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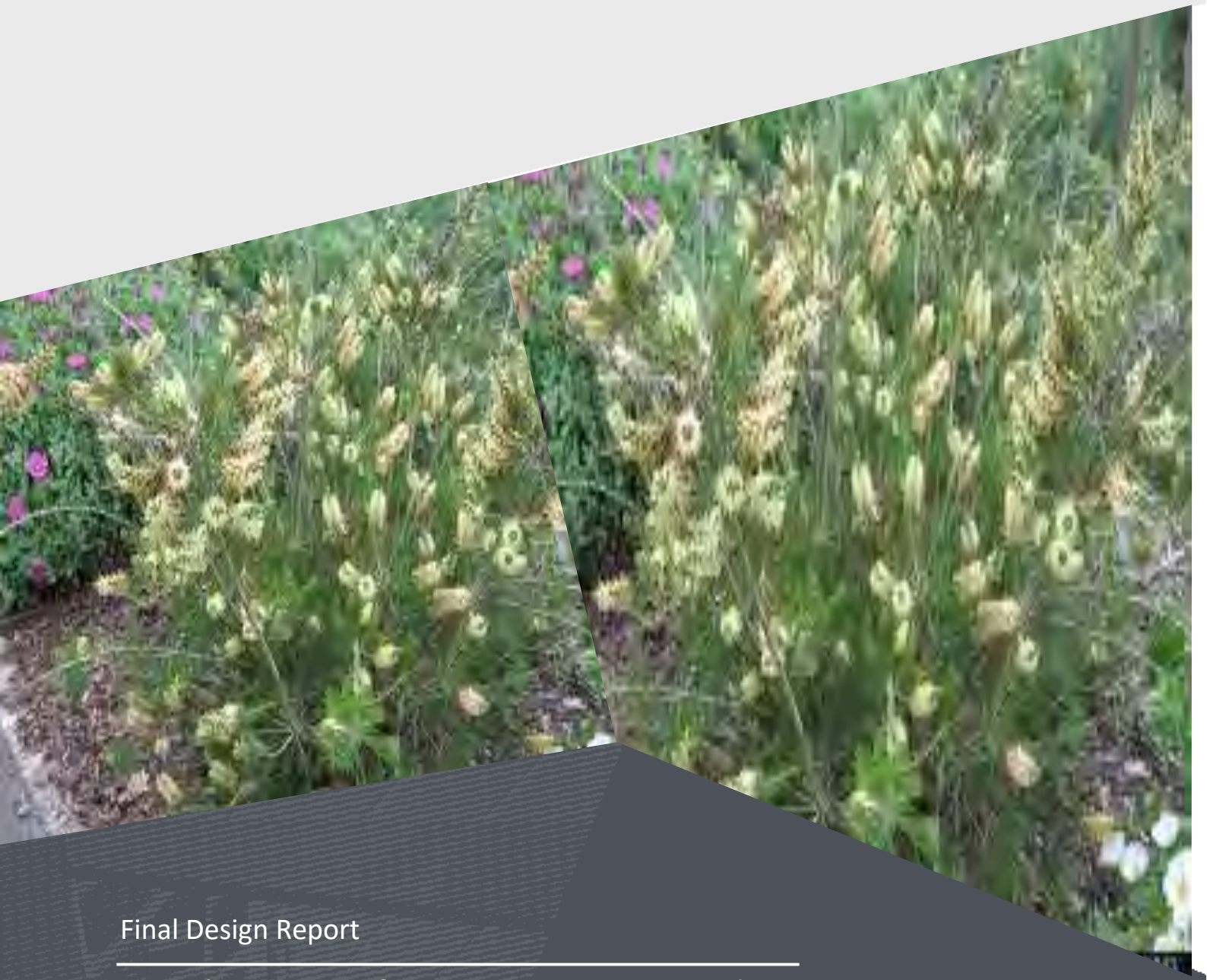

Final Design Report

Development of Streetscape Raingarden Master Plan for Austral and Leppington North

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1 Introduction

1.1 Background

The Austral and Leppington North precincts, within the Liverpool Local Government Area, are to be transformed from a rural district into an urban district including residential, commercial, and industrial zones. The proposed urban development requires stormwater management and water quality management plans to provide required infrastructure for the precinct while minimising environmental impacts on environment and natural habitats.

Previously, Cardno (2012) prepared a water cycle management strategy plan for Austral and Leppington North precincts to address potential flooding and water quality impacts caused by the proposed development. SMEC was subsequently engaged by Liverpool City Council (LCC) to prepare a detailed concept design for the stormwater management infrastructure including water quality control structures (2019). The proposed water management infrastructure provides a concept design for required trunk drainage pipes, detention basins, water quality biofilter systems, and other streetscape raingarden systems as shown in Figure 1.

Base on the detailed concept design, there are 63 sub-catchments within the precinct. It is noted that only one of the sub-catchments can maintain water quality without having streetscape raingarden systems. A streetscape raingarden master plan is required for Austral and Leppington North precinct to maintain water quality.

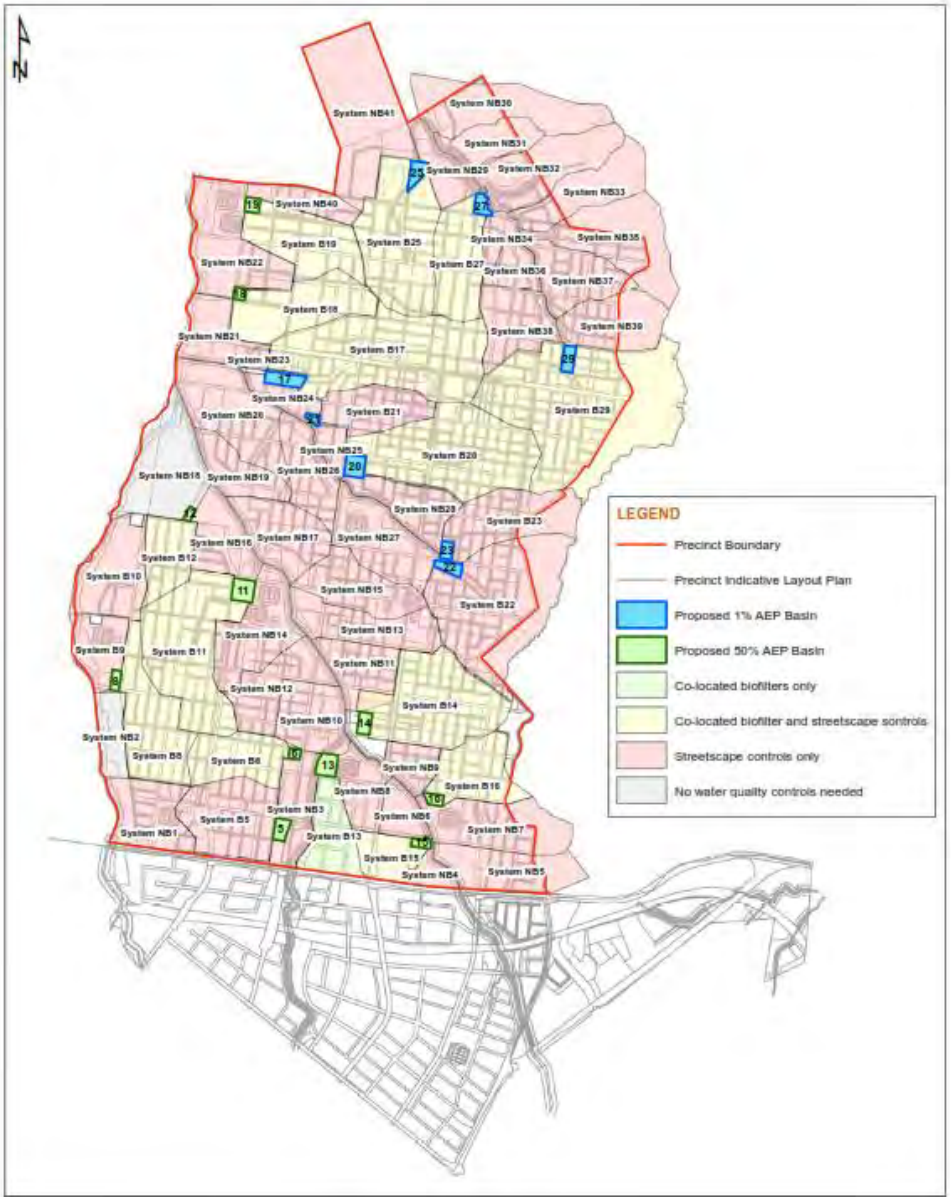

Figure 1. Water Quality Control Strategy within Austral and Leppington North Precinct (SMEC 2019)

The purpose of this report is to detail the design procedures and considerations adopted for the development of the Austral and Leppington North Precinct streetscape raingarden master plan.

1.2 Scope of Works

The following was undertaken in the development of the master plan:

- Review of available data, past reports, Council's typical street sections, and Council' GIS layers (including land use and road ILP layout).
- Review of existing contours and catchment areas.
- Review of MUSIC model for 1 ha area to check against Council's streetscape raingarden footprint design requirements.
- Identification of design parameters and constraints.
- Development of streetscape location master plan map.
- Creation of typical design drawings.
- Identify design vegetation options.
- Creation of maintenance and management plan of streetscape raingardens.
- Cost estimate for each typical streetscape raingarden design.

2 Streetscape Master Plan

To develop the Master Plan, total required footprints for streetscape raingardens within each sub-catchment and for the entire precinct were initially calculated and then a suitable configuration of streetscape raingardens was identified and mapped. The following was undertaken:

- Delineated catchments provided in the detailed concept design for the stormwater management infrastructure (2019) were reviewed against existing ground contours and deemed acceptable for preparation of master plan;
- Areas for treatment within residential, environmental, industrial, and commercial zones were determined from LCC GIS files.

For the purpose of this plan, areas with environmental land use are not required to have any streetscape raingarden since they don't include impervious areas.

As shown in Figure 1, 63 sub-catchments were assessed for provision of streetscape raingardens with the precinct. The streetscape biofilter footprint in each sub-catchment was calculated based on sub catchment type shown in Figure 1 and the following:

- In sub-catchments classified as "Co-located biofilters and streetscape", the total required footprint area for biofilter system is equivalent to 1.25% of the developable area for that sub-catchment. The 1.25% of the developable area was obtained by matching the total raingarden footprint requirement for each catchment from design drawings of biofilter basins, which were approved as part of detailed concept design for the stormwater management infrastructure including water quality control structures (2019). The total required streetscape raingarden in each catchment was calculated by subtracting the allocated footprint for designed biofilter basin from the total required biofilter system footprint.
- In sub-catchments classified as "Streetscape controls only", the total required footprint area for streetscape biofilter was calculated based on sub-catchment land use per Table 1. The presented minimum raingarden footprint values in Table 1 were also checked against a MUSIC model for 1ha catchment and the comparison showed a close agreement between these values and MUSIC model results.

Table 1. Minimum Raingarden Footprint per Hectare by Land Use in 'Streetscape Only' Areas (SMEC 2019)

Land Use	Overall Imperviousness	Minimum raingarden Footprint
Residential	85%	120 m^2/ha
Commercial	100%	150 m^2/ha
Industrial	90%	155 m^2/ha

The total required streetscape biofilter area was calculated as 109,750 m^2.

To determine streetscape raingarden locations, SMEC considered the following requirements in consultation with LCC:

- Minimisation of the number of construction points through preference for locations that allow a larger streetscape raingarden footprint area.
- Consideration for a wholistic view focusing on the total required streetscape raingarden footprint for the entire precinct rather than for each sub-catchment.
- Prioritisation of raingardens at junctions rather than along street.
- Prioritisation of raingardens at proposed junctions over existing junctions to avoid retrofitting costs for upgrading existing junctions to include raingardens.

Using proposed Indicate Layout Plan (ILP)t, provided by LCC, and the recent available aerial imagery (dated August 29th from MetroMap.com), all junctions were categorised as existing (E) or proposed (P) with an assigned value depending on the number of exits at the junction. For example, an existing T-junction, which has been already constructed, is identified as E3 and a proposed intersection is identified as P4.

The maximum possible footprint area was then determined for each type of junction: 2-way junction (bend), 3-way junction (T junction), and 4-way junction (intersections). For existing junctions, the footprint area was calculated based on the recent available aerial imagery (dated August 29th from MetroMap.com) whilst for proposed junctions the footprint area was calculated from the provided street drawings and plans provided by LCC. For example, based on the aerial imagery, an existing intersection could include 20 m^2 footprint area per raingarden patch, however, for a proposed intersection, this value increases to 48m^2. It was found that an available footprint area to construct a streetscape raingarden at an existing junction was significantly smaller compared to a proposed junction.

By utilising all proposed junctions, a total streetscape raingarden footprint area of 144,840 m^2 can be achieved which is greater than the required target. Subsequently, no streetscape raingarden at an existing junction needs to be included in the master plan. In addition, several proposed junctions, mainly 2-way junction (bend), were removed from the location list to reduce the total streetscape raingarden footprint to the required target of 109,756 m^2. In the removal process, the following factors were considered:

- Proximity to the basin and channels – which would increase potential service clashes.
- Proximity to other intersections – which may cause constructability issues.
- Distance from the downstream end of the catchment – which may suffer from lower hydraulic head to discharge treated stormwater to drainage network.

All proposed streetscape raingarden locations within each sub-catchment with their label and footprint area are consolidated in the summary sheet in Appendix A.

Table 2. Streetscape Raingarden Master Plan Summary

Total Catchment area (ha)	Total Required Biofilter Footprint (m^2)	Total Allocated Biofilter Basin Footprint (m^2)	Total Required Streetscape Raingarden Footprint (m^2)	Total Allocated Streetscape Raingarden (m^2)
1675.24	133,900	29,044	109,756	109,883

Master plan maps showing these locations and their types were also produced and are shown in Appendix B.

3 Design drawings

Typical design drawings are prepared for streetscape raingardens at proposed intersection, proposed T junction and proposed road bend. These typical drawings are presented in Appendix C. Raingardens are usually installed after the upstream catchment is 95% developed because of potential clogging during development construction works. In the interim conditions, excavated sediment traps (silt traps) are suggested as sediment control measure and later will be retrofitted into raingarden. A typical design drawing is provided for the interim silt trap Appendix C, showing their typical locations. However, the actual locations need to be confirmed based on proposed topography (road levels, and proposed drainage design) in detail design stage. It is noted that an erosion sediment control (ESC) plan needs to be developed for each specific site in detail design stage. Furthermore, the ESC plan should incorporate the current proposed interim silt traps and required safety measures.

It is noted that some safety elements like pram stop, kerb, and fencing barrier may need to be included in drawings in detail design stage for each streetscape raingarden location as they will be site specific.

3.1 Design Vegetation Options

This section presents vegetation options for the typical design drawings.

Streetscape biofilters have a cover of healthy and actively growing plants. The main function of vegetation in biofilters is to provide physical, chemical and biological stormwater treatment. They also enhance aesthetic and ecological values. The key factors influencing pollutant uptake and long-term plant survival in bioretention systems are:

- Root structure – Plants with fibrous root systems are more effective in bioretention systems compared to those with tap root systems. A combination of shallow and deep-rooted plants will enhance the bioretention systems' capacity to eliminate pollutants at different depths.

- Growth rate and plant size – Having both fast and slow growing plant species in bioretention systems is important. Slow growing plants are typically larger with well-developed root systems and their pollutant uptake and storage capacity increase gradually over time. On the other hand, fast growing plants tend to be smaller while having high nutrient demands. This allows their rapid establishment and pollutant uptake. They also provide full coverage of the filter media, which is important to protect the filter media from scour and weeds. Further, their short growing cycles replenish organic material in the filter media.

- Tolerance to wetting and drying cycles – To maintain vegetative cover over the entire year, plants must be able to tolerate prolonged dry periods as well as periodic inundation. Semi-aquatic plant species adapted to longer periods of inundation should not be used since they generally do not survive during a dry season.

Suggested species for streetscape raingardens in Austral and Leppington north Precinct need to tolerate extended dry periods and periodic flooding while having some of the following attributes:

- High growth rate.
- High root density.
- High total root, leaf and shoot biomass.
- High root: shoot ratio.
- High leaf area ratio.
- High length of longest root.

These suggested species are classified into three categories:

- Primary species – this category includes species mainly chosen to treat stormwater. On that basis, this category is considered to cover 75% of the total vegetation within a raingarden.

- Secondary species- this includes species that contribute to aesthetic and ecological aspects of raingarden while providing some level of stormwater treatment.

- Tree species- these species are provided to further add aesthetic values while providing some stormwater treatment benefits.

These suggested species are shown in Table 4 , Table 5, and Table 5. However, to minimise construction costs and safety issues at junctions and intersections, tree species are not generally suggested in streetscape raingardens at junctions.

Primary and secondary species listed in Table 4 and Table 5 were specifically chosen for Western Sydney Conditions. Council landscape strategies and plant selection guidelines also need to be considered when choosing suitable species. Planting arrangement for primary species can be random or at the border along the edge of the footprint area.

Typically install size is either tube stock or 150mm pots for primary and secondary species and a minimum of 45 litre pot for tree species.

Table 3. Primary species

Species Name	Common Name	Species Image	Size at Maturity: Height (mm) x Width (mm)	Plant Density (Number/m^2)	Planting Zone
Carex appressa*	Tall Sedge		1200 x 500-1000	8-10	Raingarden
Juncus pallidus	Pale Rush		1000 x 300-1000	8-10	Raingarden
Juncus kraussii	Sea Rush		600-1000 x 500-1000	8-10	Raingarden

Species Name	Common Name	Species Image	Size at Maturity: Height (mm) x Width (mm)	Plant Density (Number/m^2)	Planting Zone
Ficinia nodosa*	Knobby Club Rush		500-1000 x 600-1500	8-10	Raingarden

* 40% of coverage shall comprised of this plant

Table 4. Secondary species

Species Name	Common Name	Species Image	Size at Maturity: Height (mm) x Width (mm))	Plant Density (Number/m^2)	Planting Zone
Dianella longifolia	Pale Flax Lily		1200 x 400-1000	8-10	Batters & Landscape
Dianella revoluta	Blue Flax-Lily		300-400 x 400	8-10	Raingarden
Leucophyta brownii	Cushion Bush		1000 x 1000	4	Raingarden

Species Name	Common Name	Species Image	Size at Maturity: Height (mm) x Width (mm))	Plant Density (Number/m^2)	Planting Zone
Lomandra longifolia	Spiny Head Mat Rush		500-1000 x 1000	8-10	Batters & Landscape
Austrodanthonia caespitosa	Common Wallaby-grass		800 x 200	8-10	Raingarden & Batters
Microlaena stipoides	Weeping Rice-grass		700 x 200-100	8-10	Batters & landscape

Tree species are chosen to be drought resistant and suitable for clay, sand, and loam soil texture.

Table 5. Tree species

Species Name	Common Name	Tree Image	Size at Maturity: Height (m) x Width (m)	Plant Density (Number/m^2)
Callistemon viminalis	Weeping Bottlebrush		10-12 x 5	• Tolerates drought, moderate frost, and lime. • Minimal supplementary watering is required. • full sun or part shade.
Callistemon salignus	White Weeping Bottlebrush		5-10 x 3-5	• Tolerates drought. • Minimal supplementary watering is required. • Requires full sun.
Lophostemon confertus	Brush box		10-15 x 5-8	• Tolerates drought, moderate frost, pollution, fire, and salt spray. • Moderate supplementary watering is required. • full sun or part shade.
Pyrus calleryana or Aristocrat Pear	Aristocrat Pear		5-6 x 3-4	• Tolerates drought, moderate frost and pollution. • Minimal supplementary watering is required. • Requires full sun.

Species Name	Common Name	Tree Image	Size at Maturity: Height (m) x Width (m)	Plant Density (Number/m^2)
Brachychiton acerifolius	Illawarra Flame Tree		>10 x 10-15	• Tolerates drought, and light frost. • Minimal supplementary watering is required. • Requires full sun.

3.1.1 Existing vegetation

Existing native vegetation should be retained wherever it is possible. Also, large existing trees adjacent to proposed raingardens should be protected during construction period as per AS 4970 requirements. The tree protection zone, which should be protected in construction phase, is calculated by multiplying average diameter of the tree at 1.4m height times a factor of 12. However, encroachment into the tree protection zone may be possible in accordance with AS 4970 and Council's LEP and DCP.

4 Maintenance and Management of Streetscape Raingardens

Streetscape raingarden maintenance is vital to ensure that raingardens are operating properly, and designed stormwater treatment raingardens provide expected water quality benefits. Maintenance of streetscape raingardens is comprised of two phases: establishment phase and ongoing phase until the end of design life.

4.1 Maintenance during establishment phase

It is suggested to have construction activities undertaken in generally drier periods of the year. The first year post construction is the most important period to perform raingarden maintenance. Following the defect liability period, the maintenance of the raingardens during the establishment phase should be done by Council. This includes:

- Watering - per Drawing General Note, item 14.10.
- Litter removal - monthly check.
- Weed removal - monthly check.
- Raking - as required.
- Plant replacement - as required (typically 15%).
- Sediment removal after construction phase due to great amount of sediment in stormwater.
- Debris removal from inlets and outlets – every four months during the establishment phase.

Sediment removal is required to prevent a clog in filter media and any potential adverse impact on plant growth. Further, it is recommended to cover filter media with a geotextile or have the raingarden offline until construction phase is finished.

It is recommended that during the construction phase to set inlet riser in each outlet pit to be raised approximately 200mmm above the permanent sub-merged zone level by the contractor. This will assist plant establishment during dry periods. After the construction phase, the inlet riser normally will be cut to the permanent submerged zone level.

4.2 Routine ongoing maintenance

As part of urban landscape, the streetscape raingarden/tree pit should be regularly checked and maintained.

Main routine checks, which can be performed visually, and required maintenance works are:

- Plant health check
- Supplementary watering
- Litter removal
- Weed removal
- Plant loss replacement
- Ponding depth (extended detention depth) within raingarden during and after a storm event
- Integrity of stormwater infrastructure including pits, grated channels and kerb openings
- Debris removal from inlets and outlets

Table 6 provides all maintenance tasks with required frequency for long term maintenance.

Table 6. Raingarden and tree pit maintenance tasks

Item Number	Item	Check description	Frequency (number/year)	Maintenance work
1	Raingarden Inlet	Inspect for accumulation of debris and sediment at inlets including channels and kerb inlets.	4	Remove debris and sediment as required.
		Inspect raingarden kerb inlets for scour.	2	Apply scour protection measures like riprap as required.
2	Raingarden Outlet	Check the outlet for any potential blockage.	4	Clear away debris from pit openings and its connections.
		Check ponding depth (extended detention depth) and overflow levels.	4	Inspect integrity of raingarden perimeter and re-set overflow level as required.
3	Raingarden Species	Species health check	4	Treat or replace plants.
		Species density	4	Replace plants as required.
		Weed control	4	Remove weeds manually or using chemicals.
		Supplementary watering		As required
4	Raingarden Sub-soil Drainage	Check for sub-soil drainage blockage	2	Clear away accumulated debris through flushing point using water jet.
		Inspect submerged zone water level	2	Check inlet riser level is correct as designed.
		Sub-soil drainage integrity check	1	Fix or change as required.
5	Raingarden/Tree Pit surface and Filter Media	Litter build-up	4	Collect and dispose litter as required.
		Sediment accumulation	4	Remove sediment build up.
		Erosion and scour	4	Undertake raking and further use erosion and scour protection measures such as geotextile or riprap revetment. Filter media top up may be required.
		Filter media infiltration rate	Once in three years	Replace filter media if infiltration rate is below lower range of designed threshold, typically 50mm/hr

5 Cost Estimate

Concept cost estimates have been developed for the proposed streetscape raingardens. Total cost for streetscape raingardens is comprised of construction cost and maintenance costs.

5.1 Construction cost

Direct construction costs for streetscape raingardens at bend, T junction and intersection were calculated generally based on Australian Construction Handbook (Rawlinsons Quantity Surveyors and Construction Cost Consultants, 2018). Further a benchmark multiplier was calculated from IPART Local Infrastructure Benchmark Costs guideline (2014) to obtain the total construction costs. Construction cost estimates and details are presented in Appendix D. The undertaken construction cost estimate showed \$831.74/m^2, \$912.42/m^2, \$937.80/m^2 for a proposed intersection, proposed road bend, and proposed T junction, respectively. These values are in a close agreement with Melbourne Water construction cost estimate which is \$1000/m^2 for streetscape raingardens with footprints in a range of 50-250 m^2.

5.2 Maintenance cost

Although maintenance costs could vary site to site, there are common routine maintenance activities for every streetscape raingarden system. These activities are presented in Table 7.

Table 7. Routine maintenance cost estimate (GHD, 2013)

Routine Maintenance Task – Not Dependent on Surface Area	Frequency (/year)	Time Required (h/person)	Labour Cost/Fee (\$/year)
Litter Removal	4	0.5	\$200
Sediment Removal/Ameliorate Surface	4	1	\$400
Raking to Reinstate Surface at Erosion Points	4	0.5	\$200
Top-up Filter Media and Regrade Surface	1	2	\$200
Infiltration Test	1 in 3 years		\$500
Weeding	4	1	\$400
Inspect and Flush-out Drainage	2	1	\$200
Remove Debris from Inlets	4	0.5	\$200
Remove Debris from Outlets	4	0.5	\$200
Total			**\$2,500**
Routine Plant replacement – Dependent on Surface Area	**Frequency (/year)**	**Cost (\$/m^2)**	**Labour Cost/Fee (\$/m^2/year)**
Replace Plants where Dead	4	\$2	\$8
Time Required	0.5 h/m^2	\$25	\$100
Total			**\$108**

Based on the cost estimate provided in Table 7, and the assumption that only 15% plant replacement needs to be undertaken per year, it is estimated that for an intersection with 287 m^2 raingarden footprint, maintenance cost will be $7149/yr. This equates a maintenance cost estimate of $24.91/$m^2$/yr for streetscape raingarden within the precinct. The estimated maintenance cost is in good agreement with the maintenance cost estimate range of $15/$m^2$/yr - $29.2/$m^2$/yr suggested by Melbourne Water.

6 References

A detailed concept design for the stormwater management infrastructure including water quality control structures. SMEC, 2019.

Local infrastructure benchmark costs guideline. IPART (Independent Pricing and Regulatory Tribunal), 2014.

Streetscape WSUD raingarden & tree pit design package for Moreland City Council. GHD, 2013.

Appendix A Streetscape Raingarden Location Summary

P = PROPOSED
P4 = INTERSECTION
P3 = T-JUNCTION
P2 = BEND

Catchment	Catchment Area (ha)	Total Biofilter and Streetscape Area Required (m2)	Allocated Biofilter Basin Footprint (m2)	Target Streetscape Raingarden Footprint (m2)	Total Allocated Streetscape Raingarden Area (m2)	ID	Raingarden Footprint (m2)
B05	32.149	3800	0	3800	3210	B05_P4_01	287
						B05_P4_02	287
						B05_P4_03	287
						B05_P4_04	287
						B05_P4_05	287
						B05_P4_06	287
						B05_P3_01	144
						B05_P3_02	144
						B05_P3_03	144
						B05_P3_04	144
						B05_P3_05	144
						B05_P3_06	144
						B05_P3_07	144
						B05_P3_08	144
						B05_P3_09	144
						B05_P2_01	96
						B05_P2_02	96
B06	21.496	2500	1124	1376	1437	B06_P4_01	287
						B06_P4_02	287
						B06_P4_03	287
						B06_P3_01	144
						B06_P3_02	144
						B06_P3_03	144
						B06_P3_04	144
B08	33.14	4100	1606	2494	4020	B08_P4_01	287
						B08_P4_02	287
						B08_P4_03	287
						B08_P4_04	287
						B08_P4_05	287
						B08_P4_06	287
						B08_P4_07	287
						B08_P4_08	287
						B08_P4_09	287
						B08_P4_10	287
						B08_P4_11	287
						B08_P4_12	287
						B08_P3_01	144
						B08_P3_02	144
						B08_P3_03	144
						B08_P3_04	144
B09	15.43	0	0	0	0	-	-
B10	28.01	1150	0	1150	624	B10_P3_01	144
						B10_P3_02	144
						B10_P3_03	144
						B10_P2_01	96
						B10_P2_02	96
						B11_P4_01	287
						B11_P4_02	287

Catchment	No. P4	No. P3	No. P2	Total No. Intersections	Total Allocated Raingarden Area (m2)
B05	6	9	2	17	3210
B06	3	4	0	7	1437
B08	12	4	0	16	4020
B10	0	3	2	5	624
B11	12	15	0	27	5604
B12	4	4	0	8	1724
B14	8	13	0	21	4168
B15	0	2	0	2	288
B16	9	10	0	19	4023
B17	13	19	0	32	6467
B18	3	7	0	10	1869
B19	10	8	0	18	4022
B20	15	24	0	39	7761
B21	11	9	0	20	4453
B22	14	27	0	41	7906
B23	2	6	0	8	1438
B25	3	12	0	15	2589
B27	1	4	0	5	863
B29	6	30	0	36	6042
NB01	0	11	0	11	1584
NB05	1	4	4	9	1247
NB07	4	8	0	12	2300
NB08	0	1	0	1	144
NB09	2	1	3	6	1006
NB10	1	3	2	6	911
NB11	1	7	0	8	1295
NB12	6	10	0	16	3162
NB13	5	9	0	14	2731
NB14	3	8	0	11	2013
NB15	2	9	1	12	1966
NB16	0	2	0	2	288
NB17	3	12	0	15	2589
NB19	2	5	0	7	1294
NB20	5	6	2	13	2491
NB21	0	0	2	2	192
NB22	2	2	1	5	958
NB23	0	3	0	3	432
NB24	0	4	0	4	576
NB25	0	2	0	2	288
NB26	2	13	0	15	2446
NB27	1	7	1	9	1391
NB28	2	8	0	10	1726
NB29	0	2	0	2	288
NB30	0	0	1	1	96
NB31	0	1	1	2	240
NB32	0	4	1	5	672
NB33	1	2	0	3	575
NB34	2	1	0	3	718

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						B11_P3_05	144
						B11_P3_06	144
						B11_P3_07	144
						B11_P3_08	144
						B11_P3_09	144
						B11_P3_10	144
						B11_P3_11	144
						B11_P3_12	144
						B11_P3_13	144
						B11_P3_14	144
						B11_P3_15	144
						B12_P4_01	287
						B12_P4_02	287
						B12_P4_03	287
B12	17.095	2050	696	1354	1724	B12_P4_04	287
						B12_P3_01	144
						B12_P3_02	144
						B12_P3_03	144
						B12_P3_04	144
B13	18.83	0	0	1950	0	-	-
						B14_P4_01	287
						B14_P4_02	287
						B14_P4_03	287
						B14_P4_04	287
						B14_P4_05	287
						B14_P4_06	287
						B14_P4_07	287
						B14_P4_08	287
						B14_P3_01	144
						B14_P3_02	144
B14	45.489	5400	2421	2979	4168	B14_P3_03	144
						B14_P3_04	144
						B14_P3_05	144
						B14_P3_06	144
						B14_P3_07	144
						B14_P3_08	144
						B14_P3_09	144
						B14_P3_10	144
						B14_P3_11	144
						B14_P3_12	144
						B14_P3_13	144
B15	12.632	1250	1037	213	288	B15_P3_01	144
						B15_P3_02	144
						B16_P4_01	287
						B16_P4_02	287

NB35	0	4	1	5	672
NB36	1	2	1	4	671
NB37	0	8	0	8	1152
NB38	2	3	0	5	1006
NB39	0	4	0	4	576
NB40	1	7	0	8	1295
NB41	0	0	4	4	384

Total	181	383	29	593	109,883

						B16_P4_03	287
						B16_P4_04	287
						B16_P4_05	287
						B16_P4_06	287
						B16_P4_07	287
						B16_P4_08	287
						B16_P4_09	287
B16	22.845	2550	1618	932	4023	B16_P3_01	144
						B16_P3_02	144
						B16_P3_03	144
						B16_P3_04	144
						B16_P3_05	144
						B16_P3_06	144
						B16_P3_07	144
						B16_P3_08	144
						B16_P3_09	144
						B16_P3_10	144
						B17_P4_01	287
						B17_P4_02	287
						B17_P4_03	287
						B17_P4_04	287
						B17_P4_05	287
						B17_P4_06	287
						B17_P4_07	287
						B17_P4_08	287
						B17_P4_09	287
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						B17_P4_13	287
						B17_P3_01	144
						B17_P3_02	144
						B17_P3_03	144
B17	73.055	8550	3026	5524	6467	B17_P3_04	144
						B17_P3_05	144
						B17_P3_06	144
						B17_P3_07	144
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						B17_P3_09	144
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						B18_P4_02	287
						B18_P4_03	287
						B18_P3_01	144
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B18	32.166	4000	1029	2971	1869	B18_P3_03	144
						B18_P3_04	144
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						B18_P3_06	144
						B18_P3_07	144

B19	29.551	3600	1936	1664	4022	B19_P4_01	287
						B19_P4_02	287
						B19_P4_03	287
						B19_P4_04	287
						B19_P4_05	287
						B19_P4_06	287
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						B19_P3_02	144
						B19_P3_03	144
						B19_P3_04	144
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						B19_P3_06	144
						B19_P3_07	144
						B19_P3_08	144
B20	58.393	7100	2346	4754	7761	B20_P4_01	287
						B20_P4_02	287
						B20_P4_03	287
						B20_P4_04	287
						B20_P4_05	287
						B20_P4_06	287
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						B20_P3_21	144
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						B20_P3_23	144
						B20_P3_24	144
						B21_P4_01	287
						B21_P4_02	287

B21	20.355	2550	0	2550	4453	B21_P4_03	287
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						B22_P4_09	287
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						B22_P4_13	287
						B22_P4_14	287
						B22_P3_01	144
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						B22_P3_03	144
						B22_P3_04	144
						B22_P3_05	144
						B22_P3_06	144
						B22_P3_07	144
						B22_P3_08	144
						B22_P3_09	144
						B22_P3_10	144
						B22_P3_11	144
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						B22_P3_14	144
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						B22_P3_19	144
						B22_P3_20	144
						B22_P3_21	144
						B22_P3_22	144
						B22_P3_23	144
						B22_P3_24	144
						B22_P3_25	144
						B22_P3_26	144
						B22_P3_27	144

B23	30.714	2350	0	2350	1438	B23_P4_01	287
						B23_P4_02	287
						B23_P3_01	144
						B23_P3_02	144
						B23_P3_03	144
						B23_P3_04	144
						B23_P3_05	144
						B23_P3_06	144
B25	48.022	4900	2829	2071	2589	B25_P4_01	287
						B25_P4_02	287
						B25_P4_03	287
						B25_P3_01	144
						B25_P3_02	144
						B25_P3_03	144
						B25_P3_04	144
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						B25_P3_09	144
						B25_P3_10	144
						B25_P3_11	144
						B25_P3_12	144
B27	26.379	3300	1587	1713	863	B27_P4_01	287
						B27_P3_01	144
						B27_P3_02	144
						B27_P3_03	144
						B27_P3_04	144
B29	102.823	7950	2408	5542	6042	B29_P4_01	287
						B29_P4_02	287
						B29_P4_03	287
						B29_P4_04	287
						B29_P4_05	287
						B29_P4_06	287
						B29_P3_01	144
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						B29_P3_03	144
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						B29_P3_09	144
						B29_P3_10	144
						B29_P3_11	144
						B29_P3_12	144
						B29_P3_13	144
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						B29_P3_16	144
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						B29_P3_20	144
						B29_P3_21	144
						B29_P3_22	144
						B29_P3_23	144
						B29_P3_24	144
						B29_P3_25	144

						B29_P3_26	144
						B29_P3_27	144
						B29_P3_28	144
						B29_P3_29	144
						B29_P3_30	144
						NB01_P3_01	144
						NB01_P3_02	144
						NB01_P3_03	144
						NB01_P3_04	144
						NB01_P3_05	144
NB01	23.384	1550	0	1550	1584	NB01_P3_06	144
						NB01_P3_07	144
						NB01_P3_08	144
						NB01_P3_09	144
						NB01_P3_10	144
						NB01_P3_11	144
NB02	10.94	0	0	0	0	-	-
NB03	17.96	0	0	1150	0	-	-
NB04	5.96	0	0	750	0	-	-
						NB05_P4_01	287
						NB05_P3_01	144
						NB05_P3_02	144
						NB05_P3_03	144
NB05	25.916	1450	0	1450	1247	NB05_P3_04	144
						NB05_P2_01	96
						NB05_P2_02	96
						NB05_P2_03	96
						NB05_P2_04	96
NB06	10.11	0	0	1050	0	-	-
						NB07_P4_01	287
						NB07_P4_02	287
						NB07_P4_03	287
						NB07_P4_04	287
						NB07_P3_01	144
NB07	31.681	1800	0	1800	2300	NB07_P3_02	144
						NB07_P3_03	144
						NB07_P3_04	144
						NB07_P3_05	144
						NB07_P3_06	144
						NB07_P3_07	144
						NB07_P3_08	144
NB08	15.403	1150	0	1150	144	NB08_P3_01	144
						NB09_P4_01	287
						NB09_P4_02	287
NB09	10.458	1000	0	1000	1006	NB09_P3_01	144
						NB09_P2_01	96
						NB09_P2_02	96
						NB09_P2_03	96
						NB10_P4_01	287
						NB10_P3_01	144
NB10	21.424	1400	0	1400	911	NB10_P3_02	144
						NB10_P3_03	144
						NB10_P2_01	96
						NB10_P2_02	96
						NB11_P4_01	287
						NB11_P3_01	144
						NB11_P3_02	144
NB11	17.689	1350	0	1350	1295	NB11_P3_03	144
						NB11_P3_04	144

						NB11_P3_05	144
						NB11_P3_06	144
						NB11_P3_07	144
NB12	22.705	2050	0	2050	3162	NB12_P4_01	287
						NB12_P4_02	287
						NB12_P4_03	287
						NB12_P4_04	287
						NB12_P4_05	287
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						NB12_P3_02	144
						NB12_P3_03	144
						NB12_P3_04	144
						NB12_P3_05	144
						NB12_P3_06	144
						NB12_P3_07	144
						NB12_P3_08	144
						NB12_P3_09	144
						NB12_P3_10	144
NB13	25.319	2050	0	2050	2731	NB13_P4_01	287
						NB13_P4_02	287
						NB13_P4_03	287
						NB13_P4_04	287
						NB13_P4_05	287
						NB13_P3_01	144
						NB13_P3_02	144
						NB13_P3_03	144
						NB13_P3_04	144
						NB13_P3_05	144
						NB13_P3_06	144
						NB13_P3_07	144
						NB13_P3_08	144
						NB13_P3_09	144
NB14	29.822	2050	0	2050	2013	NB14_P4_01	287
						NB14_P4_02	287
						NB14_P4_03	287
						NB14_P3_01	144
						NB14_P3_02	144
						NB14_P3_03	144
						NB14_P3_04	144
						NB14_P3_05	144
						NB14_P3_06	144
						NB14_P3_07	144
						NB14_P3_08	144
NB15	24.275	2700	0	2700	1966	NB15_P4_01	287
						NB15_P4_02	287
						NB15_P3_01	144
						NB15_P3_02	144
						NB15_P3_03	144
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						NB15_P3_06	144
						NB15_P3_07	144
						NB15_P3_08	144
						NB15_P3_09	144
						NB15_P2_01	96
NB16	20.372	550	0	550	288	NB16_P3_01	144
						NB16_P3_02	144
						NB17_P4_01	287

NB17	25.618	1950	0	1950	2589	NB17_P4_02 NB17_P4_03 NB17_P3_01 NB17_P3_02 NB17_P3_03 NB17_P3_04 NB17_P3_05 NB17_P3_06 NB17_P3_07 NB17_P3_08 NB17_P3_09 NB17_P3_10 NB17_P3_11 NB17_P3_12	287 287 144 144 144 144 144 144 144 144 144 144 144 144
NB18	35.25	0	0	0	0	-	-
NB19	16.621	1100	0	1100	1294	NB19_P4_01 NB19_P4_02 NB19_P3_01 NB19_P3_02 NB19_P3_03 NB19_P3_04 NB19_P3_05	287 287 144 144 144 144 144
NB20	35.672	2600	0	2600	2491	NB20_P4_01 NB20_P4_02 NB20_P4_03 NB20_P4_04 NB20_P4_05 NB20_P3_01 NB20_P3_02 NB20_P3_03 NB20_P3_04 NB20_P3_05 NB20_P3_06 NB20_P2_01 NB20_P2_02	287 287 287 287 287 144 144 144 144 144 144 96 96
NB21	16.77	1800	0	1800	192	NB21_P2_01 NB21_P2_02	96 96
NB22	37.276	3350	0	3350	958	NB22_P4_01 NB22_P4_02 NB22_P3_01 NB22_P3_02 NB22_P2_01	287 287 144 144 96
NB23	2.401	300	0	300	432	NB23_P3_01 NB23_P3_02 NB23_P3_03	144 144 144
NB24	7.761	400	0	400	576	NB24_P3_01 NB24_P3_02 NB24_P3_03 NB24_P3_04	144 144 144 144
NB25	6.352	250	0	250	288	NB25_P3_01 NB25_P3_02	144 144
NB26	19.433	1700	0	1700	2446	NB26_P4_01 NB26_P4_02 NB26_P3_01 NB26_P3_02 NB26_P3_03 NB26_P3_04 NB26_P3_05 NB26_P3_06	287 287 144 144 144 144 144 144

						NB26_P3_07	144
						NB26_P3_08	144
						NB26_P3_09	144
						NB26_P3_10	144
						NB26_P3_11	144
						NB26_P3_12	144
						NB26_P3_13	144
NB27	29.385	1850	0	1850	1391	NB27_P4_01	287
						NB27_P3_01	144
						NB27_P3_02	144
						NB27_P3_03	144
						NB27_P3_04	144
						NB27_P3_05	144
						NB27_P3_06	144
						NB27_P3_07	144
						NB27_P2_01	96
NB28	19.103	1600	0	1600	1726	NB28_P4_01	287
						NB28_P4_02	287
						NB28_P3_01	144
						NB28_P3_02	144
						NB28_P3_03	144
						NB28_P3_04	144
						NB28_P3_05	144
						NB28_P3_06	144
						NB28_P3_07	144
						NB28_P3_08	144
NB29	13.441	1050	0	1050	288	NB29_P3_01	144
						NB29_P3_02	144
NB30	36.901	1250	0	1250	96	NB30_P2_01	96
NB31	15.855	1300	0	1300	240	NB31_P3_01	144
						NB31_P2_01	96
NB32	32.071	1250	0	1250	672	NB32_P3_01	144
						NB32_P3_02	144
						NB32_P3_03	144
						NB32_P3_04	144
						NB32_P2_01	96
NB33	25.002	350	0	350	575	NB33_P4_01	287
						NB33_P3_01	144
						NB33_P3_02	144
NB34	6.882	500	0	500	718	NB34_P4_01	287
						NB34_P4_02	287
						NB34_P3_01	144
NB35	37.542	1600	0	1600	672	NB35_P3_01	144
						NB35_P3_02	144
						NB35_P3_03	144
						NB35_P3_04	144
						NB35_P2_01	96
NB36	9.261	750	0	750	671	NB36_P4_01	287
						NB36_P3_01	144
						NB36_P3_02	144
						NB36_P2_01	96
NB37	22.836	2100	0	2100	1152	NB37_P3_01	144
						NB37_P3_02	144
						NB37_P3_03	144
						NB37_P3_04	144
						NB37_P3_05	144
						NB37_P3_06	144
						NB37_P3_07	144
						NB37_P3_08	144

NB38	23.029	2400	0	2400	1006	NB38_P4_01 NB38_P4_02 NB38_P3_01 NB38_P3_02 NB38_P3_03	287 287 144 144 144
NB39	25.595	1400	0	1400	576	NB39_P3_01 NB39_P3_02 NB39_P3_03 NB39_P3_04	144 144 144 144
NB40	11.391	1100	0	1100	1295	NB40_P4_01 NB40_P3_01 NB40_P3_02 NB40_P3_03 NB40_P3_04 NB40_P3_05 NB40_P3_06 NB40_P3_07	287 144 144 144 144 144 144 144
NB41	55.08	4600	0	4600	384	NB41_P2_01 NB41_P2_02 NB41_P2_03 NB41_P2_04	96 96 96 96
NB42	5.67	0	0	0	0	-	-

Catchment	Catchment Area (ha)	Total Biofilter and Streetscape Area Required (m2)	Allocated Biofilter Basin Footprint (m2)	Target Streetscape Raingarden Footprint (m2)	Total Allocated Streetscape Raingarden Area (m2)	ID	Raingarden Footprint (m2)
Total	**1675.24**	**133,900**	**29,044**	**109,756**	**109,883**	**-**	**109,883**

Appendix B Streetscape Raingarden Master Plan Map

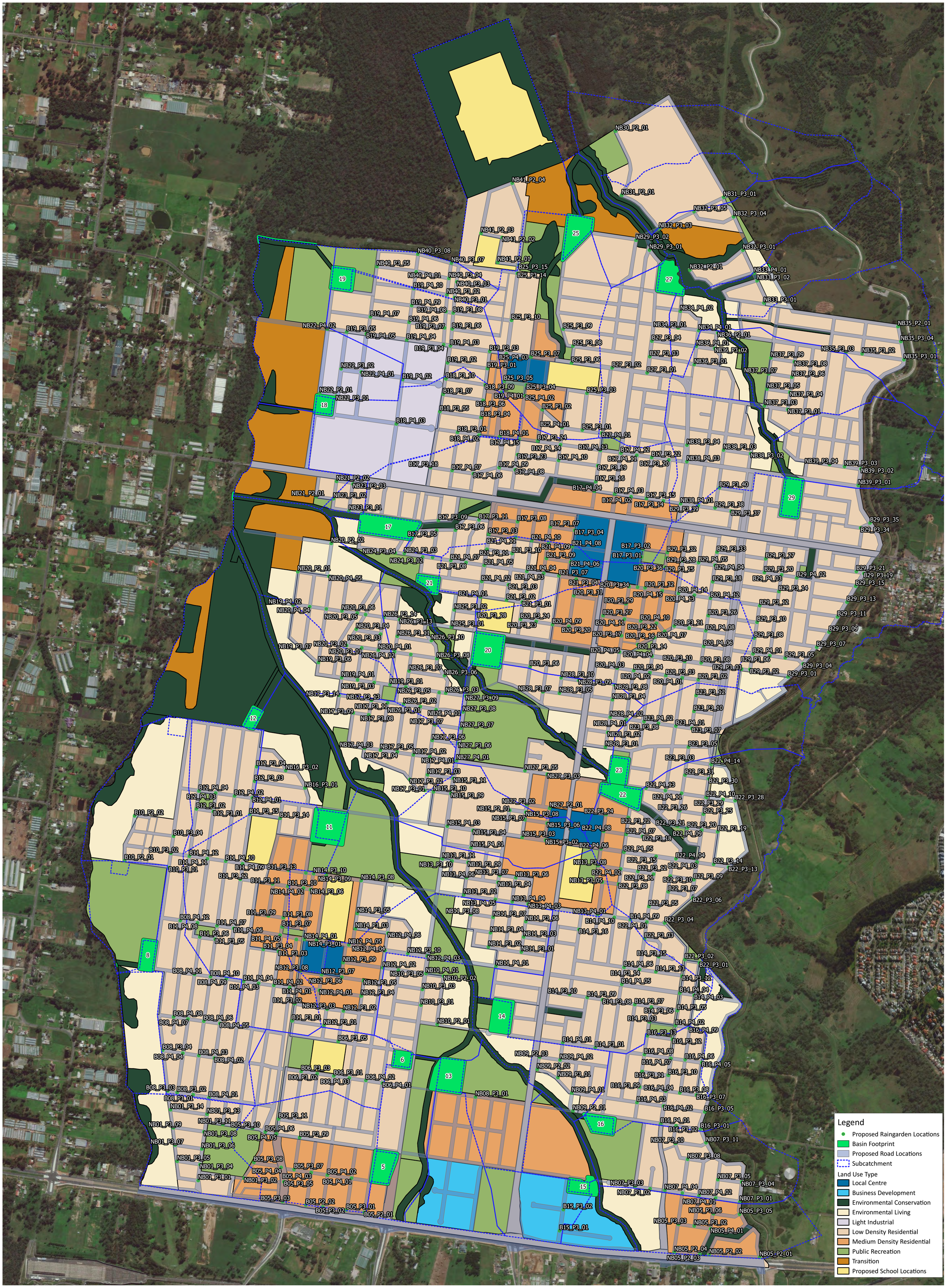

FIGURE TITLE	PROPOSED STREETSCAPE LOCATIONS - ENTIRE CATCHMENT	DATE	10-02-2021
DRAWING NO.			
PROJECT NO.	30013411	PROJECT TITLE	STREETSCAPE WSUD MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

0 250 500 750 1,000 m

N

PAGE SIZE	A1
CREATED BY	O.GLIXMAN
SOURCES	ESRI Satellite

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Appendix C Streetscape Raingarden Typical Design Drawings

LIVERPOOL CITY COUNCIL

DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN

SCHEDULE OF DRAWINGS

DRG No.	DRAWING TITLE	REV
30013411-001	COVER SHEET AND SCHEDULE OF DRAWINGS	02
30013411-002	RAIN GARDEN DESIGN GENERAL NOTES	01
30013411-010	RAIN GARDEN DESIGN GENERAL ARRANGEMENT & DRAINAGE PLAN - INTERSECTION (16m ROAD)	02
30013411-011	RAIN GARDEN DESIGN GENERAL ARRANGEMENT & DRAINAGE PLAN - T JUNCTION OPTION 1 (16m ROAD)	02
30013411-012	RAIN GARDEN DESIGN GENERAL ARRANGEMENT & DRAINAGE PLAN - T JUNCTION OPTION 2 (16m ROAD)	02
30013411-013	RAIN GARDEN DESIGN GENERAL ARRANGEMENT & DRAINAGE PLAN - ROAD BEND (16m ROAD)	02
30013411-014	RAIN GARDEN DESIGN GENERAL ARRANGEMENT & DRAINAGE PLAN - INTERSECTION (20m COLLECTOR ROAD)	01
30013411-015	RAIN GARDEN DESIGN GENERAL ARRANGEMENT & DRAINAGE PLAN - T JUNCTION OPTION 1 (20m COLLECTOR ROAD)	01
30013411-016	RAIN GARDEN DESIGN GENERAL ARRANGEMENT & DRAINAGE PLAN - T JUNCTION OPTION 2 (20m COLLECTOR ROAD)	01
30013411-017	RAIN GARDEN DESIGN GENERAL ARRANGEMENT & DRAINAGE PLAN - ROAD BEND (20m COLLECTOR ROAD)	01
30013411-018	RAIN GARDEN DESIGN INTERIM SILT PLAN TYPICAL DETAILS	01
30013411-020	RAIN GARDEN DESIGN SECTIONS - SHEET 1 OF 2	02
30013411-021	RAIN GARDEN DESIGN SECTIONS - SHEET 1 OF 2	02
30013411-022	RAIN GARDEN DESIGN TYPICAL DETAILS	02

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REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	18.12.2020	ISSUED FOR CLIENT REVIEW	001	AC
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TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
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PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING

DESIGNER
SMEC
Member of the Surbana Jurong Group

SMEC PROJECT No 300xxxxx

CLIENT
LIVERPOOL CITY COUNCIL

PROJECT TITLE
DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH
RAINGARDEN DESIGN
COVER SHEET AND SCHEDULE OF DRAWINGS

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-001	02

BIORETENTION SYSTEM SPECIFICATION

1. REFERENCED DOCUMENTS. THE FOLLOWING DOCUMENTS ARE INCORPORATED INTO THIS SPECIFICATION BY REFERENCE:
   - 1.1. STANDARDS:
     - 1.1.1. AS 1289 - METHODS OF TESTING SOILS FOR ENGINEERING PURPOSES
     - 1.1.2. AS 1289.5.4.1-2007- SOIL COMPACTION AND DENSITY TESTS--COMPACTION CONTROL TEST--DRY DENSITY RATIO, MOISTURE VARIATION AND MOISTURE RATIO
     - 1.1.3. AS 1289.5.7.1-2006 - SOIL COMPACTION AND DENSITY TESTS--COMPACTION CONTROL TEST--HILF DENSITY RATIO AND HILF MOISTURE VARIATION (RAPID METHOD)
     - 1.1.4. AS 2758 - AGGREGATES AND ROCK FOR ENGINEERING PURPOSES
     - 1.1.5. AS 4419 - SOILS FOR LANDSCAPING AND GARDEN USE
     - 1.1.6. AS 4454 - COMPOSTS, SOIL CONDITIONERS AND MULCHES
   - 1.2. OTHER PUBLICATIONS:
     - 1.2.1. GUIDELINES FOR SOIL FILTER MEDIA IN BIORETENTION SYSTEMS (FAWB) - THE CURRENT VERSION OF THE GUIDELINE CAN BE FOUND AT HTTP://WWW.MONASH.EDU.AU/FAWB/
     - 1.2.2. CONSTRUCTION AND ESTABLISHMENT GUIDELINES - SWALES, BIORETENTION SYSTEMS AND WETLANDS (WATER BY DESIGN) HTTP://WATERBYDESIGN.COM.AU/CEGUIDE/
     - 1.2.3. TRANSFERRING OWNERSHIP OF VEGETATED STORMWATER ASSETS (WATER BY DESIGN) HTTP://WATERBYDESIGN.COM.AU/TRANSFERGUIDE/
     - 1.2.4. BIORETENTION TECHNICAL DESIGN GUIDELINES (WATER BY DESIGN) HTTP://WATERBYDESIGN.COM.AU/TECHGUIDE/
     - 1.2.5. WATER SENSITIVE URBAN DESIGN FIELD GUIDE (WATER BY DESIGN)
2. ABBREVIATIONS AND DEFINITIONS:
   - 2.1. THE BIORETENTION SYSTEM SPECIFICATION CONSISTS OF THE FOLLOWING ABBREVIATIONS AND DEFINITIONS:
   - 2.2. FILTER: SOIL LAYER WHICH ACTS AS A POLLUTANT FILTER AND SUPPORTS PLANT GROWTH.
   - 2.3. IMPERMEABLE LINERS: THE LINER THAT PREVENTS WATER MOVEMENT BETWEEN THE FILTER AND THE SURROUNDING SOILS AND DEFINES THE EDGE OF THE SYSTEM
   - 2.4. TRANSITION LAYER: LAYER TO SEPARATE FILTER LAYER FROM THE DRAINAGE LAYER TO AVOID MIGRATION OF SOILS FROM THE FILTER TO THE DRAINAGE LAYER
   - 2.5. DRAINAGE LAYER: RELATIVELY FREE DRAINING LAYER TO CONVEY INFILTRATED WATER TO THE UNDERDRAINAGE.
   - 2.6. UNDER-DRAINS: SLOTTED DRAINS COLLECT TREATED STORMWATER FROM THE DRAINAGE LAYER AT THE BASE OF THE BIORETENTION SYSTEM.
3. TEST METHODS AND STANDARDS:
   - 3.1. THE FOLLOWING TEST METHODS AND STANDARDS ARE TO BE USED AS SPECIFIED IN THE ABOVE GUIDELINES WHEN CONDUCTING TESTS ASSOCIATED WITH THIS SPECIFICATION:
   - 3.2. THE HYDRAULIC CONDUCTIVITY OF POTENTIAL FILTER MEDIA SHALL BE MEASURED USING THE ASTM F1815-11 METHOD
   - 3.3. PARTICLE SIZE DISTRIBUTION: AS1289.3.6.1 - 1995
   - 3.4. SOILS FOR LANDSCAPING AND GARDEN USE: AS4419 - 2003.
4. MATERIALS:
   - 4.1. MATERIALS SHALL MEET THE REQUIRED SPECIFICATIONS DETAILED IN SECTION 8 FILTER MEDIA, SECTION 9 TRANSITION LAYER, SECTION 10 DRAINAGE LAYER, SECTION 11 UNDER DRAINAGE, SECTION 12 PERMEABLE LINER, SECTION 13 IMPERMEABLE LINER AND SECTION 14 LANDSCAPING OF THIS DOCUMENT.
   - 4.2. ALL MATERIALS MUST BE CERTIFIED BY THE SUPPLIER WITH CERTIFICATION AND DELIVERY SUPPLY DOCKETS SHALL BE PROVIDED ON REQUEST TO CERTIFY THE MATERIAL DELIVERED IS THE MATERIAL TESTED.
5. TIMING AND EROSION AND SEDIMENT CONTROL:
   - 5.1. THE TIMING OF CIVIL AND LANDSCAPE WORKS FOR BIORETENTION SYSTEMS MUST BE CAREFULLY PLANNED TO ENSURE THAT BOTH THE BIORETENTION SYSTEM AND THE DOWNSTREAM WATERWAYS, ARE NOT IMPACTED BY STORMWATER AND SEDIMENT (E.G. THROUGH BEST PRACTICE EROSION AND SEDIMENT CONTROL). IN PARTICULAR, THE DRAINAGE LAYER, TRANSITION LAYER AND FILTER MEDIA MUST NOT BE PLACED UNTIL THE RISK OF HIGH SEDIMENT LOADING FROM UPSTREAM CONSTRUCTION ACTIVITIES HAS BEEN MITIGATED. THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY THE SUPERINTENDENT.
   - 5.2. EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION MUST BE DELIVERED IN ACCORDANCE WITH ALL LEGISLATIVE REQUIREMENTS INCLUDING, WHERE REQUIRED, THE PREPARATION OF SITE-SPECIFIC ESC PLAN/S IN ACCORDANCE WITH CURRENT BEST PRACTICE EROSION AND SEDIMENT CONTROL (E.G. IECA 2008, OR LATEST VERSION).
6. EARTHWORKS AND HYDRAULIC STRUCTURES:
   - 6.1. THE CONSTRUCTION OF HYDRAULIC STRUCTURES MUST ENSURE THE DESIGN LEVELS ARE ACHIEVED. BUNDS/ EMBANKMENTS SURROUNDING THE SYSTEM SHALL BE AT CORRECT LEVELS. THE BELOW TABLE SUMMARISES THE CONSTRUCTION TOLERANCES FOR EACH ELEMENT OF A TYPICAL BIORETENTION SYSTEM.
   - 6.2. BIORETENTION SYSTEMS TOLERANCES

BIORETENTION ELEMENT	TOLERANCE (UNLESS SPECIFIED OTHERWISS)
HYDRAULIC STRUCTURES	+/- 25mm (+/- 15mm FOR STREETSCAPE SYSTEMS)
EARTHWORKS	+/- 50mm
UNDER-DRAINAGE	+/- 25mm
DRAINAGE AND TRANSITION LAYERS	+ 25mm
SURFACE LEVEL	+/- 25mm +/- 40mm FOR FILTER MEDIA >300m² PROVIDED THE AVERAGE EXTENDED DETENTION REQUIREMENT IS WITHIN 25mm OF THE DESIGN REQUIREMENT
EMBANKMENTS AND BUNDS	-25mm, +50mm

7. MAINTENANCE ACCESS:
   - 7.1. MAINTENANCE ACCESS IS PROVIDED IN ACCORDANCE WITH THE DESIGN DRAWINGS.
8. FILTER MEDIA:
   - 8.1. MATERIALS A FUNDAMENTAL PART OF BIORETENTION SYSTEMS IS THE FILTER MEDIA. THE MAIN ROLE OF THE FILTER MEDIA IS TO SUPPORT VEGETATION AND REMOVE POLLUTANTS. FILTER MEDIA SHOULD BE LOAMY SAND THAT HAS HIGH PERMEABILITY WHEN COMPACTED. IT SHOULD NOT CONTAIN ANY RUBBISH OR DELETERIOUS MATERIAL. THE LOAMY SAND SHOULD CONTAIN SOME ORGANIC MATTER TO IMPROVE WATER-HOLDING CAPACITY AND PLANT HEALTH, BUT IT SHOULD BE LOW IN NUTRIENT CONTENT. THE FILTER MEDIA MUST BE COMPLIANT WITH AS4419 - SOILS FOR LANDSCAPING AND GARDEN USE, AND MEET THE FOLLOWING REQUIREMENTS:

PARAMETER	TEST METHOD IN ACCORDANCE WITH	REQUIREMENT
SATURATED HYDRAULIC CONDUCTIVITY	ASTM f1815-11	50-300 mm/hr (240 PREFFERED)
pH	AS 4419	5.5 - 7.5
ELECTRICAL CONDUCTIVITY	AS 4419	<1.2 dS/m
NITROGEN CONTENT	AS 4419	<800mg/kg
PHOSPHORUS CONTENT	AS 4419	<40 mg/kg
ORGANIC CONTENT	AS 4419	3% - 10% WHERE ORGANIC CONTENT IS BELOW THIS THRESHOLD, THE FILTER MEDIA MAY BE AMELIORATED BY ADDING 50mm OF COMPOST AND TINING IT INTO THE TOP 150mm OF FILTER MEDIA
PARTICLE SIZE DISTRIBUTION	AS 1289.3.6.1 - 1995	CLAY & SILT 3 - 6% (<0.05mm) VERY FINE SAND 5 - 30% (0.05 - 0.15mm) FINE SAND 10 - 30% (0.15 - 0.25mm) MEDIUM TO COARSE SAND 40 - 60% (0.25 - 1.0mm) COARSE SAND 7 - 10% (1.0 - 2.0mm) FINE GRAVEL <3% (2.0 - 3.4%)

SOURCE: GUIDELINES FOR SOIL FILTER MEDIA IN BIORETENTION SYSTEMS (FAWB) AND BIORETENTION TECHNICAL DESIGN GUIDELINES (WATER BY DESIGN) FILTER MEDIA MUST BE FREE OF WEEDS AND PROPAGATES.

FILTER MEDIA PARAMETERS AND PARTICLE SIZE DISTRIBUTION TO BE APPROVED BY CONSULTANT BEFORE CONSTRUCTION. OTHER CHARACTERISTICS OF THE FILTER MEDIA REQUIRED FOR PLANT GROWTH SHOULD BE CONFIRMED WITH A SOIL ANALYSIS OR CONFIRMED WITH A HORTICULTURIST/LANDSCAPE ARCHITECT.

- 8.2. TESTING FREQUENCY
  SUITABLE FILTER MEDIA CAN BE DELIVERED TO SITE OR IMPORTED SAND CAN BE AMELIORATED TO MEET THE ABOVE SPECIFICATION. IN EITHER CASE, THE MEDIA SHALL BE TESTED AGAINST THE ABOVE PARAMETERS AT ONE SAMPLE PER 500 M3 OF FILTER MEDIA. FOR SOIL SUPPLIED TO SITE, TESTING MUST BE UNDERTAKEN ON THE ACTUAL MATERIAL TO BE DELIVERED TO THE BIORETENTION SYSTEM. THE SUPPLIER AND CONTRACTOR WILL BE RESPONSIBLE FOR ENSURING THE FILTER MEDIA MEETS THE SPECIFICATION AND THE CORRECT MATERIAL IS DELIVERED TO SITE PRIOR TO INSTALLATION.
- 8.3. INSTALLATION AND COMPACTION
  WHEN INSTALLING, THE FOLLOWING SPECIFICATIONS SHALL BE APPLIED:
  - 8.3.1. FILTER MEDIA SHALL BE INSTALLED AND COMPACTED IN TWO LIFTS FOR DEPTHS OF OVER 500 MM. COMPACTION SHALL BE LIGHT AND EVEN ACROSS THE SURFACE
  - 8.3.2. THE TOP SURFACE OF THE DRAINAGE LAYER, TRANSITION LAYER AND THE FILTER MEDIA LAYER SHALL BE LEVEL AND FREE FROM LOCALISED DEPRESSIONS TO ENSURE EVEN DISTRIBUTION OF STORMWATER FLOWS ACROSS THE SURFACE AND PREVENT LOCALISED PONDING.
  - 8.3.3. FILTER FABRIC MUST NOT BE USED BETWEEN DRAINAGE LAYER, TRANSITION LAYER AND THE FILTER MEDIA LAYERS OR WRAPPED AROUND THE UNDER-DRAINAGE

9. TRANSITION LAYER
   - 9.1. TRANSITION LAYERS PREVENT FILTER MEDIA MIGRATING INTO THE DRAINAGE LAYER.
     - 9.1.1. MATERIALS
       - 9.1.1.1. TRANSITION LAYER SHALL BE MINIMUM THICKNESS OF 100mm COARSE SAND UNLESS OTHERWISE SPECIFIED (TYPICALLY 1MM PARTICLE SIZE DIAMETER) WITH <2% FINES.
       - 9.1.1.2. A PARTICLE SIZE DISTRIBUTION FOR THE SAND SHALL BE OBTAINED TO ENSURE THAT IT MEETS THE FOLLOWING CRITERIA (VICROADS).
       - 9.1.1.3. D15 (TRANSITION LAYER) ≤ 5 X D85 (FILTER MEDIA)
   - 9.2. TESTING
     A SAMPLE OF THE PROPOSED TRANSITION LAYER IS TO BE PROVIDED TO THE SUPERINTENDENT FOR APPROVAL PRIOR TO INSTALLATION. THE SUPERINTENDENT MAY REQUIRE THE TRANSITION LAYER TO BE TESTED TO ENSURE ITS PARTICLE SIZE
10. DRAINAGE LAYER:
DRAINAGE LAYERS CONVEY INFILTRATED WATER INTO THE SLOTTED UNDER-DRAINAGE PIPES.
   - 10.1. MATERIALS
     - 10.1.1. DRAINAGE LAYER SHALL BE COMPRISED OF FINE GRAVEL (NOMINAL 2-5 MM) WITH <2% FINES AND A MINIMUM SATURATED HYDRAULIC CONDUCTIVITY OF 400 MM/HR. THE DEPTH OF THE DRAINAGE LAYER SHALL ENSURE AT LEAST 50 MM OF AGGREGATE COVER OVER ALL PERFORATED UNDER-DRAINAGE PIPES.
     - 10.1.2. A PARTICLE SIZE DISTRIBUTION FOR THE GRAVEL SHALL BE OBTAINED TO ENSURE THAT IT MEETS THE FOLLOWING BRIDGING CRITERIA (VICROADS): D15 (DRAINAGE LAYER) ≤ 5 X D85 (TRANSITION LAYER)
   - 10.2. TESTING A SAMPLE OF THE PROPOSED DRAINAGE LAYER IS TO BE PROVIDED TO THE SUPERINTENDENT FOR APPROVAL PRIOR TO INSTALLATION. THE SUPERINTENDENT MAY REQUIRE THE DRAINAGE LAYER TO BE TESTED TO ENSURE ITS PARTICLE SIZE.
11. UNDER-DRAINAGE
   - 11.1. MATERIALS EITHER SLOTTED RIGID PIPE (HDPE OR SIMILAR) OR AG-PIPE CAN BE USED FOR UNDER-DRAINAGE AS SPECIFIED IN THE CONSTRUCTION DRAWINGS. WHEN INSTALLING, THE FOLLOWING SPECIFICATIONS SHALL BE CONSIDERED:
     - 11.1.1. TYPICALLY 100 MM-SLOTTED HDPE PIPE IS THE PREFERRED TYPE OF RIGID PIPE
     - 11.1.2. THE SLOTS IN THE PIPE SHALL NOT ALLOW THE DRAINAGE LAYER AGGREGATE TO FREELY ENTER THE PIPE. UNDER-DRAINAGE WITH SLOT WIDTH OF 2 MM OR SMALLER IS PREFERRED, MAXIMUM 4MM WIDE, WITH MINIMUM 1,500 MM² OPENINGS/M).
     - 11.1.3. UNDER-DRAINAGE PIPES MUST NOT BE SURROUNDED BY ANY GEOFABRIC OR SOCK.
   - 11.2. INSTALLATION
     - 11.2.1. THE MAXIMUM SPACING OF UNDER-DRAINS FOR BIO-RETENTION SYSTEMS <100 M2 IS 1.5 M FROM CENTRE TO CENTRE. FOR BIORETENTION SYSTEMS >100 M2 THE MAXIMUM SPACING CAN BE INCREASED TO 2.0 - 2.5 M IF SPECIFIED IN THE CONSTRUCTION DRAWINGS.
     - 11.2.2. THE UNDER-DRAINS SHALL BE SLOPED TOWARDS THE OUTLET PIT (MIN. 0.5% LONGITUDINAL GRADE) AND THE BASE OF FILTRATION TRENCH SHALL BE FREE FROM LOCALISED DEPRESSIONS. FOR BIORETENTION SYSTEMS WITH A SATURATED ZONE A 0% PIPE GRADE IS ACCEPTABLE.
     - 11.2.3. ALL JUNCTIONS AND CONNECTIONS SHALL BE APPROPRIATELY SEALED.
     - 11.2.4. UNDER-DRAINAGE PIPES SHALL BE SEALED INTO THE OVERFLOW PIT.
     - 11.2.5. ALL UNDER DRAINAGE PIPES TO HAVE RAISED CLEAN OUT POINTS CONSTRUCTED FROM NON-SLOTTED PIPES WHICH EXTEND TO 150 MM ABOVE FILTER MEDIA SURFACE
     - 11.2.6. JOINTS TO BE RUBBER RING JOINT, BENDS SHOULD BE 45° TO ENSURE THAT THE PIPE CAN BE FLUSHED
12. PERMEABLE LINER (WHERE SPECIFIED)
   - 12.1. A PERMEABLE GEOTEXTILE LINER FABRIC MUST BE USED TO LINE THE OUTSIDE OF THE BIORETENTION SYSTEM.
   - 12.2. THE LINER MUST EXTEND AT LEAST 500 MM BEYOND THE TOP OF THE SIDES AND MUST BE KEYED INTO BATTER AND COVERED BY AT LEAST 200 MM OF TOPSOIL.
   - 12.3. THE LINER MUST BE RESISTANT TO ALL SOIL ACIDS AND ALKALIS, RESISTANT TO MICROORGANISMS AND COMPLY WITH THE REQUIREMENTS OF AS3706.12 AND AS3706.13.
13. IMPERMEABLE LINER (WHERE SPECIFIED)
   - 13.1. MATERIALS LINER OPTIONS INCLUDE CLAY, GEOSYNTHETIC BENTONITE CLAY LINERS OR HIGH-DENSITY POLY ETHYLENE (HDPE) LINERS. REFER TO THE PROJECT DRAWINGS FOR LINER DETAILS.
   - 13.2. INSTALLATION MUST BE IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS AND DESIGN DRAWINGS AND ACHIEVE THE FOLLOWING:
     - 13.1.1. THE LINERS SHALL BE KEYED INTO THE BATTERS AND TO THE EMBANKMENTS.
     - 13.1.2. LINERS MUST BE SEALED AROUND PROTRUSIONS SUCH AS OUTLET PIPES.
     - 13.1.3. MUST ACHIEVE A MAXIMUM PERMEABILITY OF 1X10-9M/S
14. LANDSCAPING
   - 14.1. REFER TO LANDSCAPE DESIGN DRAWINGS AND TECH. NOTE.
   - 14.2. BATTER SLOPES MUST HAVE MIN 200 MM TOPSOIL WHICH MUST BE TESTED BY A NATA-ACCREDITED LABORATORY IN ACCORDANCE WITH AS 4419.
   - 14.3. SUBSOILS TO BE CULTIVATED TO 150 MM PRIOR TO PLACING TOPSOIL ON BATTER SLOPES.
   - 14.4. PLANTING DENSITIES AND SPECIES MUST BE CONSISTENT WITH THE LANDSCAPE DESIGN DRAWINGS. NO SUBSTITUTIONS SHOULD BE MADE UNLESS APPROVED BY THE SUPERINTENDENT.
   - 14.5. PLANTS SUPPLIED TO SITE MUST:
     - 14.5.1. BE GROWN IN CLEAN, WEED- AND PEST-FREE CONDITIONS;
     - 14.5.2. BE WELL DEVELOPED, SUN-HARDENED AND CONTAIN A FULLY ESTABLISHED ROOT BALL THAT DOES NOT CRUMBLE WHEN REMOVED FROM ITS CONTAINER.
     - 14.5.3. BE AT LEAST 200 MM HIGH.
     - 14.5.4. SHOW NO SIGN OF PEST AND DISEASE
     - 14.5.5. SHOW NO SIGNS OF NUTRIENT DEFICIENCY
     - 14.5.6. BE FREE FROM WEEDS AND BE CLEARLY LABELLED
     - 14.5.7. BE SUPPLIED IN A CONTAINER THAT IS AT LEAST: 90 MM HIGH X 50 MM WIDE
   - 14.6. PREPARING FILTER MEDIA: UNLESS SPECIFIED OTHERWISE, EACH PLANT MUST RECEIVE AT LEAST 10 G OF SLOW-RELEASE NATIVE FERTILIZER IN GRANULAR OR TABLET FORM. PRE-HYDRATED WATER CRYSTALS MAY BE APPLIED AT 1-2% BY WEIGHT.
   - 14.7. MULCH MUST BE APPLIED IN ACCORDANCE WITH THE DESIGN DRAWINGS AND DESIGN TECH. NOTE, BE APPLIED PRIOR TO PLANTING, PROVIDE COVERAGE OF THE SOIL AND NOT EXCEED 75 MM THICKNESS, AND BE KEPT 50 MM CLEAR OF PLANT STEMS. UNLESS OTHERWISE SPECIFIED, MULCH SHOULD BE FINE SUGAR CANE MULCH SECURED IN PLACE BY A LOOSE WEAVE JUTE NET PINNED AT 500 MM CENTRES.
   - 14.8. FILTER MEDIA SURFACE AND PLANT STOCK ARE TO BE WATERED IMMEDIATELY PRIOR TO PLANTING. UNLESS OTHERWISE SPECIFIED, PLANTS SHOULD BE PLANTED IN CLUMPS OF THE SAME SPECIES, AND LARGE MONOCULTURES AVOIDED.
   - 14.9. PLANT METHOD MUST MINIMISE SOIL COMPACTION AND ENSURE THAT ALL ROOTS ARE COVERED BY AT LEAST 10 - 20 MM OF SOIL, AVOID COVERING PLANT CROWN
   - 14.10. UNLESS SPECIFIED OTHERWISE, THE FOLLOWING IRRIGATION SCHEDULE APPLIES DURING PLANT ESTABLISHMENT (AT 2.5 - 5 L PER PLANT PER WEEK) - WEEK 1-5 FIVE WATERINGS PER WEEK - WEEK 6-10 THREE WATERINGS PER WEEK - WEEK 11-15 TWO WATERINGS PER WEEK - THEREAFTER AS REQUIRED TO SUSTAIN PLANTS UNTIL SUCCESSFUL ESTABLISHMENT
   - 14.11. REPLANTING MUST OCCUR DURING THE ESTABLISHMENT PERIOD IF LESS THAN 90% OF PLANTS SURVIVE.
   - 14.12. SUCCESSFUL PLANT ESTABLISHMENT IN BIORETENTION SYSTEMS IS CONSIDERED WHEN THE PLANTS ARE ROBUST AND SELF-SUSTAINING, AND MEET THE FOLLOWING CRITERIA. - VEGETATION MUST COVER AT LEAST 90% OF THE BIORETENTION SURFACE WITH MULCH COVERING THE REMAINDER (< 10% MULCH VISIBLE FROM ABOVE) - AVERAGE GROUNDCOVER PLANT HEIGHT MUST BE GREATER THAN 500 MM. - PLANTS MUST BE HEALTHY AND FREE FROM DISEASE. - NO WEEDS OR LITTER TO BE PRESENT.
15. CERTIFICATION AND CHAIN OF CUSTODY
   - 15.1. THE FOLLOWING CERTIFICATION AND THE CHAIN OF CUSTODY APPLIES TO BIORETENTION MEDIA:
     - 15.1.1. THE SUPPLIER AND CONTRACTOR ARE RESPONSIBLE FOR ENSURING THE BIORETENTION MEDIA MEETS THE SPECIFICATIONS OUTLINED IN THESE GUIDELINES AND THAT THE CORRECT MATERIAL IS DELIVERED TO SITE. THE SUPPLIER MUST ARRANGE FOR TESTING OF THE FILTER MEDIA BY A SOIL LABORATORY CERTIFIED FOR THE METHODS IN ACCORDANCE WITH THE REQUIREMENTS LISTED ABOVE. ON THE BASIS OF THE TESTING, THE SOIL LABORATORY AND SUPPLIER MUST CERTIFY THE MATERIAL MEETS THESE SPECIFICATIONS. THE SUPPLIER MUST PROVIDE THE CERTIFICATION AND LABORATORY TEST RESULTS TO THE CONTRACTOR WITH THE SUPPLY DOCKET.
     - 15.1.2. THE CONTRACTOR PROVIDES A COPY OF THE SUPPLIER'S CERTIFICATION, TEST RESULTS AND SUPPLY DOCKET TO THE SITE SUPERINTENDENT OR BIORETENTION DESIGNER FOR REVIEW.
     - 15.1.3. FOLLOWING REVIEW OF THE CERTIFICATION, TEST RESULTS AND THE SUPPLY DOCKET, THE SITE SUPERINTENDENT OR BIORETENTION DESIGNER APPROVES INSTALLATION OF THE BIORETENTION MEDIA.
     - 15.1.4. THE RELEVANT SECTIONS OF THE BIORETENTION MEDIA SIGN-OFF FORM AS PER THE CONSTRUCTION AND ESTABLISHMENT GUIDELINES (WATER BY DESIGN) SHOULD BE COMPLETED AND SIGNED. THIS SIGN-OFF FORM IS PROVIDED AS PART OF THE CONSTRUCTION CERTIFICATION BY THE SITE SUPERINTENDENT OR BIORETENTION DESIGNER.
16. HOLD POINTS
   - 16.1. THE FOLLOWING HOLD POINTS MUST BE OBSERVED IN ACCORDANCE WITH THE MOST RECENT WATER BY DESIGN CONSTRUCTION CHECKLISTS AND SUPERINTENDENT APPROVAL IS REQUIRED FOR WORKS TO PROCEED:
     - 16.1.1. PRESTART MEETING
     - 16.1.2. COMPLETION OF HYDRAULIC STRUCTURES AND UNDER-DRAINAGE
     - 16.1.3. PRIOR TO PLACING FILTER MEDIA
     - 16.1.4. AFTER PLACEMENT OF FILTER MEDIA (PRIOR TO APPLYING MULCH AND PLANTING).
17. COMPLIANCE TESTING (FOR ON-MAINTENANCE OR OFF-MAINTENANCE)
   - 17.1. COMPLIANCE TESTING MUST BE IN ACCORDANCE WITH CHAPTER 5 OF TRANSFERRING OWNERSHIP OF VEGETATED STORMWATER ASSETS (WATER BY DESIGN). CHECKLISTS MUST BE COMPLETED AND SIGNED BY THE SUPERINTENDENT.

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TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
DESIGN CHECK	N.PANNIPITIYA
PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING

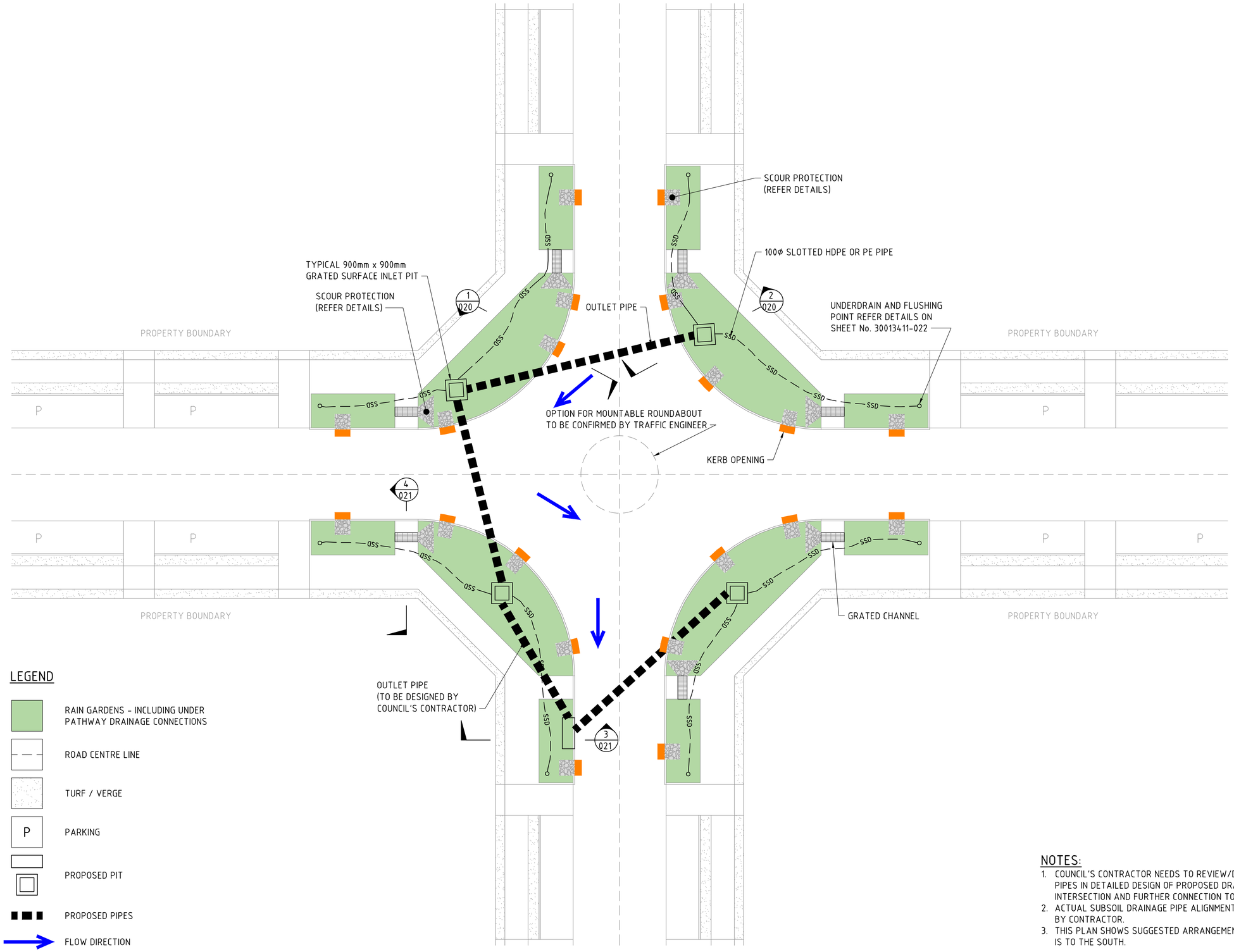
DESIGNER: SMEC
Member of the Surbana Jurong Group
© ABN 47 065 475 149
SMEC PROJECT No 300xxxxx

CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN GENERAL NOTES

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-002	02



LEGEND

- RAIN GARDENS – INCLUDING UNDER PATHWAY DRAINAGE CONNECTIONS
- ROAD CENTRE LINE
- TURF / VERGE
- P — PARKING
- PROPOSED PIT
- PROPOSED PIPES
- FLOW DIRECTION

NOTES:

1. COUNCIL'S CONTRACTOR NEEDS TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AT THE INTERSECTION AND FURTHER CONNECTION TO AN EXISTING DRAINAGE NETWORK.
2. ACTUAL SUBSOIL DRAINAGE PIPE ALIGNMENT AND LOCATION TO BE DETERMINED BY CONTRACTOR.
3. THIS PLAN SHOWS SUGGESTED ARRANGEMENT WHEN GENERAL GROUND SLOPE IS TO THE SOUTH.

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PLOT DATE: 10 Feb 2021 TIME: 16:59:20

EXTERNAL REFERENCE FILES: X_30013411_SMEC_A1 X_PLAN

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	18.12.2020	ISSUED FOR CLIENT REVIEW	001	AC
02	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
DESIGN CHECK	N.PANNIPITIYA
PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING
SCALE 1:125 (1.25 0 2.5 5)

DESIGNER: SMEC — Member of the Surbana Jurong Group — © ABN 47 065 475 149
SMEC PROJECT No 300xxxxx

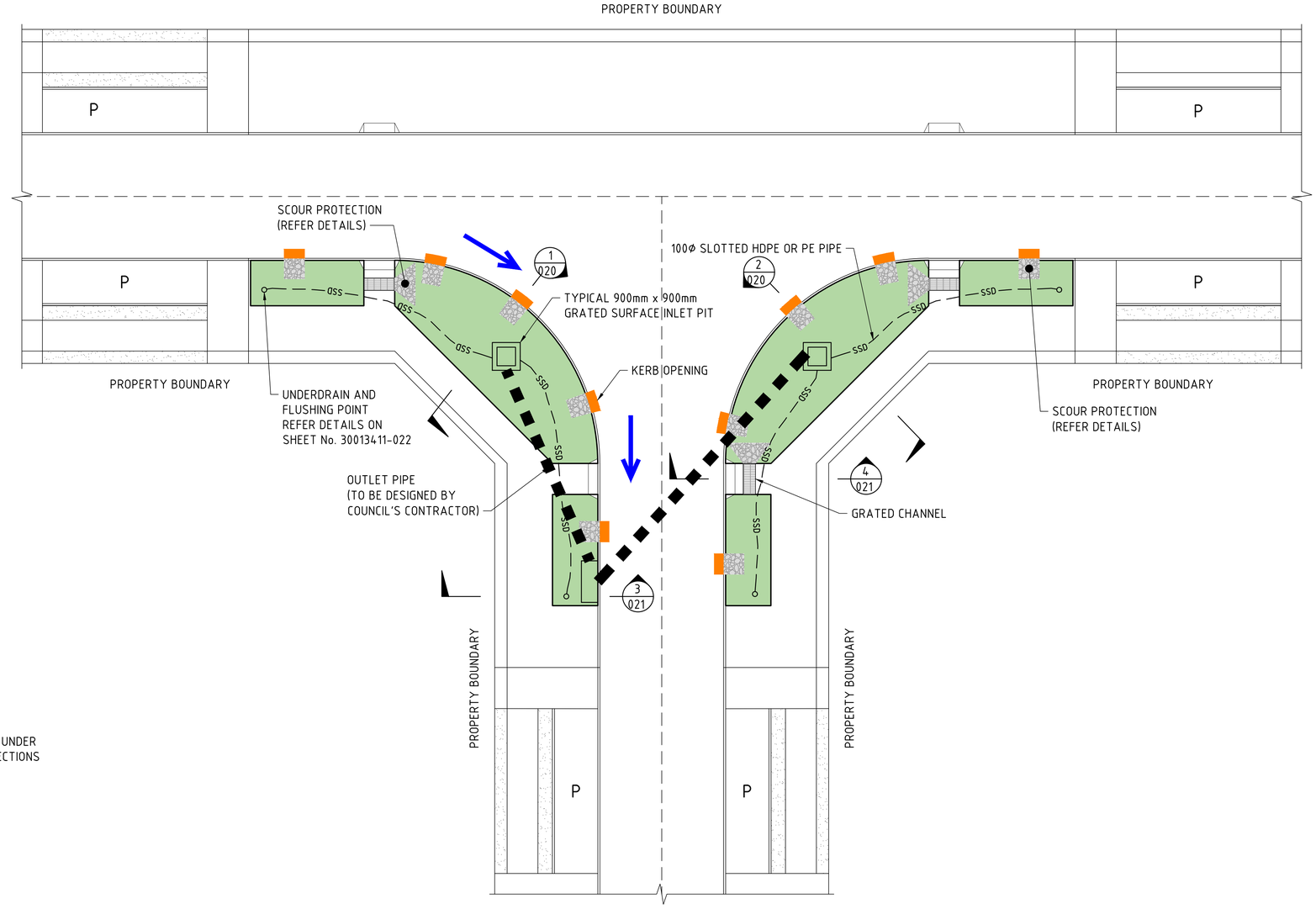
CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN GENERAL ARRANGEMENT & DRAINAGE PLAN INTERSECTION (16m ROAD)

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-010	02

A1 150 mm ON ORIGINAL



LEGEND

- RAIN GARDENS - INCLUDING UNDER PATHWAY DRAINAGE CONNECTIONS
- ROAD CENTRE LINE
- TURF / VERGE
- P — PARKING
- PROPOSED PIT
- PROPOSED PIPES
- FLOW DIRECTION

NOTES:

1. COUNCIL'S CONTRACTOR NEEDS TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AT THE T-JUNCTION AND FURTHER CONNECTION TO AN EXISTING DRAINAGE NETWORK.
2. ACTUAL SUBSOIL DRAINAGE PIPE ALIGNMENT AND LOCATION TO BE DETERMINED BY CONTRACTOR.

150 mm ON ORIGINAL

A1 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

DRAWING FILE LOCATION / NAME: V:_Vault\Projects\3001\30013411\110_CADD\CAD\DWG\30013411-011.dwg
PLOT DATE: 10 Feb 2021 TIME: 16:59:48

EXTERNAL REFERENCE FILES: X_30013411_SMEC_A1, X_PLAN

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	18.12.2020	ISSUED FOR CLIENT REVIEW	001	AC
02	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
DESIGN CHECK	N.PANNIPITIYA
PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING
SCALE 1:125 (1.25 0 2.5 5)

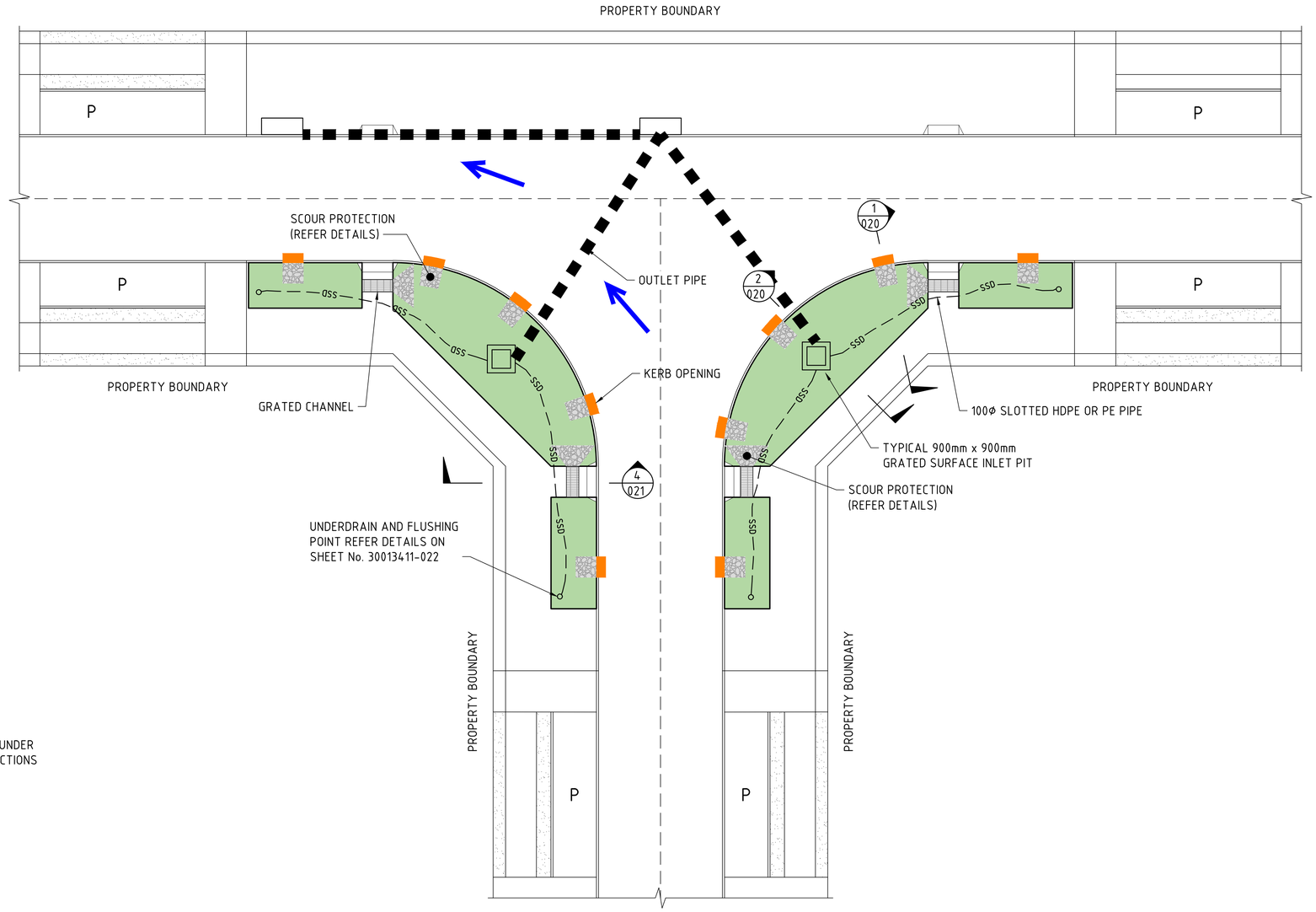
DESIGNER: SMEC — Member of the Surbana Jurong Group — © ABN 47 065 475 149
SMEC PROJECT No 300xxxxx

CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN
GENERAL ARRANGEMENT & DRAINAGE PLAN
T JUNCTION OPTION 1 (16m ROAD)

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-011	02



LEGEND

- RAIN GARDENS - INCLUDING UNDER PATHWAY DRAINAGE CONNECTIONS
- ROAD CENTRE LINE
- TURF / VERGE
- P — PARKING
- PROPOSED PIT
- PROPOSED PIPES
- FLOW DIRECTION

NOTES:

1. COUNCIL'S CONTRACTOR NEEDS TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AT THE T-JUNCTION AND FURTHER CONNECTION TO AN EXISTING DRAINAGE NETWORK.
2. ACTUAL SUBSOIL DRAINAGE PIPE ALIGNMENT AND LOCATION TO BE DETERMINED BY CONTRACTOR.

DRAWING FILE LOCATION / NAME: V:_Vault\Projects\3001\30013411\110_CADD\CAD\DWG\30013411-012.dwg
PLOT DATE: 10 Feb 2021 TIME: 17:00:30

EXTERNAL REFERENCE FILES: X_30013411_SMEC_A1 X_PLAN

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	18.12.2020	ISSUED FOR CLIENT REVIEW	001	AC
02	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
DESIGN CHECK	N.PANNIPITIYA
PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING
SCALE 1:125 (1.25 0 2.5 5)

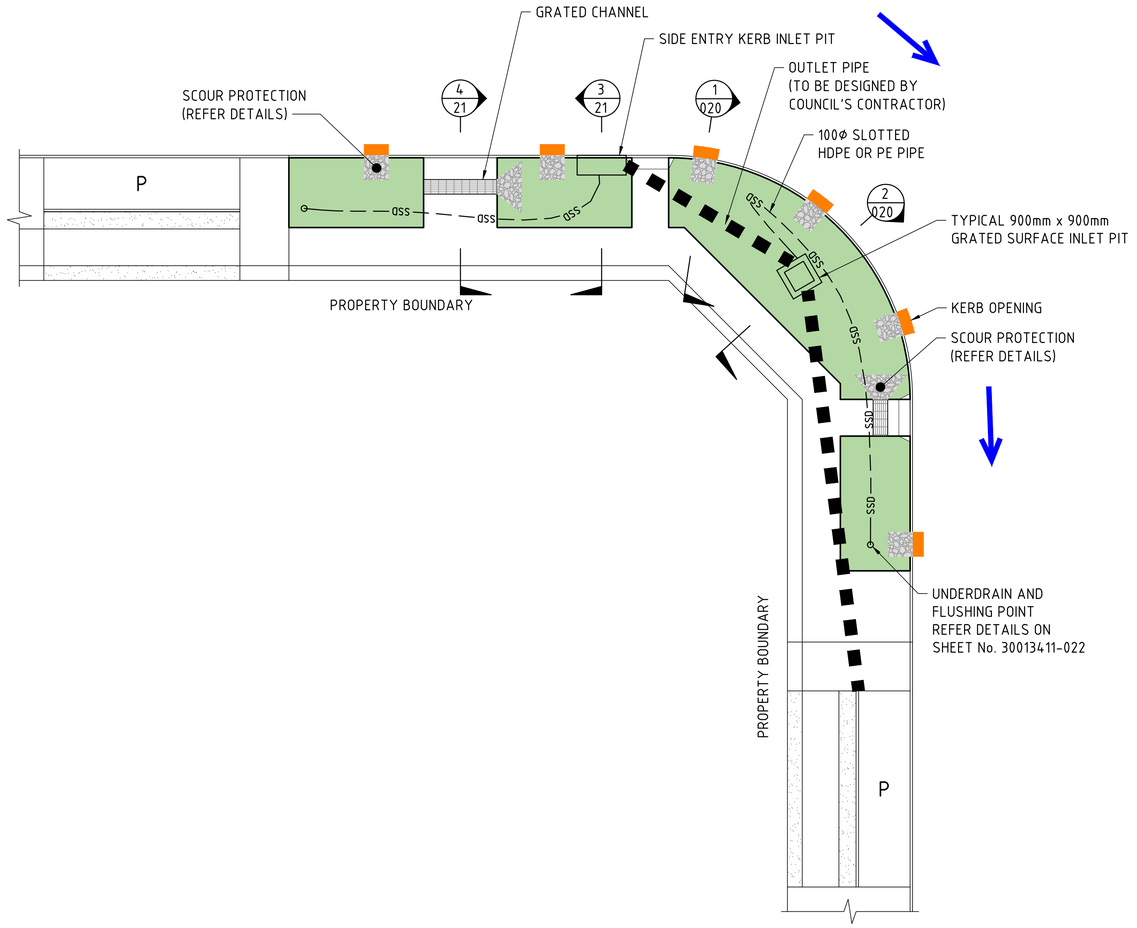
DESIGNER: SMEC
Member of the Surbana Jurong Group
© ABN 47 065 475 149
SMEC PROJECT No 300xxxxx

CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH
RAINGARDEN DESIGN
GENERAL ARRANGEMENT & DRAINAGE PLAN
T JUNCTION OPTION 2 (16m ROAD)

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-012	02

150 mm ON ORIGINAL
A1



LEGEND

- RAIN GARDENS – INCLUDING UNDER PATHWAY DRAINAGE CONNECTIONS
- TURF / VERGE
- P — PARKING
- PROPOSED PIT
- PROPOSED PIPES
- FLOW DIRECTION

NOTES:

1. COUNCIL'S CONTRACTOR NEEDS TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AT THE ROAD BEND AND FURTHER CONNECTION TO AN EXISTING DRAINAGE NETWORK.
2. ACTUAL SUBSOIL DRAINAGE PIPE ALIGNMENT AND LOCATION TO BE DETERMINED BY CONTRACTOR.

DRAWING FILE LOCATION / NAME: V:_Vault\Projects\3001\30013411\110_CADD\CAD\DWG\30013411-013.dwg
PLOT DATE: 10 Feb 2021 TIME: 17:00:59

EXTERNAL REFERENCE FILES: X_30013411_SMEC_A1 X_PLAN

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	18.12.2020	ISSUED FOR CLIENT REVIEW	001	AC
02	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
DESIGN CHECK	N.PANNIPITIYA
PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING: SCALE 1:125 (1.25 0 2.5 5)

DESIGNER: SMEC — Member of the Surbana Jurong Group — © ABN 47 065 475 149 — SMEC PROJECT No 300xxxxx

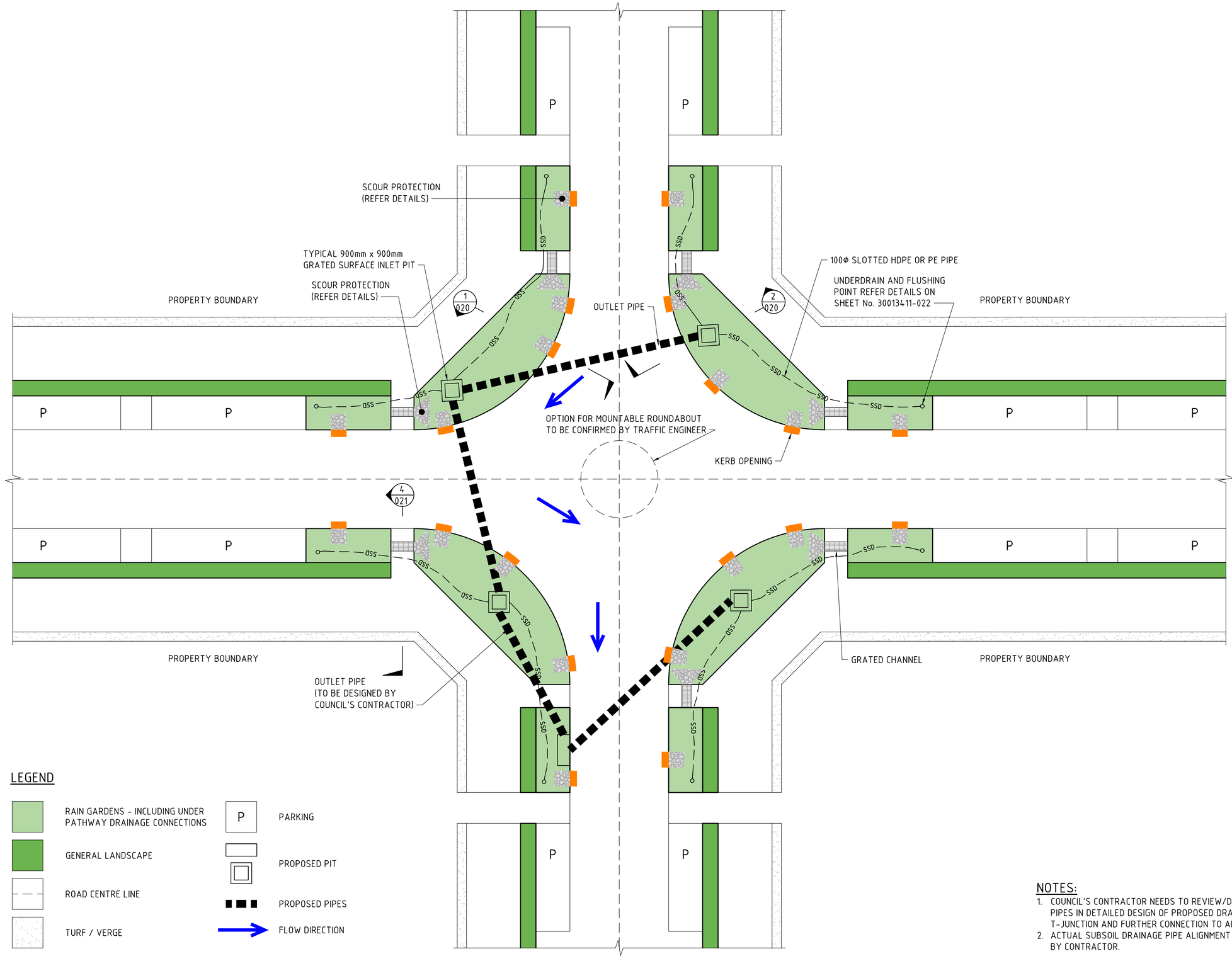
CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN
GENERAL ARRANGEMENT & DRAINAGE PLAN
ROAD BEND (16m ROAD)

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-013	02

A1 150 mm ON ORIGINAL



LEGEND

- RAIN GARDENS - INCLUDING UNDER PATHWAY DRAINAGE CONNECTIONS
- GENERAL LANDSCAPE
- ROAD CENTRE LINE
- TURF / VERGE
- P — PARKING
- PROPOSED PIT
- PROPOSED PIPES
- FLOW DIRECTION

NOTES:

1. COUNCIL'S CONTRACTOR NEEDS TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AT THE T-JUNCTION AND FURTHER CONNECTION TO AN EXISTING DRAINAGE NETWORK.
2. ACTUAL SUBSOIL DRAINAGE PIPE ALIGNMENT AND LOCATION TO BE DETERMINED BY CONTRACTOR.

DRAWING FILE LOCATION / NAME: V:_Vault\Projects\3001\30013411\110_CADD\CAD\DWG\30013411-014.dwg					PLOT DATE: 10 Feb 2021	TIME: 17:01:41
EXTERNAL REFERENCE FILES	REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL	TITLE / NAME
X_30013411_SMEC_A1 X_PLAN	01	10.02.2020	FINAL	002	AC	DRAFTER: R.PHILLIS; DRAFTING CHECK: T.LITTLE; DESIGNER: G.NAGHIB; DESIGN CHECK: N.PANNIPITIYA; PROJECT MANAGER: G.NAGHIB; PROJECT DIRECTOR: M.BOX

SCALES AT A1 SIZE DRAWING — SCALE 1:125 (1.25 0 2.5 5)

DESIGNER: SMEC — Member of the Surbana Jurong Group — © ABN 47 065 475 149 — SMEC PROJECT No 300xxxxx

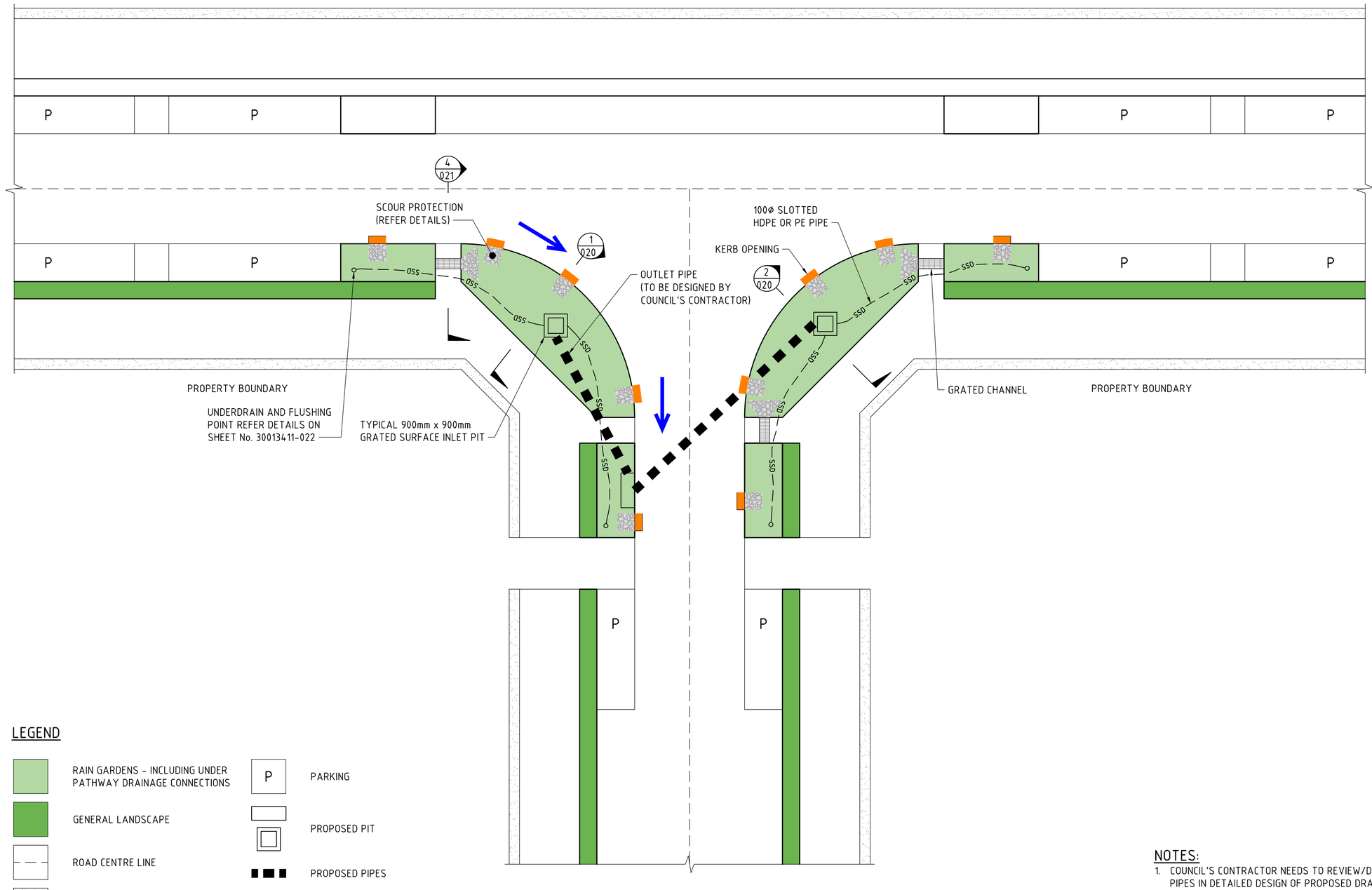
CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN
GENERAL ARRANGEMENT & DRAINAGE PLAN
INTERSECTION (20m ROAD)

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-014	01

150 mm ON ORIGINAL — A1



LEGEND

- RAIN GARDENS - INCLUDING UNDER PATHWAY DRAINAGE CONNECTIONS
- GENERAL LANDSCAPE
- ROAD CENTRE LINE
- TURF / VERGE
- P — PARKING
- PROPOSED PIT
- PROPOSED PIPES
- FLOW DIRECTION

NOTES:

1. COUNCIL'S CONTRACTOR NEEDS TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AT THE T-JUNCTION AND FURTHER CONNECTION TO AN EXISTING DRAINAGE NETWORK.
2. ACTUAL SUBSOIL DRAINAGE PIPE ALIGNMENT AND LOCATION TO BE DETERMINED BY CONTRACTOR.

DRAWING FILE LOCATION / NAME: V:__Vault\Projects\3001\30013411\110__CADD\CAD\DWG\30013411-015.dwg
PLOT DATE: 10 Feb 2021 TIME: 17:02:09

EXTERNAL REFERENCE FILES: X_30013411_SMEC_A1 X_PLAN

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
DESIGN CHECK	N.PANNIPITIYA
PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING
SCALE 1:125 (1.25 0 2.5 5)

DESIGNER: SMEC — Member of the Surbana Jurong Group — © ABN 47 065 475 149
SMEC PROJECT No 300xxxxx

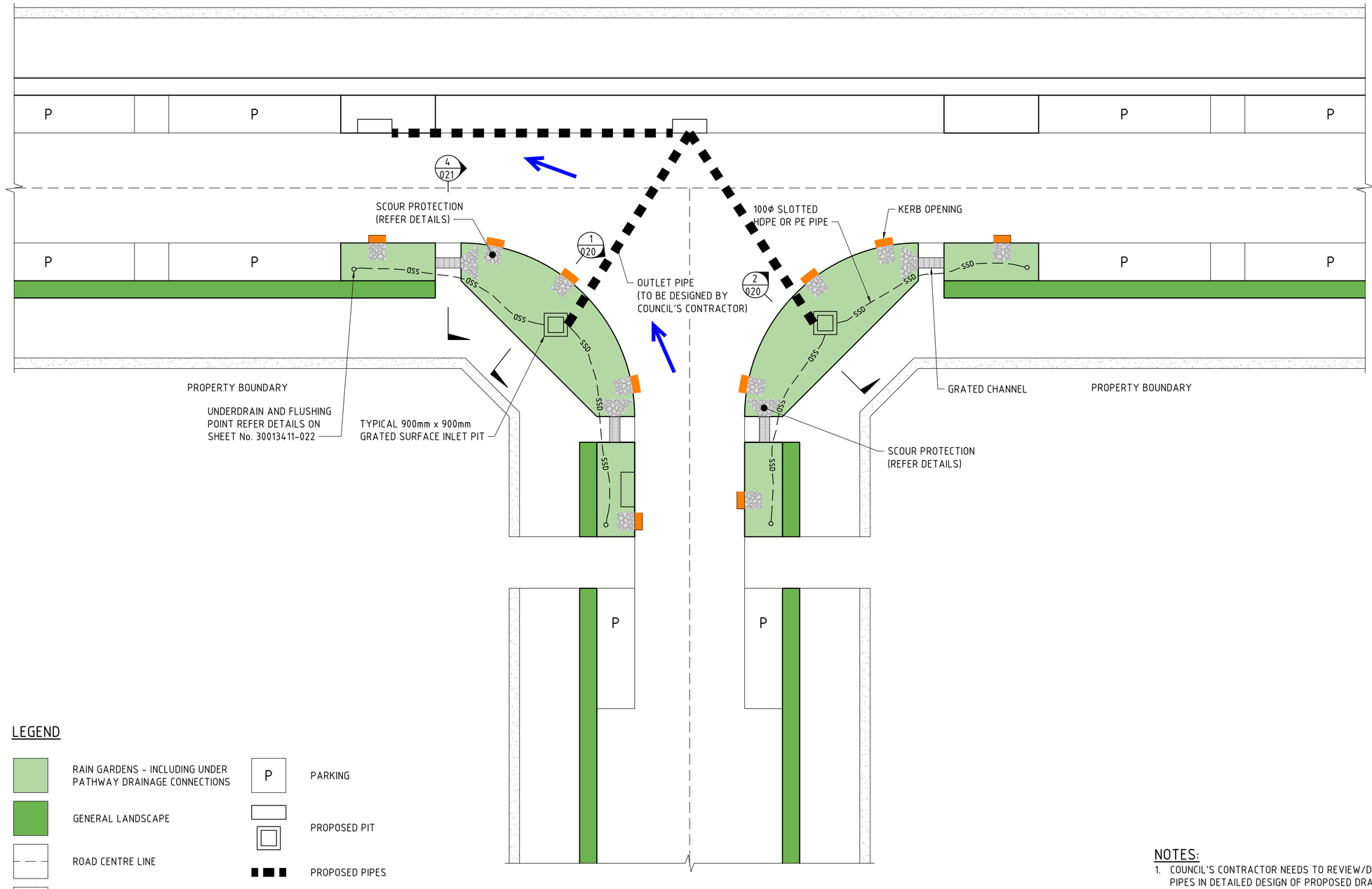
CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN
GENERAL ARRANGEMENT & DRAINAGE PLAN
T JUNCTION OPTION 1 (20m ROAD)

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-015	01

A1 150 mm ON ORIGINAL



LEGEND

- RAIN GARDENS - INCLUDING UNDER PATHWAY DRAINAGE CONNECTIONS
- GENERAL LANDSCAPE
- ROAD CENTRE LINE
- TURF / VERGE
- P — PARKING
- PROPOSED PIT
- PROPOSED PIPES
- FLOW DIRECTION

NOTES:

1. COUNCIL'S CONTRACTOR NEEDS TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AT THE T-JUNCTION AND FURTHER CONNECTION TO AN EXISTING DRAINAGE NETWORK.
2. ACTUAL SUBSOIL DRAINAGE PIPE ALIGNMENT AND LOCATION TO BE DETERMINED BY CONTRACTOR.

150 mm ON ORIGINAL

A1

DRAWING FILE LOCATION / NAME: V:_Vault\Projects\3001\30013411\110_CADD\CAD\DWG\30013411-016.dwg
PLOT DATE: 10 Feb 2021 TIME: 17:02:37

EXTERNAL REFERENCE FILES	REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL	TITLE	NAME
X_30013411_SMEC_A1 X_PLAN	01	10.02.2020	FINAL	002	AC	DRAFTER	R.PHILLIS
						DRAFTING CHECK	T.LITTLE
						DESIGNER	G.NAGHIB
						DESIGN CHECK	N.PANNIPITIYA
						PROJECT MANAGER	G.NAGHIB
						PROJECT DIRECTOR	M.BOX

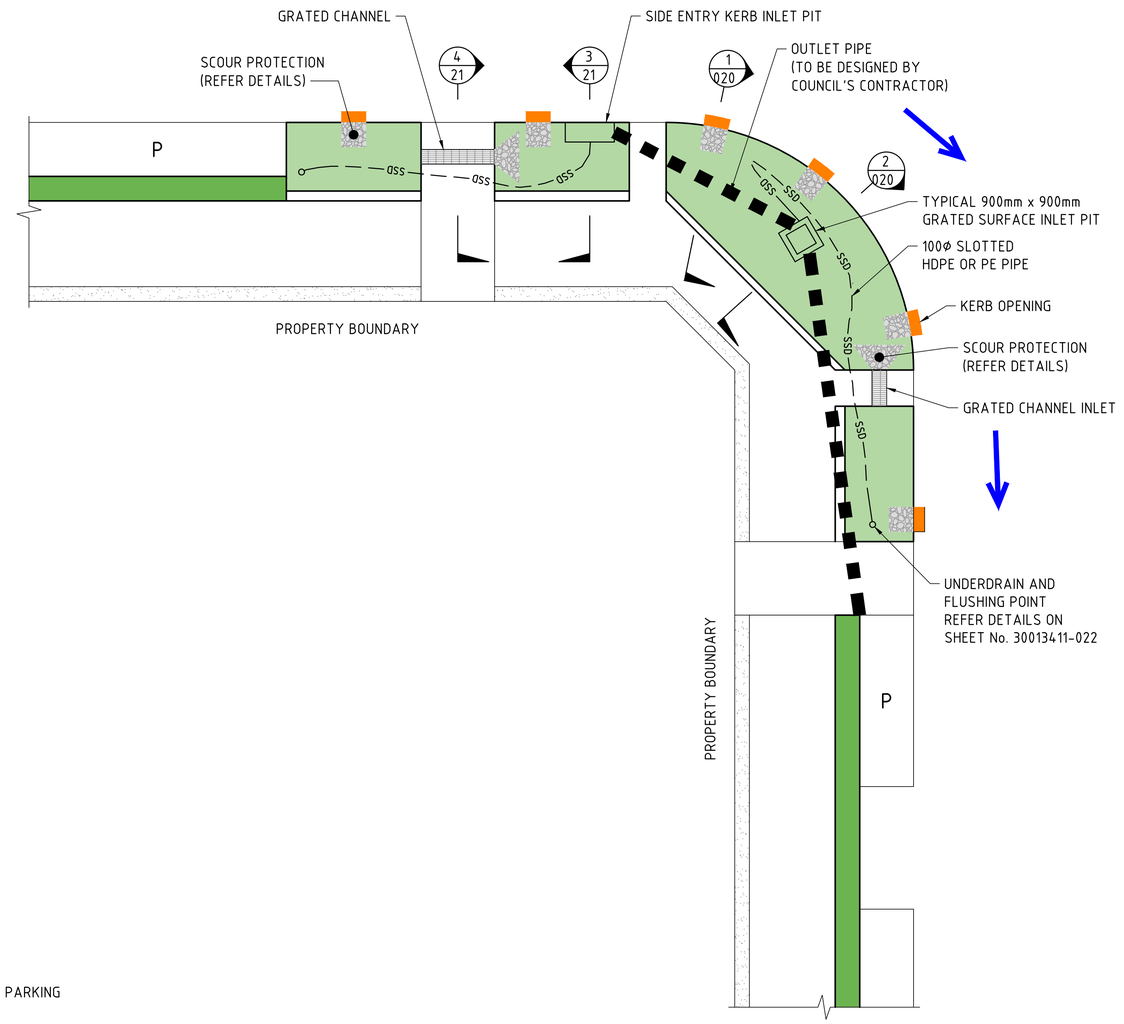
SCALES AT A1 SIZE DRAWING
SCALE 1:125 (1.25 0 2.5 5)

DESIGNER
SMEC
Member of the Surbana Jurong Group
© ABN 47 065 475 149
SMEC PROJECT No 300xxxxx

CLIENT
LIVERPOOL CITY COUNCIL

PROJECT TITLE
DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH
RAINGARDEN DESIGN
GENERAL ARRANGEMENT & DRAINAGE PLAN
T JUNCTION OPTION 2 (20m ROAD)

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-016	01



LEGEND

- RAIN GARDENS – INCLUDING UNDER PATHWAY DRAINAGE CONNECTIONS
- GENERAL LANDSCAPE
- ROAD CENTRE LINE
- TURF / VERGE
- P — PARKING
- PROPOSED PIT
- PROPOSED PIPES
- FLOW DIRECTION

NOTES:

1. COUNCIL'S CONTRACTOR NEEDS TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AT THE T-JUNCTION AND FURTHER CONNECTION TO AN EXISTING DRAINAGE NETWORK.
2. ACTUAL SUBSOIL DRAINAGE PIPE ALIGNMENT AND LOCATION TO BE DETERMINED BY CONTRACTOR.

150 mm ON ORIGINAL
A1

DRAWING FILE LOCATION / NAME: V:_Vault\Projects\3001\30013411\110_CADD\CAD\DWG\30013411-017.dwg
PLOT DATE: 10 Feb 2021 TIME: 17:03:05

EXTERNAL REFERENCE FILES: X_30013411_SMEC_A1 X_PLAN

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
DESIGN CHECK	N.PANNIPITIYA
PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING
SCALE 1:125 (1.25 0 2.5 5)

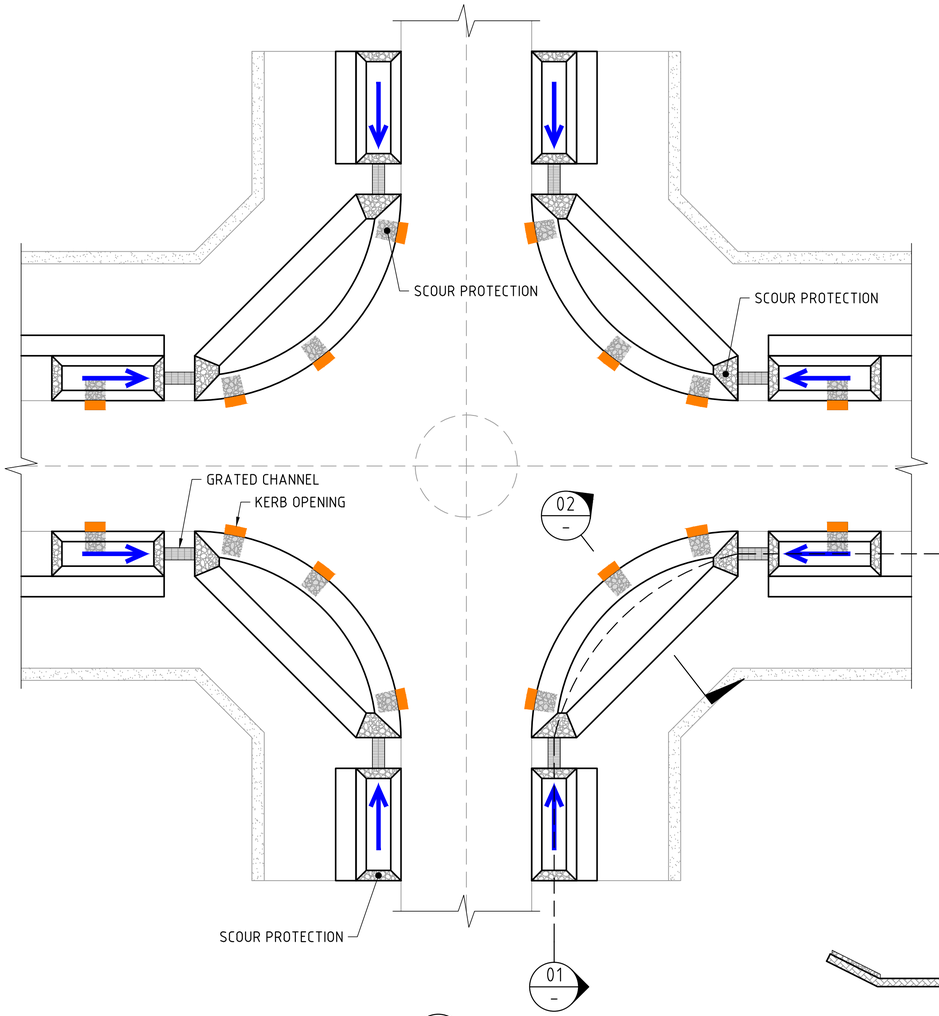
DESIGNER: SMEC
Member of the Surbana Jurong Group
© ABN 47 065 475 149
SMEC PROJECT No 300xxxxx

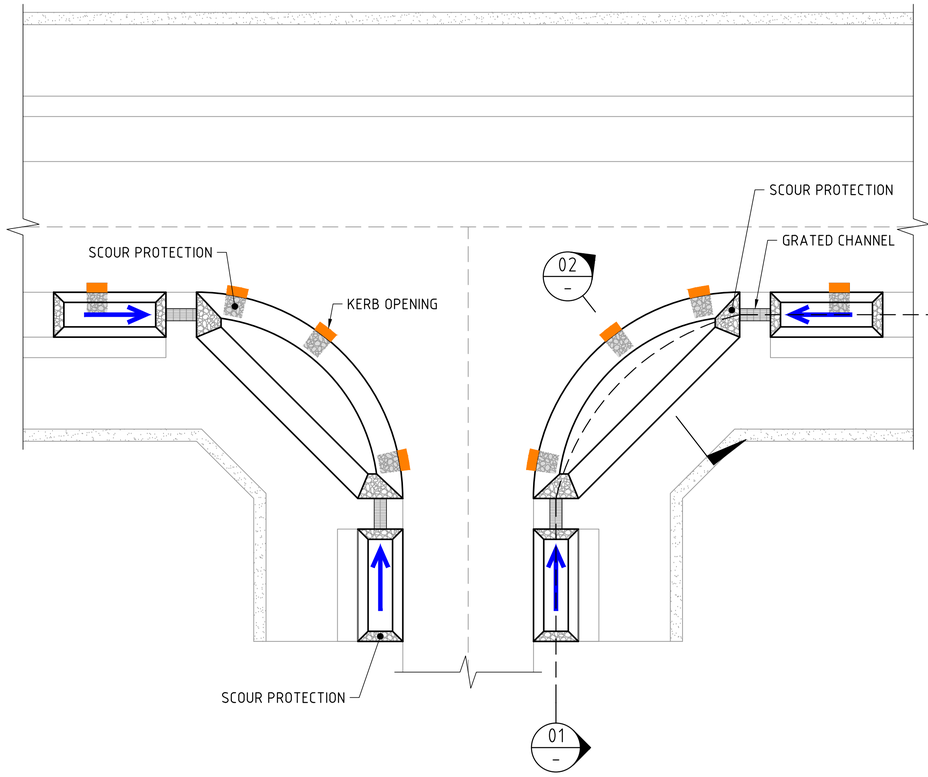
CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

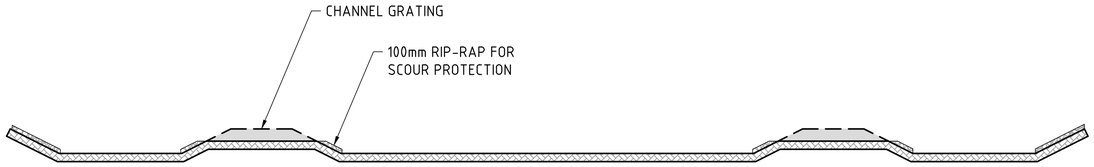
RAINGARDEN DESIGN
GENERAL ARRANGEMENT & DRAINAGE PLAN ROAD BEND (20m ROAD)

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-017	01

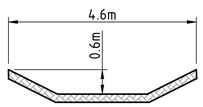




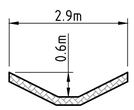
INTERIM SILT TRAP



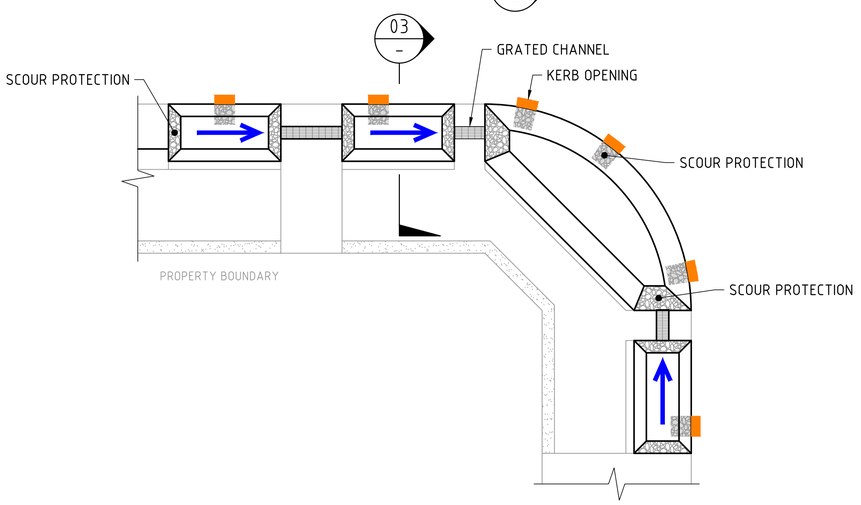
SECTION 01 / SCALE 1:75



SECTION 02 / SCALE 1:75



SECTION 03 / SCALE 1:75



INTERIM SILT TRAP GENERAL NOTES

RAINGARDENS ARE USUALLY INSTALLED AFTER THE UPSTREAM CATCHMENT IS 95% DEVELOPED BECAUSE OF POTENTIAL CLOGGING DURING DEVELOPMENT CONSTRUCTION WORKS. IN THE INTERIM CONDITIONS, EXCAVATED SEDIMENT TRAPS (SILT TRAPS) ARE SUGGESTED AS SEDIMENT CONTROL MEASURE AND LATER WILL BE RETROFITTED INTO RAINGARDEN.

1. CONSTRUCTION
   - 1.1. SOME OF THESE INTERIM SILT TRAPS MAY NOT BE USED. THE LOCATIONS TO BE CONFIRMED BASED ON PROPOSED TOPOGRAPHY (ROAD LEVELS, AND PROPOSED DRAINAGE DESIGN) IN DETAIL DESIGN STAGE.
   - 1.2. THE CURRENT PLAN ONLY SUGGEST PROPOSED LOCATION OF SILT TRAPS AND SOME GENERAL DETAILS. EROSION SEDIMENT CONTROL (ESC) PLAN NEEDS TO BE DEVELOPED FOR EACH SPECIFIC SITE IN DETAIL DESIGN STAGE. FURTHERMORE, THE ESC PLAN SHOULD INCORPORATE THE CURRENT PROPOSED INTERIM SILT TRAPS AND REQUIRED SAFETY MEASURES.
   - 1.3. THE APPROVED CONSTRUCTION CONTRACTOR, IN COORDINATION WITH COUNCIL, MUST CONSIDER SOME SAFETY MEASURES FOR PEDESTRIANS DURING AND POST CONSTRUCTION OF THE INTERIM SILT TRAPS.
   - 1.4. UNLESS OTHERWISE SPECIFIED IN EROSION SEDIMENT CONTROL PLAN FOR THE SITE, OR ADVISED BY AN APPROVED CONTRACTOR, THE EXCAVATED SILT TRAP SHOULD HAVE SIDE SLOPE OF 1(V):2(H).
   - 1.5. DEPTH OF THE INTERIM SILT TRAP IS SUGGESTED AS 0.6M. IF REQUIRED, DEPTH CAN INCREASE TO 1M PROVIDED THAT SAFEY MEASURES ARE IN PLACE DURING AND AFTER CONSTRUCTION PERIOD.
   - 1.6. APPROPRIATELY STABLISE ANY BANK SUBJECT TO DIRECT INFLOW.
   - 1.7. ESTABLISH ALL NECESSARY UP-SLOPE DRAINAGE CONTROL MEASURES TO ENSURE THAT SEDIMENT -LADEN RUNOFF IS APPROPRIATELY DIRECTED INTO THE SEDIMENT TRAP.
   - 1.8. EXCAVATED SEDIMENT TRAP SHOULD NOT BE USED IN DISPERSIVE SOIL AREAS WITHOUT EXPERT ADVICE.

2. MAINTENANCE
   - 2.1. INTERIM SILT TRAPS NEEDS TO BE CHECKED AFTER EACH RUNOFF EVENT AND REPAIRED IMMEDIATELY.
   - 2.2. SIDE SLOPES TO BE CHECKED FOR EXCESSIVE SCOUR.
   - 2.3. THE STRUCTURE AND SURROUNDING CHANNEL BANKS ARE TO BE CHECKED FOR DAMAGE DUE TO OVERTOPPING FLOWS AND FURTHER REPAIRED AS REQUIRED.
   - 2.4. RESTORE ORIGINAL SEDIMENT STORAGE VOLUME BY REMOVING SEDIMENT EXCEEDING 30% OF THE EXCAVATED SILT TRAP VOLUME.
   - 2.5. DISPOSE ACCUMULATED SEDIMENT AND DEBRIS SAFELY WITHOUT CREATING POLLUTION HAZARD OR AN EROSION.

LEGEND

- ROAD CENTRE LINE
- TURF / VERGE
- FLOW DIRECTION

150 mm ON ORIGINAL

A1

DRAWING FILE LOCATION / NAME: V:__Vault\Projects\3001\30013411\110__CADD\CAD\DWG\30013411-018.dwg
PLOT DATE: 11 Feb 2021 TIME: 15:18:38

EXTERNAL REFERENCE FILES: X_30013411_SMEC_A1 X_PLAN

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
DESIGN CHECK	N.PANNIPITIYA
PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING: SCALE 1:125 (1.25 0 2.5 5)

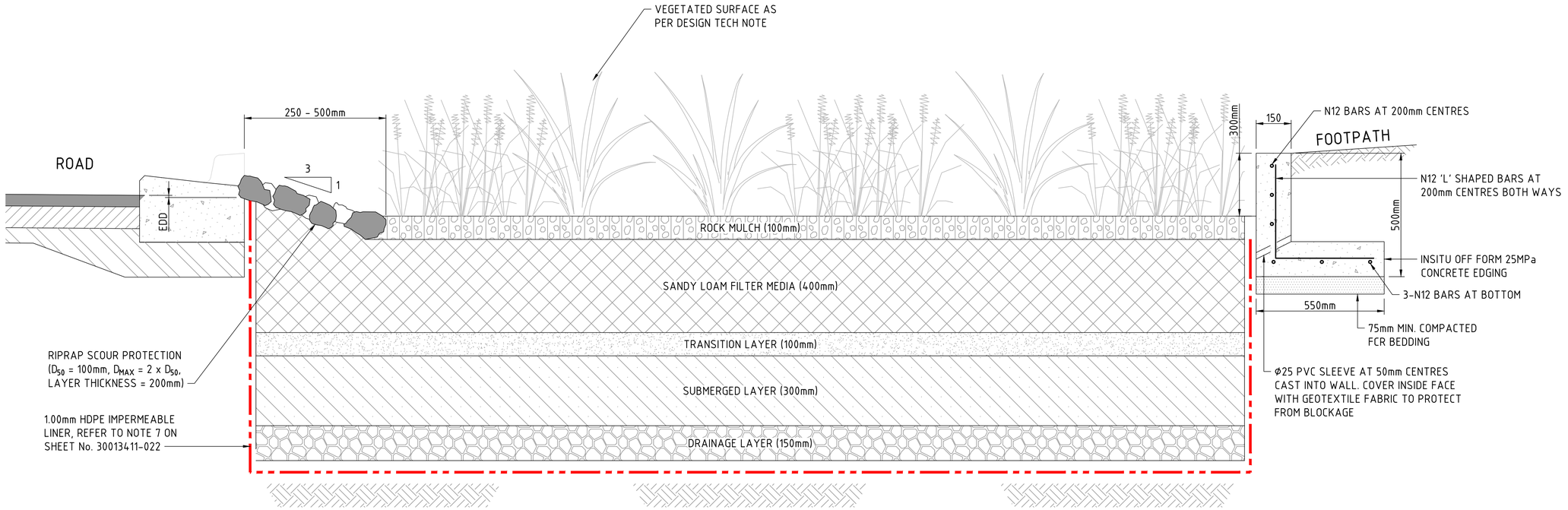
DESIGNER: SMEC — Member of the Surbana Jurong Group — © ABN 47 065 475 149 — SMEC PROJECT No 300xxxxx

CLIENT: LIVERPOOL CITY COUNCIL

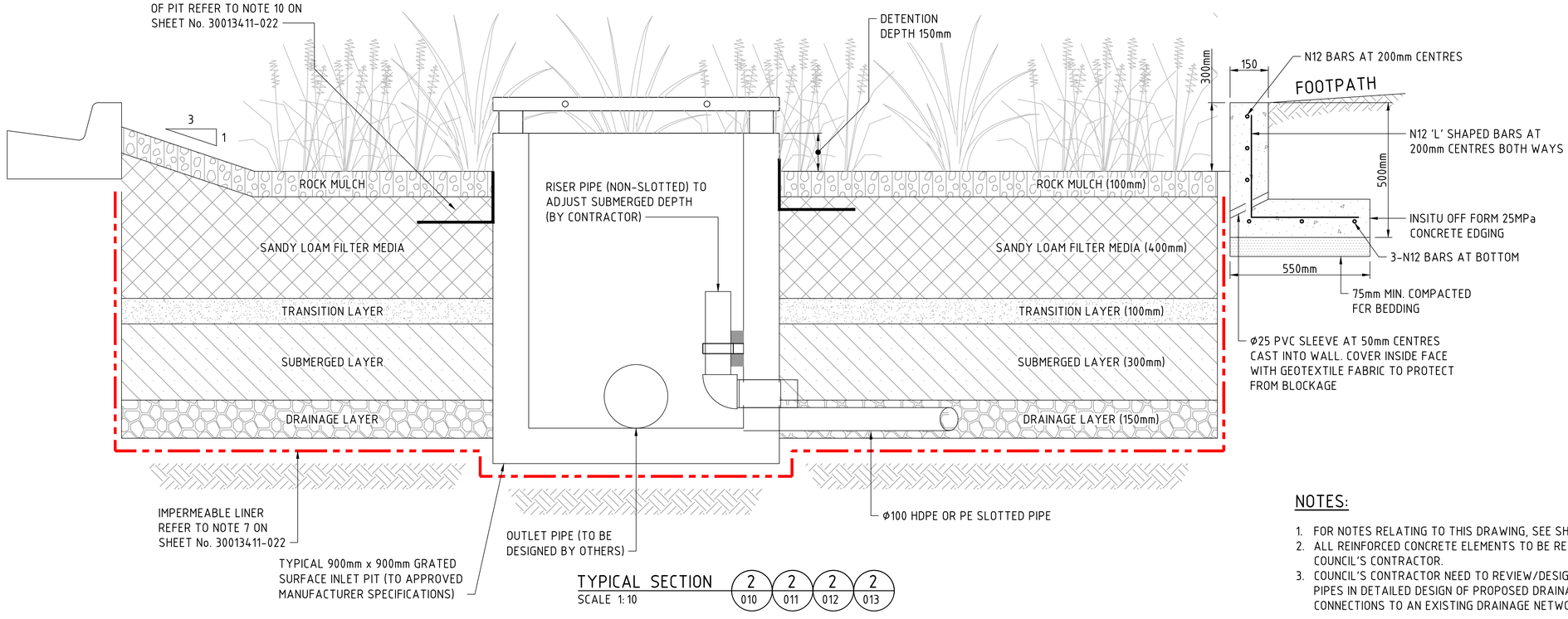
PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN INTERIM SILT PLAN TYPICAL DETAILS

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-018	01



TYPICAL SECTION — 1/010 1/011 1/012 1/013
SCALE 1: 10



TYPICAL SECTION — 2/010 2/011 2/012 2/013
SCALE 1: 10

NOTES:

1. FOR NOTES RELATING TO THIS DRAWING, SEE SHEET No. 30013411-002 & 022.
2. ALL REINFORCED CONCRETE ELEMENTS TO BE REVIEWED/DESIGNED BY COUNCIL'S CONTRACTOR.
3. COUNCIL'S CONTRACTOR NEED TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AND FURTHER CONNECTIONS TO AN EXISTING DRAINAGE NETWORK.

DRAWING FILE LOCATION / NAME: V:__Vault\Projects\3001\30013411\110__CADD\CAD\DWG\30013411-020.dwg
PLOT DATE: 10 Feb 2021 TIME: 17:04:00

EXTERNAL REFERENCE FILES	REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
X_30013411_SMEC_A1	01	18.12.2020	ISSUED FOR CLIENT REVIEW	001	AC
	02	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
DESIGN CHECK	N.PANNIPITIYA
PROJECT MANAGER	G.NAGHIB
PROJECT DIRECTOR	M.BOX

SCALES AT A1 SIZE DRAWING
SCALE 1:10 (0.1 0 0.1 0.2 0.3 0.4 0.5)

DESIGNER: SMEC — Member of the Surbana Jurong Group — © ABN 47 065 475 149
SMEC PROJECT No 300xxxxx

CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH
RAINGARDEN DESIGN SECTIONS SHEET 1 OF 2

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-020	02

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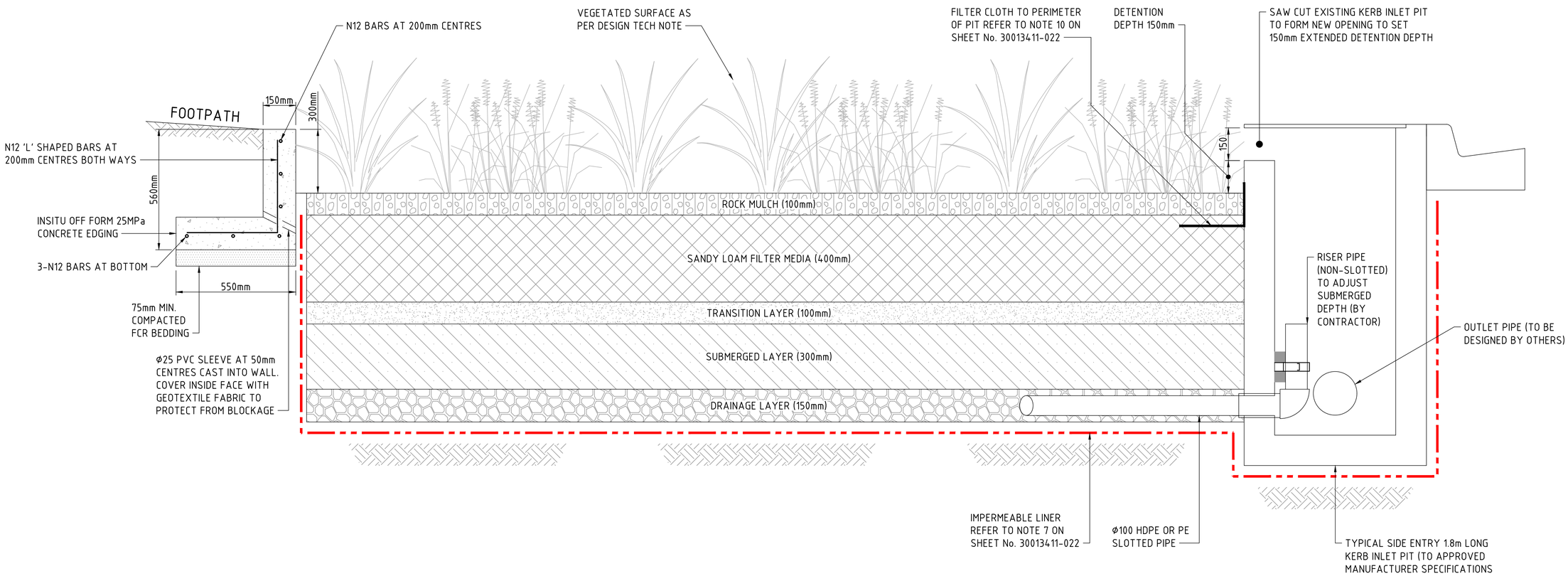
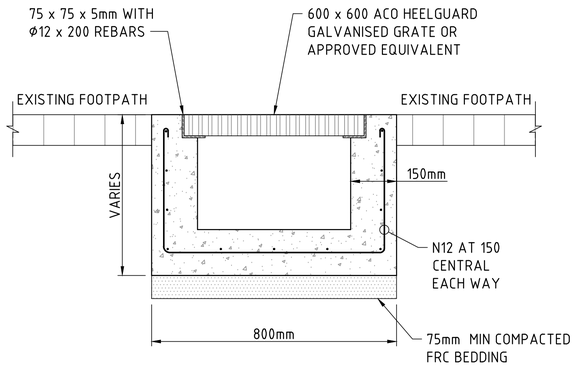
A1



TYPICAL SECTION 3/010 3/011 3/012 3/013
SCALE 1:10



TYPICAL SECTION 4/011 4/012 4/013
SCALE 1:10

NOTES:

1. FOR NOTES RELATING TO THIS DRAWING, SEE SHEET No. 30013411-002 & 022.
2. ALL REINFORCED CONCRETE ELEMENTS TO BE REVIEWED/DESIGNED BY COUNCIL'S CONTRACTOR.
3. COUNCIL'S CONTRACTOR NEED TO REVIEW/DESIGN THE PROPOSED PITS AND PIPES IN DETAILED DESIGN OF PROPOSED DRAINAGE SYSTEM AND FURTHER CONNECTIONS TO AN EXISTING DRAINAGE NETWORK.

150 mm ON ORIGINAL
A1

DRAWING FILE LOCATION / NAME: V:_Vault\Projects\3001\30013411\110_CADD\CAD\DWG\30013411-021.dwg
PLOT DATE: 10 Feb 2021 TIME: 17:04:27

EXTERNAL REFERENCE FILES: X_30013411_SMEC_A1

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	18.12.2020	ISSUED FOR CLIENT REVIEW	001	AC
02	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
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SCALES AT A1 SIZE DRAWING
SCALE 1:10 (0.1 0 0.1 0.2 0.3 0.4 0.5)

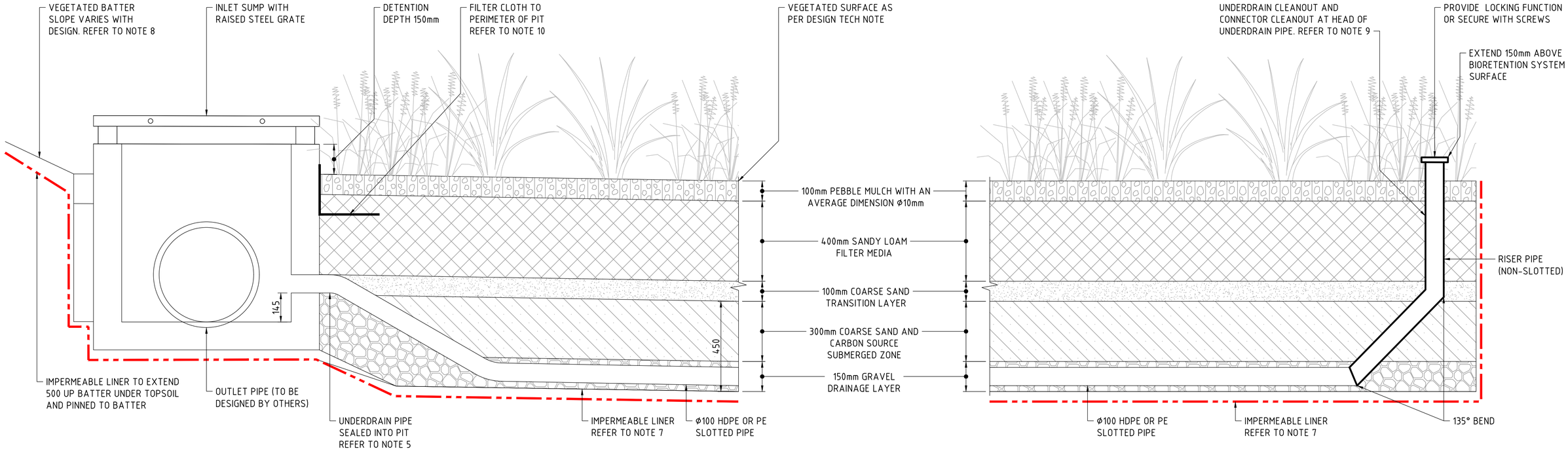
DESIGNER: SMEC — Member of the Surbana Jurong Group — © ABN 47 065 475 149
SMEC PROJECT No 300xxxxx

CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN SECTIONS SHEET 2 OF 2

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-021	02



TYPICAL GRATED OUTLET PIT DETAIL NEAR A BATTER

SCALE 1:10

TYPICAL CLEANOUT PIPE DETAIL

SCALE 1:10

NOTES:

1. BIORETENTION SYSTEM SURFACE IS TOP SURFACE LEVEL OF FILTER MEDIA.
2. FILTER MEDIA SPECIFICATION SHALL BE IN ACCORDANCE WITH THE 'ADOPTION GUIDELINES FOR STORMWATER BIOFILTERATION SYSTEMS' (CRC FOR WATER SENSITIVE CITIES) AND BIORETENTION SYSTEM SPECIFICATION NOTE.
3. HYDRAULIC CONDUCTIVITY SHALL BE IN ACCORDANCE WITH SYSTEM SPECIFICATION NOTE. THE NUMBER OF SAMPLES TO BE TESTED SHALL BE IN ACCORDANCE WITH THE 'CONSTRUCTION AND ESTABLISHMENT GUIDELINES-SWALES, BIORETENTION SYSTEMS AND WETLANDS' (WATER BY DESIGN).
4. CONSTRUCTION TOLERANCES SHALL BE IN ACCORDANCE WITH BIORETENTION SYSTEM SPECIFICATION NOTE AND WATER BY DESIGN GUIDELINE.
5. TRANSITION LAYER AND DRAINAGE LAYER DEPTHS MAY VARY WITH DESIGN. DEPTHS AND SPECIFICATIONS TO BE IN ACCORDANCE WITH PROJECT DRAWINGS AND THE 'BIORETENTION TECHNICAL DESIGN GUIDELINES' (WATER BY DESIGN)
6. UNDERDRAIN PIPES SHALL BE SEALED INTO PITS USING GROUT OR OTHER APPROVED WATER TIGHT SEAL.
7. IMPERMEABLE LINER CAN BE CONSTRUCTED BY USING COMPACTED CLAY OR SYNTHETIC LINER WITH PERMEABILITY OF NO GREATER THAN 1 X 10-9 M/S. IMPERMEABLE LINER TO BE SEALED AROUND ALL PROTRUSIONS. SYNTHETIC LINERS TO BE INSTALLED AND SEALED IN ACCORDANCE WITH MANUFACTURES REQUIREMENTS. GEOSYNTHETIC BENTONITE CLAY LINERS PREFERRED.
8. VEGETATED BATTER SLOPE AND PLANTING TO BE IN ACCORDANCE WITH DESIGN TECH. NOTE.
9. VERTICAL SOLID (NON-SLOTTED) PIPE SECTION ATTACHED TO THE END OF EACH UNDERDRAIN FOR INSPECTION/CLEAN OUT PURPOSES IN ACCORDANCE WITH THE PROJECT DRAWINGS AND THE 'BIORETENTION TECHNICAL DESIGN GUIDELINES' (WATER BY DESIGN).
10. FILTER CLOTH TO BE FIXED TO PERIMETER OF PIT TO AVOID RUNNELLING OF WATER BETWEEN PIT AND SOIL INTERFACE. BEGIN FILTER CLOTH 100MM ABOVE SURFACE, EXTEND TO 100MM BELOW SURFACE AND CONTINUE 300MM HORIZONTALLY INTO FILTER MEDIA.

150 mm ON ORIGINAL

A1

DRAWING FILE LOCATION / NAME: V:__Vault\Projects\3001\30013411\110__CADD\CAD\DWG\30013411-022.dwg

PLOT DATE: 10 Feb 2021 TIME: 17:04:53

EXTERNAL REFERENCE FILES: X_30013411_SMEC_A1

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	18.12.2020	ISSUED FOR CLIENT REVIEW	001	AC
02	10.02.2020	FINAL	002	AC

TITLE	NAME
DRAFTER	R.PHILLIS
DRAFTING CHECK	T.LITTLE
DESIGNER	G.NAGHIB
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SCALES AT A1 SIZE DRAWING

SCALE 1:10 0.1 0 0.1 0.2 0.3 0.4 0.5

DESIGNER: SMEC Member of the Surbana Jurong Group © ABN 47 065 475 149

SMEC PROJECT No 300xxxxx

CLIENT: LIVERPOOL CITY COUNCIL

PROJECT TITLE: DEVELOPMENT OF STREETSCAPE RAINGARDEN MASTERPLAN FOR AUSTRAL AND LEPPINGTON NORTH

RAINGARDEN DESIGN TYPICAL DETAILS

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	FINAL	30013411-022	02

Appendix D Streetscape Raingarden Cost Estimate

Benchmark Cost Multiplier

Base Cost

Direct Costs	**$**	**1.00**	
Contractor Indirect Costs	$	0.20	Equal to 20% of the direct costs (IPART Table 4.1)
Contractor Margin	$	0.12	Equal to 10% of direct and indirect costs (IPART Table 4.1)
Council Oncost	$	0.13	Equal to 10% of total costs (IPART Table 4.2)
Total Base Cost	$	1.45	
Base Cost Multiplier		1.45	

Adjustment Factors

Distance Factor	101%	Assuming supplier will be found within a 25km radius, most probably towards penrith-parramatta. (IPART Table 4.3)
Congestion Factor	17.5%	Since 25% of intersections are adjacent to medium density residential zone, they were assumed to be moderately congested. The rest (75%) are assumed to be lightly congested. Hence the relative ratio (between 15% and 25%) was used for congestion factor (IPART Table 4.4)
Total Adjustment Factor	17.7%	
Adjustment Multiplier	1.177	

Contingency Factor

Contingency Factor	120%	(IPART Table 13.5)
Contingency Multiplier	1.200	

Benchmark Costing

Benchmark Cost	**$**	**2.05**	
Benchmark Multiplier		**2.050**	Using IPART Lcoal Infrastructure Benchmark Costs (2014)

Intersection Cost Estimate

DIRECT COSTS	QUANTITY	UNIT	BASE RATE	COST
Earthworks				
Earthworks Excavation	431.59	m3	$ 8.05	$ 3,474.32
Earth disposal	690.55	tonne	$ 54.18	$ 37,413.85
15km Additional Cartage Over 10km	431.59	m3	$ 8.55	$ 3,690.11
				$ -
Roadworks				
Saw Cutting Kerb (150mm depth)	20	m	$ 69.10	$ 1,382.00
Inlet Scour Protection	10	m2	$ 72.00	$ 720.00
375mm Diameter Pipes (assumed outlet)	64	m	$ 210.00	$ 13,440.00
				$ -
Raingarden Construction				
S.G pit (900x900mm)/1.8m kerb inlet pit	4	unit	$ 2,550.00	$ 10,200.00
Pit Cover	4	unit	$ 340.00	$ 1,360.00
Filter Cloth	8	m2	$ 8.75	$ 70.00
Surface Vegetation	287.1	m2	$ 24.00	$ 6,890.88
Pepple Mulch	28.712	m3	$ 94.00	$ 2,698.93
Filter Media (sandy loam)	114.848	m3	$ 49.00	$ 5,627.55
Transition Layer (coarse sand)	28.712	m3	$ 49.00	$ 1,406.89
Submerged Zone	86.136	m3	$ 49.00	$ 4,220.66
Drainage Layer (gravel)	43.068	m3	$ 75.00	$ 3,230.10
Impermeable Liner	410.32	m2	$ 21.67	$ 8,891.63
Underdrain Ag Pipe	270.4	m	$ 16.25	$ 4,394.00
Concrete Channel with Grate including excavation works	16		$ 460.00	$ 7,360.00
Total Costs				

Total Direct Costs	$	116,470.92
Benchmark Costs	**$**	**238,808.39**
Cost per Square Meter ($/m2)	$	831.74

T Junction Cost Estimate

DIRECT COSTS	QUANTITY	UNIT	BASE RATE	COST
Earthworks				
Earthworks Excavation	219.62	m3	$ 8.05	$ 1,767.92
Earth disposal	351.39	tonne	$ 54.18	$ 19,038.25
15km Additional Cartage Over 10km	219.62	m3	$ 8.55	$ 1,877.73
Roadworks				
Saw Cutting Kerb (150mm depth)	10	m	$ 69.10	$ 691.00
Inlet Scour Protection	7	m2	$ 72.00	$ 504.00
375mm Diameter Pipes	48	m	$ 210.00	$ 10,080.00
Raingarden Construction				
S.G pit (900x900mm)/1.8m kerb inlet pit	3	unit	$ 2,550.00	$ 7,650.00
Pit Cover	3	unit	$ 340.00	$ 1,020.00
Filter Cloth	6	m2	$ 8.75	$ 52.50
Surface Vegetation	144	m2	$ 24.00	$ 3,456.00
Pepple Mulch	14.4	m3	$ 94.00	$ 1,353.60
Filter Media (sandy loam)	57.6	m3	$ 49.00	$ 2,822.40
Transition Layer (coarse sand)	14.4	m3	$ 49.00	$ 705.60
Submerged Zone	43.2	m3	$ 49.00	$ 2,116.80
Drainage Layer (gravel)	21.6	m3	$ 75.00	$ 1,620.00
Impermeable Liner	208.68	m2	$ 21.67	$ 4,522.10
Underdrain Ag Pipe	108	m	$ 16.25	$ 1,755.00
Concrete Channel with Grate including excavation works	10.5	m	$ 460.00	$ 4,830.00
Total Costs				

Total Direct Costs	$ 65,862.90
Benchmark Costs	**$ 135,043.26**
Cost per Square Meter ($/m2)	$ 937.80

Road Bend Cost Estimate

DIRECT COSTS	QUANTITY	UNIT	BASE RATE	COST
Earthworks				
Earthworks Excavation	145.98	m3	$ 8.05	$ 1,175.15
Earth disposal	233.57	tonne	$ 54.18	$ 12,654.84
15km Additional Cartage Over 10km	145.98	m3	$ 8.55	$ 1,248.14
Roadworks				
Saw Cutting Kerb (150mm depth)	6	m	$ 69.10	$ 414.60
Inlet Scour Protection	4	m2	$ 72.00	$ 288.00
375mm Diameter Pipes	32	m	$ 210.00	$ 6,720.00
Raingarden Construction				
S.G pit (900x900mm)/1.8m kerb inlet pit	2	unit	$ 2,550.00	$ 5,100.00
Pit Cover	2	unit	$ 340.00	$ 680.00
Filter Cloth	4	m2	$ 8.75	$ 35.00
Surface Vegetation	96	m2	$ 24.00	$ 2,304.00
Pepple Mulch	9.6	m3	$ 94.00	$ 902.40
Filter Media (sandy loam)	38.4	m3	$ 49.00	$ 1,881.60
Transition Layer (coarse sand)	9.6	m3	$ 49.00	$ 470.40
Submerged Zone	28.8	m3	$ 49.00	$ 1,411.20
Drainage Layer (gravel)	14.4	m3	$ 75.00	$ 1,080.00
Impermeable Liner	139.12	m2	$ 21.67	$ 3,014.73
Underdrain Ag Pipe	64	m	$ 16.25	$ 1,040.00
Concrete Channel with Grate including excavation works	5	m	$ 460.00	$ 2,300.00
Total Costs				

Total Direct Costs	$	42,720.07
Benchmark Costs	**$**	**87,591.91**
Cost per Square Meter ($/m2)	$	912.42

INTERSECTION TYPE	TOTAL DIRECT COSTS	BENCHMARK COSTS	COST PER SQUARE METER	NUMBER OF INTERSECTIONS	ESTIMATED COST
Intersection	$ 116,470.92	$ 238,808.39	$ 831.74	181	$ 43,224,318.39
T Junction	$ 65,862.90	$ 135,043.26	$ 937.80	383	$ 51,721,568.86
Bend	$ 42,720.07	$ 87,591.91	$ 912.42	29	$ 2,540,165.41

Total	**$ 97,486,052.66**

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global experience

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