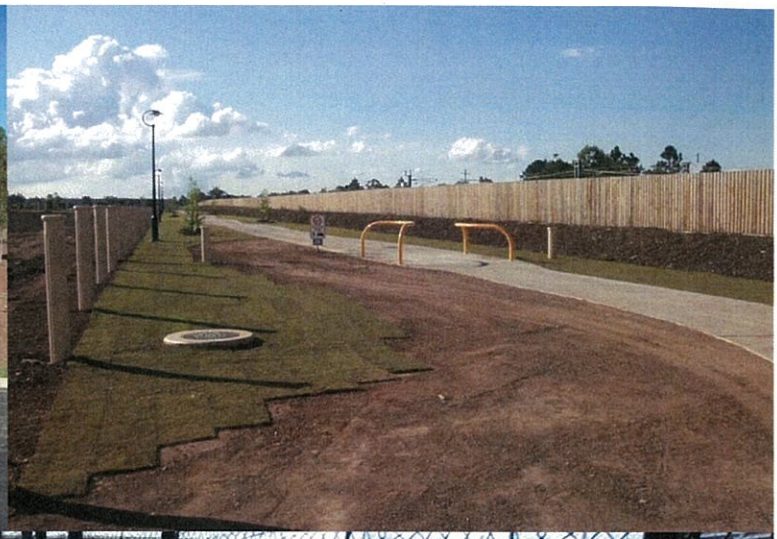

PROPOSED HOTEL AND CARPARK DEVELOPMENT

Cnr Wren and Campbell Street, Bowen Hills 4006

Ian Smith

Site Based Stormwater Management Plan – Quality

LOCAL AUTHORITY: Brisbane City Council
REPORT NUMBER: C14-016 SBSMP - Quality
DATE PREPARED: February 2015
APPLICATION No: -

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PLANS AND DOCUMENTS
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1.0 INTRODUCTION

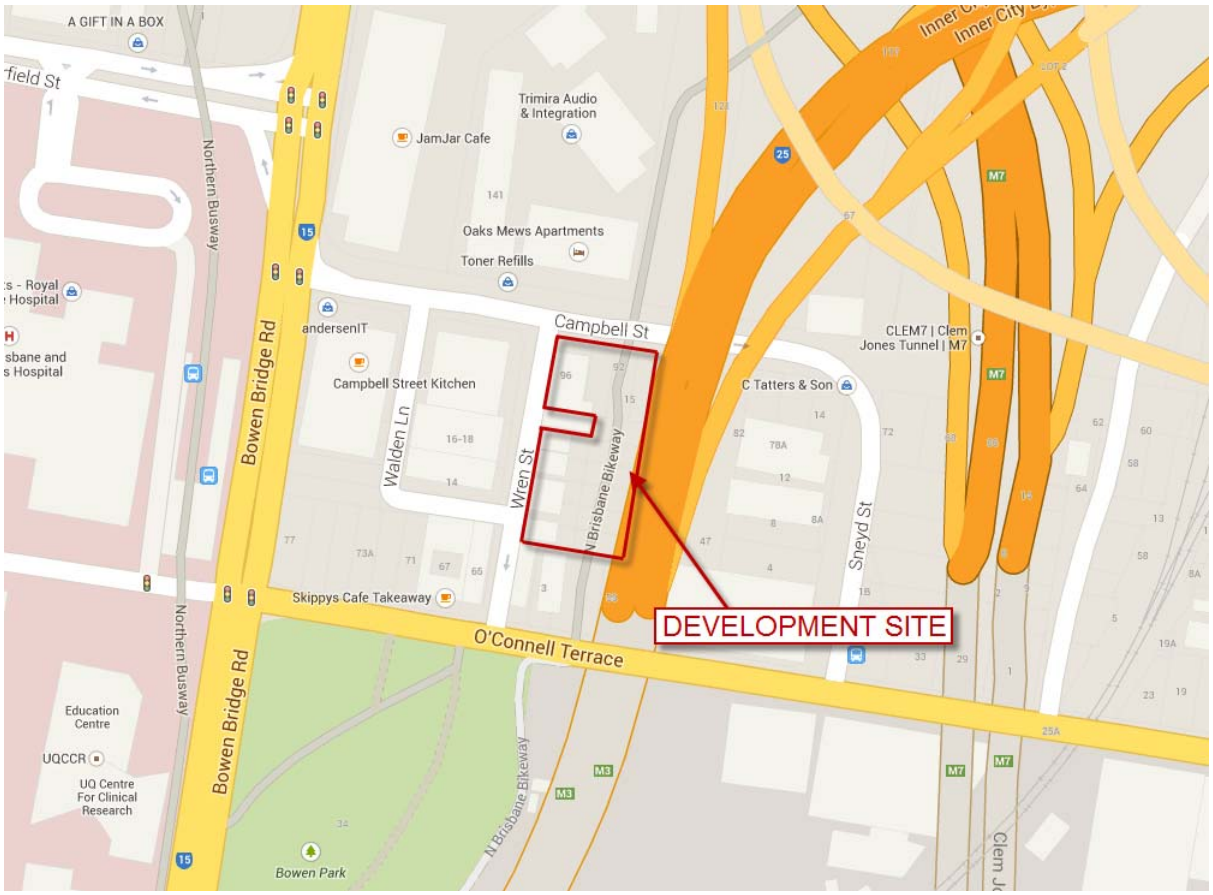
BG Civil Pty Ltd has been engaged by our client Ian Smith to prepare a site-based stormwater management report for a new Hotel and Carpark development at Cnr Wren & Campbell Street, Bowen Hills. This report will form part of the development application which will be submitted to Brisbane City Council (BCC) as supporting documentation for the proposed development.

1.1. AVAILABLE INFORMATION

- Architectural drawings for the hotel prepared by Thomas Adsett and the carpark prepared by Cottee Parker
- Detail survey prepared by Michael Jolly Surveys Pty Ltd
- Council eBIMAP and Flood Search Documentation

1.2. LOCALITY PLAN

Figure 1-1 SITE LOCATION



2.0 SCOPE OF REPORT

This report will address the following stormwater issues:

- Identify the location of the legal discharge point(s) for the development.
- Prepare a conceptual stormwater layout for the proposed development.

LEGAL POINT OF DISCHARGE

- Identify the location of the legal point(s) of discharge for the development in compliance with the Local Authority guidelines.

STORMWATER QUALITY

- Identify the development sites classification (high or low risk) and the relevant planning policies and guidelines that the development must comply with,
- If applicable, identify Water Quality Objective Targets as determined by Local Authority Planning Schemes & Department of Environment & Resource Management.
- Identify a suitable “stormwater treatment train” aimed to comply with the set Water Quality Objectives.
- If applicable, demonstrate compliance to the determined Water Quality Objectives with the use of “Model for Urban Stormwater Improvement Conceptualisation” Software (MUSIC Version 6.0.1).
- Prepare a conceptual stormwater layout highlighting all stormwater quality treatment devices proposed for this development.
- Provide details on monitoring and maintenance requirements for all stormwater treatment devices incorporated within this development.

EROSION AND SEDIMENT CONTROL

- Provide details of an Erosion and Sediment Control Management Plan.

3.0 SITE CHARACTERISTICS

3.1. LOCATION

The development site is located approximately 3km North of Brisbane City CBD. The site address is Cnr Wren and Campbell Street, Bowen Hills and is formally described as Lots 18-20, 24-34 on RP9941 & Lot 22 on RP155465.

3.2. SITE DESCRIPTION

The site in its current state is sloping with grades up to 8% and has a total area of approximately 3011m^2. The subject site falls to the Northern boundary of the site towards Campbell Street.

Figure 3-2 AERIAL PHOTOGRAPH

4.0 EXISTING SITUATION

4.1. EXISTING LAND USE

The development site consists of 15 lots;

Lots 18-20 & 29-34 on RP9941 are currently occupied by a section of the existing North Brisbane concrete bike way and associated garden / landscaped areas.

Lot 22 on RP 155465 is currently occupied by a brick commercial development with associated concrete hardstand areas and access driveways.

Lot 24-28 on RP 9941 are currently occupied by several rendered timber buildings consisting of both residential and commercial developments with associated open space and access driveways. The remainder of the lots are landscaped / vegetated.

4.2. EXISTING STORMWATER DISCHARGE

Based on the eBimap information obtained from Brisbane City Council, there does not seem to be any internal drainage from the existing buildings located within the development site, however it would be reasonable to assume that the roof drainage is connected to the existing kerb and channel via kerb adaptors located in Wren Street. It is assumed that minor surface flows are allowed to travel overland. All kerb flows are captured by the existing gully catchpits located downstream of the site.

A 2700dia Council stormwater exists within lot 19 on RP9941 and Lots29-34 on RP9941. Stormwater from the Inner City Bypass also connects to this infrastructure.

Refer to Appendix D for council BiMAP data.

5.0 PROPOSED SITUATION

5.1. PROPOSED LAND USE

The proposal is for a mixed used development consisting of a hotel with commercial tenancies located on the ground floor. The remainder of the site is proposed to be a multi-level carpark with commercial tenancies on the ground floor. The development is to include modifications / relocation of the existing bikeway and the construction of an urban jungle to the frontage of the hotel. The ground level consists of both pedestrian access and landscaped areas. The proposed development will cover approximately 90% of the site with the remainder being landscaping, driveways and open space areas.

Refer to Appendix A for Architectural documentation which is current at the time in preparing this report.

5.2. DEVELOPED STORMWATER DISCHARGE

The proposed development is made up of Hotel & Carpark roof (84% or 2540m^2), driveway & impervious ground areas (6% or 196m^2) and landscape / ground areas (10% or 275m^2). As there are significant roof areas, the installation of rainwater harvesting devices are highly recommended, however not included within this report.

It is proposed that all roof areas of both the hotel & multi-level carpark shall be captured by a series of gutters and downpipes and be directed to the stormwater 360 manhole which consists of 12 x tall cartridges located on below the ground level. All downpipes are to be fitted with leaf eater (rain heads) and it is recommended that a first flush device is installed to downpipes to reduce pollutants from roof areas exiting the development site.

All stormwater from impervious ground areas in the hotel driveway and multi-level carpark is to be captured by a series of strategically placed field inlet pits fitted with Enviropod 200 trash bags by Stormwater 360 prior to discharging to the stormfilter system. The design of this internal drainage is to be undertaken during the operational works phase of the development.

All ground areas which are unable to be captured by the field inlet pits are to be directed to shallow vegetated swales located in the landscape areas prior to discharging from the site.

All captured stormwater will discharge to the existing 2700dia stormwater infrastructure.

As mentioned above, it is recommended that rainwater re-use tanks be utilised to harvest collected water by the roof areas. These tanks should be used as hose down and for landscaping as a minimum however this is not included within this report.

Refer to Appendix D for Concept Stormwater Drainage Plan.

6.0 STORMWATER QUALITY

6.1. SITE CLASSIFICATION

The implementation of a suitable stormwater management plan for the proposed development is determined from the following:

- Identify if compliance with the Department of Environment and Resource Management, State Planning Policy is required, or
- Identify if compliance with the local authorities Stormwater Quality is required, or
- Implement Best Management Practice Guidelines for low risk sites as per local authority development guidelines.

Either compliance objective will still be designed based on the following key principles:

- The use of Water Sensitive Urban Design (WSUD) principles are to be adopted throughout the site where possible,
- Water Quality controls are to be considered under two separate phases of the development, the construction phase and the operational phase,
- The construction phase requires the assessment of the site during the construction and maintenance period of the development.
- The operational phase requires assessment of the site over the total life of the site and its water quality control measures.

6.2. STATE PLANNING POLICY ASSESSMENT

To determine whether compliance with DERM's State Planning Policy is required, it is important to undertake the State Planning Policies Checklist. If any of the trigger questions are answered Yes, then compliance is expected with the State Planning Policy, if all trigger questions are answered No, then local authority Stormwater Quality assessment is required.

Table 6-1 STATE PLANNING POLICY CHECKLIST

MATERIAL CHANGE OF USE FOR URBAN PURPOSES THAT INVOLVES A LAND AREA GREATER THAN 2500m^2 THAT:	YES
Will result in an impervious area greater than 25 per cent of the net developable area, or	YES
Will result in 6 or more dwellings;	YES
RECONFIGURATING A LOT FOR URBAN PURPOSES THAT INVOLVES A LAND AREA GREATER THAN 2500m^2, AND WILL RESULT IN SIX (6) OR MORE LOTS.	NO
OPERATIONAL WORK FOR URBAN PURPOSES THAT INVOLVE DISTURBING MORE THAN 2500m^2 OF LAND.	YES

Highlighted in the above table are the items applicable to this development application. As one or more of the above items are applicable to this development, the State Planning Policy is applicable and compliance is expected from the local authority

6.3. LOCAL AUTHORITY ASSESSMENT

As this development triggers one or more of the State Planning Policies checklist criteria, compliance with DERM's State Planning Policy is required therefore a Local Authority Assessment will not be carried out.

6.4. POLLUTANT CONCERNS

The pollutants of concern are summarised below. These pollutants can have adverse environmental impacts within the downstream catchment. It is proposed to adopt Site-Based Water Sensitive Urban Design to provide capture and treatment to the below mentioned pollutants.

Table 6-2 TYPICAL POLLUTANTS

POLLUTANT	SOURCE
LITTER	PAPER, CONSTRUCTION PACKAGING, FOOD WASTE, CEMENT, OFF - CUTS
SEDIMENT	UNPROTECTED EXPOSED SOILS, STOCKPILES, EROSION
HYDROCARBONS	FUEL AND OIL SPILLS, LEAKS FROM MACHINERY
TOXIC MATERIALS	CEMENT SLURRY, ASHPALT PRIMER, SOLVENTS, CLEANING AGENTS
PH ALTERING SUBSTANCES	ACID SULPHATE SOILS, CEMENT SLURRY, WASH WATER
THERMAL POLLUTION	VEHICLES AND MACHINERY, INCREASED IMPERVIOUS AREAS

6.5. CONSTRUCTION PHASE

During the construction phase, the potential exists for significant increases in the amount of pollutants, particularly sediment, escaping from the site. During this period, an erosion and sediment control plan is required to be prepared as part of the overall Environmental Management Plan prepared for the construction phase.

An erosion and sediment control plan has been prepared in accordance with Local Authority Guidelines and with recognised industry standards. This plan will also be submitted to Ipswich City Council for operational works approval.

6.6. OPERATIONAL PHASE

The Department of Environment and Resource Management, State Planning Policy, outlines the criteria for which types of developments are deemed 'high risk' for which the State Planning policy applies. Developments that fall outside the 'high risk' category are deemed to be 'low risk' and shall comply with local council requirements.

As this development has been identified as 'high risk', selection of appropriate Stormwater Quality Improvement devices is required to ensure relevant water quality objectives can be achieved. A stormwater treatment model is to be produced to assess pollutants and the performance of the proposed stormwater treatment train to be adopted for this development.

6.7. WATER QUALITY OBJECTIVES

For this development, it is necessary to identify the Water Quality Objectives (WQO's) with regards to the future stormwater discharge from the site. Based on "Urban Stormwater Quality Planning Guidelines 2010" obtained from Queensland Government, Department of Environment and Resource Management, the removal of the following pollutants from stormwater discharge will be required to meet the water quality objectives.

Table 6-3 WATER QUALITY OBJECTIVES

INDICATOR	ENTIRE % REDUCTION
TSS (Total Suspended Solids)	80%
TP (Total Phosphorus)	60%
TN (Total Nitrogen)	45%
GP (Gross Pollutants)	90%

7.0 MUSIC MODELLING

MUSIC Version V6.0.1 was used to assess pollutants and the performance of the proposed stormwater treatment train to be adopted for this development. Modelling was undertaken in accordance with "Water by Design – Music Modelling Guidelines Version 1.0 – 2010"

7.1. RAINFALL DATA & MODELLING PARAMETERS

Council: Brisbane City Council

Station ID: 40214

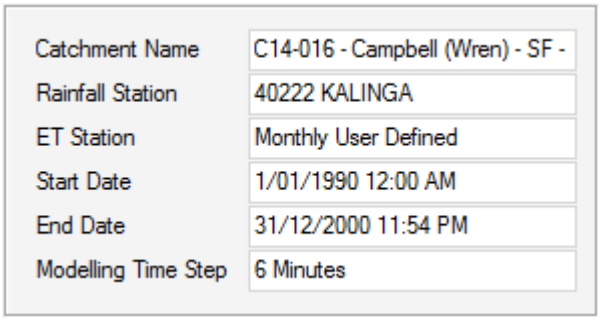
Station Name: Brisbane Regional Office

Climate Period for MUSIC: 01/01/1980 to 31/12/1989

Mean Annual Rainfall over Period: 1178mm

Time Step Adopted: 6 minutes

Figure 7-3 CATCHMENT PROPERTIES



The following Mean Potential Evapo-Transpiration Values were obtained from "Water By Design – Music Modelling Guidelines Version 1.0 – 2010" and the below table represented the values adopted for this MUSIC model.

Table 7-4 MEAN POTENTIAL EVAPO-TRANSPIRATION VALUES

MEAN POTENTIAL EVAPO-TRANSPIRATION (mm) (CLIMATE OF AUSTRALIA)											
JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
188	146	146	107	74	63	65	84	111	144	171	192

7.2. RAINFALL RUNOFF PARAMETERS

The following recommended MUSIC rainfall run-off parameters were obtained from "Water by Design – Music Modelling Guidelines Version 1.0 – 2010" and the below table represented the values adopted for this MUSIC model.

Table 7-5 POLLUTANT GENERATION INPUTS

PARAMETER	Urban Residential	Commercial & Industrial	Rural Residential	Forested
Rainfall Threshold (mm)	1	1	1	1
Soil Storage Capacity (mm)	500	18	98	120
Initial Storage (% Capacity)	10	10	10	10
Field Capacity (mm)	200	80	80	80
Infiltration Capacity Coefficient a	211	243	84	200
Infiltration Capacity Exponent b	5.0	0.6	3.3	1.0
Initial Depth (mm)	50	50	50	50
Daily Recharge Rate (%)	28	0	100	25
Daily Baseflow Rate (%)	27	31	22	3
Daily Deep Seepage Rate (%)	0	0	0	0

NOTE: The highlighted columns represent the rainfall runoff parameters adopted for the development.

7.3. POLLUTANT EXPORT PARAMETERS

The following pollutant export parameters were obtained from "Water by Design – Music Modelling Guidelines Version 1.0 – 2010" and the below table represented the values adopted for this MUSIC model.

Table 7-6 POLLUTANT GENERATION INPUTS

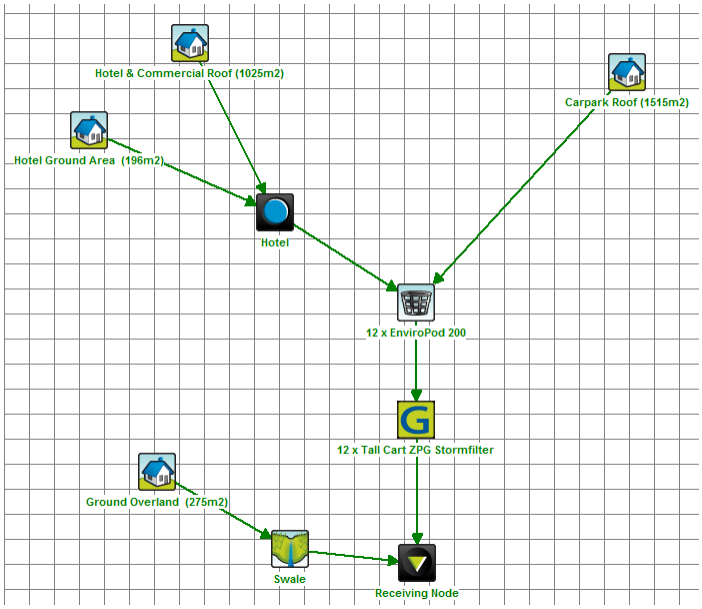
Land Use	Flow Type	Surface Type	Total Suspended Solids (Log10 mg/L)		Total Phosphorus (Log10 mg/L)		Total Nitrogen (Log10 mg/L)	
			Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
URBAN RESIDENTIAL	Baseflow Parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
		Roads	1.00	0.34	-0.97	0.31	0.20	0.20
		Ground Level	1.00	0.34	-0.97	0.31	0.20	0.20
	Stormflow Parameters	Roof	1.30	0.39	-0.89	0.31	0.26	0.23
		Roads	2.43	0.39	-0.30	0.31	0.26	0.23
		Ground Level	2.18	0.39	-0.47	0.31	0.26	0.23
INDUSTRIAL	Baseflow Parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
		Roads	0.78	0.45	-1.11	0.48	0.14	0.20
		Ground Level	0.78	0.45	-1.11	0.48	0.14	0.20
	Stormflow Parameters	Roof	1.30	0.44	-0.89	0.36	0.25	0.32
		Roads	2.43	0.44	-0.30	0.36	0.25	0.32
		Ground Level	1.92	0.44	-0.59	0.36	0.25	0.32
COMMERCIAL	Baseflow Parameters	Roof	N/A	N/A	N/A	N/A	N/A	N/A
		Roads	0.78	0.39	-0.60	0.50	0.32	0.30
		Ground Level	0.78	0.39	-0.60	0.50	0.32	0.30
	Stormflow Parameters	Roof	1.30	0.38	-0.89	0.34	0.37	0.34
		Roads	2.43	0.38	-0.30	0.34	0.37	0.34
		Ground Level	2.16	0.38	-0.39	0.34	0.37	0.34

NOTE: The highlighted columns represent the pollutant export parameters adopted for the development.

7.4. STORMWATER QUALITY MANAGEMENT STRATEGY

The below MUSIC model seeks to meet the applicable Water Quality Objectives by selecting and testing various stormwater management methods. The adopted "stormwater treatment train" for this development is illustrated below;

Figure 7-4 PROPOSED STORMWATER TREATMENT TRAIN TO BE ADOPTED



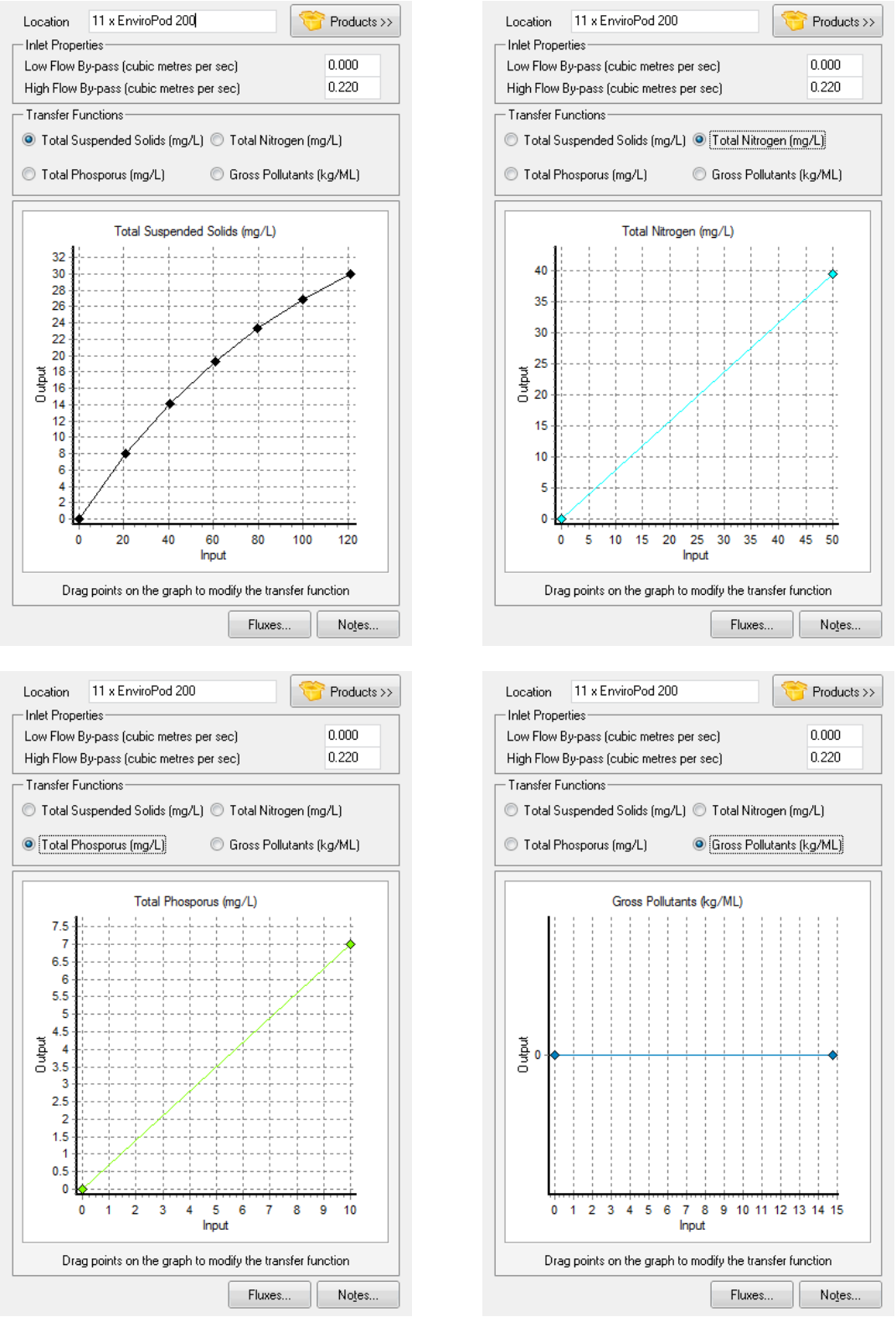
The proposed stormwater treatment train will consist of:

- All roof water is to be collected by the hydraulic engineer and directed to the stormwater 360 manhole which consists of 12 x tall cartridges located on below the ground level. All downpipes are to be fitted with leaf eater (rain heads) and it is recommended that a first flush device is installed to downpipes to reduce pollutants from roof areas exiting the development site.
- All stormwater from impervious ground areas in the hotel driveway and multi-level carpark is to be captured by a series of strategically placed field inlet pits fitted with Enviropod 200 trash bags by Stormwater 360 prior to discharging to the stormfilter system.
- All ground areas which are unable to be captured by the field inlet pits are to be directed to shallow vegetated swales located in the landscape areas prior to discharging from the site.
- All captured stormwater will discharge to the existing 2700dia stormwater infrastructure.
- As this development is a mixed use development with retail tenancies & a hotel, regular maintenance will be undertaken to the landscape areas to remove gross pollutants from the site.

7.5. MUSIC MODEL DETAILS

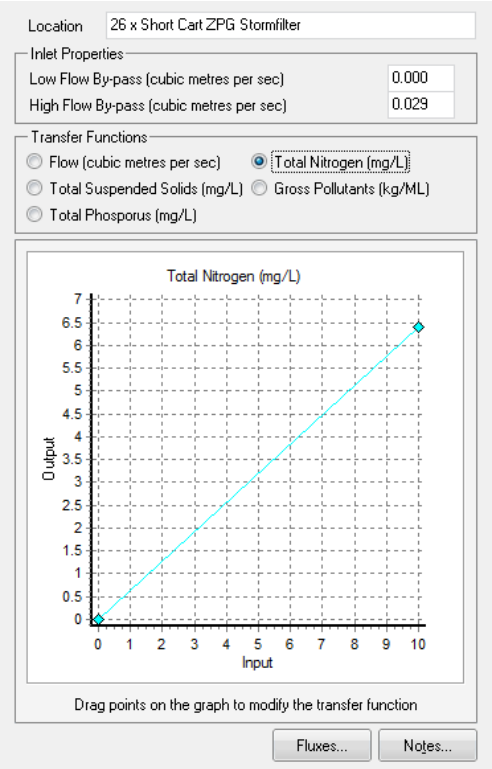
Treatment nodes with the following parameters have been modelled;

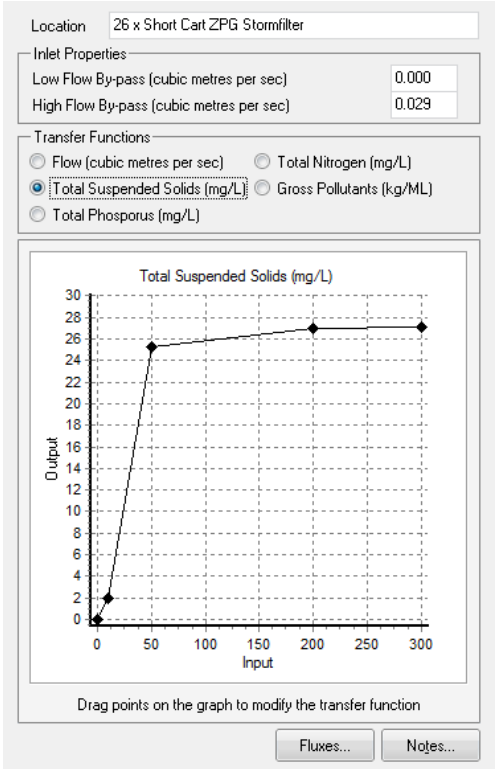
Figure 7-5 EXAMPLE OF ENVIROPOD MODELLING PARAMETERS

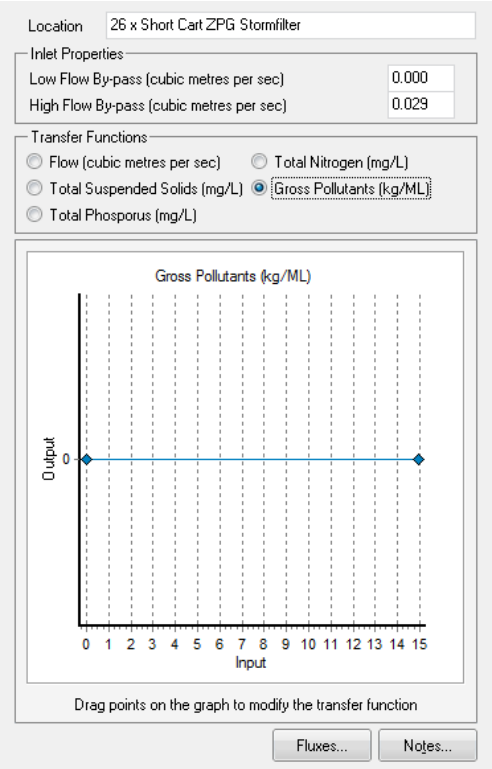


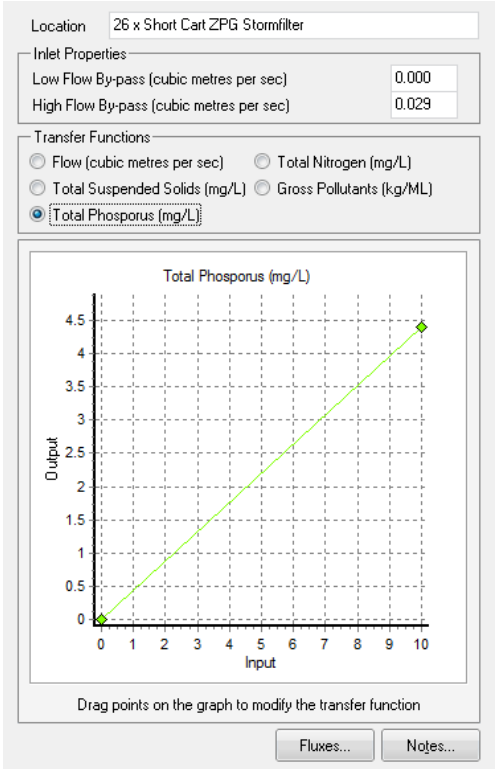
The MUSIC nodes for the “Enviropods” have been obtained directly from the manufacturer and have not been modified. The manufacturer is able to supply testing data upon request.

Figure 7-6 EXAMPLE OF STROMFILTER MODELLING PARAMETERS









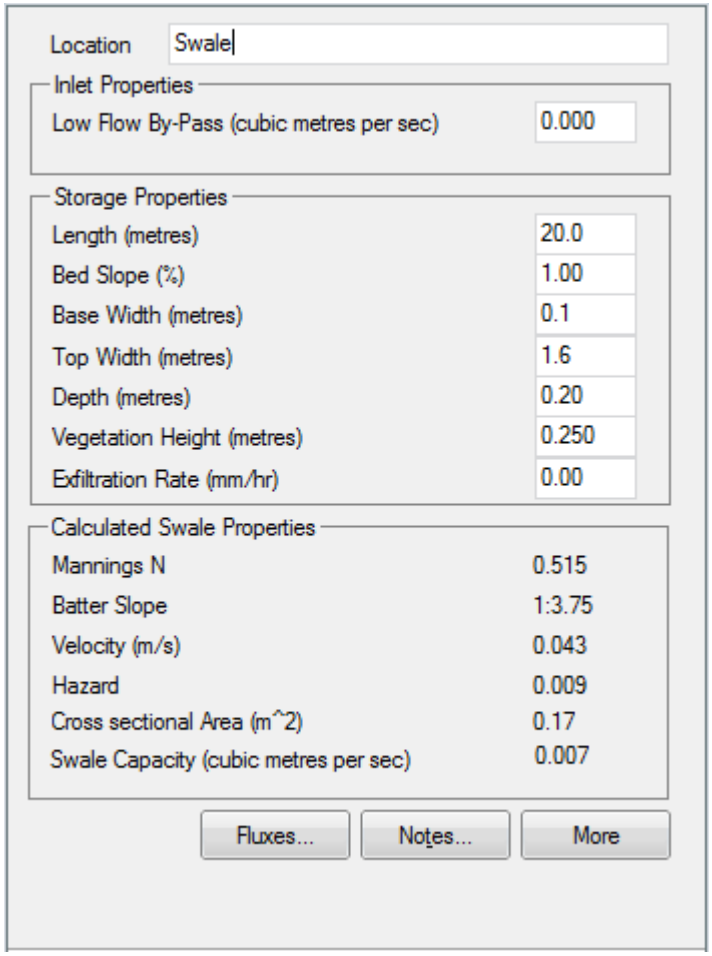
The MUSIC nodes for the “Stormfilters” have been obtained directly from the manufacturer and have not been modified. The manufacturer is able to supply testing data upon request.

Refer to Appendix D for StormFilter (by Stormwater 360) guidelines for maintenance and technical information regarding installation.

Figure 7-7 EXAMPLE STORMFILTER

Image is a worked example of a StormFilter installation – From www.stormwater360.com.au

Figure 7-8 SWALE MODELLING PARAMETERS



7.6. MUSIC ANALYSIS / RESULTS

A MUSIC analysis was carried out on the proposed development site based on the "treatment train" shown in Figure 7-3. The results of the annual pollutant load reductions based on the above design calculations are shown below;

Table 7-7 SUMMARY OF POLLUTANT TARGETS

INDICATOR	WQO's Target	WQO's ACHIEVED	OBJECTIVES MET
TSS (Total Suspended Solids)	80%	88.3%	YES
TP (Total Phosphorus)	60%	66.8%	YES
TN (Total Nitrogen)	45%	45.4%	YES
GP (Gross Pollutants)	90%	100%	YES

Figure 7-9 TREATMENT TRAIN EFFECTIVENESS

	Sources	Residual Load	% Reduction
Flow (ML/yr)	1.91	1.91	0
Total Suspended Solids (kg/yr)	103	12.1	88.3
Total Phosphorus (kg/yr)	0.428	0.142	66.8
Total Nitrogen (kg/yr)	6.08	3.32	45.4
Gross Pollutants (kg/yr)	46.4	0	100

8.0 MONITORING AND MAINTENANCE

8.1. MAINTENANCE REQUIREMENTS

Routine maintenance of the proposed infrastructure is required to minimise the potential for untreated stormwater discharging from the site.

The stormwater treatment device(s) shall be maintained using the following documentation;

- Manufacturers specifications for proprietary stormwater management devices,
- Water by Design's "Maintaining Vegetated Stormwater Assets" Manual,
- Maintenance checklists and rectification works attached within Appendix F.

8.2. MAINTENANCE FREQUENCY

The proposed maintenance frequencies for the elements of the stormwater management plan are detailed within Appendix F.

More detailed performance information with regard to maintenance frequency and scheduled maintenance tasks for the site can be obtained by actively developing a maintenance log (refer below); however, it does not supersede maintenance requirements outlined in the manufacturers' specifications for proprietary elements of the SBSMP.

8.3. MAINTENANCE RECORD

A record of all maintenance checks for all stormwater controls on-site should be kept to evolve an appropriate maintenance routine to reflect the particular characteristics of the adopted treatment devices. It will also allow management of the site to refine the maintenance frequencies listed in this report, which were based on generic devices located in typical urban environments.

The maintenance report contained within Appendix F is to be carried out to create a chain of responsibility for maintenance. The maintenance report should include details of the following:

- The date of maintenance,
- The name of the persons performing the maintenance,
- What types of maintenance actions were performed for each water quality device,
- The environmental state of the device including an estimate of the type and weight of litter removed and the amount of sediment captured where appropriate.

9.0 EROSION AND SEDIMENT MANAGEMENT

9.1. OBJECTIVES

The objective of Erosion and Sediment Management is to limit soil erosion and control sediment discharge from the proposed development by using suitable control devices during the four (4) primary phases; Existing, Earthworks, Construction and the Proposed Use.

Typical erosion and sediment control measures that will be incorporated into these development phases are highlighted in the following section.

9.2. EROSION & SEDIMENT MANAGEMENT DURING DEVELOPMENT PHASES

PHASE 1 - EXISTING

Prior to construction commencing, the following sediment and erosion control measures will be implemented to minimise disturbance and ensure water quality is maintained:

- Designation of transport routes to ensure minimal vegetation disturbance. Transport routes will have construction exits in accordance with IEAust Guidelines,
- Construction entry/exit to be installed and will comprise of a designed gravel pad or placement of hardwood logs in accordance with the IEAust Guidelines,
- Install sediment fences around the proposed site (along tow of batter alignment),
- Install check dams if required, and
- Install dust control fences adjacent to the proposed earthworks areas (along property boundary).

PHASE 2 - EARTHWORKS AND PHASE 3 - CONSTRUCTION

The following measures will be undertaken to mitigate water quality impacts during construction phase:

- Sediment fences to be erected at the base of all batters and stockpiles to prevent sediment transportation off site,
- Turf filter strips to be placed along all road verges,
- Diversion swales to divert sediment laden water,
- Rock check dams are to be placed intermittently along diversion swales,
- Incorporate a temporary sediment basin in the treatment of sediment laden water.
- Re-vegetation of all disturbed areas as soon as possible,
- All sediment control structures to be maintained in an effective manner and inspected after each stormwater event. No structure is to accumulate sediment above 40% of its capacity,

- Construction of water quality treatment devices are to be undertaken in the final stages of construction of the development to ensure that clogging of the filter media is avoided, and
- Regular monitoring of water quality to determine the effectiveness of the sediment and erosion control measures.

PHASE 4 - PROPOSED DEVELOPMENT

Once construction is completed, the following strategies will be implemented to limit soil erosion and control sediment discharge leaving the site:

A monitoring program will be established for the stormwater treatment devices.

9.3. EROSION CONTROL MEASURES

The time of disturbance on-site should be kept to a minimum by ensuring that construction works immediately follow the earthworks phase. Consideration to staging works should be given to minimise the area of exposed works at any given time.

Areas that may be subject to concentrated flow and that have been cleared may require turfing to ensure gully erosion does not start.

Any overburden that is not to be taken off-site should be stockpiled nearby and covered to prevent the mobilization of any particles into the drainage system.

The remaining exposed areas of the site are to be damped down as deemed necessary by the site supervisor to prevent dust. All batters are to have mulch or erosion control mates installed immediately after achieving final level.

Dust fencing is to be installed around the perimeter of earthworks to prevent wind velocities at ground level over the site.

The site is to be landscaped and revegetated in accordance with the approved Landscape Plans immediately after completion of construction activities to minimise the risk of erosion from exposed earthworks.

9.4. SEDIMENT CONTROL MEASURES

With reference to the IEAust Guidelines and Current Best Practice methods, there are four fundamental sediment control principles that have been identified for use during construction for this development site and are as follows:

- Construction Exit
- Sediment Fences
- Sediment Barriers
- Turfed Filter Strips

Construction Exit

A dedicated construction exit is to be located at the sites entry and exit point for vehicles. This exit will be established to facilitate the removal of soil, mud, dust and debris from the tyres of vehicles prior to leaving the construction site. The construction exit can comprise of a gravel pad designed or placement of hardwood logs, constructed and maintained in accordance with the IEAust Guideline. Alternatively, a vibratory grid system can be hired or constructed. The advantages of the grid system include ease of movement and they can be used for several years.

Sediment Fences

Sediment fencing is to be established down slope of any exposed earthworks where there is a risk of contaminated water leaving the site prior to clearing and site works commencing. Sediment fencing may be required at regular spacing down the disturbed grade to limit rutting caused by concentration of sheet flow. Sediment fences shall be used to protect any temporary stockpile areas on an as-needs basis. Sediment collected from sediment barriers is to be regularly removed and either taken off site as part of the earthworks phase of the proposed development or stockpiled for use during revegetation.

Sediment Barriers

Sediment barriers are to be constructed around all stormwater drainage inlet points where contaminated water may drain to. This will aid in ensuing sediments are settled out prior to flows entering the underground stormwater drainage system. Sediment barriers are to be gravel wrapped in geotextile ‘sausage’ or similar.

Turf Filter Strips

If required, turf filter strips approximately 600mm minimum wide can be placed on the upstream side of the proposed concreted footpath. These will act in conjunction with sediment fences to further treat any overland flow from the site. Turf filter strips are to be constructed and maintained in accordance with the IEAust Guidelines.

10.0 CONCLUSION

10.1. LEGAL POINT OF DISHARGE

The legal point of discharge will be to the existing 2700dia stormwater infrastructure.

10.2. STORMWATER QUALITY

A MUSIC model was developed to assess the performance of the proposed stormwater treatment train against the requirements of the State Planning Policy. The results of the modelling indicate that an acceptable level of treatment is achieved. BG Civil recommends that all measures included within this report be adhered to ensure that actual results onsite reflect the performance modelled.

The following is a summary of the minimum requirement;

- All roof water is to be collected by the hydraulic engineer and directed to the stormwater 360 manhole which consists of 12 x tall cartridges located on below the ground level. All downpipes are to be fitted with leaf eater (rain heads) and it is recommended that a first flush device is installed to downpipes to reduce pollutants from roof areas exiting the development site.
- All stormwater from impervious ground areas in the hotel driveway and multi-level carpark is to be captured by a series of strategically placed field inlet pits fitted with Enviropod 200 trash bags by Stormwater 360 prior to discharging to the stormfilter system.
- All ground areas which are unable to be captured by the field inlet pits are to be directed to shallow vegetated swales located in the landscape areas prior to discharging from the site.
- All captured stormwater will discharge to the existing 2700dia stormwater infrastructure.
- As this development is a mixed use development with retail tenancies & a hotel, regular maintenance will be undertaken to the landscape areas to remove gross pollutants from the site.

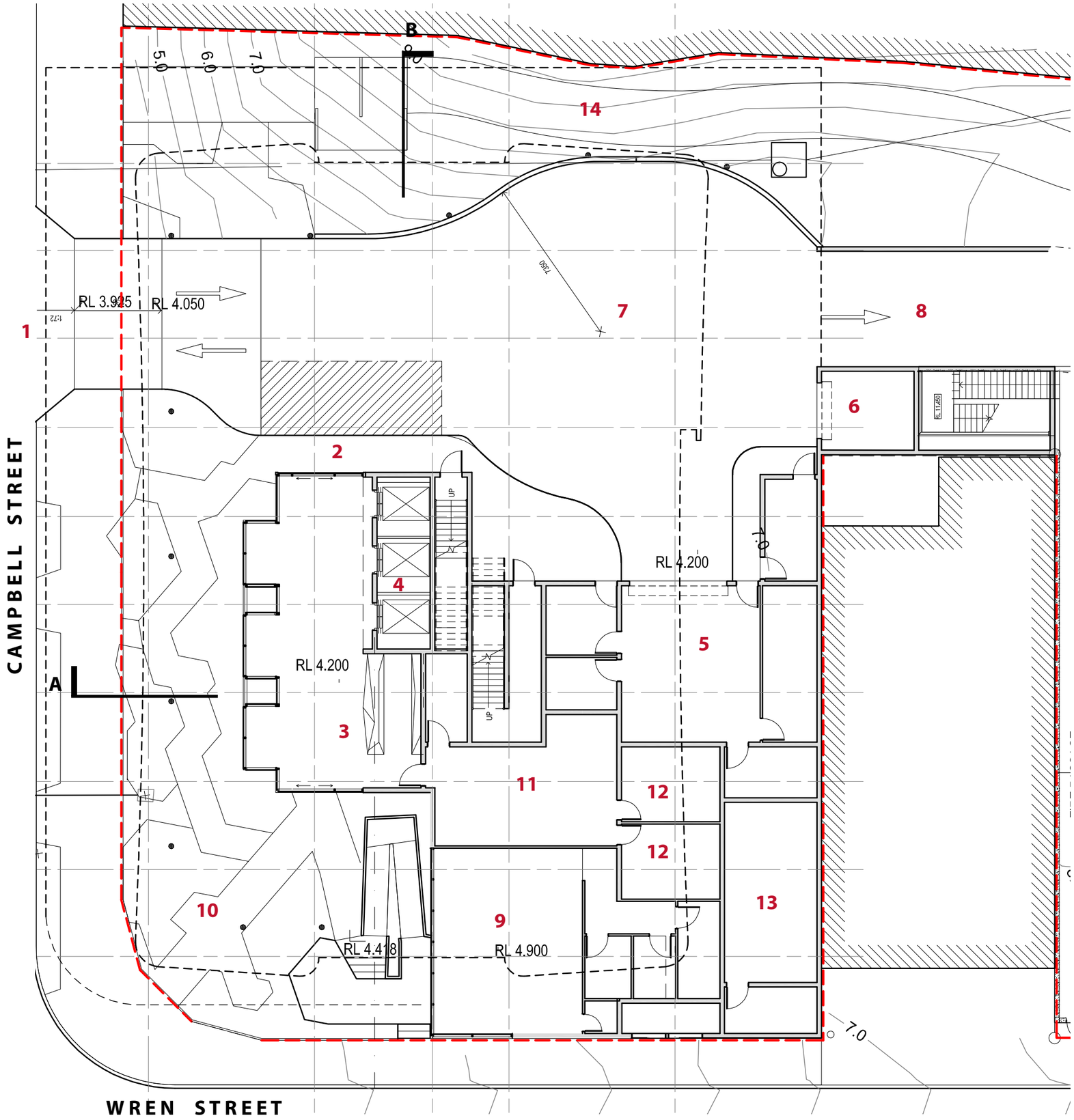
10.3. EROSION AND SEDIMENT CONTROL

An Erosion and Sediment Control (ESC) plan has been created for this Development, and the recommendations included within this Report including the drawings attached within the Appendices shall be undertaken prior to work commencing on site. This Report and plan shall remain on site at all times, and it is the responsibility of the Contractor on-site to ensure the assembly and maintenance of all devices throughout the Development.

Appendix A - ARCHITECTURAL PLANS

Hotel Ground Floor

1. Street entrance
2. Main hotel entrance
3. Reception
4. Lifts
5. Deliveries
6. Bin store & refuse collection
7. Vehicle turning
8. Internal road to carpark - one way
9. Cafe
10. Garden 'Urban Jungle'
11. Administration
12. Staff Change and WC
13. Building services
14. Bicycle path



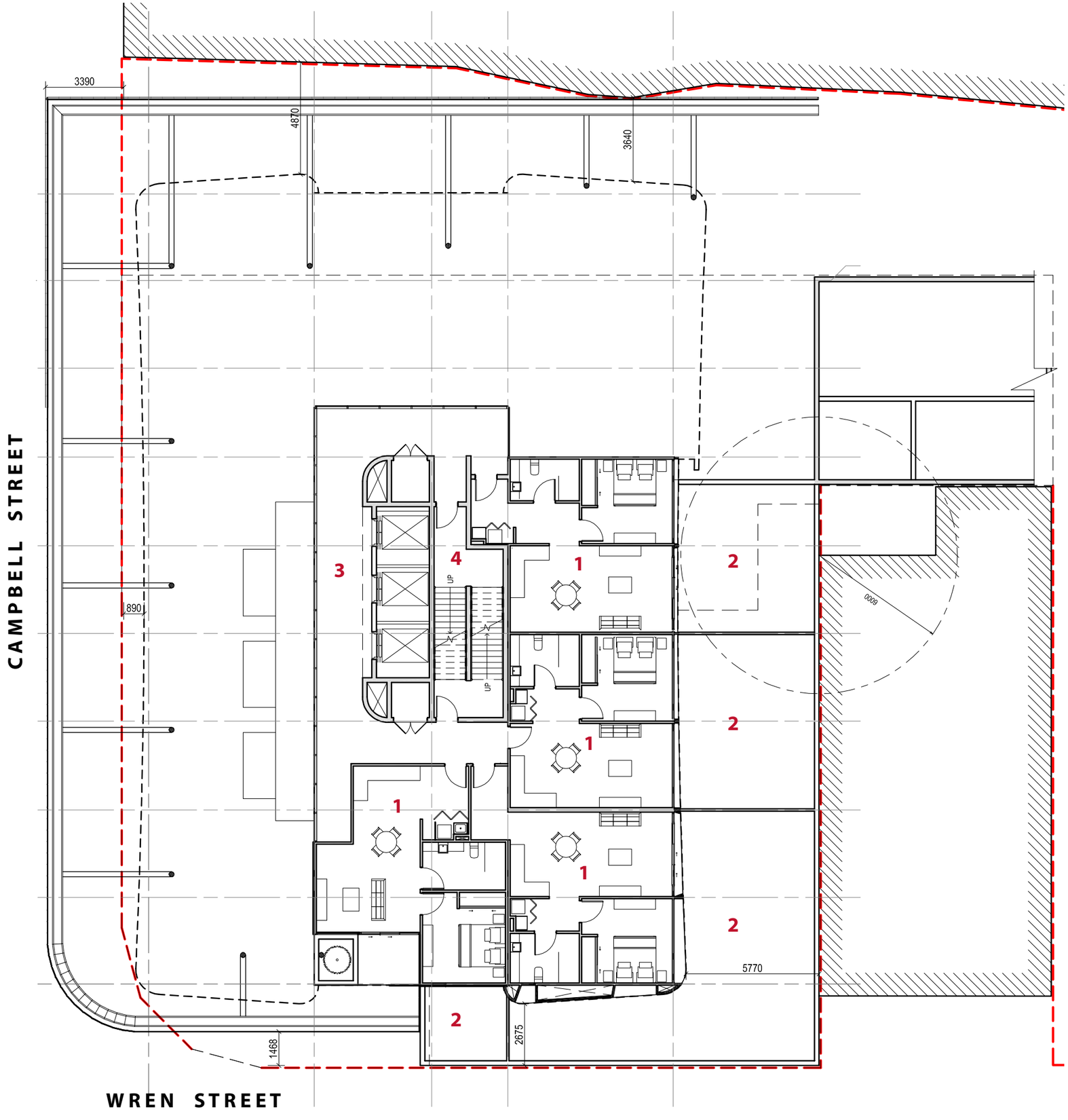
Ground Floor Plan

Scale 1:200

0 10m

Hotel Level 1

1. One bedroom apartment
2. Garden terrace (private use by apartment occupants)
3. Lifts
4. Stairs



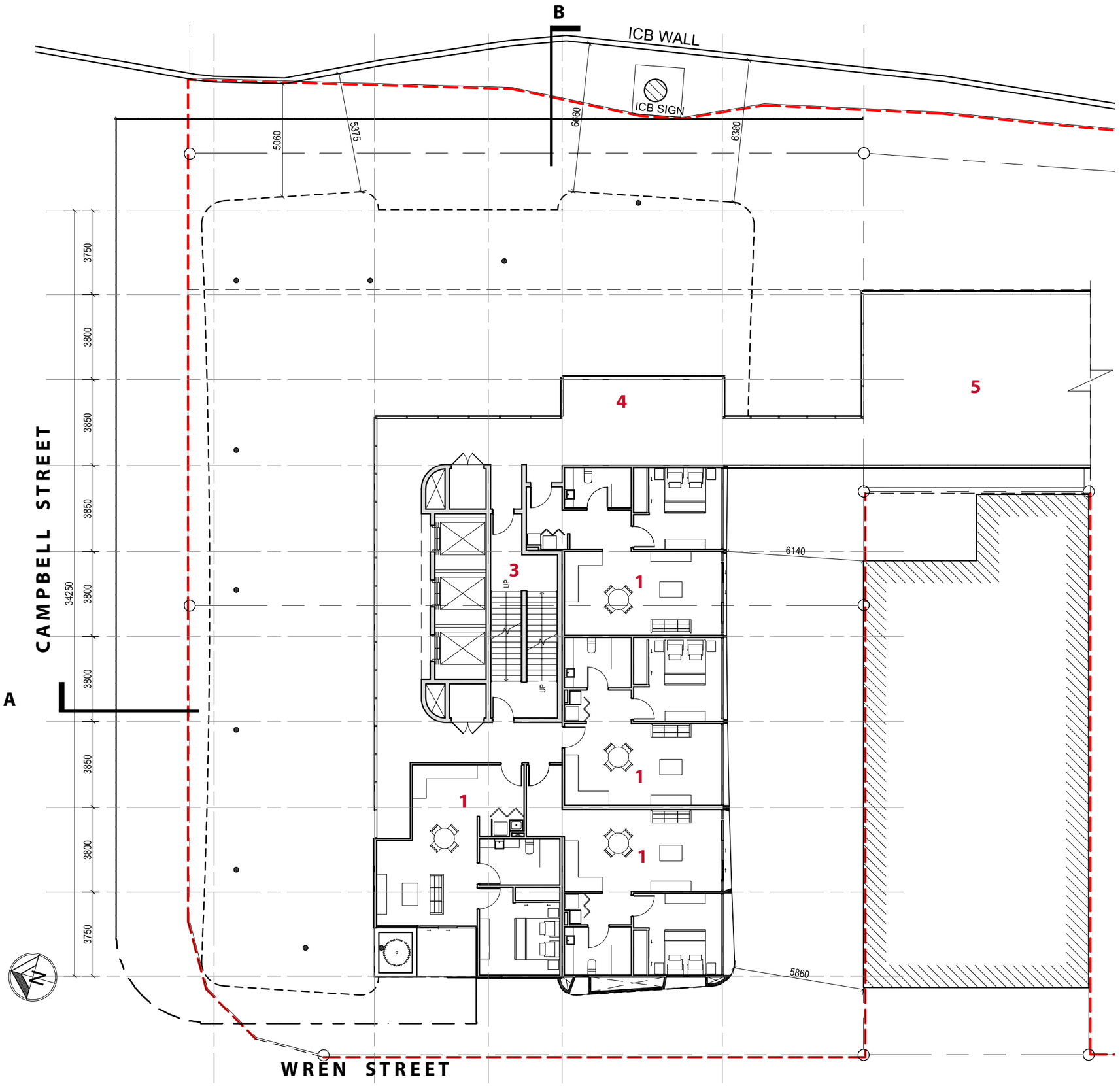
Level 1 Floor Plan

Scale 1:200

0 10m

Hotel Level 2 & 3

1. One bedroom apartment
2. Lifts
3. Stairs
4. Residents lounge / vending machine cafe
5. Link to carpark



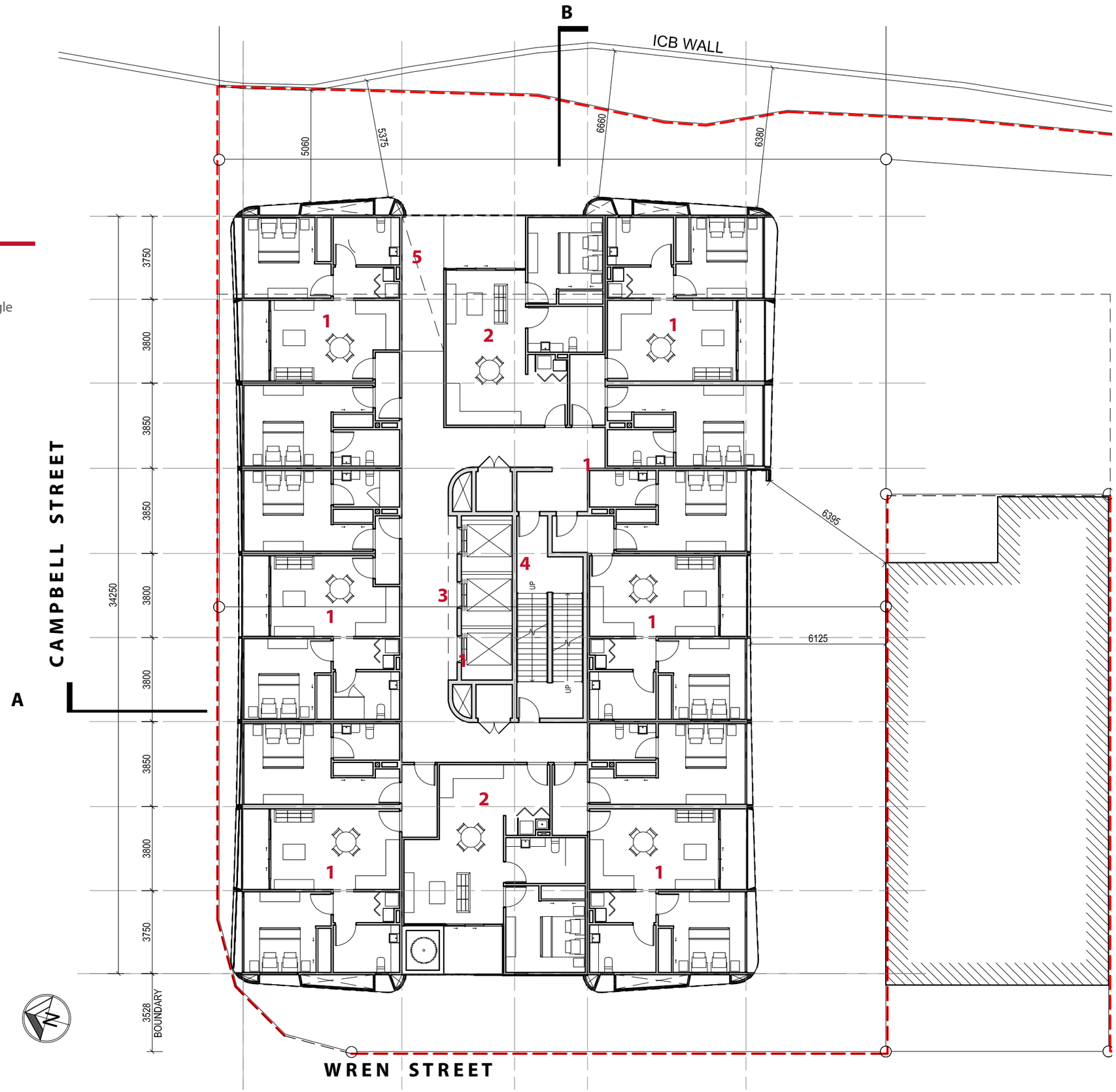
Level 2 & 3 - Carpark Link

Scale 1:200

0 10m

Hotel Typical Floor Plan

1. Dual-key apartment comprising one Single bed apartment and one Hotel room.
2. One bedroom apartment
3. Lifts
4. Stairs
5. Respite Gardens

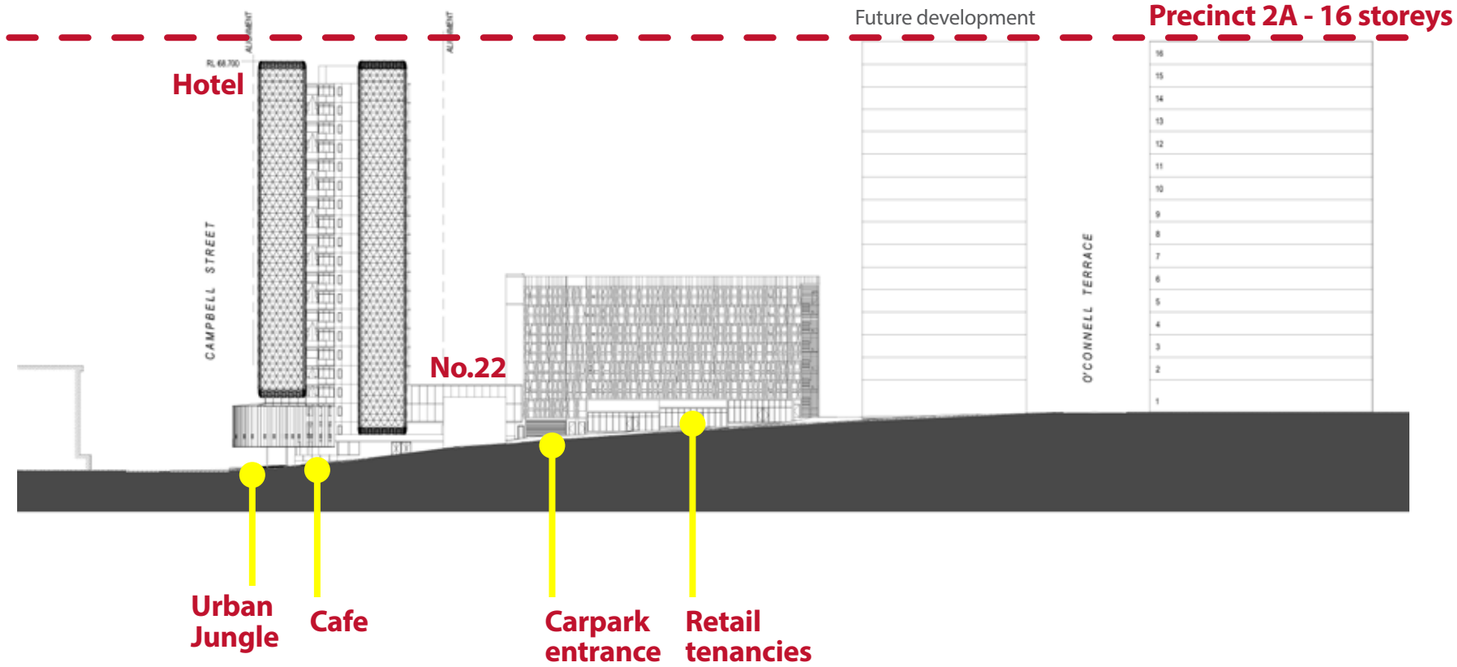


Level 5-19 - Typical Floor

Scale 1:200

0 10m

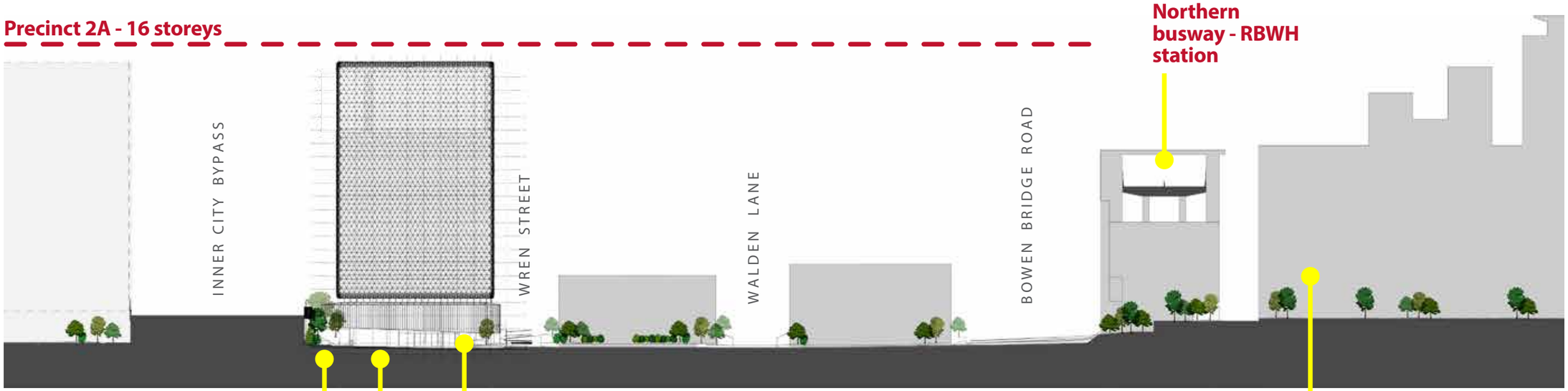
Wren Street Contextual Elevation



Wren Street Contextual Elevation
Scale 1:1000

0 50m

Campbell Street Contextual Elevation



Campbell Street Contextual Elevation

Scale 1:1000

0 50m

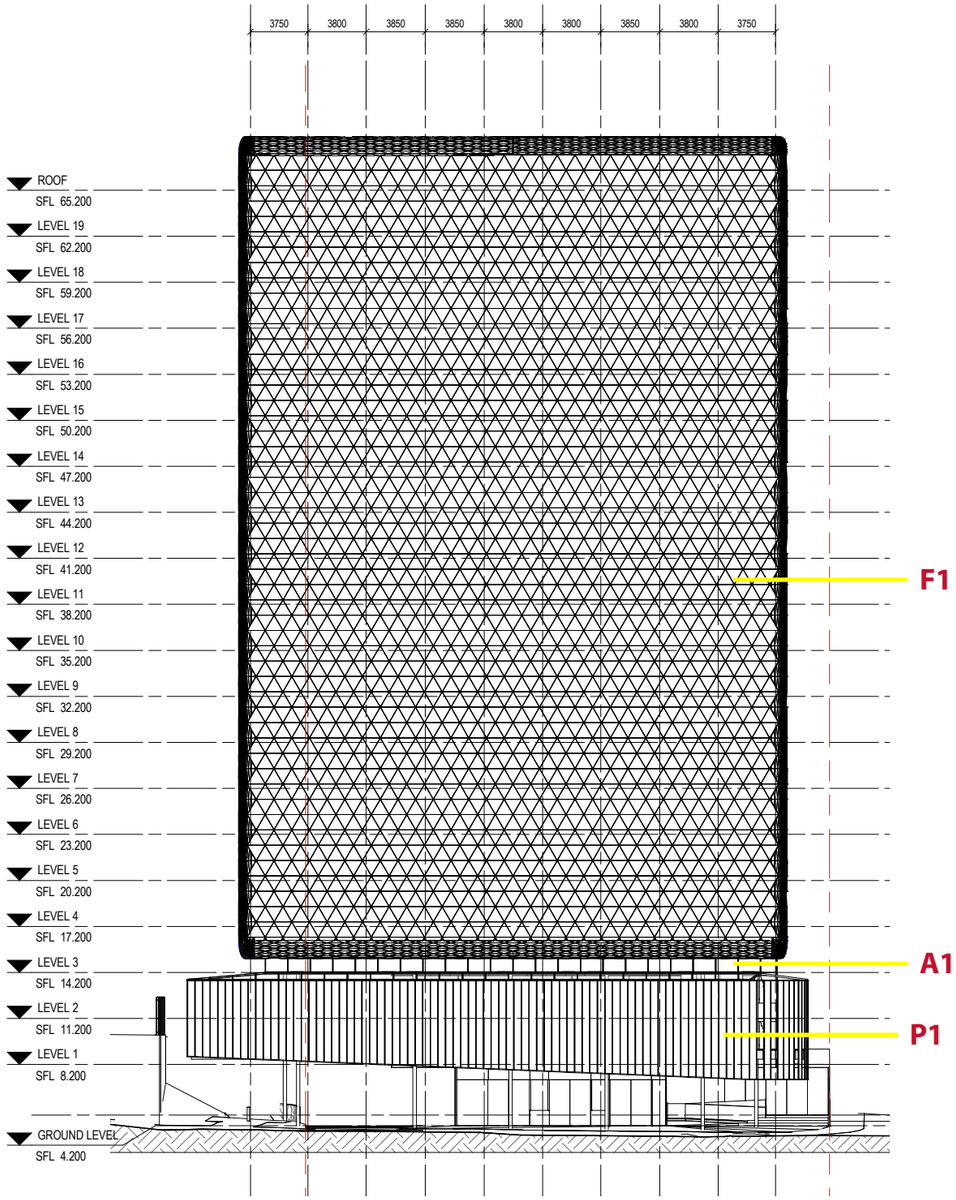
Hotel Elevations

F1 Facade system / curtain wall system of solid, translucent and transparent panels.

A1 Street awning including safety glazed roof and shading.

P1 Linear planter running the perimeter of the awning.

Detail
Scale 1:50

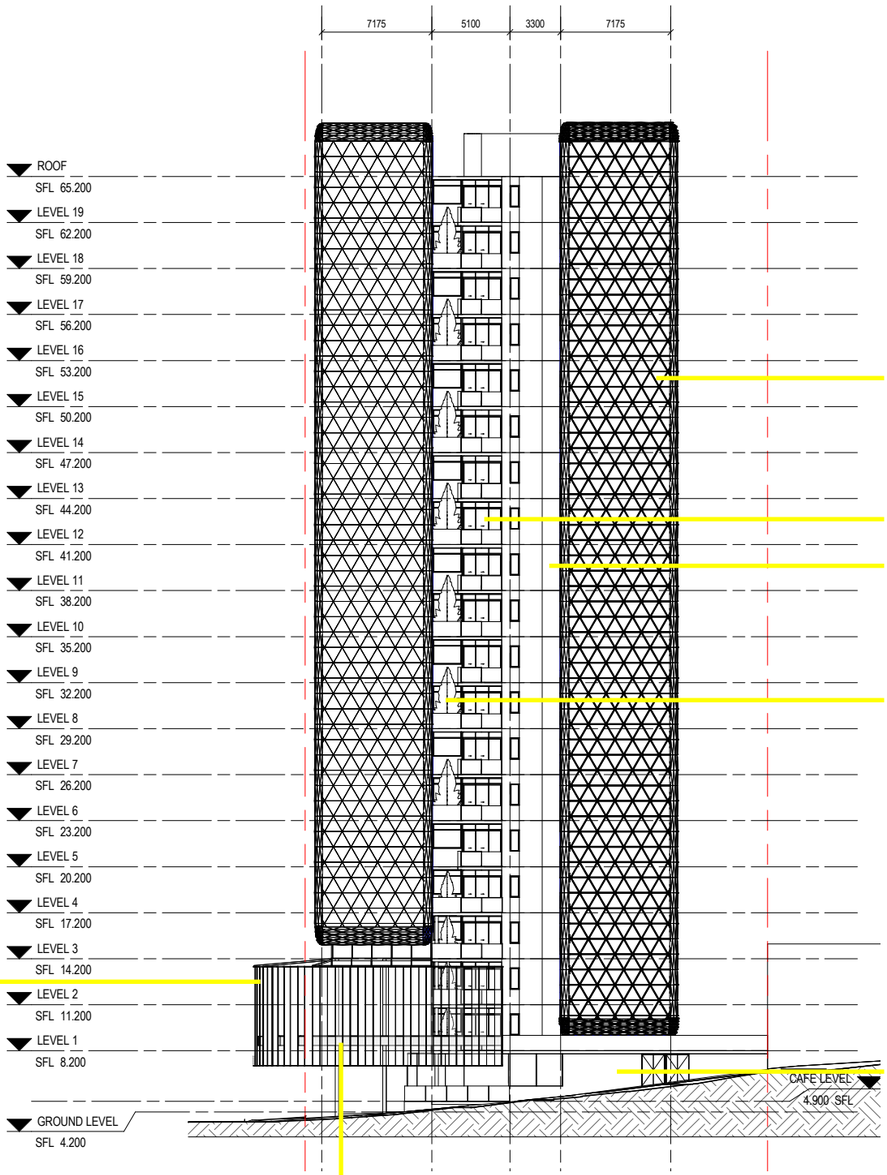


Campbell Street Elevation

Hotel Elevations
Scale 1:200

0 25m

Hotel Elevations



F1 Facade system / curtain wall system of solid, translucent and transparent panels.

F2 Facade system / window wall system

F3 Facade system / rainscreen with hi-build paint finish

P2 Modular balcony planter - pre-planted for establishment of landscape prior to installation in building.

A1 Street awning including safety glazed roof and shading.

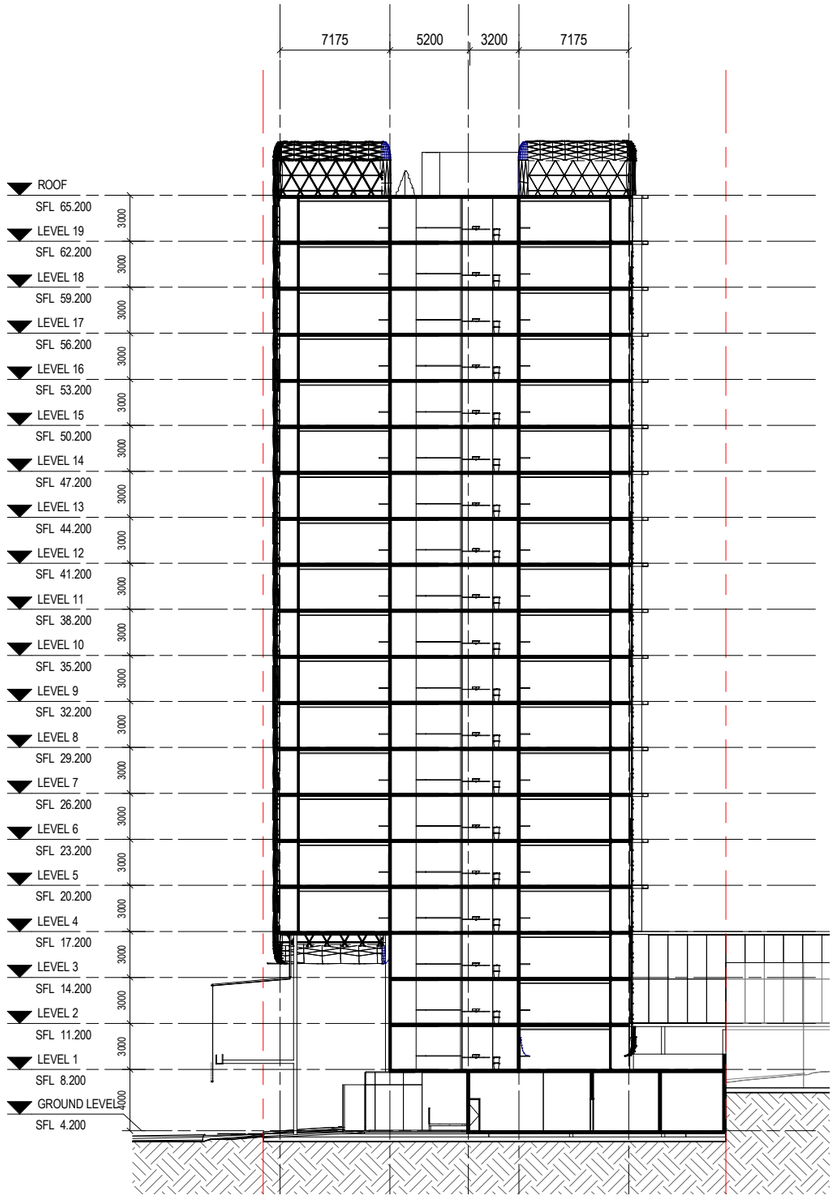
F4 Facade / public realm. Solid surface / stone / porcelain tile.

P1 Linear planter running the perimeter of the awning.

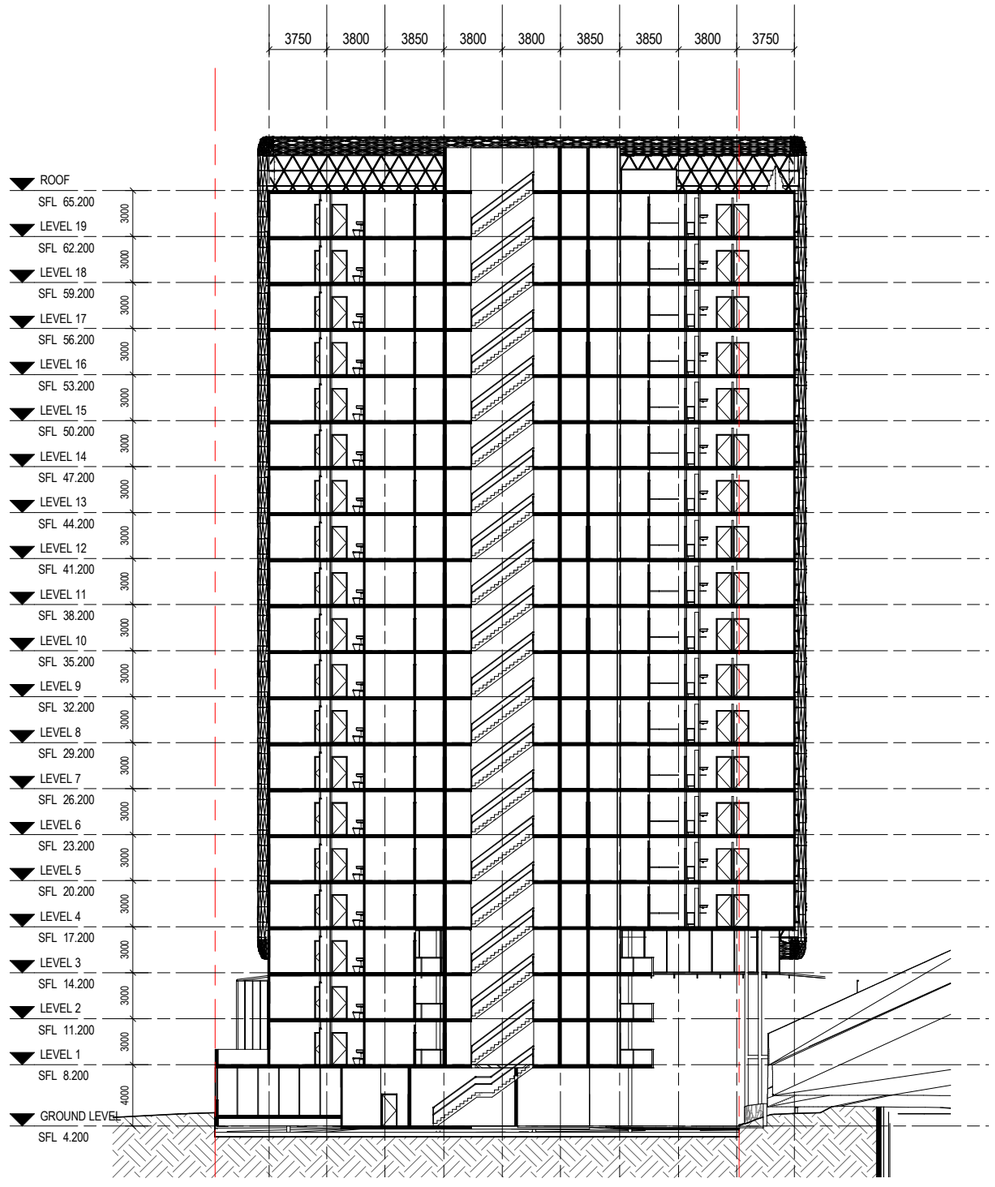
Wren Street Elevation
Scale 1:200

0 25m

Hotel Sections



SECTION A



SECTION B

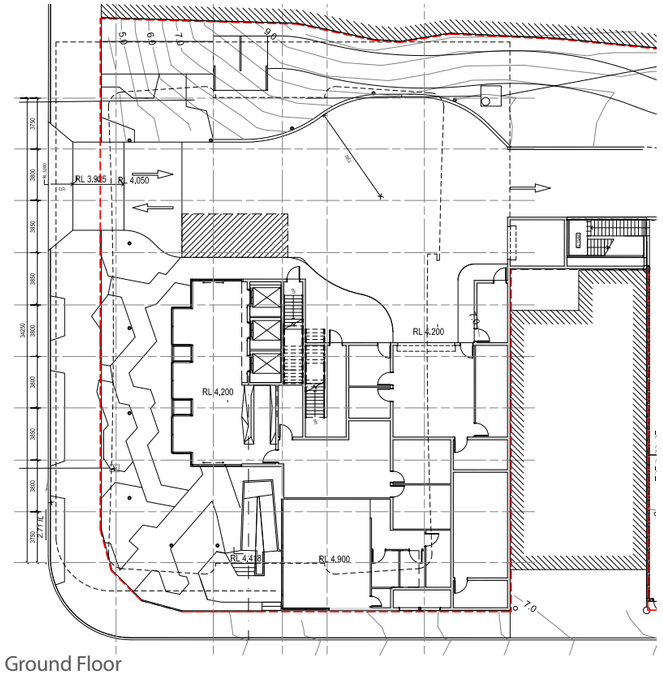
Hotel Sections
Scale 1:200

0 25m

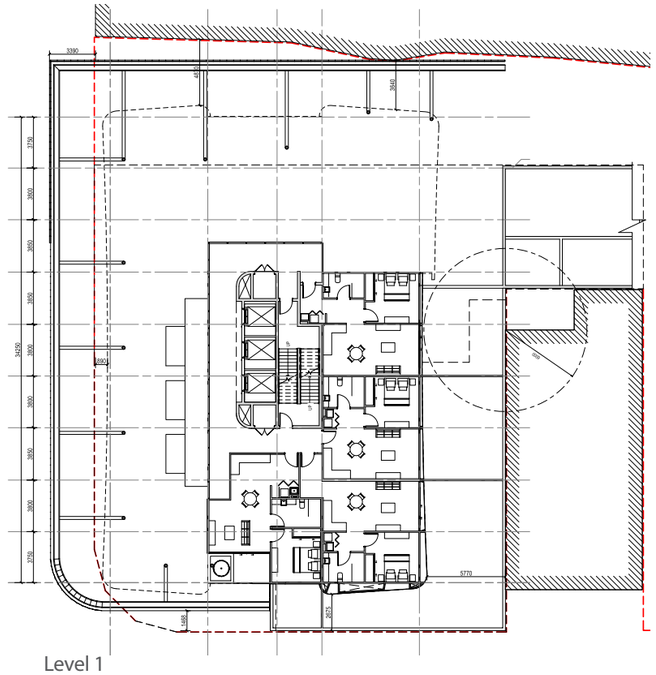
Area Schedule

AREA SCHEDULE (GFA)		
LEVEL	NAME	AREA (m²)
GROUND LEVEL	GROSS FLOOR AREA	475
LEVEL 1	GROSS FLOOR AREA	307
LEVEL 2	GROSS FLOOR AREA	307
LEVEL 3	GROSS FLOOR AREA	307
LEVEL 4	GROSS FLOOR AREA	686
LEVEL 5	GROSS FLOOR AREA	686
LEVEL 6	GROSS FLOOR AREA	686
LEVEL 7	GROSS FLOOR AREA	686
LEVEL 8	GROSS FLOOR AREA	686
LEVEL 9	GROSS FLOOR AREA	686
LEVEL 10	GROSS FLOOR AREA	686
LEVEL 11	GROSS FLOOR AREA	686
LEVEL 12	GROSS FLOOR AREA	686
LEVEL 13	GROSS FLOOR AREA	686
LEVEL 14	GROSS FLOOR AREA	686
LEVEL 15	GROSS FLOOR AREA	686
LEVEL 16	GROSS FLOOR AREA	686
LEVEL 17	GROSS FLOOR AREA	686
LEVEL 18	GROSS FLOOR AREA	686
LEVEL 19	GROSS FLOOR AREA	686
Grand total		12376

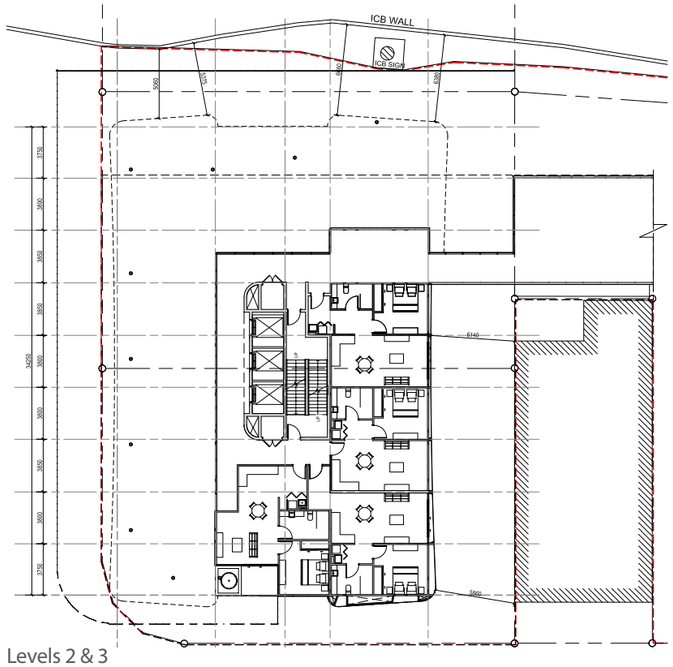
OPEN SPACE		
LEVEL	NAME	AREA (m²)
GROUND LEVEL	COMMUNAL OPEN SPACE	537
LEVEL 5	COMMUNAL OPEN SPACE	7
LEVEL 7	COMMUNAL OPEN SPACE	7
LEVEL 9	COMMUNAL OPEN SPACE	7
LEVEL 11	COMMUNAL OPEN SPACE	7
LEVEL 13	COMMUNAL OPEN SPACE	7
LEVEL 15	COMMUNAL OPEN SPACE	7
LEVEL 17	COMMUNAL OPEN SPACE	7
LEVEL 19	COMMUNAL OPEN SPACE	7
COMMUNAL OPEN SPACE		591
LEVEL 1	PRIVATE OPEN SPACE	213
LEVEL 2	PRIVATE OPEN SPACE	15
LEVEL 3	PRIVATE OPEN SPACE	15
LEVEL 4	PRIVATE OPEN SPACE	42
LEVEL 5	PRIVATE OPEN SPACE	42
LEVEL 6	PRIVATE OPEN SPACE	42
LEVEL 7	PRIVATE OPEN SPACE	42
LEVEL 8	PRIVATE OPEN SPACE	42
LEVEL 9	PRIVATE OPEN SPACE	42
LEVEL 10	PRIVATE OPEN SPACE	42
LEVEL 11	PRIVATE OPEN SPACE	42
LEVEL 12	PRIVATE OPEN SPACE	42
LEVEL 13	PRIVATE OPEN SPACE	42
LEVEL 14	PRIVATE OPEN SPACE	42
LEVEL 15	PRIVATE OPEN SPACE	42
LEVEL 16	PRIVATE OPEN SPACE	42
LEVEL 17	PRIVATE OPEN SPACE	42
LEVEL 18	PRIVATE OPEN SPACE	42
LEVEL 19	PRIVATE OPEN SPACE	42
PRIVATE OPEN SPACE		923
Grand total		1514



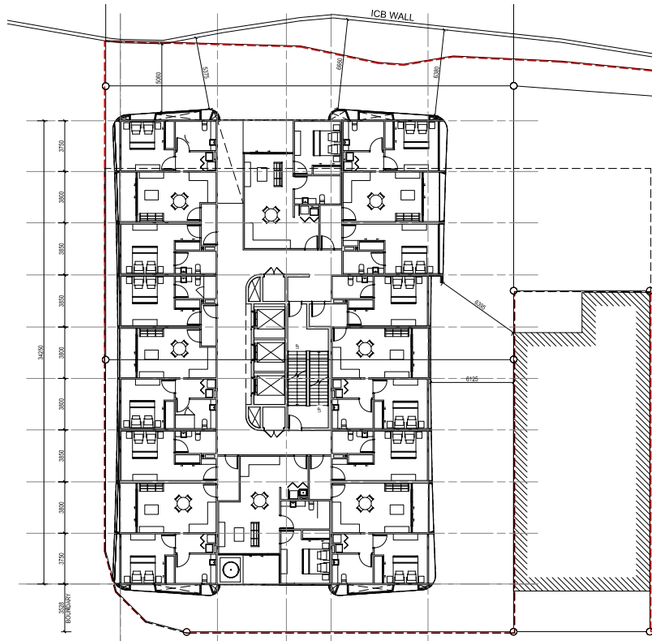
Ground Floor
Scale 1:500



Level 1
Scale 1:500



Levels 2 & 3
(Level 4 similar, without carpark link)
Scale 1:500



Level 5-19 Typical Floors
Scale 1:500

INNER CITY BYPASS

CAMPBELL STREET

O'CONNELL TERRACE

WREN STREET

LOT 18 RP 9941

LOT 34 RP 9941

LOT 33 RP 9941

LOT 32 RP 9941

LOT 31 RP 9941

LOT 30 RP 9941

LOT 29 RP 9941

LOT 5 RP 9941

LOT 4 RP 9941

LOT 3 RP 9941

LOT 2 RP 9941

LOT 1 RP 9941

LOT 19 RP 9941

LOT 20 RP 9941

LOT 22 RP155465

LOT 23 RP 9941

SRV BAY 1:20

RAMP 1:20

RAMP 1:10

RAMP 1:20

RAMP 1:10

PROPOSED CAR PARK

352 CARS + 7 PWD

PROPOSED GROUND LEVEL RETAIL/COMMERCIAL

30.175m

60.611m

50.375m

SITE PLAN
SCALE @ A1 1:200

Schematic

PROPOSED CAR PARK

SCALE 1: 200 @ A1
SCALE 1: 400 @ A3

0 2 4 6 8 10 12 14 16 18 20 metres

Issue	Revision	Date	In.

Client AUSCOM PROJECTS	**Scale** As Shown	**Date** MAY 2010	**Job no.** 4120
Project Name and Location PROPOSED CAR PARK, WREN ST, BOWEN HILLS	**Drawn** RKC	**Checked** RKC	**Approved** RKC
Drawing Title SITE PLAN	**Drawing no.** SD 1002		**Issue**

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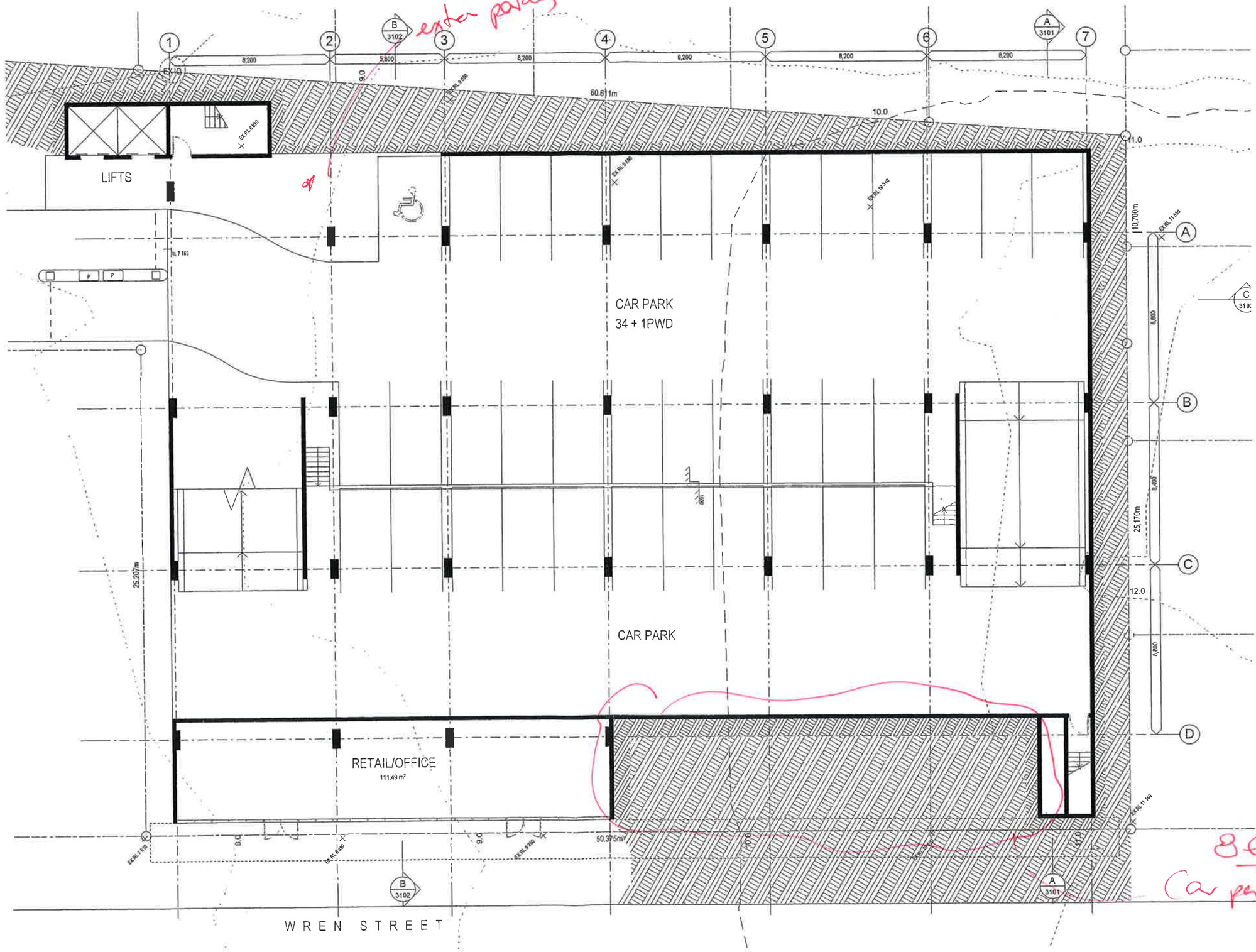

FLOOR PLAN - GROUND FLOOR
SCALE @ A1 1:100

Schematic
PROPOSED CAR PARK

SCALE 1: 100 @A1
SCALE 1: 200 @A3
0 1 2 3 4 5 6 7 8 9 10 metres

Issue	Revision	Date	In.
A	PRELIMINARY	31.05.10	RKC

Client: AUSCOM PROJECTS
Project Name and Location: PROPOSED CAR PARK, WREN ST, BOWEN HILLS
Drawing Title: FLOOR PLAN - GROUND FLOOR

Scale	Date	Job no.
As Shown	MAY 2010	4120
Drawn	Checked	Approved
RKC	RKC	RKC
Drawing no.		Issue
SD 2001		A

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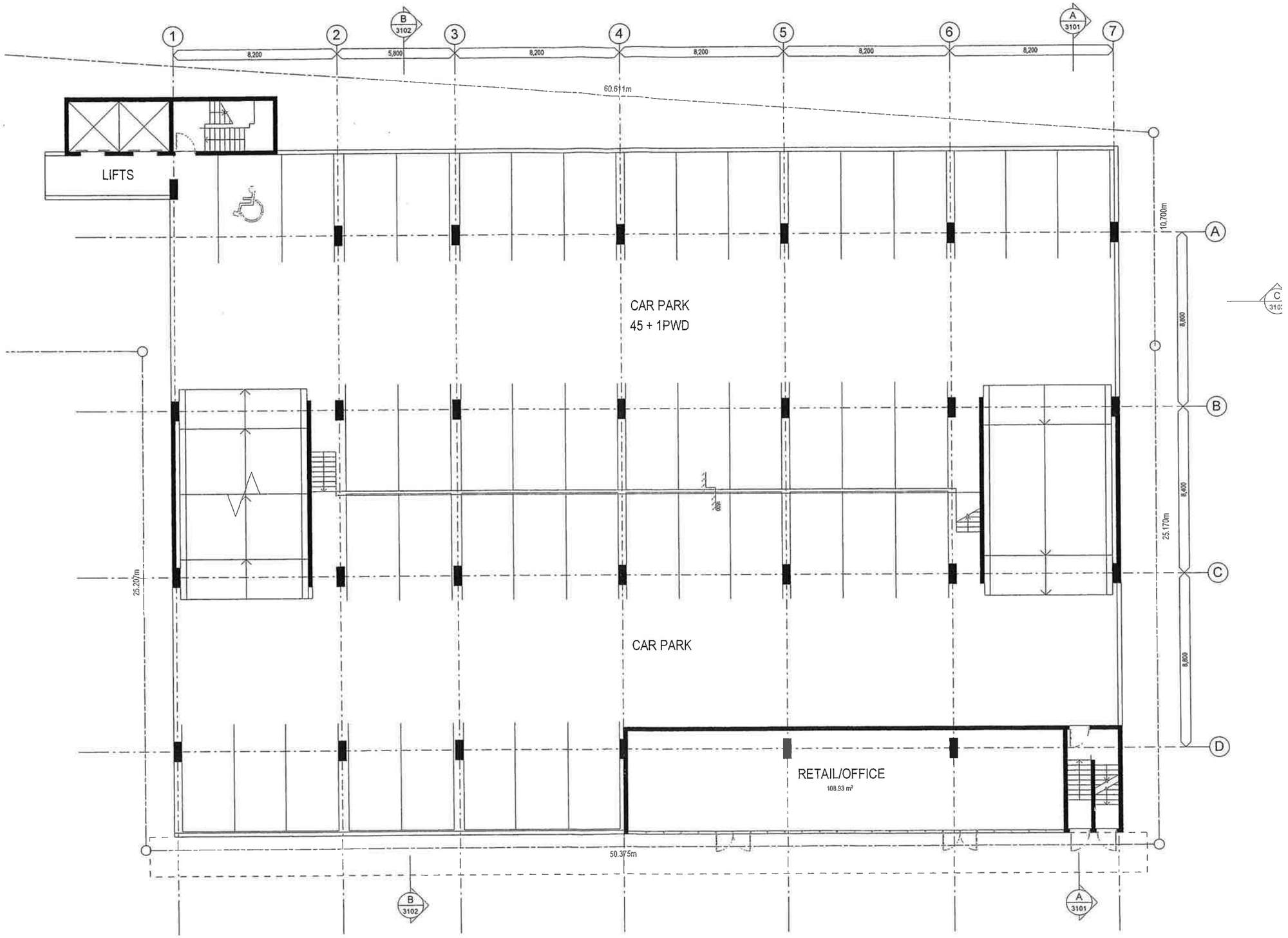

FLOOR PLAN - LEVEL 01
SCALE @ A1 1:100

0 1 2 3 4 5 6 7 8 9 10 metres
SCALE 1: 100 @ A1
SCALE 1: 200 @ A3

Issue	Revision	Date	In.
A	PRELIMINARY	31.05.10	RKC

Schematic
PROPOSED CAR PARK

Client
AUSCOM PROJECTS

Project Name and Location
PROPOSED CAR PARK, WREN ST, BOWEN HILLS

Drawing Title
FLOOR PLAN - LEVEL 01

Scale	Date	Job no.
As Shown	MAY 2010	4120
Drawn	Checked	Approved
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Drawing no.
SD 2002

Issue
A

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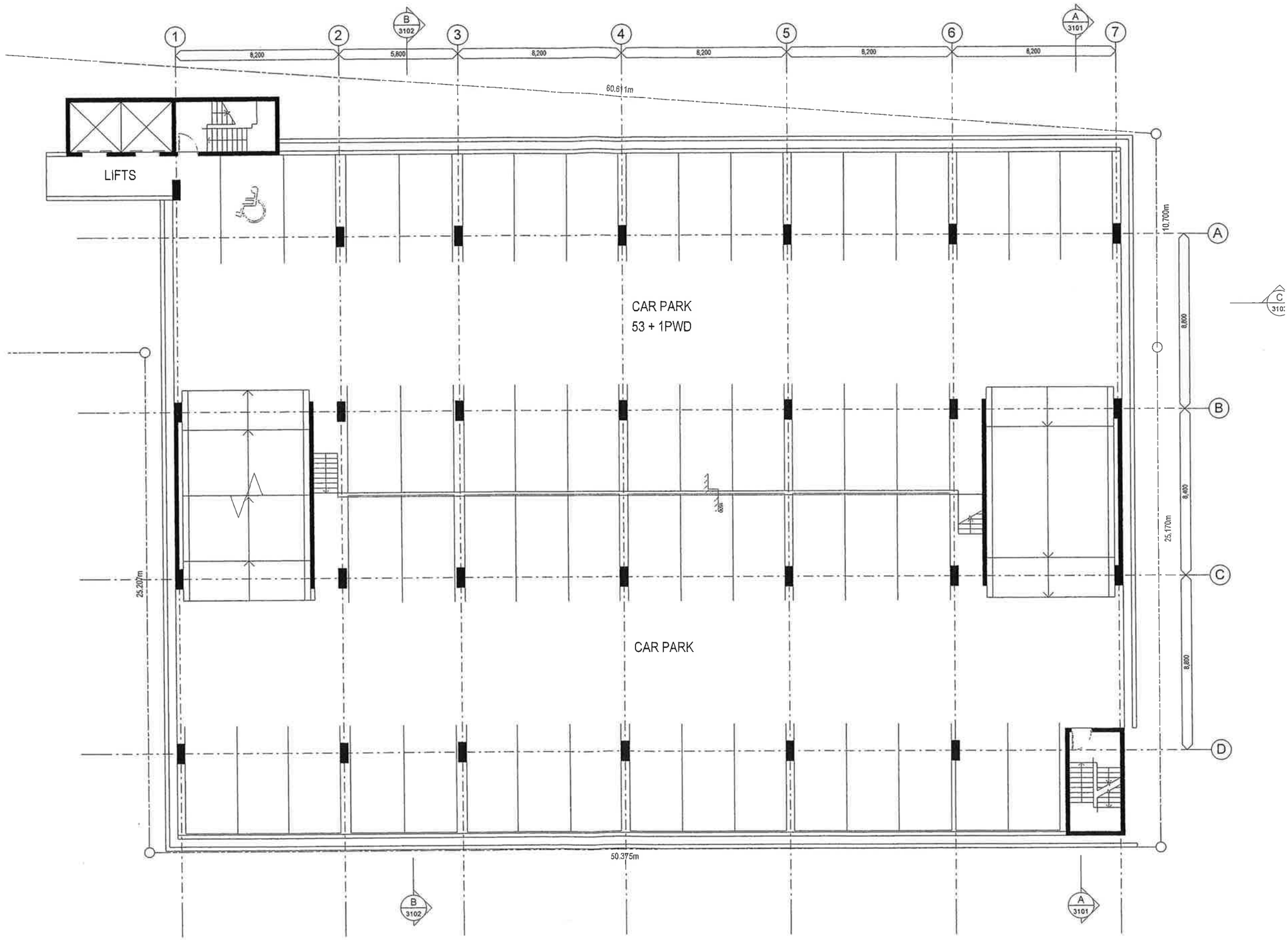

FLOOR PLAN - LEVELS 02-06
SCALE @ A1 1:100

0 1 2 3 4 5 6 7 8 9 10 metres

SCALE 1: 100 @ A1
SCALE 1: 200 @ A3

Issue	Revision	Date	In.
A	PRELIMINARY	31.05.10	RKC

Schematic
PROPOSED CAR PARK

Client AUSCOM PROJECTS	**Scale** As Shown	**Date** MAY 2010	**Job no.** 4120
Project Name and Location PROPOSED CAR PARK, WREN ST, BOWEN HILLS	Drawn RKC	Checked RKC	Approved RKC
Drawing Title FLOOR PLAN - LEVELS 02-06	**Drawing no.** SD 2003		**Issue** A

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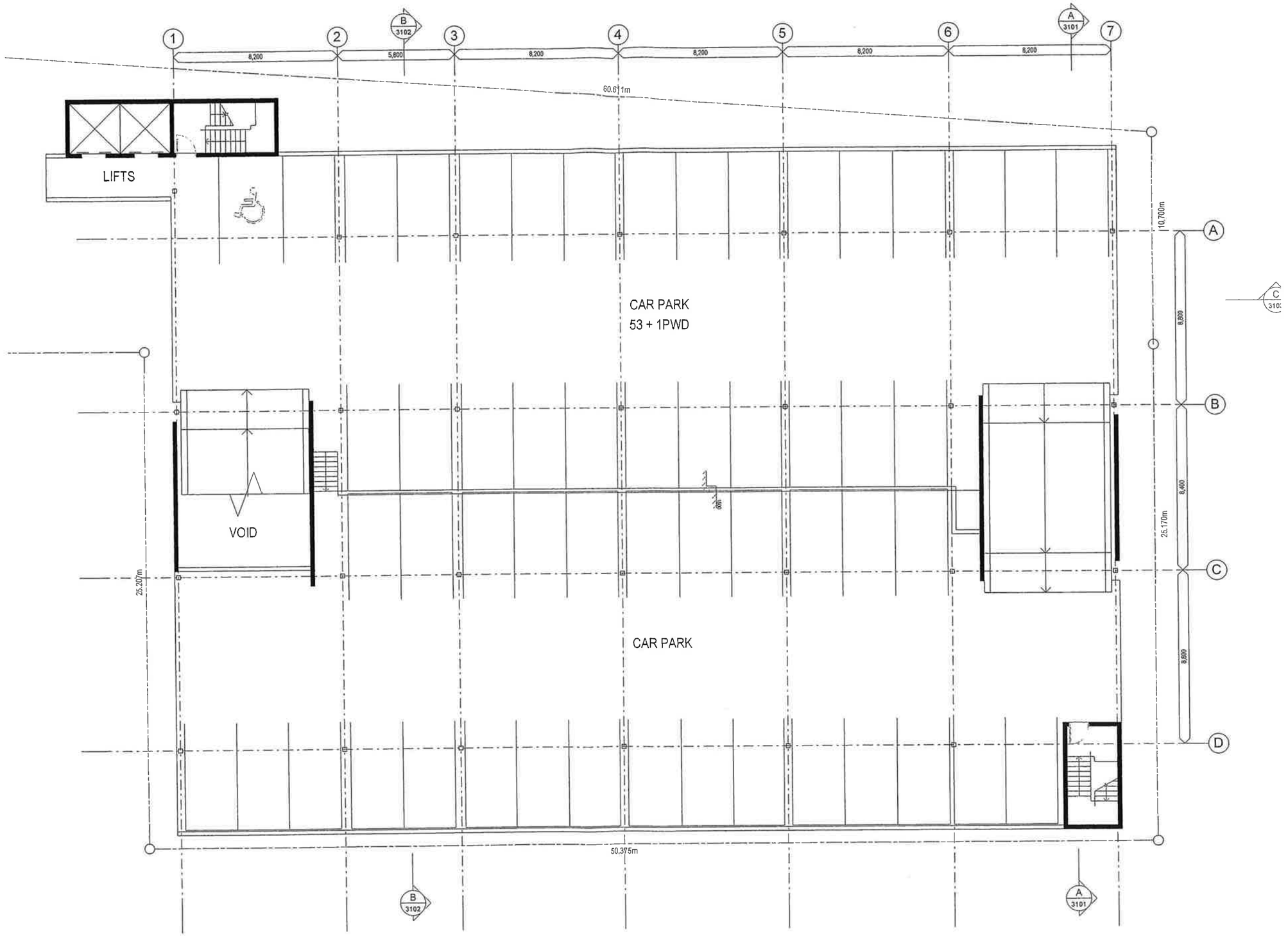

FLOOR PLAN - LEVEL 07
SCALE @ A1 1:100

0 1 2 3 4 5 6 7 8 9 10 metres

SCALE 1: 100 @ A1
SCALE 1: 200 @ A3

Issue	Revision	Date	In.
A	PRELIMINARY	31.05.10	RKC

Schematic
PROPOSED CAR PARK

Client: AUSCOM PROJECTS

Project Name and Location: PROPOSED CAR PARK, WREN ST, BOWEN HILLS

Drawing Title: FLOOR PLAN - LEVEL 07

Scale	Date	Job no.
As Shown	MAY 2010	4120
Drawn	Checked	Approved
RKC	RKC	RKC
Drawing no.		Issue
SD 2004		A

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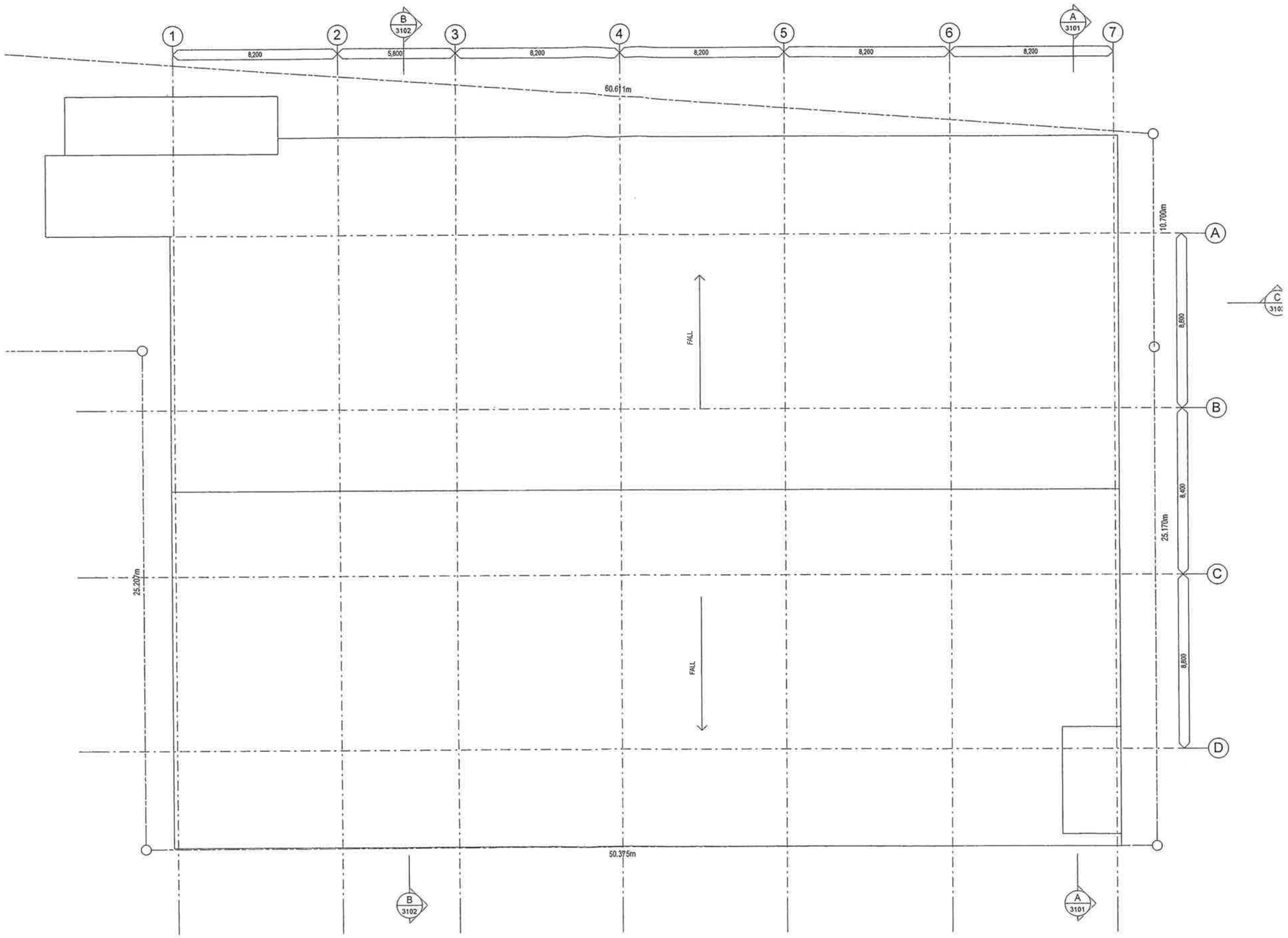

1 ROOF PLAN
SCALE @ A1 1:100

Schematic

PROPOSED CAR PARK

0 1 2 3 4 5 6 7 8 9 10 metres
SCALE 1: 100 @ A1
SCALE 1: 200 @ A3

Issue	Revision	Date	In.
A	PRELIMINARY	31.05.10	RKC

Client: AUSCOM PROJECTS	Scale: As Shown	Date: MAY 2010	Job no.: 4120
Project Name and Location: PROPOSED CAR PARK, WREN ST, BOWEN HILLS	Drawn: RKC	Checked: RKC	Approved: RKC
Drawing Title: ROOF PLAN	Drawing no.: SD 2101		Issue: A

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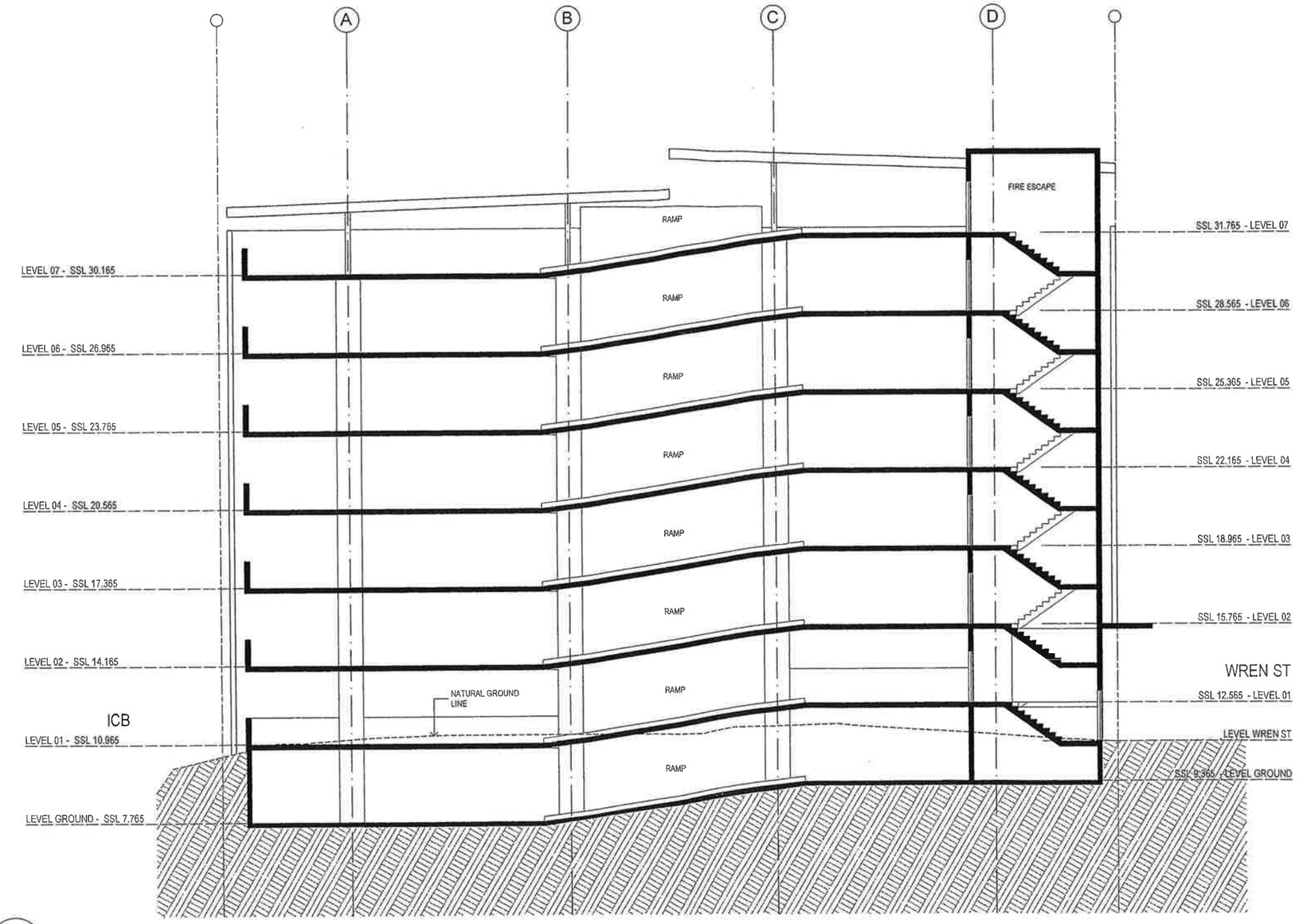

1 / - SECTION A
SCALE 1:100 @ A1
SCALE 1:200 @ A3

0 1 2 3 4 5 6 7 8 9 10 metres

Schematic
PROPOSED CAR PARK

Issue	Revision	Date	In.
A	PRELIMINARY	31.05.10	RKC

Client: AUSCOM PROJECTS

Project Name and Location: PROPOSED CAR PARK, WREN ST, BOWEN HILLS

Drawing Title: SECTIONS

Scale	Date	Job no.
As Shown	MAY 2010	4120
Drawn: RKC	Checked: RKC	Approved: RKC
Drawing no.: SD 3101		Issue: A

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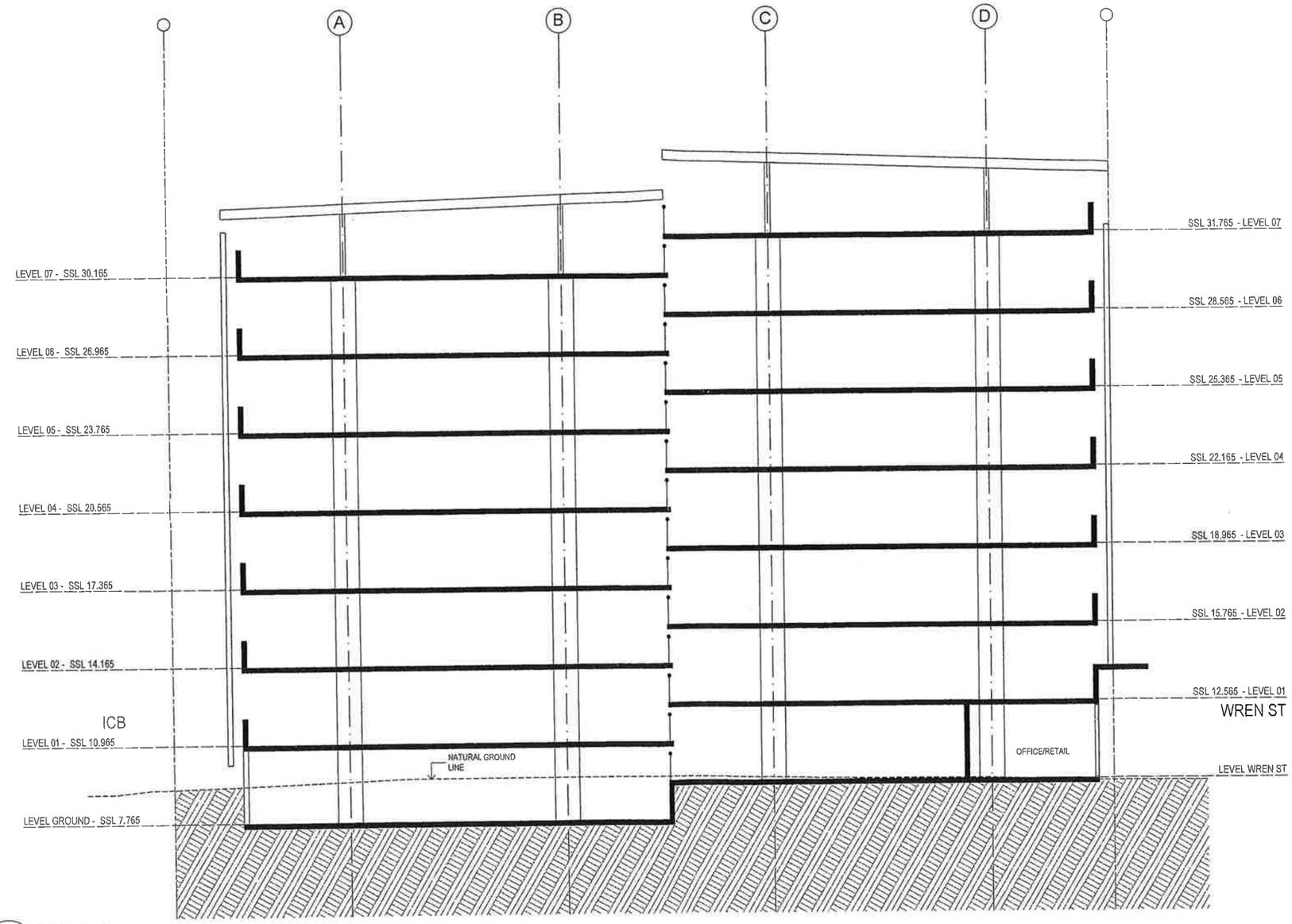

1 / - SECTION B
SCALE 1:100 @ A1
SCALE 1:200 @ A3

0 1 2 3 4 5 6 7 8 9 10 metres

Schematic

PROPOSED CAR PARK

Issue	Revision	Date	In.
A	PRELIMINARY	31.05.10	RKC

Client
AUSCOM PROJECTS

Project Name and Location
PROPOSED CAR PARK, WREN ST, BOWEN HILLS

Drawing Title
SECTIONS

Scale	Date	Job no.
As Shown	MAY 2010	4120
Drawn	Checked	Approved
RKC	RKC	RKC
Drawing no.		Issue
SD 3102		A

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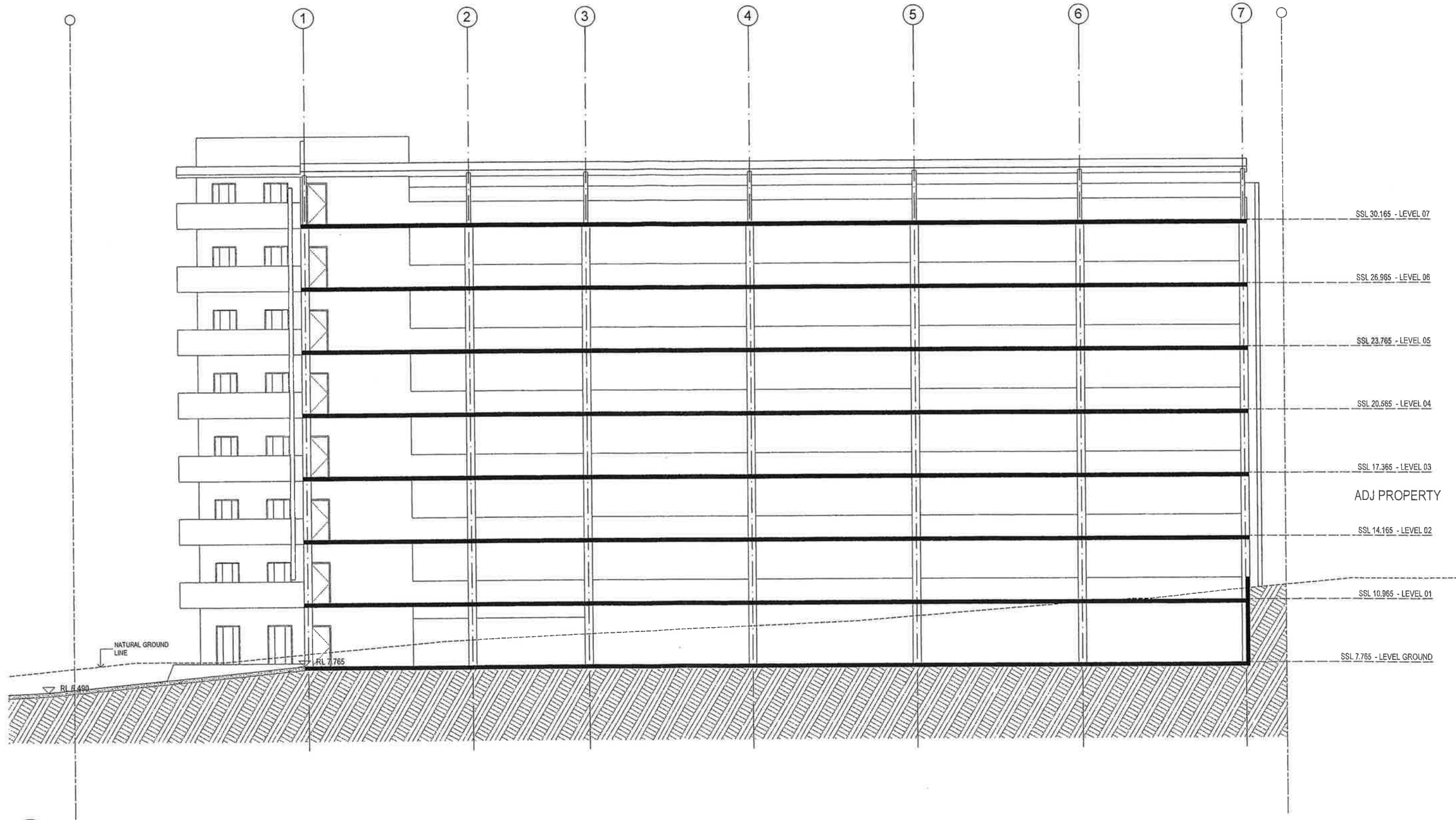

1 / - SECTION C
SCALE 1:100 @ A1
SCALE 1:200 @ A3

0 1 2 3 4 5 6 7 8 9 10 metres

Schematic
PROPOSED CAR PARK

Issue	Revision	Date	In.
A	PRELIMINARY	31.05.10	RKC

Client
AUSCOM PROJECTS

Project Name and Location
PROPOSED CAR PARK, WREN ST, BOWEN HILLS

Drawing Title
SECTIONS

Scale	Date	Job no.
As Shown	MAY 2010	4120
Drawn	Checked	Approved
RKC	RKC	RKC
Drawing no.		Issue
SD 3103		A

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COTTEE PARKER

Appendix B - DETAILED SURVEY

Scale 1:200 (A1 SIZE) – Lengths are in Metres.

2 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28

N

CP SP173226

MULTI STOREY RESIDENTIAL UNITS

Roof Height RL 20.0

Roof Height RL 20.4

Ouline of Lower Buildng Level

Roof Height RL 20.4

Roof Height RL 19.2

Roof Height RL 20.0

/ RP92589

CAMPBELL STREET

SITE BENCH MARK Screw in Kerb RL 4.082

SITE BENCH MARK Screw in Concrete RL 4.851

SITE BENCH MARK Screw in Concrete RL 9.009

SITE BENCH MARK Screw in Concrete RL 11.672

CP BUP8881

TWO STOREY CONCRETE BUILDING

Roof Height RL 13.44

CP SP159887

CP BUP7006

WREN STREET

WALDEN LANE

EVANS STREET

Traffic Islands

Bituman Surface

Concrete Surface

Grassed Surface

Chainwire Fence

Stairs

Garden

Concrete Path

Acoustic Barrier

Edge of ICB

Underside of ICB Bridge RL 10.12

Approx Pavement Height of ICB RL 10.8

Top of ICB Parapet Wall RL 12.17

Top of ICB Screen Wall RL 14.34

Conc.Retaining Wall for ICB

Stone Retaining Wall

Concrete Base

ICB Sign

Comms Pits

Comms Pit

Elect. Pit 9.52 SL

Elect. Pit 3.92 SL

Elect. Pit 4.01 SL

Elect. Pit 5.09 SL

Elect. Pit 7.37 SL

Elect. Pit 9.55 SL

Elect. Pit 11.16 SL

Elect. Pillar

Comms Pit 8.74 SL

Telstra Pit 3.82 SL

Telstra Pit 5.09 SL

Telstra Pit 3.63 SL

Telstra Pit 3.80 SL

Telstra Pit 7.50 SL

Telstra Pit 8.38 SL

Telstra Pit 10.46 SL

Telstra Pit 10.80 SL

SMH 3.56 SL

SMH 3.85 SL

SMH 5.04 SL

SMH 7.43 SL

SMH 10.57 SL

SWM 3.70 SL

SWM 7.19 SL 4.90 IL

SWM 8.12 SL

SWM 8.13 SL

SWM 6.88 SL

Comms Pit 5.04 SL

Sign

Conc. Ret. wall

Conc. Driveway

Demountable Building Approx. Posn.

Roof Height RL 15.16

Roof Height RL 16.54

Roof Height RL 18.06

Roof Height RL 16.44

Roof Height RL 15.85

Roof Height RL 17.27

Roof Height RL 42.33

ICB VENTILATION TOWER

BRICK BUILDING 22 RP155465

20 RP9941

19 RP9941

18 RP9941

BRICK BUILDING 23 RP9941

34 RP9941

RENDERED TIMBER BUILDING 24 RP9941

COLOUR–BOND SHED

25 RP9941

RENDERED TIMBER BUILDING

33 RP9941

32 RP9941

RENDERED TIMBER BUILDING 26 RP9941

31 RP9941

27 RP9941

RENDERED TIMBER BUILDING 28 RP9941

30 RP9941

29 RP9941

CONCRETE BLOCK BUILDING

CONCRETE BLOCK BUILDING

1 RP9941

2 RP9941

3 RP9941

4 RP9941

5 RP9941

1 SP201352

12 RP9953

13 RP9954

4 SP211285

3 SP211284

1 SP192454

84°08'40" 3.105

54°05'25" 3.105

24°04'10" 3.105

99°07'20" 24.247

99°07'20" 20.223

9°03'30" 24.175

89°03'30" 30.175

279°07'20" 30.175

9°03'30" 60.476

279°07'20" 50.34

189°03'30" 95.531

LEGEND

S — S	Sewer Line
W — W	Water main
T — T	Telstra Cables
— Overhead Electricity	
G — G	Gas Main
UE	Underground Elect.
SW	Stormwater Line

GP Gully Pit
SWM Stormwater Manhole
SMH Sewer Manhole
WM Water Meter
WV Water Valve
FH Fire Hydrant
SL Surface Level
Ⓟ Power Pole
K Back of Kerb
L Lip of Kerb
IL Invert Level

DATUM FOR LEVELS – AHD
PM No 133806 – RL 13.558

Contour Interval – 0.5m

The boundary position and dimensions shown hereon have been compiled from IS21832 and have not been marked on site.

The underground services shown heron have been plotted from the records of the relevant authorities, and may not be accurate.

Client
AUSCOM PROJECTS PTY LTD

Project
WREN ST & CAMPBELL ST BOWEN HILLS

CONTOUR & DETAIL SURVEY of Part of Lots 18–20, 23–34 on RP9941 & Lot 22 on RP155465 Original Portion 107 Parish of North Brisbane County of Stanley Local Authority: Brisbane C. C.

MICHAEL JOLLY SURVEYS
PTY LTD
ABN 81 054 790 144
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Fax (07) 3368 1499
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Office Address: 2/9 Camford Street, Milton
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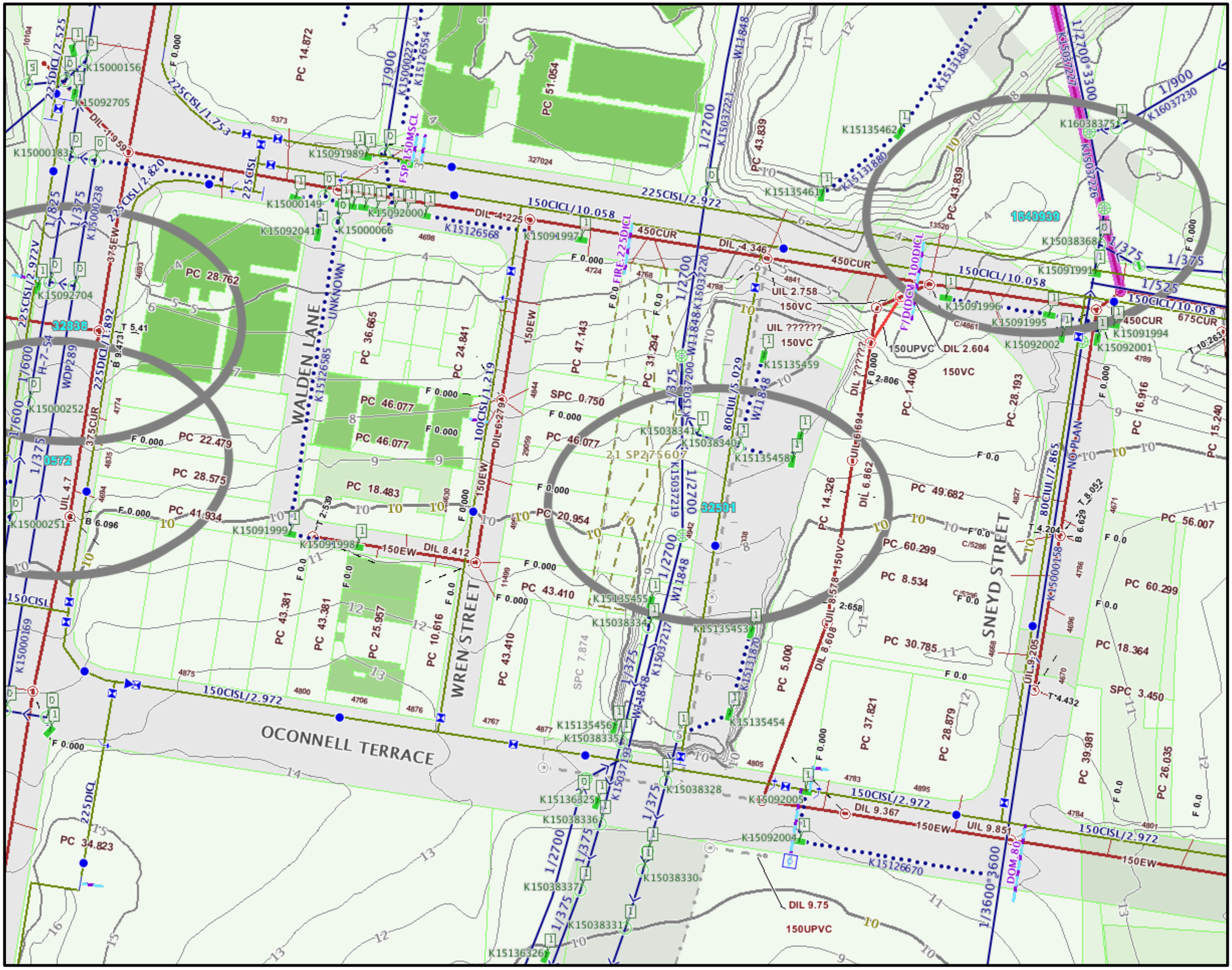
Drawn	MAJ	Date	16/07/2014
F.W.	MAJ	Checked	
F.B. 14.005	L.B.	Approved	Date
File	00100406.DWG		
SCALE	1:200		
PLAN REF.	001004.06		

Appendix C - COUNCIL eBIMAP



Date : Jan 29, 2015
User : bggroup05#937800

Scale = 1:1,000

Metres 20 40

Location :

6,964,092

N

502,939 503,168

6,963,927

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Disclaimer :

BRISBANE CITY

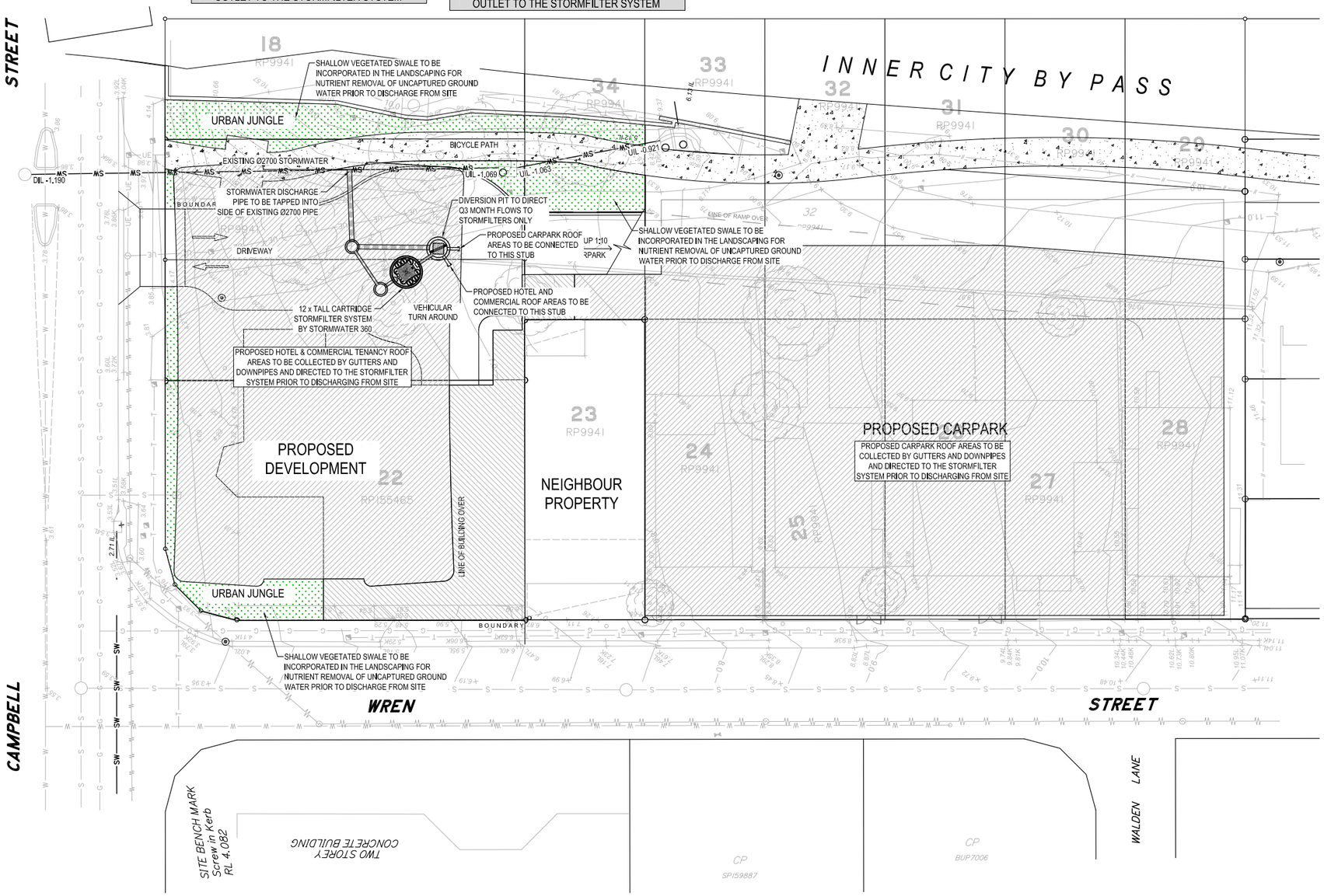
GDA

Qasco

Appendix D - CONCEPT STORMWATER DRAINAGE PLAN

DOWNPIPES TO DISCHARGE THROUGH STORMWATER 360 ENVIROPOD 200 TRASH BAGS AS PRE-TREATMENT PRIOR TO THE BEING OUTLET TO THE STORMFILTER SYSTEM

IMPERVIOUS GROUND AREAS TO BE CAPTURED BY A SERIES OF FIELD INLET PITS FITTED WITH STORMWATER 360 ENVIROPOD 200 TRASH BAGS AS PRE-TREATMENT PRIOR TO THE BEING OUTLET TO THE STORMFILTER SYSTEM



LEGEND

- PROPOSED ROOF AREAS TO BE CAPTURED BY HYDRAULIC CONSULTANT
- PROPOSED LANDSCAPE AREAS TO BE IRRIGATED VIA FIRST FLUSH FLOWS FOR NUTRIENT REMOVAL
- PROPOSED RE-ALIGNED CONCRETE BIKEWAY
- PROPOSED STORMWATER DRAINAGE PIPE
- HYDRAULIC ENGINEER TO CONNECT STORMWATER DRAINAGE TO STUB PROVIDED
- PROPOSED MANHOLE TO DIVERT LOW FLOWS TO STORMFILTER SYSTEM
- PROPOSED STORMWATER MANHOLE
- PROPOSED 12 x TALL CARTRIDGE STORMFILTER SYSTEM BY STORMWATER 360 IN Ø2400 MH

GENERAL NOTES

1. ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CURRENT LOCAL AUTHORITY SPECIFICATIONS AND STANDARDS.
2. UNLESS SPECIFIED OTHERWISE ALL MATERIALS AND WORK SHALL COMPLY WITH THE RELEVANT AUSTRALIAN STANDARDS.
3. THE CONTRACTOR SHALL VERIFY THE LOCATION AND DEPTH OF EXISTING SERVICES WITH RELEVANT AUTHORITIES BEFORE COMMENCING WORKS. BENCH MARK AND LEVELS TO AHD.
4. NOTWITHSTANDING THAT THE PRESENT AND/OR PROPOSED POSITIONS OF PUBLIC UTILITIES, FITTINGS, PIPES, POLES, MANHOLES, ETC, MAY BE INDICATED ON THE DRAWINGS, NO RESPONSIBILITY WILL BE ACCEPTED BY THE PRINCIPAL FOR THE ACCURACY OF THE PRESENTATION OR THE OMMISION THEREOF.
5. CONTACT 1100 (DIAL BEFORE YOU DIG), ENERGEX, AGILITY (GAS), SANTOS (OIL), ETC. FOR THE EXACT LOCATION OF UNDERGROUND CABLES.
6. WHERE OVERHEAD PUBLIC UTILITY LINES AND SURFACE DRAINAGE WORKS AND/OR UNDERGROUND PIPES, CONDUITS, OR CABLES, EXIST IN THE VICINITY OF THE WORKS, THE CONTRACTOR SHALL TAKE CARE TO PROTECT SUCH FACILITIES FROM DAMAGE, AND IN THE CASE OF ANY DAMAGE OCCURING TO SUCH FACILITIES, THE MATTER SHALL BE IMMEDIATELY REPORTED TO THE RELEVANT AUTHORITY AND TO THE SUPERINTENDENT, THE COST OF THE NECESSARY REPAIRS OR RENEWALS SHALL BE BORNE ENTIRELY BY THE CONTRACTOR.
7. NATURAL SURFACE LEVELS ARE FROM DIGITAL TERRAIN MODEL AS SUPPLIED BY THE PROJECT SURVEYOR.
8. THE CONTRACTOR SHALL NOT ENTER EXISTING PROPERTIES WITHOUT PRIOR WRITTEN APPROVAL FROM THE PROPERTY OWNER.
9. DESIGN FINISHED SURFACE LEVELS OF STRUCTURES ARE FOR THE CONTRACTOR'S GUIDANCE ONLY. ACTUAL FINISHED LEVELS SHALL BE SET OUT AS DIRECTED ON SITE IN KEEPING WITH THE REQUIREMENTS AND SPECIFICATIONS OF **BRISBANE CITY COUNCIL** AND ACTUAL FINISHED GROUND LEVELS.

STORMWATER DRAINAGE NOTES

ALL STORMWATER PIPES 225Ø AND GREATER SHALL BE PRECAST FIBRE OR STEEL REINFORCED CONCRETE SPUN PIPES WITH RUBBER RING JOINTS CLASS 2, UNLESS NOTED OTHERWISE ON THE DRAWINGS. PIPES ABOVE 600Ø MAY BE FLUSH JOINTED.

GRADE STORMWATER PIPES OBVERT TO OBVERT UNLESS NOTED OTHER WISE. MAINTAIN 30mm DROP THROUGH STRUCTURES BETWEEN OBVERTS OF THE SAME SIZE PIPES.

MINIMUM COVER TO STORMWATER PIPES UNDER ROAD PAVEMENTS SHALL BE 600mm UNLESS NOTED OTHERWISE.

ALL MANHOLE LIDS SHALL FINISH FLUSH WITH ADJACENT FINISHED SURFACE LEVELS

PROVIDE A 100Ø SUBSOIL DRAIN WITH SOCK DISCHARGING INTO DRAINAGE STRUCTURES FROM UPSTREAM PIPE BEDDING, EXTEND 300mm INTO PIPE BEDDING.

ALL GRATED INLETS TO HAVE INGAL ENVIROPOD LITTER BASKETS INSTALLED OR APPROVED EQUIVALENT.

SCALE 1 : 200

0 2 4 6 8 10 (m)

ANY DAMAGE TO EXISTING ROADWAYS WILL BE RECTIFIED BY THE CONTRACTOR AT HIS EXPENSE.

THE CONTRACTOR IS TO NOTIFY THE SUPERVISING ENGINEER OF ANY DISCREPANCIES BETWEEN THE DESIGN PLANS AND THE CONDITIONS ON SITE PRIOR TO COMMENCEMENT OF ANY WORK

THE CIVIL CONTRACTOR WILL BE RESPONSIBLE FOR KEEPING ALL ROADS LEADING INTO THIS DEVELOPMENT FREE FROM DEBRIS, DUST, MUD, CONCRETE, ETC THAT MAY BE DEPOSITED DURING CONSTRUCTION

DIAL BEFORE YOU DIG www.1100.com.au

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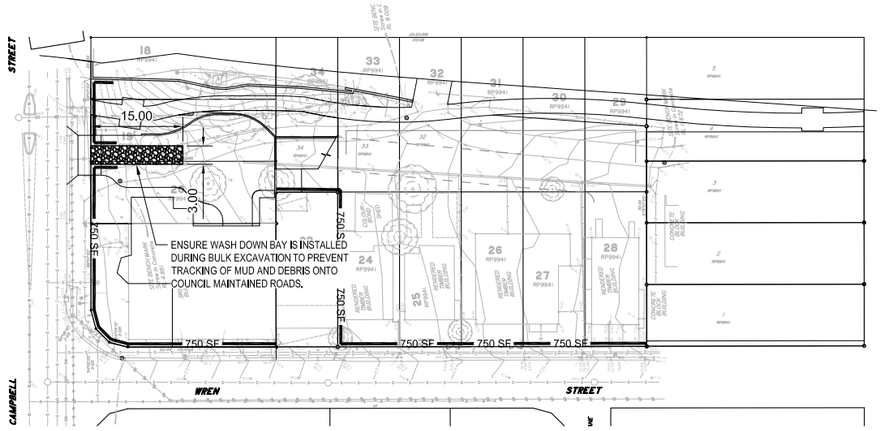
Drawn	Design	Checked	Supervisor	Drg. Size	Approved:	RPEQ.	Date:
CP	CP	GF	GF	A1		2331	

CONCEPT STORMWATER DRAINAGE PLAN

North:	Size of Land:	Job No.	Client:	Revision:
	0.301 HA	C14-016	IAN SMITH	A
	Scale: 1 : 200	Drawing No. SK01	Project: PROPOSED HOTEL AND CARPARK DEVELOPMENT AT CNR WREN AND CAMPBELL ST, BOWEN HILLS	

Appendix E - CONCEPT EROSION AND SEDIMENT CONTROL PLANS



LEGEND

- 750 SF — 750 HIGH BOUNADARY SEDIMENT FENCE
- 450 SF — 450 HIGH INTERNAL SEDIMENT FENCE
- GP GP GP — TEMPORARY SILT TRAPS
  - FABRIC DROP INLET PROTECTION
  - ON GRADE GULLY PROTECTION
  - SAG GULLY PROTECTION
- PROVIDE SHAKE-DOWN AREAS TO ROADS ENTRIES AS PER ACCESS & SHAKEDOWN AREA DETAIL ON THIS DRAWING.

ANY DAMAGE TO EXISTING ROADWAYS WILL BE RECTIFIED BY THE CONTRACTOR AT HIS EXPENSE.

BUILDER TO ENSURE ALL EXISTING SERVICES IN COUNCIL RESERVE BE PROTECTED FROM CONSTRUCTION TRAFFIC LOADS DURING CONSTRUCTION

NOTE: CONTRACTOR TO ENSURE TEMPORARY SILT TRAPS INSTALLED TO ALL STORMWATER GULLIES AND FIELD INLETS WITH 50m DOWNSTREAM OF SITE

SCALE 1 : 500

0 10 20 30 (m)

CONSTRUCTION SEQUENCE

1. ERECT SEDIMENT FENCE ALONG ADJACENT PROPERTY BOUNDARIES AND DOWNSTREAM RUNOFF BOUNDARIES. INSTALL SHACK DOWN DEVICE AT ENTRY.
2. CONSTRUCT DRAINAGE, SEWER AND WATER RETICULATION. ALL GULLY INLETS TO BE CLEAN WATER ONLY.
3. ALL ALLOTMENTS TO GRASS SEED AS DIRECTED.
4. ON COMPLETION OF WORKS AND 70% GRASS COVER AND APPROVAL BY COUNCIL. SEDIMENT BASIN TO BE REMOVED AND AREA TO BE REHABILITATED.

MAINTENANCE OF PUBLIC ROADS

ALL CONSTRUCTION VEHICLES DEPARTING THE SITE SHALL HAVE THEIR TYRES WASHED DOWN.

THE CONTRACTOR SHALL INSPECT THE PUBLIC ROADS ADJACENT TO THE SITE DAILY AND REMOVE ANY SOIL OR SILT DEPOSITS.

THE CONTRACTOR SHALL PROVIDE A WASH-DOWN AREA AND ANY STORMWATER INLETS ADJACENT TO THIS AREA ARE TO BE PROTECTED FROM SILT INFILTRATION.

THE WASH-DOWN AREA SHALL BE LOCATED SUCH THAT SILTED WATER IS FILTERED PRIOR TO LEAVING THE SITE. SHOULD THE WATER POND IT MUST BE TESTED IN ACCORDANCE WITH THE EROSION AND SEDIMENT CONTROL PROGRAM PRIOR TO DISPOSAL.

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EROSION & SEDIMENT CONTROL PROGRAM

MESH AND INLET PROTECTION DEVICES TO ALL GULLY PITS TO BE REMOVED DURING CONSTRUCTION OF ROADWAYS. AFTER ROADS HAVE BEEN COMPLETED CONTRACTOR TO ENSURE ALL GULLY GRATES ARE WRAPPED IN GEOFABRIC AND ROCK FILLED AGRICULTURAL PIPE PLACED ALONG LINTELS. (REFER DETAIL).

MESH AND INLET PROTECTION DEVICES TO FIELD INLETS TO REMAIN UNTIL SWALES HAVE BEEN TOPSOILED AND TURFED.

SEDIMENT PONDS TO BE REMOVED AT THE COMPLETION OF ALL WORKS OR WHEN ALL ALLOTMENTS HAVE 80% GRASS COVERAGE.

SEDIMENT FENCES TO REMAIN ALONG PROPERTY BOUNDARIES AND TO BE MAINTAINED/REPLACED DURING THE 'ON MAINTENANCE' PERIOD OR UNTIL LOTS ARE SOLD AND BUILDING CONSTRUCTION COMMEMCES.

THE CONTRACTOR TO REMOVE GULLY PIT PROTECTION DEVICES AFTER SUCCESSFUL 'ON MAINTENANCE' INSPECTION.

THE CONTRACTOR IS RESPONSIBLE FOR MAINTENANCE OF ALL SEDIMENT CONTROL DEVICES DURING CONSTRUCTION UNTIL AFTER SUCCESSFUL 'ON MAINTENANCE' INSPECTION.

SEDIMENT MANAGEMENT PROGRAM

1. CLEARING

- EARTH BANK AND TABLE DRAIN TO BE CONSTRUCTED ALONG THE TOP OF THE EXISTING BATTER.
- SEDIMENT FENCE, SAND BAGS, SEDIMENT BASINS AND EARTH RILLS TO BE ERECTED AS INDICATED OR REQUIRED.
- EXISTING GRASSED AREAS TO BE KEPT WHERE POSSIBLE.
- SHAKE DOWN/WASH DOWN BAY AT ENTRY/EXIT POINT AS REQUIRED BY COUNCIL OFFICER.

2. EARTHWORKS

- SEDIMENT FENCES, SEDIMENT BASINS AND EARTH RILLS WITHIN ROADS TO BE ERECTED AS INDICATED OR REQUIRED.

3. SEWER / ROOFWATER / STORMWATER / SERVICES

- EXCAVATED MATERIAL TO BE PLACED ON HIGH SIDE OF TRENCH AND TO PROTECT PIPE WORK AND DIRECT SURFACE MATERIAL AWAY FROM EXCAVATIONS.
- TOPSOIL AND GRASS SEED AREAS IN ALLOTMENTS IMMEDIATELY AFTER COMPLETING THE SEWER AND ROOFWATER DRAINAGE CONSTRUCTION.
- DEPRESS GROUND AROUND TEMPORARY FIELD INLETS TO CREATE SEDIMENT POND.

4. STOCKPILE

- SEDIMENT FENCE TO BE ERECTED 5m FROM TOE OF BATTER ON LOW SIDE OF STOCKPILE.

5. ROADWORKS

- SEDIMENT FENCES TO ALLOTMENTS TO BE ERECTED.
- KERB INLET PROTECTION TO BE PROVIDED.
- SAND BAGS SURROUND SAG GULLY PITS AS INDICATED.

6. ALLOTMENTS

- MULCH AS DIRECTED AND TOPSOIL AND SEED ALLOTMENTS.
- SEDIMENT FENCES TO ALLOTMENTS TO BE RE-ERECTED.
- COVERS TO GULLY GRATES TO BE REMOVED IF THE SUPERINTENDENT INDICATES THE GRASS STRIKE IS SUFFICIENT.
- ESTABLISHMENT OF 70% COVERAGE WITHIN 30 CALENDAR DAYS OF COMPLETION OF WORKS.

7. MAINTENANCE PERIOD

- ALL ESC MEASURES SHALL BE INSPECTED.
  a. AT LEASE DAILY (WHEN WORK IS OCCURRING ON SITE) OR WEEKLY (WHEN WORK IS NOT OCCURRING ON SITE)
  b. WITHIN 24 HOURS OF EXPECTED RAIN, AND
  c. WITHIN 18 HOURS OF A RAINFALL EVENT
- ALL ESC MEASURES SHALL BE MAINTAINED THE SAME DAY WHEN THE CAPACITY OF THE ESC MEASURE FALLS BELOW 75%.

SILT AND SEDIMENTATION NOTES

DESIGNED IN ACCORDANCE WITH SOIL EROSION AND SEDIMENT CONTROL ENGINEERING GUIDELINES FOR QUEENSLAND & REGULATORY AUTHORITIES REQUIREMENTS.

ALL WORK, FIXTURES, FITTINGS & STRUCTURES SHALL COMPLY WITH & BE CARRIED OUT TO SOIL EROSION & SEDIMENT CONTROL ENGINEERING GUIDELINES OF QLD REGULATORY AUTHORITIES REQUIREMENTS

PROVIDE, INSTALL AND MAINTAIN ALL BARRIERS, GROSS POLLUTANT TRAPS, CONSTRUCTION EXITS, PUMP SUCTION PITS, POLLUTANT AND SEDIMENT TRAPS FENCES NECESSARY FOR THE CONTROL OF EROSION AND SEDIMENTATION WITHIN AND AROUND THE SITE DURING CONSTRUCTION. ALL IN ACCORDANCE WITH SOIL EROSION AND SEDIMENT CONTROL ENGINEERING GUIDELINES FOR QUEENSLAND & REGULATORY AUTHORITIES REQUIREMENTS.

EXACT DETAIL, TYPE & EXTENT OF SEDIMENT FENCE SHALL BE DETERMINED ON SITE IN CONJUNCTION WITH REGULATORY AUTHORITY TO ACHIEVE & MAINTAIN A SUITABLE LEVEL OF PERFORMANCE FOR THE EXPECTED FLOWS, INCLUDING POSSIBLE OVERLAND FLOWS.

PROVIDE AND INSTALL 700mm HIGH SEDIMENT FENCE AROUND SITE. EXACT EXTENT OF FENCE SHALL BE DETERMINED ON SITE IN CONJUNCTION WITH REGULATORY AUTHORITY.

PROVIDE AND INSTALL 450mm HIGH SEDIMENT FENCE COMPLETELY AROUND ALL OPEN STORMWATER PIPES AT THE END OF EACH DAYS WORK & IMMEDIATELY PRIOR TO ANY STORM EVENT.

PROVIDE AND INSTALL 450mm HIGH SEDIMENT FENCE COMPLETELY AROUND ALL SWSs, GRATED TRENCHES & GRATES.

PROVIDE AND INSTALL CONSTRUCTION ENTRY / EXIT SEDIMENT CONTROL STRUCTURE.

PROVIDE AND INSTALL SEDIMENT BARRIERS TO ALL EXISTING ROAD INLET GULLIES AFFECTED BY CONSTRUCTION.

CONSTRUCTION OF ALL SEDIMENT MANAGEMENT DEVICES SHALL BE COMPLETED AND EFFECTIVE PRIOR TO STRIPPING OF TOP SOIL AND GRASS, BULK EARTHWORKS TO SITE, AND SERVICE INSTALLATION.

ALL SEDIMENT MANAGEMENT DEVICES ARE TO REMAIN IN PLACE UNTIL WRITTEN NOTICE FROM LICENSING AND COMPLIANCE.

BOTH TEMPORARY AND PERMANENT SEDIMENTATION MANAGEMENT DEVICES SHALL BE MAINTAINED AT A SUITABLE LEVEL / CONDITION THROUGHOUT CONSTRUCTION.
SEDIMENT FENCES ARE TO BE CLEANED OUT WHEN CAPACITY IS REDUCED BY 30%.

PRIOR TO COMMENCEMENT OF CONSTRUCTION, APPROVAL SHALL BE OBTAINED FROM LICENSING AND COMPLIANCE FOR THE LOCATION OF THE SITE ACCESS POINT AND WASH DOWN AREA WHICH SHALL BE MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD.

IF EROSION AND SEDIMENT CONTROL DEVICES HAVE BEEN FOUND TO BE DEFICIENT OR FAILED IN SERVICE, DUE TO UNFORESEEN CIRCUMSTANCES, CORRECTIVE ACTION IS TO BE UNDERTAKEN IMMEDIATELY WHICH MAY INCLUDE AMENDMENTS / ADDITIONS TO THE ORIGINAL EROSION CONTROL PLANS. SUCH ADDITIONS OR AMENDMENTS ARE TO BE APPROVED BY LICENSING AND COMPLIANCE OFFICER AND REGULATORY AUTHORITY.

THE INSTALLATION, REMOVAL, RELOCATION, OR MODIFICATION TO EROSION AND SEDIMENT CONTROL DEVICES MAY BE MADE BY A LICENSING AND COMPLIANCE OFFICER AND REGULATORY AUTHORITY IF DEEMED NECESSARY AND RELEVANT.

ALL MUD TRACKED ONTO COUNCIL ROADS SHALL BE BROOMED OFF IMMEDIATELY (NOT WASHED OFF ONTO COUNCIL STORMWATER SYSTEM).

ADDITIONAL SEDIMENT AND EROSION CONTROL MEASURES TO BE IMPLEMENTED DURING CONSTRUCTION WHERE AS DIRECTED BY COUNCIL REPRESENTATIVE.

NOTE

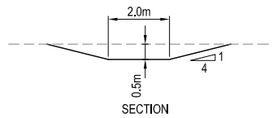
ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CURRENT BRISBANE CITY COUNCIL SPECIFICATIONS, STANDARD DRAWINGS AND STANDARD DETAILS.

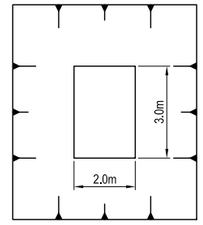
PUMP WATER NOTE:
IF PUMPED SITE WATER IS PROPOSED TO DISCHARGE TO KERB & CHANNEL, THE OUTLET FROM THE PUMP IS TO FEED TO A MANHOLE/CHAMBER (LOCATED WITHIN THE PROPERTY BOUNDARY) WHICH THEN DRAINS BY GRAVITY TO THE KERB AND CHANNEL (WITH DISCHARGE LIMITED TO 30L/s)

ANY WATER WHICH IS PUMPED FROM THE SITE MUST BE FLOCULATED PRIOR BEING DISCHAGRED INTO EXISTING KERB & CHANNEL / STORMWATER GULLY PIT. ALTERNATIVELY ALL WATER IS TO BE COLLECTED VIA A SUITABLE TRUCK AND DISPOSED OF AT AN APPROVED FACILITY.

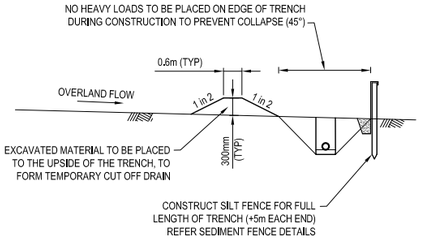
SUMP NOTES

1. AT THE END OF EACH DAYS WORK, OR BEFORE RAINFALL EVENTS, A TEMPORARY SUMP SHALL BE PROVIDED AT THE CURRENT EARTHWORKS LEVEL FOR EACH BUILDING.
2. ALL EXPOSED AREAS SHALL DRAIN TOWARDS THE BASIN
3. EROSION AND SEDIMENT CONTROL DEVICES SHALL BE IMPLEMENTED AT ALL TIME TO MINIMIZE THE SCOURING OF THE EXPOSED SURFACE

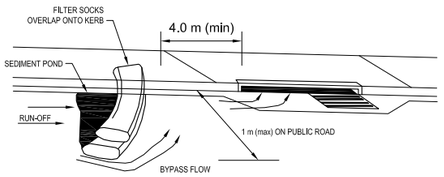




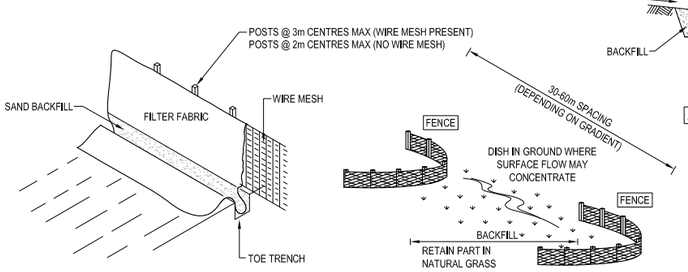
SUMP DETAIL



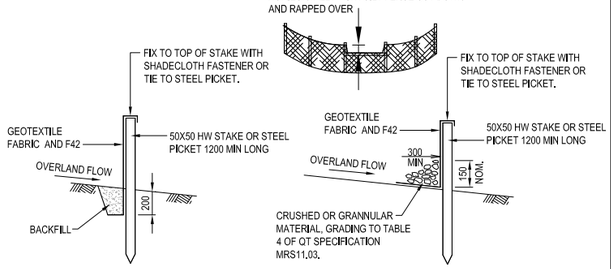
TYPICAL TRENCH LAYOUT

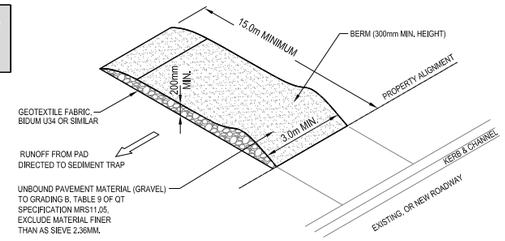


ON-GRADE KERB INLET SEDIMENT TRAP



SEDIMENT FENCE

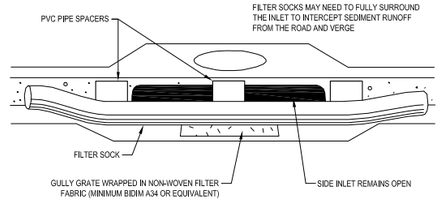




TEMPORARY CONSTRUCTION ENTRY / EXIT SEDIMENT TRAP

ENTRY / EXIT NOTES

1. TEMP CONSTRUCTION ENTRY/EXIT SEDIMENT TRAP.
   1.a. ADJACENT STORMWATER RUNOFF TO BE DIVERTED AWAY FROM ENTRY/EXIT.
   1.b. WHEEL - WASH OR SPRAY UNIT MAY BE REQUIRED DURING WET WEATHER.
2. SAFETY ISSUES MUST BE CONSIDERED AT ALL TIMES. INCORPORATE TRAFFIC CONTROL DEVICES TO THE SATISFACTION OF THE SUPERINTENDENT.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS INDICATED OTHERWISE.



NOTE:

1. SAG GULLIES SHALL HAVE EQUAL PORTIONS OF AGGREGATE FILLED SUBSOIL DRAIN TO BOTH SIDES OF GRATE
2. TRAP SHALL BE MANUALLY CLEANED AFTER EACH RAINFALL EVENT OR AS INSTRUCTED BY SUPERINTENDENT
3. IF SUBSOIL DRAIN MOVEMENT IS EVIDENT WEIGH DOWN WITH INTERMITTENT SAND BAGS

SAG INLET SEDIMENT TRAP

200mm TO 300mm GAP AT LOWEST POINT OF SILT FENCE FOR OVERFLOW. STAKE WIRED HORIZONTALLY WITH SILT FENCE CUT DOWN AND RAPPED OVER

SILT FENCE NOTES

A. NOT TO BE LOCATED IN AREAS OF CONCENTRATED FLOW.
B. NORMALLY LOCATED ALONG THE CONTOUR WITH A MAXIMUM CATCHMENT AREA 0.6 HA PER 100M LENGTH OF FENCE.
C. WOVEN FABRICS ARE PREFERRED, NON-WOVEN FABRICS MAY BE USED ON SMALL WORK SITES, I.E. OPERATIONAL PERIOD LESS THAN 6 MONTHS OR ON SITES WHERE SIGNIFICANT SEDIMENT RUNOFF IS NOT EXPECTED.
D. WHERE FENCES NEED TO BE LOCATED ACROSS THE CONTOUR THE LAYOUT SHALL CONFORM TO 'TYPICAL LAYOUT ACROSS GRADE'.
E. FENCES ARE REQUIRED 2M MIN FROM TOE OF CUT OR FILL BATTERS, WHERE NOT PRACTICAL ONE FENCE CAN BE AT THE TOE WITH A SECOND FENCE 1M MIN AWAY, FENCE SHOULD NOT BE LOCATED PARALLEL WITH TOE IF CONCENTRATION OF FLOW WILL OCCUR BEHIND THE FENCE.

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CONCEPT EROSION AND SEDIMENT CONTROL

North:	Size of Land:	Job No.	Client:	Revision:
	0.301 HA	C14-016	IAN SMITH	A
	Scale: 1 : 500	Drawing No. SK02	Project: PROPOSED HOTEL AND CARPARK DEVELOPMENT AT CNR WREN AND CAMPBELL ST, BOWEN HILLS	

Appendix F - MONITORING AND MAINTENANCE DOCUMENTATION

OPERATION AND MAINTENANCE GUIDELINES

StormFilter

Note: This guideline should be used as a part of the site stormwater management plan and is to be read in conjunction with the site specific Maintenance Schedule.

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SECTION 1

1.1 DESCRIPTION

StormFilter is a passive, flow-through stormwater filtration system. It consists of vaults that house rechargeable cartridges filled with a variety of filter media. The filter systems are installed in-line with storm drains. The StormFilter works by passing stormwater through media-filled cartridges, which trap particulates and adsorb materials such as dissolved metals and hydrocarbons. After being filtered through the media, the treated stormwater flows into a collection pipe or discharges into an open channel drainage way. StormFilter is offered in three different configurations: cast-in-place, precast and linear. The precast and linear models utilize pre-manufactured vaults. The cast-in-place units are customized for larger flows and may be either covered or uncovered underground units.

1.2 OPERATION

1.2.1 Purpose

The StormFilter is a passive stormwater filtration system designed to improve the quality of stormwater runoff from the urban environment before it enters receiving waterways.

Through independent third party studies, it has been demonstrated that the StormFilter is highly effective for treatment of first flush flows and flow-paced flows during the latter part of a storm. In general, StormFilter's efficiency is highest when pollutant concentrations are highest. The primary target pollutants for removal are: sediments (TSS), soluble metals, soluble phosphorus, nitrates, and oil and grease.

1.2.2 Sizing

The StormFilter® is typically sized to treat the peak flow of a water quality design storm as it passes through the filter. The peak flow is determined by calculations based on the contributing watershed hydrology and using a design storm magnitude. The design storm is usually based on the regulatory requirements set by the local stormwater management agency. The particular size of a StormFilter is determined by the number of filter cartridges (see Figure 4) required to treat the peak stormwater flow. Each cartridge is designed to treat a peak flow of 1 Litre/second. For example: a peak design stormwater flow rate of 10L/s would require that 10 cartridges be used in the treatment vault.

Because of the highly porous nature of the granular filter media, the flow through a newly installed cartridge is restricted to 1L/s, using a restrictor disc, to ensure adequate pollutant-media contact time.

1.2.3 Basic Function

The StormFilter is designed to siphon stormwater runoff through a filter cartridge containing media. The variety of media available can be designed to act as a mechanical filter to remove sediments, as an ion exchanger to remove dissolved heavy metals, and as an adsorber to remove oils and greases.

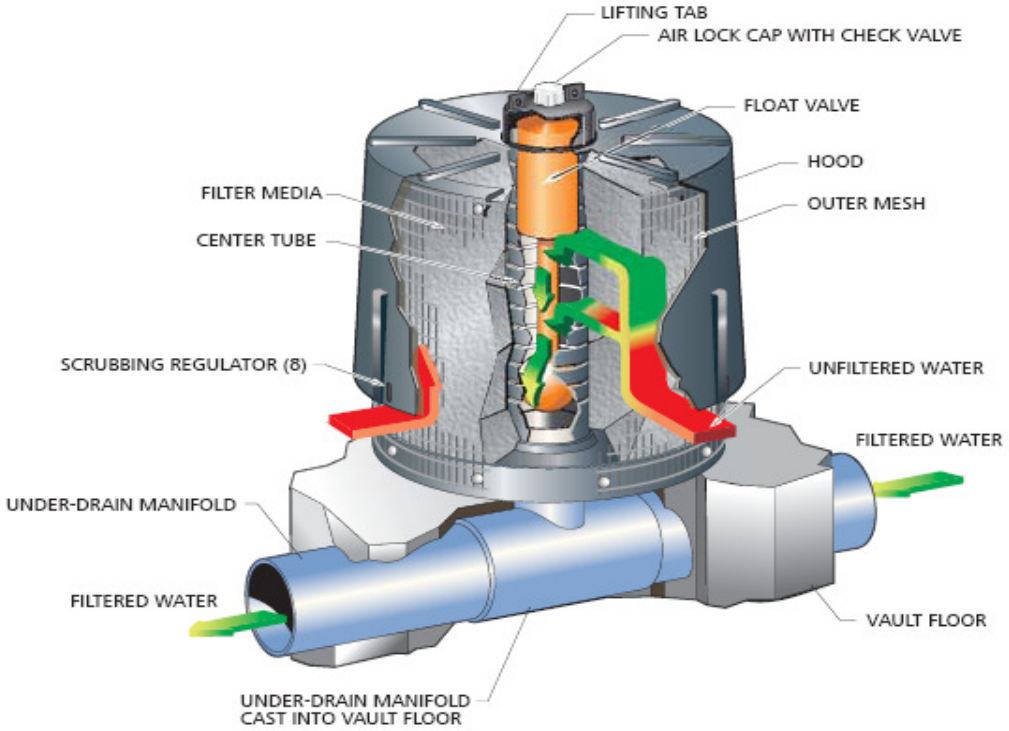

Figure 4. Filter Cartridge

1.2.4 Priming System Function

The treated stormwater collects in the centre tube of the cartridge, which is equipped with a self-priming siphon system. Figure 1 illustrates this system. The key component of the system is the plastic float. The float consists of a ball located at the base leading up to a larger portion, which provides increased buoyancy. Initially the ball rests in a seat effectively closing off the port to the drainage manifold.

As a result, the filter fills the centre drainage tube until the water level has risen high enough to purge the air from the filter cartridges and displaces the float. At a water depth of 22 inches the float pulls loose and allows the filtered water to drain out through the manifold. This effectively "primes" a siphon within the drainage tube and greatly increases the potential across the filter. The priming system increases StormFilter's ability to be loaded with sediment. A related feature is the cartridge "hood". This hood maintains the siphon effect by preventing air from being drawn into the cartridge until the external water level drops below the bottom of the hood.

Cartridges are connected to the manifold with a plastic connector. Since some media used is potentially buoyant, a threaded connector affixed to the manifold with compression bolts is necessary to ensure the cartridge isn't lifted out of place. For the heavier leaf media, a slip connector is used.

StormFilter is also equipped with flow spreaders that trap floating debris and surface films, even during overflow conditions. Depending on individual site characteristics, some systems are equipped with high and/or low flow bypasses. High flow bypasses are installed when the calculated peak storm event generates a flow that overcomes the overflow capacity of the system. This is especially important for precast systems. Low flow bypasses are sometimes installed to bypass continuous inflows caused by ground water seepage, which usually do not require treatment. All StormFilter units are designed with an overflow. The overflow operates when the inflow rate is greater than the infiltration capacity of the filter media.

1.2.5 Maintenance Overview

The primary purpose of the StormFilter is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. To assist the owner with maintenance issues, Stormwater360 provides detailed Operation & Maintenance Guidelines with each unit.

Stormwater360 can provide maintenance services completely, or in part. Available services include tracking of installed systems, advising the system's owner of maintenance needs, and notification of the regulatory agency once the system has been maintained.

Maintenance is usually performed in the dryer periods to rejuvenate the filter media and prepare the system for the next rainy period. Maintenance activities can also be required in the event of a chemical spill or excessive sediment loading due to site erosion or extreme storms. It is good practice to inspect the system after severe storm events.

END OF SECTION 1

SECTION 2

RECOMMENDED MAINTENANCE AND EXPECTED PERFORMANCE

2.1 TYPES OF MAINTENANCE

Presently, procedures have been developed for two levels of maintenance: Inspection/minor maintenance and major maintenance. Inspection/minor maintenance activities are combined since the minor maintenance does not require special equipment and typically little or no materials are in need of disposal. Inspection/minor maintenance typically involves opening the flow restricting valves (to pre-set levels) and cleanup of vegetation and debris. Major maintenance typically includes cartridge recharging. Major maintenance may involve disposal of materials that require consideration of regulatory guidelines. Depending on the particular unit configuration and equipment used, major maintenance may require an understanding of OSHA rules. Table 1 summarizes the primary activities associated with StormFilter maintenance.

Table 1: StormFilter

Facility Component Requiring Maintenance	Maintenance Activity	When Maintenance Activity Is Required	Expected Facility Performance After Maintaining
StormFilter® Cartridges and Containment Structure	Trash and Debris Removal	Floatable objects or other trash is present in the filter. Remove to avoid hindrance of filtration and eliminate unsightly debris and trash.	Permanent removal from storm system.
	Cartridge Replacement and Sediment Removal	1. Media has been contaminated by high levels of pollutants, such as after a spill.	1. New media is able to effectively treat stormwater.
Drainage System Piping	Flushing With Water	Drainage system is obstructed by debris or sediment.	Outflow is not restricted.

2.2 MAINTENANCE ACTIVITIES

2.2.1 Maintenance Activity Timing

Two scheduled inspections/maintenance activities should take place during the year. During the minor maintenance activities (routine inspection, debris removal), the type of major maintenance required is determined and, if required for disposal, samples of the sediments and media are obtained. The next scheduled date is to perform major maintenance activities (replacement of the filter cartridges and associated sediment removal). In addition to the scheduled activities, it is important to check the condition of the filter after major storms to check for damage caused by high flows and to check for high sediment accumulation, which may be caused by localised erosion in the drainage area. It may be necessary to adjust maintenance activity scheduling depending on the actual operating conditions encountered by the system.

2.2.2 Maintenance Activity Frequency

The primary factor controlling timing of maintenance for the StormFilter is sedimentation. A properly functioning system will remove solids from water by trapping these particulates within the porous structure of the media. The flow through the system will naturally decrease as more and more solids are trapped. Eventually the flow through a system will be low enough to require replacement of the cartridges. Sediment should be removed from upstream trapping devices on an as needed basis to prevent material from being re-suspended and discharged to the system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction should be inspected and maintained more often than those in fully established areas. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after large storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual filter. It is recommended that the maintenance agency develop a database to properly manage StormFilter maintenance programs.

Prior to the development of the maintenance database, maintenance frequencies shown in Table 3 should be followed. Frequencies should be updated as required. The recommended initial frequency for inspection/minor maintenance is two times per year for the system. StormFilter units should be inspected after all major storms. Sediment removal on an annual basis is recommended until further knowledge is gained about a particular system.

Table 3: FREQUENCY OF MAINTENANCE ACTIVITY

	INSPECTION/MINOR MAINTENANCE (TIMES/YEAR)	MAJOR MAINTENANCE (TIMES/YEAR)
StormFilter	2 (and after major storms)	1 (except in case of a spill)

2.3 MAINTENANCE CREW REQUIREMENTS

Table 4 lists the anticipated crew requirements for maintenance operations. Removal of water and sediments during major maintenance activities can be accomplished using either a pump and water truck or a vacuum truck. All applicable safety (OH & S) and disposal regulations should be followed. A general description of the maintenance activities follows.

Table 4: ANTICIPATED CREW REQUIREMENTS

	Inspection/Minor Maintenance	Major Maintenance: Sediment Removal	Major Maintenance: Cartridge Replacement
Labourer	1		1
Skilled Worker	1	1	1
Vacuum/Water Truck Operator		1	0/1
Total	**2***	**2***	**2/3***
Special Requirements	Knowledge of Proper StormFilter Function	Knowledge of Disposal Requirements	Knowledge of Cartridge Removal and Installation Procedures

* May require OH & S trained person if/when vault entry occurs.

2.4 MAINTENANCE METHODS

2.4.1 Minor Maintenance/Inspection (Twice A Year)

Minor maintenance typically will involve the steps below, however if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

Steps for Minor Maintenance

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.

2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also set up appropriate safety equipment for work near roadways.

3. Inspect the external condition of the unit and take notes concerning defects/problems.

4. Open the doors to the vault and allow the system to air out for 5-10 minutes.

5. **Without entering the vault**, inspect the inside of the unit, including components.

6. Take notes about the external and internal condition. This includes inspecting pit penetrations, walls, lids, ladders & grates etc.

7. Give particular attention to recording the level of sediment build-up on the floor of the vault in the forebay (or pre-treatment bay), and on top of the internal components. If flow is occurring, note the level of water and estimate the flow rate per drainage pipe. Record all observations.

8. Remove large loose debris and trash using a pole with a grapple or net on the end.

9. Close and fasten the door, and remove safety equipment.

10. Finally, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.

2.4.2 Major Maintenance Inspection (Once a Year)

The primary goal of the major maintenance inspection is to assess the condition of the cartridges relative to the level of sediment loading. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present and very little flow will be discharging from the drainage pipes. It is likely that the cartridges need to be replaced. Major maintenance inspection will typically involve the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained**.

Steps for Pre-Major Maintenance Inspection

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.

2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.

3. Inspect the external condition of the unit and take notes concerning defects/problems.

4. Open the doors to the vault and allow the vault to air out for 5-10 minutes.

5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.

6. Take notes about the external and internal condition.

7. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.

8. Remove large loose debris and trash using a pole with a grapple or net on the end.

9. If the visit is during a storm, make the flow observations discussed above.

10. Close and fasten the door, and remove safety equipment.

11. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.

12. Review the condition reports from the previous minor and major maintenance visits and schedule for cartridge replacement if needed.

2.4.3 Major Maintenance: Sediment Removal & Cartridge Replacement (& Emergency)

Major maintenance/filter cartridge replacement typically involves the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.** Depending on the configuration of the particular system, a worker may be required to enter the vault to perform some tasks. If vault entry is required, OH & S rules for general confined space entry must be strictly adhered to. Filter cartridge replacement should occur during dry weather and it may be necessary to plug the filter inlet pipe if base flows exist. Standing water present in the vault should be regarded as polluted and contained during this operation by temporarily capping the manifold connectors.

Steps For Cartridge Replacement Maintenance (With Vacuum Truck)

1. Depending on the particular unit, one or two utility workers and a hauling truck operator will deliver the replacement cartridges to the site. Information concerning how to obtain the replacement cartridges is available from Stormwater360.

2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.

3. Inspect the external condition of the unit and take notes concerning defects/problems.

4. Open the doors to the vault and allow the system to air out for 5-10 minutes.

5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.

6. Make notes about the external and internal condition.

7. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.

8. Remove large loose debris and trash using a pole with a grapple or net on the end.

9. Ensuring safe working procedures are met, off load the replacement cartridges (16-39kgs each) and set aside.

10. Remove the top cap (threaded), upper seal and float from the cartridge. Repeat procedure for every cartridge within StormFilter vault. Place items in a large plastic container to be lifted form the vault.
    Note: * Confined space entry may be required on StormFilter systems. In this case, please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 immediately.

11. Using a cordless drill and 8mm hex head, remove the three screws located around the top perimeter of the cartridge hood. Place screws in the large plastic container and, once full or completed, remove plastic container form vault.

12. Move the Vacuum truck near the StormFilter vault on the down wide side. Be sure that the Vacuum truck is not too close to the vault so as the fumes will not enter the vault. Make sure that the last 500mm of the nozzle is approx. 100-125mm in outside diameter.

13. Feed vacuum nozzle into cartridge bay and start vacuum truck. Remove cartridge hood and place nozzle directly onto filter media. Completely remove media from each cartridge and repeat process for every cartridge in vault.

14. Once completed unthread cartridges from vault floor and place hood back on cartridges

15. Using the appropriate lifting cap, attach the cable and remove the cartridge (up to 10kgs. each) from the vault. Personnel standing under suspended cartridges is strictly prohibited. Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless maintenance activities are being performed by Stormwater360 and damage is not related to discharges to the system.

16. Set the used cartridge aside or load onto the hauling truck.

17. Repeat steps 14 to 15 once all cartridges have been removed.

18. Remove deposited sediment from the floor of the vault and, if large amounts are present, from the forebay. This can be accomplished by using the Vacuum truck

15 Once the sediments are removed, it is necessary to assess the condition of the vault, particularly the manifold and the connectors. These are short sections of 2-inch schedule 50 PVC, or threaded schedule 80 PVC that should protrude above the floor of the vault. If required, apply a light coating of FDA approved silicon grease to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe. Replace any damaged connectors.

16. Using the boom, crane, or tripod, lower and install the new cartridges (typically 16-17kgs. for perlite cartridges). Once again, take care not to damage connections.

17. Close and fasten the door, and remove safety equipment.

18. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.

19. Finally, dispose of the residual materials in accordance with applicable regulations. Make arrangements to return the used cartridges to Stormwater360.

<u>Steps For Cartridge Replacement Maintenance (Without Vacuum Truck)</u>

1. Depending on the particular unit, one or two utility workers and a hauling truck operator will deliver the replacement cartridges to the site. Information concerning how to obtain the replacement cartridges is available from Stormwater360.

2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.

3. Inspect the external condition of the unit and take notes concerning defects/problems.

4. Open the doors to the vault and allow the system to air out for 5-10 minutes.

5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.

6. Make notes about the external and internal condition.

7. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.

8. Remove large loose debris and trash using a pole with a grapple or net on the end.

9. Ensuring safe working procedures are met, off load the replacement cartridges (16-39kgs each) and set aside.

10. Using the appropriate lifting cap, attach the cable from the boom, crane, or tripod to the cartridge being removed. Personnel standing under suspended cartridges is strictly prohibited. For more information contact Stormwater360. This activity may require that workers enter the vault* to remove the cartridges from the drainage system, and place them under the vault opening for lifting. Note that cartridges require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary. (See figure 4).

    Note: * Confined space entry may be required on StormFilter systems. In this case, please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 immediately.

11. Remove the cartridge (up to approx. 60kgs. each for Perlite/Zeolite mix saturated & occluded cartridges) from the vault. Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless maintenance activities are being performed by Stormwater360 and damage is not related to discharges to the system.

12. Set the used cartridge aside or load onto the hauling truck.

13. Continue steps 10 through 12 until all cartridges have been removed.

14. Remove deposited sediment from the floor of the vault and, if large amounts are present, from the forebay. This can usually be accomplished by shoveling the sediment into containers which, once full, are lifted mechanically from the vault and placed onto the hauling truck. In some cases of extreme sediment loading, especially if the sediment is saturated, a vacuum truck may be required.

15 Once the sediments are removed, it is necessary to assess the condition of the vault, particularly the manifold and the connectors. These are short sections of 2-inch schedule 50 PVC, or threaded schedule 80 PVC that should protrude above the floor of the vault. If required, apply a light coating of FDA approved silicon grease to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe. Replace any damaged connectors.

16. Using the boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.

17. Close and fasten the door, and remove safety equipment.

18. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.

19. Finally, dispose of the residual materials in accordance with applicable regulations. Make arrangements to return the used cartridges to Stormwater360.

2.4.4 Related Maintenance Activities (Performed on an as-needed basis)

StormFilter units are often just one of many components in a more comprehensive stormwater drainage and treatment system. The entire system may include catch basins, detention vaults, sedimentation vaults and manholes, detention/retention ponds, swales, artificial wetlands, and other miscellaneous components. In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities. In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil and grease loading, and discharges of inappropriate materials.

2.5 TYPICAL EQUIPMENT REQUIRED FOR MAINTENANCE ACTIVITIES

Typical equipment required for conducting maintenance is shown in Table 5. Some of the materials listed are suggestions rather than requirements. It should be noted that there is more than one way to accomplish some tasks. Owners with available labour and equipment resources may desire to use alternative methods. However, it is advisable that guidance from Stormwater360 be obtained prior to using alternative techniques.

Table 5: MAINTENANCE EQUIPMENT REQUIREMENTS

Maintenance Equipment Required		
Minor Maintenance	**Pre-Major Maintenance Inspection**	**Major Maintenance Cartridge Replacement**
Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.	Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.	Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.
Work Clothes: Rubber boots, overalls, and gloves.	Work Clothes: Rubber boots, overalls, and gloves.	Work Clothes: Rubber boots, overalls, and gloves.
Door Bolt, Wrench, proprietary lifters (eg Gatic) and Miscellaneous Tools.	Door Bolt, Wrench, proprietary lifters (eg Gatic) and Miscellaneous Tools.	Door Bolt, Wrench, Pentasocket and Miscellaneous Tools.
Tape Measure	Tape Measure	Tape Measure
Flashlight	Flashlight	Flashlight
Grapple or Net Pole	Grapple or Net Pole	Grapple or Net Pole
Record Keeping Forms	Record Keeping Forms	Record Keeping Forms
Trash/Debris Container	Trash/Debris Container	Vacuum Truck
		Replacement Cartridges
		Cartridge Hauling Truck
		Crane, Tripod and Hoist, or Other Lifting Device (150kg minimum capacity)
		Shovels
		Extra 50mm PVC cartridge connectors
		Spare Flow Restrictor disks
		Trash/Debris Container
		Vault Inlet Pipe Plug
		Dolly
		PVC Pipe Cutter
		Ladder
		Cartridge Installation and Removal Sling

*** Confined space equipment may be required for vault entry. This equipment must be used by personnel with the appropriate OH & S training. This equipment typically includes: Atmospheric testing devices, atmospheric purging and ventilating devices, and entry, exit, and rescue assisting devices.**

2.6 MATERIAL DISPOSAL

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in a manner that will not allow the material to affect surface or ground water. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads. Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. It is not appropriate to discharge these materials back to the stormwater drainage system. Part of arranging for maintenance to occur should include coordination of disposal of solids (landfill coordination) and liquids (municipal vacuum truck decant facility, local wastewater treatment plant, on-site treatment and discharge). Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals. Disposal methods or reuse of the media contained in the cartridges will be determined by Stormwater360. If the material has been contaminated with any unusual substance, the cost of special handling and disposal will be the responsibility of the owner.

Sample StormFilter Minor Maintenance Inspection Data Sheet

Date: _____ **Location**: _____

System Size: _____ TYPE: Cast-In-Place Precast Linear

Personnel: _____

System Observations

Media Months in Service: _____

Oil and Grease in Forebay: _____

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

_____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged? (Yes _____ No _____) How Deep? _____

StormFilter Minor Maintenance Activities (check off if done and give description)

Remove Trash and Debris: _____

Minor Structural Repairs: _____

Drainage Area Report

Excessive Oil and Grease Loading (Yes _____ No _____) Source: _____

Sediment Accumulation on Pavement (Yes _____ No _____) Source: _____

Erosion of Landscaped Areas (Yes _____ No _____) Source: _____

Items Needing Further Work: _____

_____

_____

Comments: _____

_____

Sample StormFilter Major Maintenance Inspection Data Sheet

It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present, very little flow will be discharging from the drainage pipes, and it is likely that the cartridges need to be replaced during major maintenance.

Date: _____ **Location**: _____

System Size: _____ **TYPE: Cast-In-Place Precast Linear**

Personnel: _____

System Observations

Media Months in Service: _____

Oil and Grease in Forebay: _____

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged? (Yes _____ No _____) How Deep? _____

Drainage Area Report

Excessive Oil and Grease Loading (Yes _____ No _____) Source: _____

Sediment Accumulation on Pavement (Yes _____ No _____) Source: _____

Erosion of Landscaped Areas (Yes _____ No _____) Source: _____

Comments: _____

_____

_____

_____

Review the condition reports from the previous minor and major maintenance visits.

Sample StormFilter Major Maintenance/Cartridge Replacement Data Sheet

Date: _____ **Location**: _____

System Size: _____ **TYPE: Cast-In-Place Precast Linear**

Personnel: _____

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Media Months in Service: _____

Oil and Grease in Forebay: _____

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Drainage Area Report

Excessive Oil and Grease Loading (Yes _____ No _____) Source: _____

Sediment Accumulation on Pavement (Yes _____ No _____) Source: _____

Erosion of Landscaped Areas (Yes _____ No _____) Source: _____

StormFilter Cartridge Replacement Maintenance Activities (check off it done and give description)

Remove Trash and Debris (Yes _____ No _____) Details: _____

Replace Cartridges (Yes _____ No _____) Details: _____

Sediment Removed (Yes _____ No _____) Details: _____

Quantity of Sediment Removed (estimate?): _____

Minor Structural Repairs (Yes _____ No _____) Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes/Problems: _____