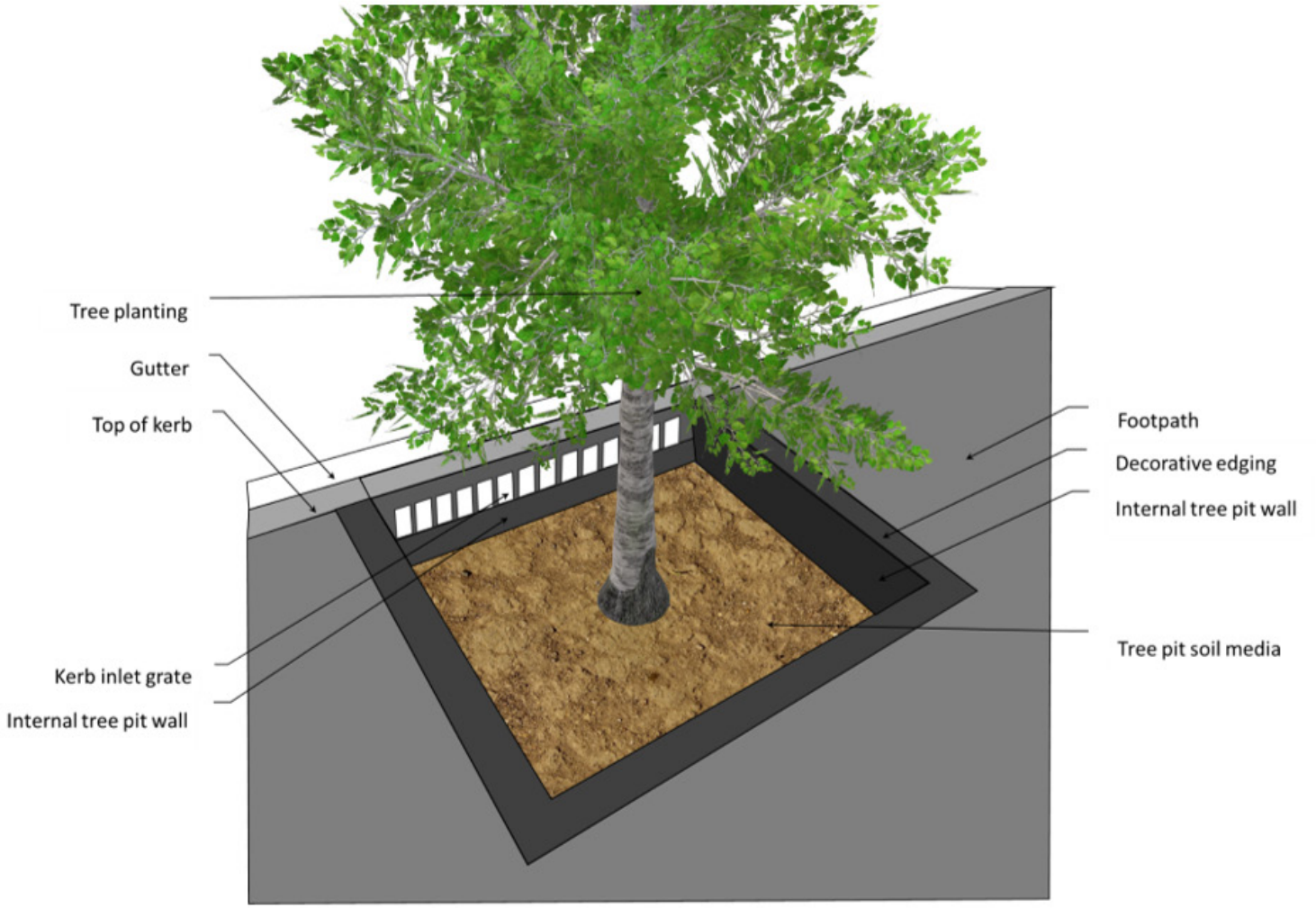
Grated Tree Pit Schematic

In-kerb tree pit (with grate cover on)



Grated Tree Pit Schematic

In-kerb tree pit (with grate cover off)



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Green Infrastructure Maintenance Checklist

Form instructions - vegetated tree pit

Step 1.

Fill out the inspection form in Table 4.

Step 2.

For each tree pit item in Table 5, complete the following:

i. Identify the item's location within the asset. If the tree pit item is not relevant to the asset, place an 'N/A' in the three shaded columns.

ii. If the item is present, assess the item's condition with the listed inspection item questions. Reference photos for each item (1-8) are provided in Table 6 to aid the condition assessment.

iii. Place a number 1-3 in the condition column for the condition observed.

- 1 = Good - the item is functioning as designed and no works are required
- 2 = Maintenance needed – the item requires some cleaning and general upkeep
- 3 = Rectification needed – the functionality of the item is heavily limited and special attention/works is required.

iv. Review the pical maintenance response/s if the item receives either a 2 or 3 condition assessment.

v. Apply the typical maintenance response (or an alternative action) if it will improve the item's condition without negatively impacting other asset items. Place a 'Y' in the Action Taken column if a repair was undertaken or place a 'N' if not.

vi. Place a 'Y' in the Repaired column if the condition of the item was restored to a 'Good' condition status by the action. If further works need to be undertaken to achieve this, place a 'N' instead.

vii.For items that receive an 'N' in the Repaired column, please provide a comment in the Notes area of Table 1 on what further works/actions that need to be undertaken so that the item can be restored to a 'Good' condition. Accompany all notes with the item number it refers to.

Table 4. Grated tree pit inspection register

Inspection Register	
Date	
Location	
Asset name	
Asset ID	
Inspected by (name)	
Date	
Notes / Further Works Required	

Green Infrastructure Inspection Checklist

Table 5. Grated tree pit inspection and maintenance form

Item	Tree pit item	Inspection item	Condition (1,2,3)	Typical maintenance response	Action Taken (Y/N)	Repaired (Y/N)
1	**Inlet blockage**	Is there scour or erosion where water enters the tree pit?		Re-profile with hand tools. Place gravel or stones at the inlet to absorb inflow energy. Take care not to increase surface level.		
		Is there rubbish, leaf litter or sediment blocking the inlet?		Remove by hand or other appropriate mechanism (i.e. water jetting) and dispose responsibly.		
2	**Surface level**	Is the level of the tree pit surface sitting less than 50 mm below the tree pit's edges/borders, inlet and outlet?		Lower the level surface with hand tools so it sits about 50-100 mm below inlet and outlet.		
3	**Surface condition**	Is the surface of the tree pit covered with sediment, leaf litter, and/or rubbish?		Remove debris from the top of the tree pit and check water will filter through exposed media.		
		Are there areas which appear to be higher and are not getting wet during rain events?		Smooth out surface so it is flat and even with hand tools.		
		Are there areas which have been eroded away or scoured? Are inflows being concentrated to particular areas?		Smooth out surface so it is flat and even with hand tools.		
4	**Tree(s)**	Are the tree/s looking unhealthy or dying?		Prune diseased sections, irrigate, replace dead trees. If trees die repeatedly, seek further investigation of causes and replace with a different species which is more tolerant of dry or wet conditions, depending on catchment. Avoid or minimise fertilizer use as this will pollute downstream waterways. Apply same approach to understorey plantings if present.		
		Are there weeds present?		Remove weeds by hand and dispose responsibly.		
5	**Filter media**	Is the tree pit holding water for more than a couple of hours after the rain has stopped?		Remove and replace up to the top 100 mm of planting media (loamy sand). Dispose responsibly.		
6	**Underdrainage**	Is there water in the inspection pipe?		Remove cap to check for blockages and flush underdrain if needed. Replace cap if missing.		
7	**Associated infrastructure**	Is there any damage to other structures associated with the asset (tree pit lid, tree guard, support stakes etc.)? Are there any safety concerns for residents or general public?		Repairs for structural issues to be undertaken immediately.		

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Table 6. Grated tree pit item reference photos

Item	Good Condition – Example	Poor Condition - Example 1	Poor Condition - Example 2
1. Inlet blockage			
2. Surface level			

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Green Infrastructure Inspection Checklist

Item	Good Condition – Example	Poor Condition - Example 1	Poor Condition - Example 2
3. Surface Condition			
4. Trees / Weeds			

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Green Infrastructure Inspection Checklist

Item	Good Condition – Example	Poor Condition - Example 1	Poor Condition - Example 2
5. Filter Media			
6. Underdrainage			

Green Infrastructure Inspection Checklist

Item	Good Condition – Example	Poor Condition - Example 1	Poor Condition - Example 2
7. Associated Infrastructure