The University of Sydney

ETP Stage 1

Civil Design Report

70% Detail Design

THE UNIVERSITY OF SYDNEY

Prepared for The University of Sydney

Report Amendment Register

Rev. No.	Page No.	Issue/Amendment	Author/Initials		Reviewer/Initials		Date
A	-	Issue for SSDA	Aleksandar Vasiloski	AV	Stephen Naughton	SN	1/12/17
B	-	30% Schematic Design	Aleksandar Vasiloski	AV	Stephen Naughton	SN	2/07/18
C	-	Updated flooding section	Jacky Hu	JH	Stephen Naughton	SN	3/09/18
D	-	Updated water quantity & quality (70% DD)	Jacky Hu	JH	Vincent Chu	VC	3/10/18
E	-	70% DD	Jacky Hu	JH	Stephen Naughton	SN	25/10/18
F		70% DD	Jacky Hu	JH	Stephen Naughton	SN	26/10/18
G		70% DD	Jacky Hu	JH	Stephen Naughton	SN	06/11/18
H		70% DD	Jacky Hu	JH	Vincent Chu	VC	23/11/18

Table of Contents

1. Design, Authority & Compliance Issues

1.1. Summary

The civil design complies with authority requirements as it demonstrates that there are no adverse flooding impacts off site and that adequate protection to the 1% AEP flood level at proposed building entrances are provided. Stormwater quantity and quality targets have also been met. Below provides a summary of the authority's requirements.

Authority	Requirement	Compliance
City of Sydney Interim Floodplain Management Policy	Protection of commercial property on merit-based approach to a minimum of 1% AEP level.	Building entrances have been protected to the 1% AEP via the incorporation of landscaping, walls and subsurface drainage. Refer to section 3.2.
City of Sydney Interim Floodplain Management Policy	Existing development will not be adversely flood affected through increased damage or hazard as a result of any new development	Flood afflux mapping have been produced to demonstrate no adverse impact as a result of the development.
Sydney Water Corporation On Site Detention Policy	OSD designed to meet Permissible Site Discharge (which is Maximum rate of discharge for the total site that the existing downstream stormwater system can handle). Post developed flow to be less than pre developed flow.	OSD is to be incorporated into basin D (Micky Mouse basin) and post developed flows will be less than or equal to pre developed flows. Refer to section 3.4
City of Sydney (CoS) Development Control Plan 2012	Stormwater quality assessment is required to demonstrate that the development will achieve the post development pollutant load standards as follows: • 90% reduction in Gross Pollutants greater than 5mm, • 85% reduction in Total Suspended Solids, • 65% reduction in total phosphorous runoff, and • 45% reduction in total nitrogen runoff.	Water quality treatment measures have been proposed such that water quality targets are met and comply with CoS DCP requirements. Refer to section 3.5.

1.2. Schedule of potential design changes/clarifications required

There are several design directions awaiting. These are listed below.

Item	Issue	Status/Potential Civil Impact
01	-	-

1.3. Other Authority/Compliance/Departure Issues

Refer to the dispensation register to CIS. We do not believe that there are any major civil related departures from the Design Excellence requirements or CIS Standards.

2. SITE DESCRIPTION

2.1. Location

2.1.1. Overview

The existing J03 Electrical Engineering Building is located within the Engineering Precinct of the University of Sydney Camperdown Campus, at the South-Eastern side of the campus. The existing Electrical Engineering Building is approximately 50x50m and is bordered by Maze crescent to the west, PNR Building to the South, Engineering Link Building and Aeronautical/Mechanical Engineering Building to the East and Blackwattle Creek Lane to the North.

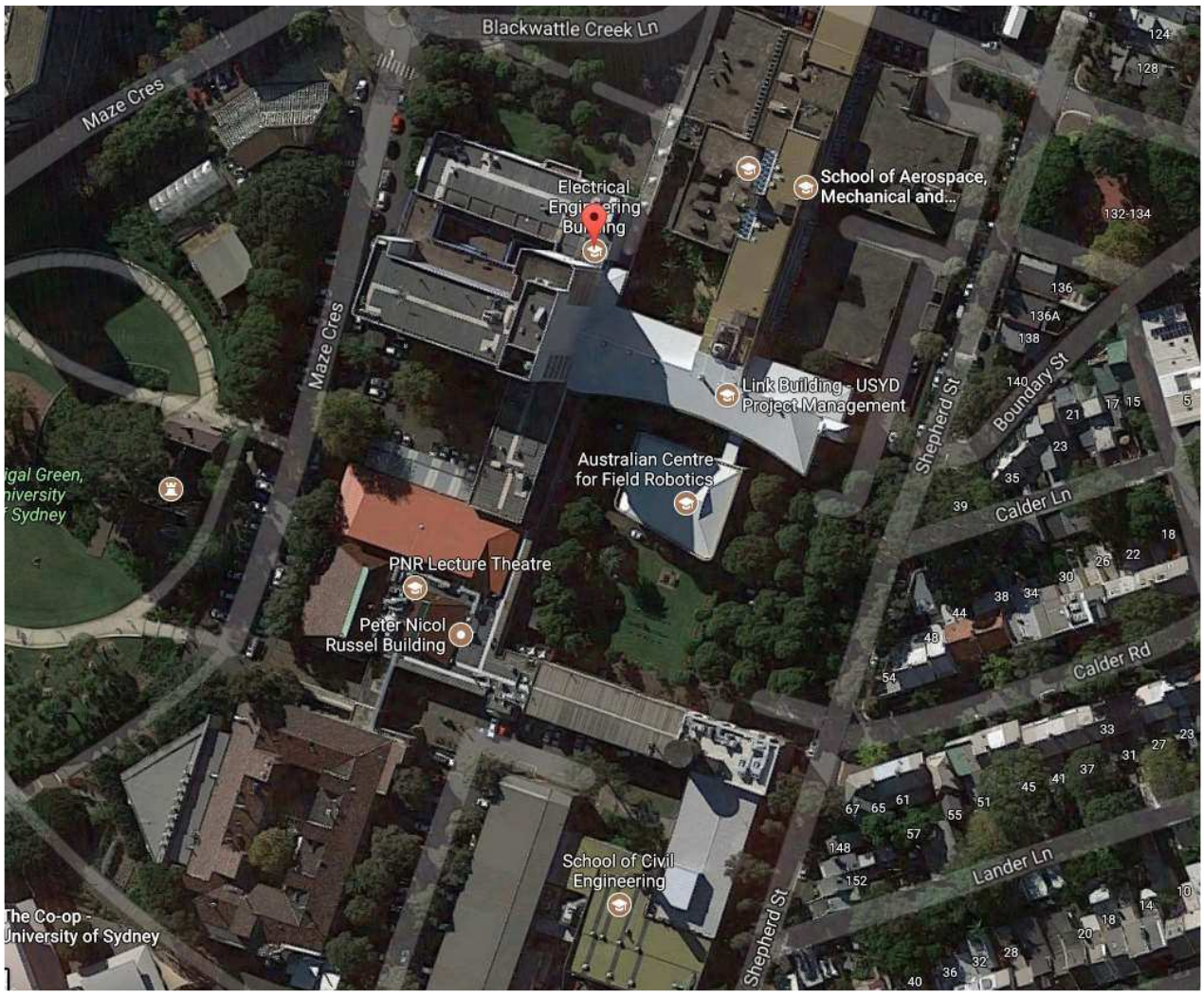


Figure 2-1 - University of Sydney Engineering Precinct

2.1.2. Topography

The Engineering Precinct generally slopes from Cadigal Green (west) to Sheppard Street (east). The existing buildings generally drain to the campus stormwater network that ultimately discharges to Sydney Water and Council's stormwater pit and pipe network. In significant storm events, various locations within the precinct flood.

2.1.3. References

The report relies on the following reports (which have been reviewed and accepted as a basis of design in relation to flood assessment:

- WMA Water – University of Sydney Flood Risk Management Stage 1 – Campus Flood Study Review (September 2013),
- WMA Water – University of Sydney Engineering Precinct Flood Mitigation Plan (draft),
- TTW Civil / Flood Study, University of Sydney Engineering Precinct Civil / Flood Study (draft), December 2015, and
- The University of Sydney Engineering and Technology Precinct Redevelopment – Volume 7.23: Stormwater and Flooding Design Requirements (Revision B, 25 September 2017).
- GRC Hydro 20 August 2018 – Re: University of Sydney Engineering Precinct – Stage 1 Works – Flood Report.

2.1.4. Basis of Design

The design of the civil works has been based on:

- Architectural Layout of the building and site prepared by COX,
- Landscape concept plans prepared by TCL,
- Survey by Monteith & Powys, and
- University of Sydney Campus Infrastructure & Services Standards.

2.1.5. Design Criteria and Standards

The design criteria and standards for the civil works include:

- Stormwater design in accordance with Australian Rainfall & Runoff,
- City of Sydney guidelines including;
    - City of Sydney DCP 2012,
    - Interim Floodplain Management Policy (2014)
- Australian Standards,
- Sydney Water policies and requirements,
- Landcom's Publication - Managing Urban Stormwater: Soils and Construction (the "Blue Book"), and
- University of Sydney Campus Infrastructure & Services Standards.

2.1.6. Existing Services

All existing services located adjacent to, or within the proposed location of the Stage 1 of the Engineering and Technology Precinct that may be affected by the development are to be:

- Capped, sealed and removed, if redundant, or
- Isolated and diverted if being retained.

All works associated with capping, diverting or connecting to Sydney University infrastructure shall be coordinated with Campus Infrastructure Services (CIS) prior to any works being carried out. These works are to be coordinated with any enabling works.

3. PROPOSED DEVELOPMENT

3.1. General Description

The proposed redevelopment involves demolition of the northern portion of the existing electrical engineering building, and construction of a new 10 storey building, demolition of the adjacent carpark to the south and constructing a flood mitigation storage basin (also referred to as Micky Mouse Basin), reconstruction of the public domain areas adjacent to Blackwattle Creek Lane to the north (Northern landscape) and demolition of the courtyard to the east (referred to as Jurassic Park) and construction of new stores and loading dock. Stormwater from the new building and loading dock will drain to the existing precinct stormwater network, while the new flood mitigation basin will drain to the existing Sydney Water stormwater main traversing the site. Below is a snapshot of the areas described above.

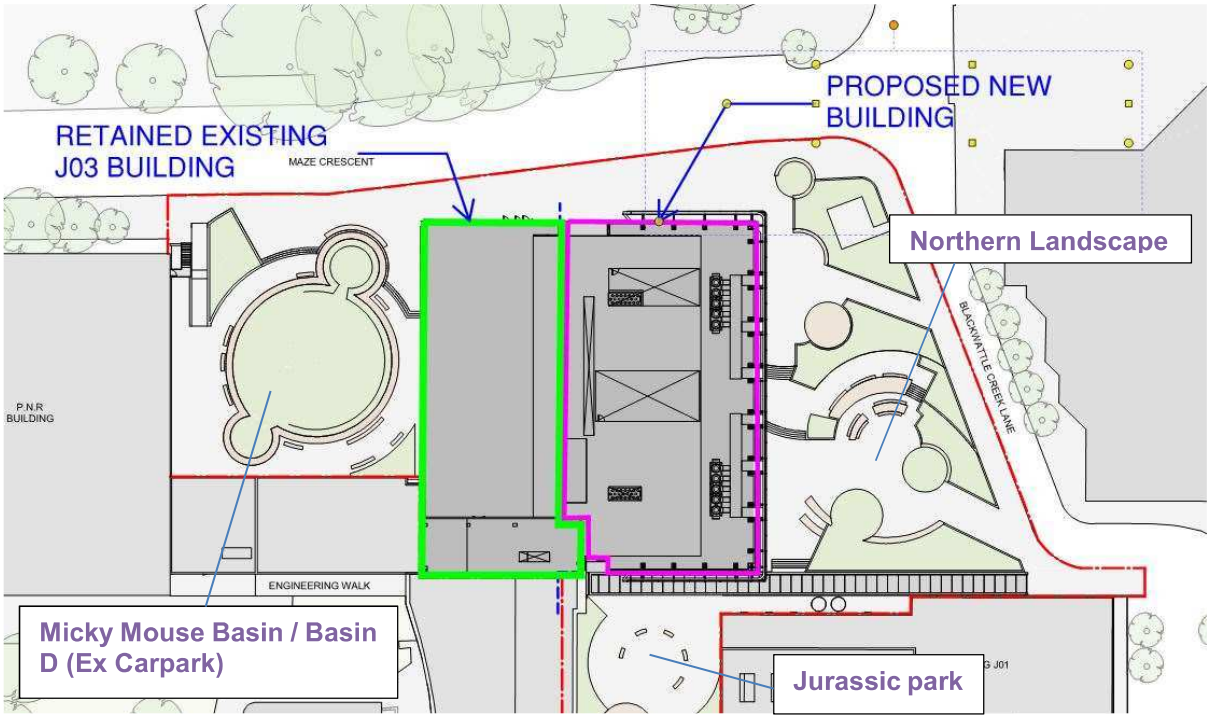


Figure 3-1 - Proposed Redevelopment of Existing Electrical Engineering Building

3.2. Flood Impact Assessment

A Campus wide flood study "University of Sydney Engineering Precinct Civil / Flood Study" has been produced by TTW on behalf of University of Sydney. The engineering precinct is flood affected as noted in Principal Project Requirements Volume 7.23: Stormwater & Flooding Design Requirements. The CoS Interim Floodplain Management Policy has the following requirement:

- Protection of commercial property on merit-based approach to a minimum of 1% AEP level.

The University of Sydney Campus Infrastructure Services (CIS) has the following requirement:

- Avoid inundation and maintain the lesser of either 500mm freeboard above the modelled 1in 100 year flood level or the PMF level.

As discussed in Technical Review Group (TRG) meetings, building entrances will be protected in accordance to CoS Floodplain Management Policy, i.e. to the 1% AEP level and building entrances will be demonstrated to be flood free (after protection measures have been implemented- protection measures will be in the form of

landscape terrain modifications). The FFL has been set to the existing slab levels and building entrances are required to be DDA (disability discrimination act) compliant. Due to these constraints, provision of 500mm freeboard is not readily achievable. Compliance to the CoS Interim Floodplain Management Policy will be achieved.

3.2.1. Flood Levels and Freeboard

The construction of basin D as part of Stage 1 Engineering Precinct complies with "City of Sydney Interim Floodplain Management Policy", protection of commercial property on merit-based approach to a minimum of 1% AEP level. Flood protection to the entrances is achieved by providing wall/landscaping to RL20.05 on the north edge of basin D and RL20.70 on the north west edge of the basin (refer to drawing 00031-00033). To provide flood protection to entrances located on engineering walk, grated sag drains and pits are provided to collect flows from the 1% AEP event. Refer to drawing 00033. To provide protection to entrance from northern landscape, local landscape grading has been provided from building entrance to the location of bioretention basin which is low point at northern landscape area. A flood model has been run to demonstrate that all entrances are flood free. This therefore complies with CoS Floodplain Management Policy.

The design produces no adverse impact off site. It is observed that there are areas of maximum flood increase of more than 10mm. However, given the coarseness of the flood model, the areas of increase being relatively small (few grid sizes), no coherence and direct causation of the affectation a long distance from the site, it can be concluded that there is no adverse impact off site. This is endorsed by peer reviewer GRC Hydro in the letter dated 20 August 2018 which stated that "impacts observed are presumed to relate to instability issue".

3.2.2. Basis for the Design

The TUFLOW modelling has been based on:

- TUFLOW model supplied by CIS ("existing" situation). This is assumed to be the WMA base TUFLOW model, updated to incorporate the latest works undertaken at the University
- Architectural Layout of the building and site prepared by COX
- Landscape concept plans prepared by TCL
- Survey by Monteith & Powys

3.2.3. Adjustments to "Existing" TUFLOW Model

Adjustments were made to the existing TUFLOW model to:

- Correct pipe sizes and locations as identified by survey,
- Digitize kerb to Maze Crescent,
- Digitised engineering walk flow path and reduced levels,
- Survey RLs,
- Major features in the existing carpark and surrounding landscape not picked up by survey or existing TUFLOW model i.e. carpark walls, RLs etc.
- ARR87 will be retained to be consistent with CoS's Blackwattle Bay Study which defines official design flood levels in the catchment. This has also been endorsed/adopted by peer reviewer GRCHydro.

3.2.4. TUFLOW Results

Numerous runs of the proposed redevelopment were undertaken with various basin layouts. These included (note all volumes are calculated from proposed surface to RL19.35, which is 300mm below the J03 building floor level):

- "Box" layout of detention basin (Basin D in previous reports) to maximize volume. The volumes provided were approximately 930m3 (which would require the sewer to be adjusted) and also 1300m3 (which would also require demolition of Tyree building), and

- "Design Excellence" basin layout (also known as "Micky Mouse") refer to Figure 3-3. The volumes provided is approx. 530m^3 and does not require sewer to be adjusted.

The Bonacci modelling results shown in Figure below models the Design Excellence layout. With the current design, no adverse flood impact to offsite areas is achieved and adequate protection to building finish floor levels have been provided. For 1% AEP afflux, refer to Figure 3-2.

Entrances on engineering walk are protected using 300mm wide strip drain along engineering walk as shown on drawings 00033 and 00034. Overland flow through engineering walk are conveyed through pit and pipe system towards shepherd St away from proposed building entrance on engineering walk.

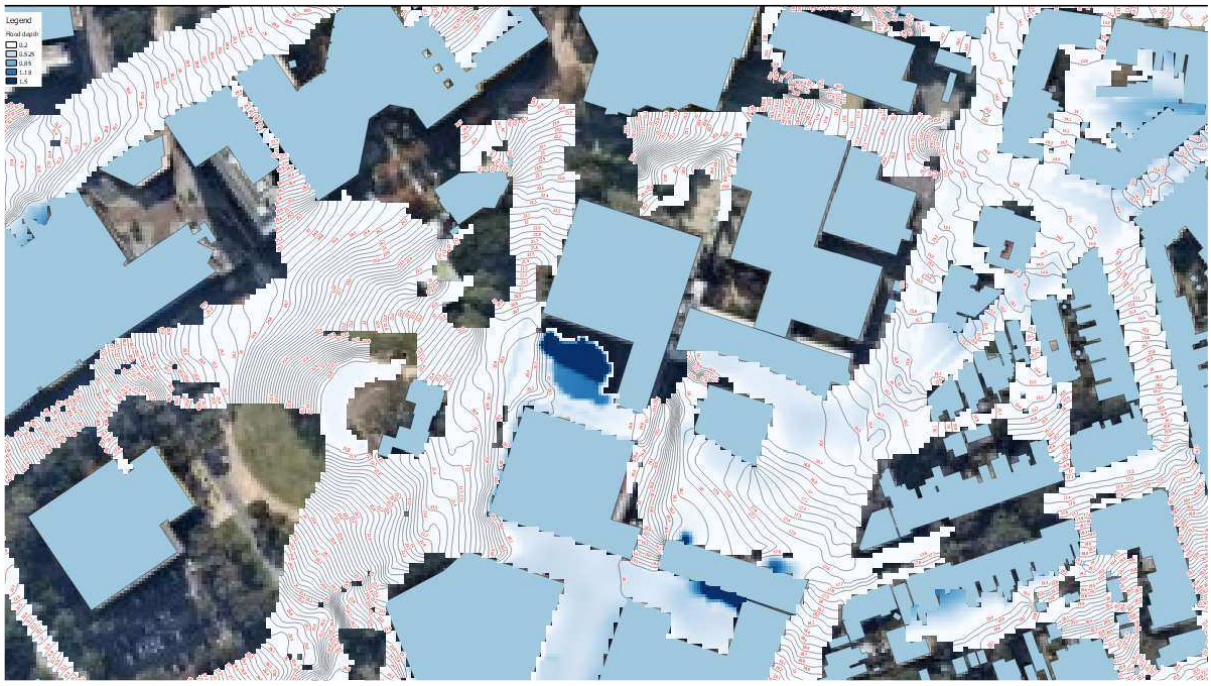


Figure 3-2 – Bonacci 100year ARI Flood Depth (Figure 21, BON032)

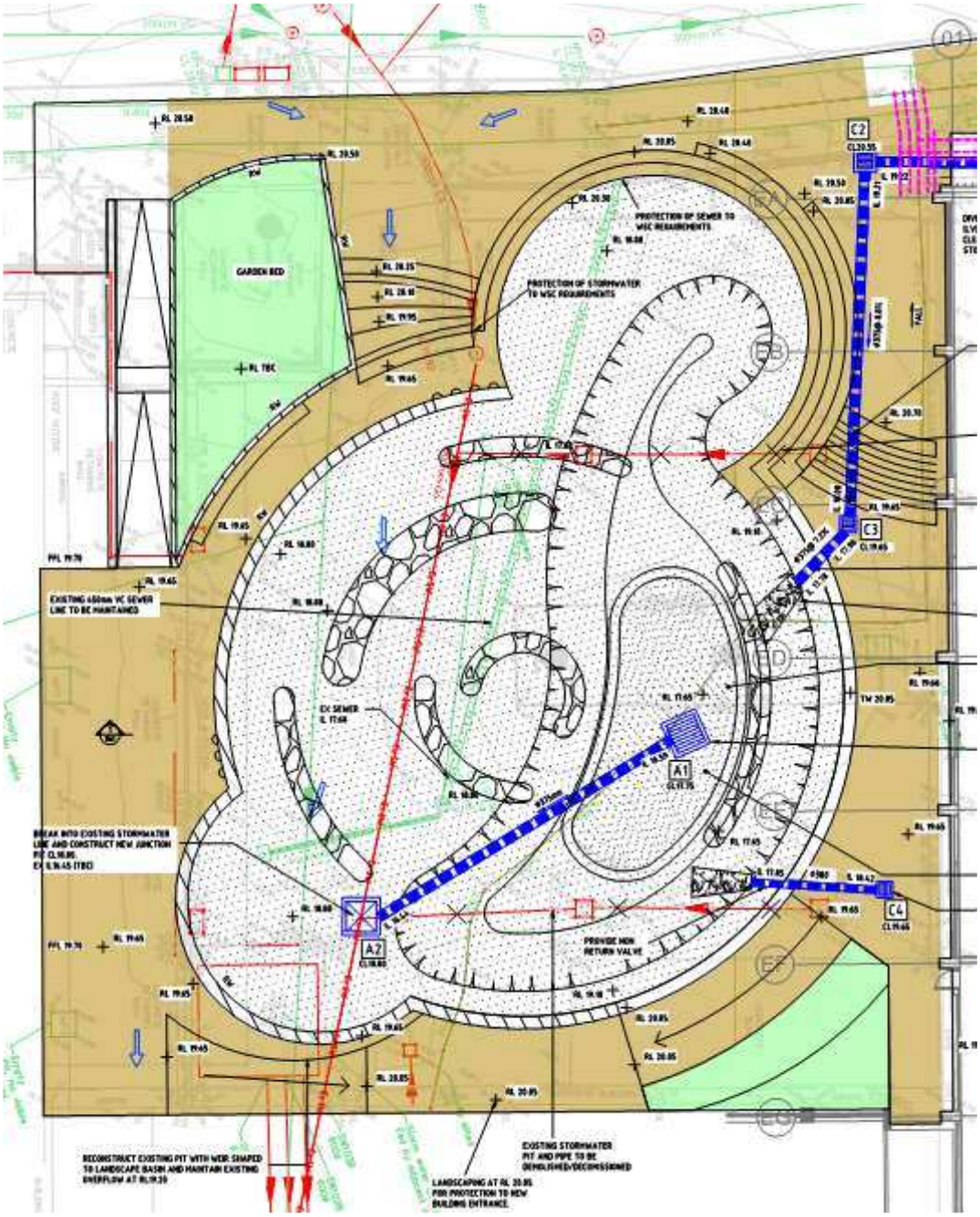


Figure 3-3 – Micky Mouse basin (Basin D)

3.3. Stormwater Infrastructure

3.3.1. Existing Drainage

The existing site generally falls from Maze Cres (north-west) to Shepherd St (south-east). There is existing stormwater infrastructure originating from multiple external catchments and multiple defined overland flow paths traversing the proposed works site. These drain Cadigal Green, Maze Cres, Electrical Engineering building (subject works site), PNR Lecture Theatre, and other sites further afield. The existing Electrical Engineering Carpark serves as an ill-defined minor flood storage basin.

There is an overland flow path that conveys stormwater through the existing Electrical Engineering Carpark from the north-west (Cadigal Green and Maze Cres). There exists a 900mm diameter Sydney Water Stormwater Main that traverses the carpark site. Triple 600mm diameter pipes convey the overland water flow from the existing carpark, under the existing Tyree Labs and Engineering Walk and towards Shepherd St.

3.3.2. Concept Stormwater Design

The key drainage criteria in accordance with the requirements from City of Sydney Council and AS3500.3 include:

- Minor drainage system capturing and conveying the 5% AEP,
- Minimum pipe grade of 1%,
- Minimum pipe diameter of 375mm,
- Minimum fall through a pit of 20mm, and
- Pipe material to be steel reinforced concrete pipe (RCP).

The stormwater strategy is to incorporate the above criteria where possible as the site experiences several invert level constraints particularly from Jurassic Park area towards Shepherd St. The stormwater strategy for the new building meets CoS water quality requirements via rainwater reuse, bioretention filters, stormfilters and enviropods. Water quantity requirements are met via stormwater & floodwater detention basin.

3.4. Water Quantity

3.4.1. Background

CoS requires compliance with Sydney Water Corporation (SWC)'s On Site Detention policy. SWC has the following On Site Detention (OSD) requirements. The OSD must be designed to meet:

- Permissible Site Discharge (PSD): Maximum rate of discharge for the total site that the existing downstream stormwater system can handle.

The WMA Water 2016 University of Sydney Engineering Precinct, Flood Mitigation Plan (WMA Mitigation Report) has identified a methodology to facilitate the redevelopment of Sydney University land. This methodology has been accepted by Sydney Water and involves mitigating the effects of development via a campus-wide strategy. A new flood storage basin (Basin D) was identified in the WMA Mitigation Report. The proposed basin is located at the existing electrical engineering carpark, a current low point and overland flow path. As part of the current development, the newly constructed basin will provide approximately 530m3 of volume below RL19.35.

3.4.2. OSD Strategy

To meet SWC's OSD strategy, the 530m^3 flood storage basin is proposed to be used as an above ground on-site detention basin such that post-development flows are less than the permissible site discharge (in accordance with SWC requirements). Given that the site is flood affected, existing subsurface drainage system generally flowing at capacity even for smaller events (i.e. 5 year ARI) and the impracticality of increasing drainage capacity via installation of larger pipes (as per Section 6.1 WMA Water 2013 University of Sydney Flood Risk Management Stage 1- Campus Flood Study Review), the permissible site discharge is adopted as the pre-development site flow such that there is no worsening in site runoff due to the development. Overland flow would be modelled via TUFLOW (refer to flooding section of the report). The OSD will be incorporated into the flood storage basin and a 200mm diameter orifice plate is to be installed in pit A1 (refer drawing 00031) in order to comply with SWC's OSD requirement.

The Micky Mouse basin/OSD is drained via pit and pipe at the lowest point in the basin (pit A1). In the unlikely event this pit is 100% blocked, overflow will occur to the 3x600mm culvert at invert RL19.2. In the unlikely event both pit A1 and 3x600mm culvert is blocked, emergency overland flow will occur through engineering walk at RL19.69 prior to flooding of proposed building.

3.4.3. Hydrology

The hydrology for the proposed site was established using a DRAINS model. The intensity-frequency-duration (IFD) data for the site was extracted from Bureau of Meteorology's 2016 data and temporal patterns using the latest AR&R 2016 is used.

3.4.4. OSD

The above ground basin D is proposed to limit post development site discharge to the PSD (pre-development site discharge). The basin is located at the natural depression south of the proposed building at the existing carpark. The basin surface level is approximately RL17.65 with a spill level adjacent to engineering walk at approximately RL19.69. Two DRAINS model has been produced: Existing Case and Proposed Case. Screenshots of the models are shown below (Figure 3-4,Figure 3-5).

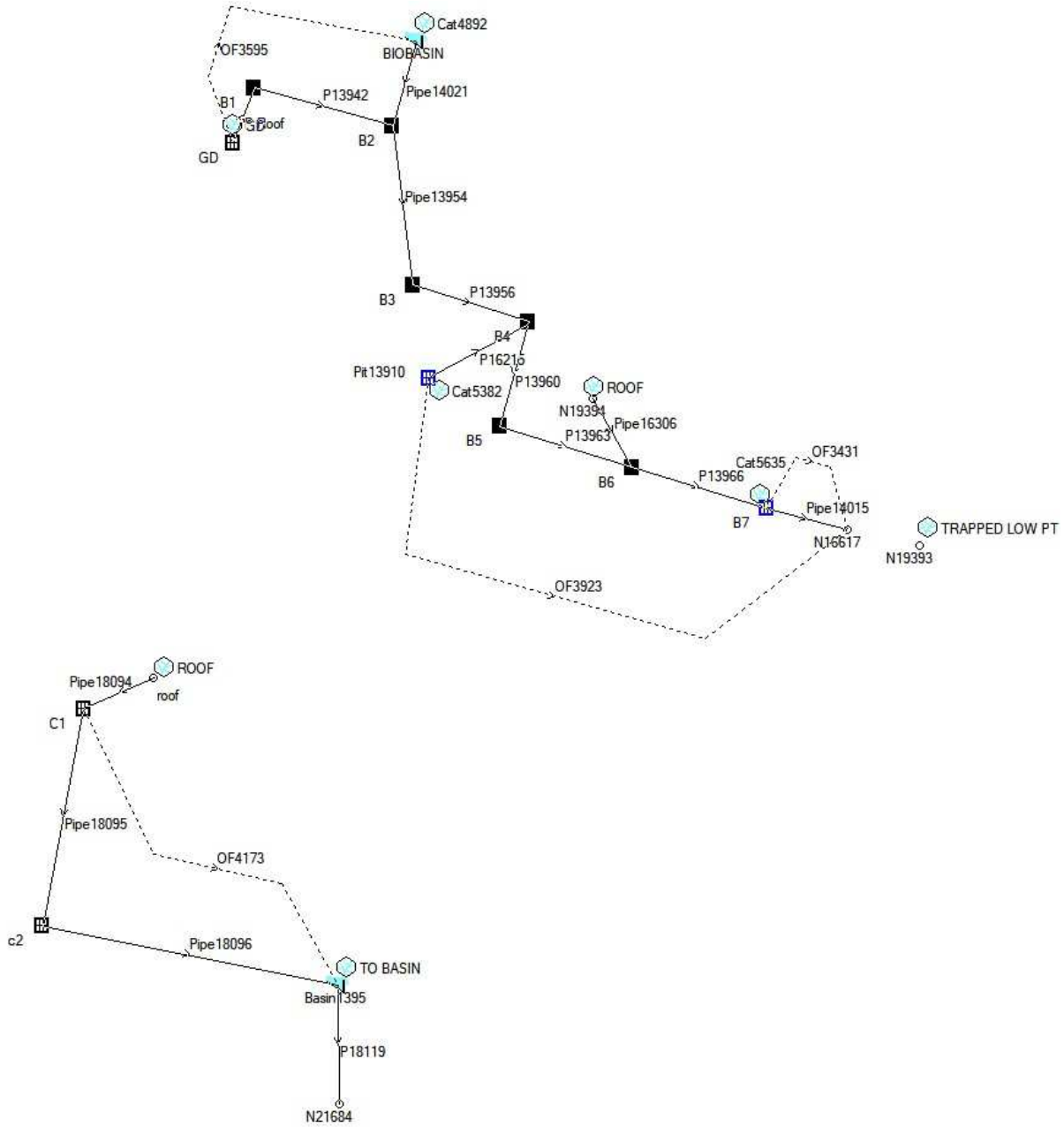


Figure 3-4 Post development model

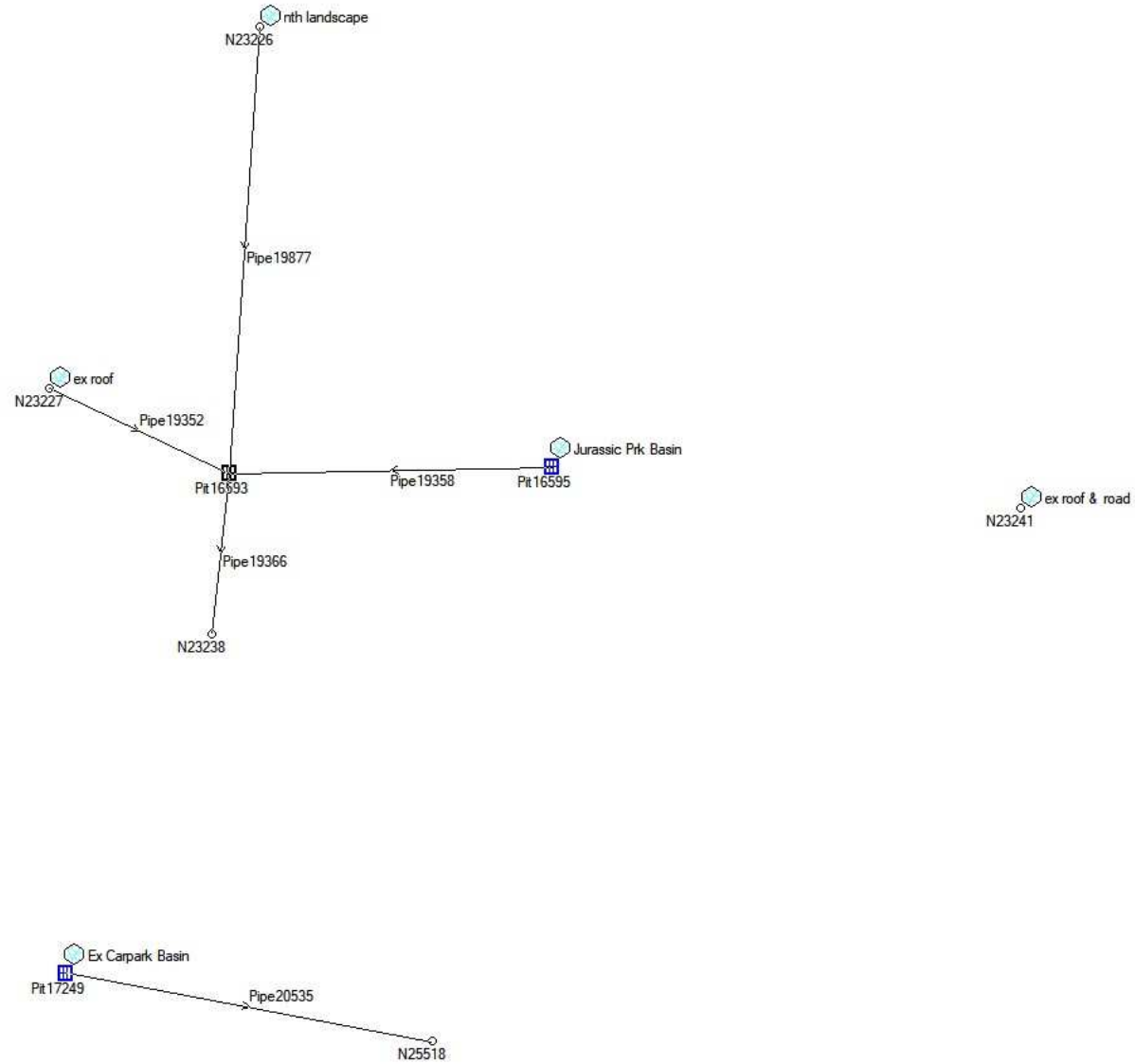


Figure 3-5 Pre-development model

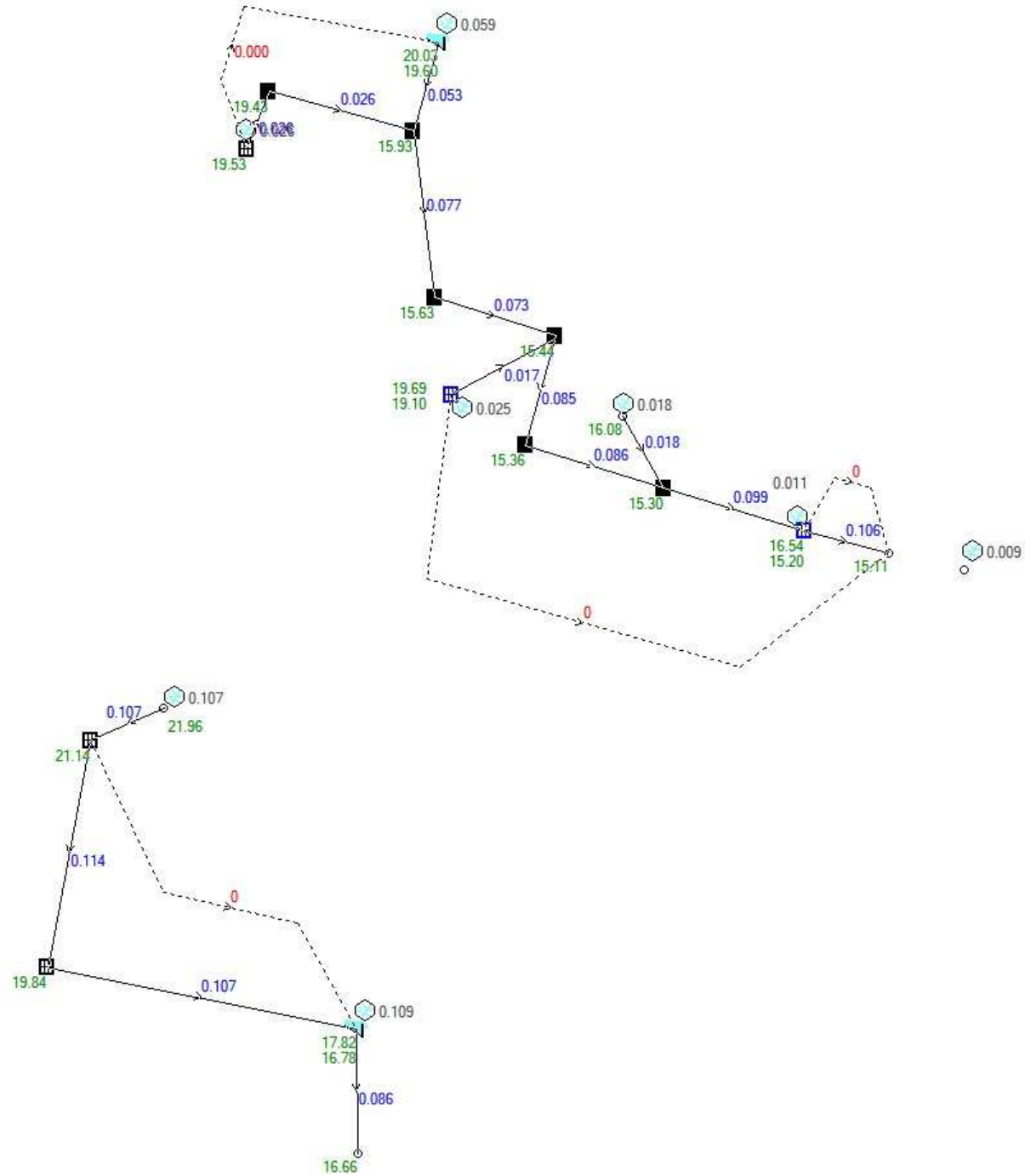


Figure 3-6 Post development model - 1% AEP result

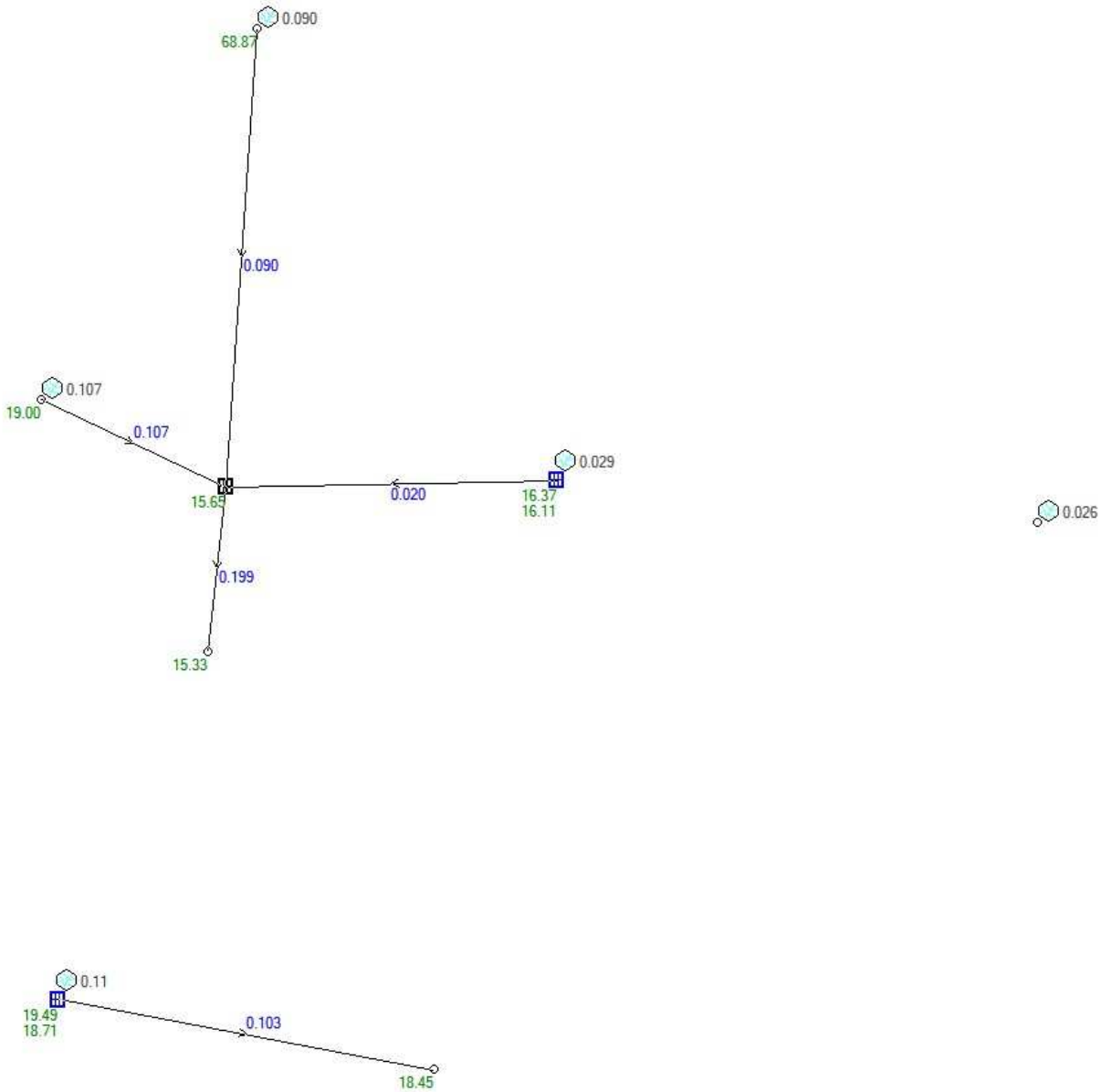


Figure 3-7 Pre-development model - 1% AEP result

3.4.5. Results

The peak site discharge for the developed scenario is compared against the pre-development flows (PSD). The results are summarised in table below. It has been demonstrated that basin D effectively reduced post developed flows to the PSD values and therefore complies with CoS DCP requirements. The DRAINS results text files are outputted to Appendix E. The modelled design and existing DRAINS catchment areas are shown the figure below. The total development area is approximately 6070m^2.

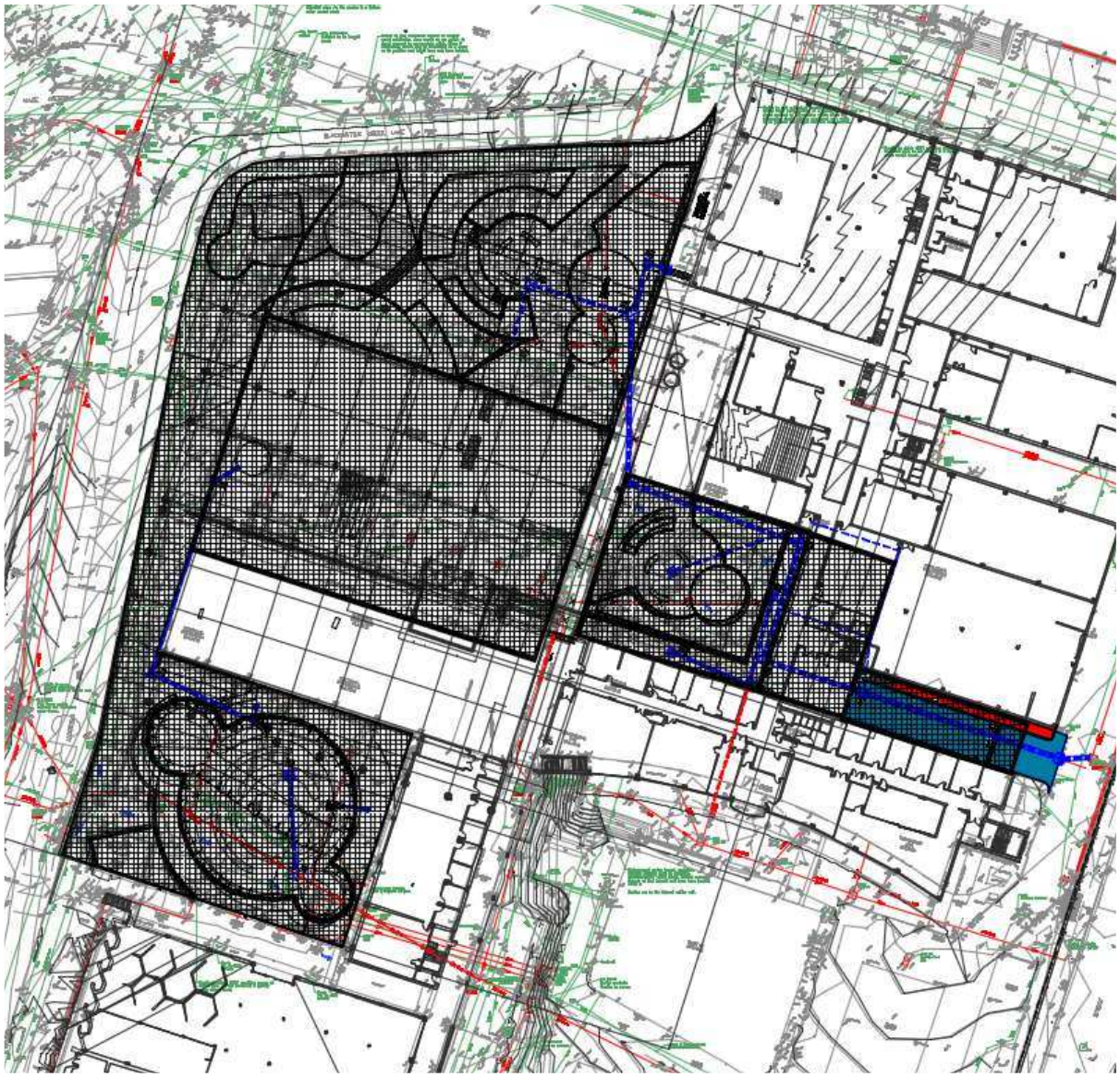


Figure 3-8 DRAINS Catchment Plan

Table 3-1 Peak Flows

Design storms (AEP)	***Post Develop Site Discharge (m^3/s)***	***PSD (m^3/s)***
0.2 EY	0.140	0.173
5%	0.169	0.259
1%	0.201	0.328

3.4.6. Subsoil Drainage

Sub-soil drainage will be provided to proposed retaining walls, sub-floor space and podium planting/landscaping in accordance with structural engineer and landscape architect's requirements. The sub-soil drainage will discharge into the stormwater drainage system.

3.5. Water Quality

The proposed new building stormwater strategy incorporates Water Sensitive Urban Design principles by allowing for infiltration opportunities where possible and building roof runoff being captured and reused via a 45kL rainwater tank, treatment of suspended solids via enviropods and treatment of finer pollutants via bioretention filtration. Water quality improvement device(s) has been specified and modelled using MUSIC (Version 6.3), demonstrating compliance with the water quality targets set in the Sydney City Council Development Control Plans (2012).

Currently the site does not have any stormwater quality treatment measures. The proposed development provides water quality measures specifically for the new building and associated works at Micky Mouse basin (existing carpark), northern landscape area and eastern building and road adjacent to Engineering Walk. The proposed water quality strategy for the site is described in detail below.

3.5.1. City of Sydney - Stormwater Quality Improvement Targets

Development of a site greater than 1000m2 must undertake a stormwater quality assessment to demonstrate that the development will achieve the post development pollutant load standards as follows:

- 90% reduction in Gross Pollutants greater than 5mm,
- 85% reduction in Total Suspended Solids,
- 65% reduction in total phosphorous runoff, and
- 45% reduction in total nitrogen runoff.

3.5.2. Water Quality Strategy

The proposed water quality discharge measures for the site are provided to reduce existing pollutant loads. The water quality strategy for the new building incorporates a 45kL rainwater tank, Enviropods, stormfilters and bioretention basins. For summary of sub-catchments and water quality measures, refer to Table 3-2.

Table 3-2: Summary of Sub-catchments and Water Quality Measures for overall Site

Sub-catchments	Area (ha)	Impervious Fraction (%)	WSUD Treatment Measures	Comments
Roof	0.088	100	Rainwater Tank, Enviropod, Bioretention	
Basin D	0.191	68	Bioretention	
Roof (Bypass RWT)	0.074	100	Enviropod, Bioretention	
North Landscape (Bypass)	0.048	45	Enviropod, Stormfilter	
North Landscape	0.107	48	Bioretention, Enviropod, Stormfilter	
Building @ Jurassic Park	0.045	60	Enviropod	
Level 1 Open to Sky	0.014	100	Enviropod	

Road	0.018	100	Stormfilter
Road bypass	0.003	100	N/A
East Roof	0.027	100	Stormfilter
Total	0.615		

3.5.3. Water Quality Model

The water quality strategy for the proposed site was established using *MUSIC* [Version 6.3] model. The MUSIC model is constructed using City of Sydney Council MUSIC Link. A screen shot of Music [version 6.3] model representing the site is provided in the figure below. As a summary, the roof is partially treated by rainwater tank with water usage in accordance with Argent Consulting Group Rainwater Reuse Water Balance dated 12/03/18. The remainder of the roof is treated by bioretention and enviropod within the Micky Mouse basin. The northern landscape is treated by bioretention and enviropod in the landscaped areas before draining through 3 stormfilters adjacent to Shepherd St. Jurassic park and loading dock pavement is to be treated by enviropods and the 3 stormfilters adjacent to Shepherd St. Refer to figure below for the water quality catchment plan.

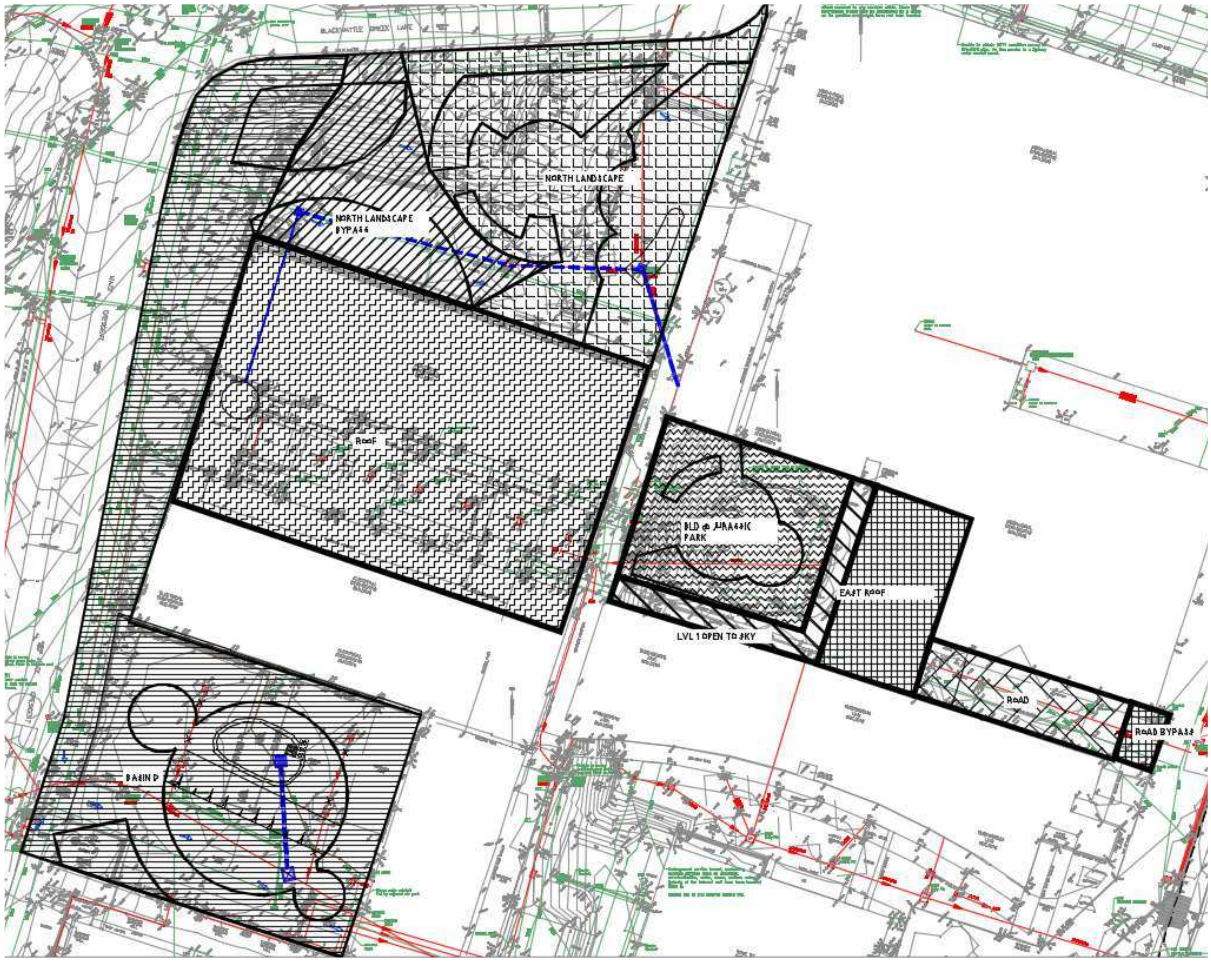


Figure 3-9 MUSIC Catchment Plan

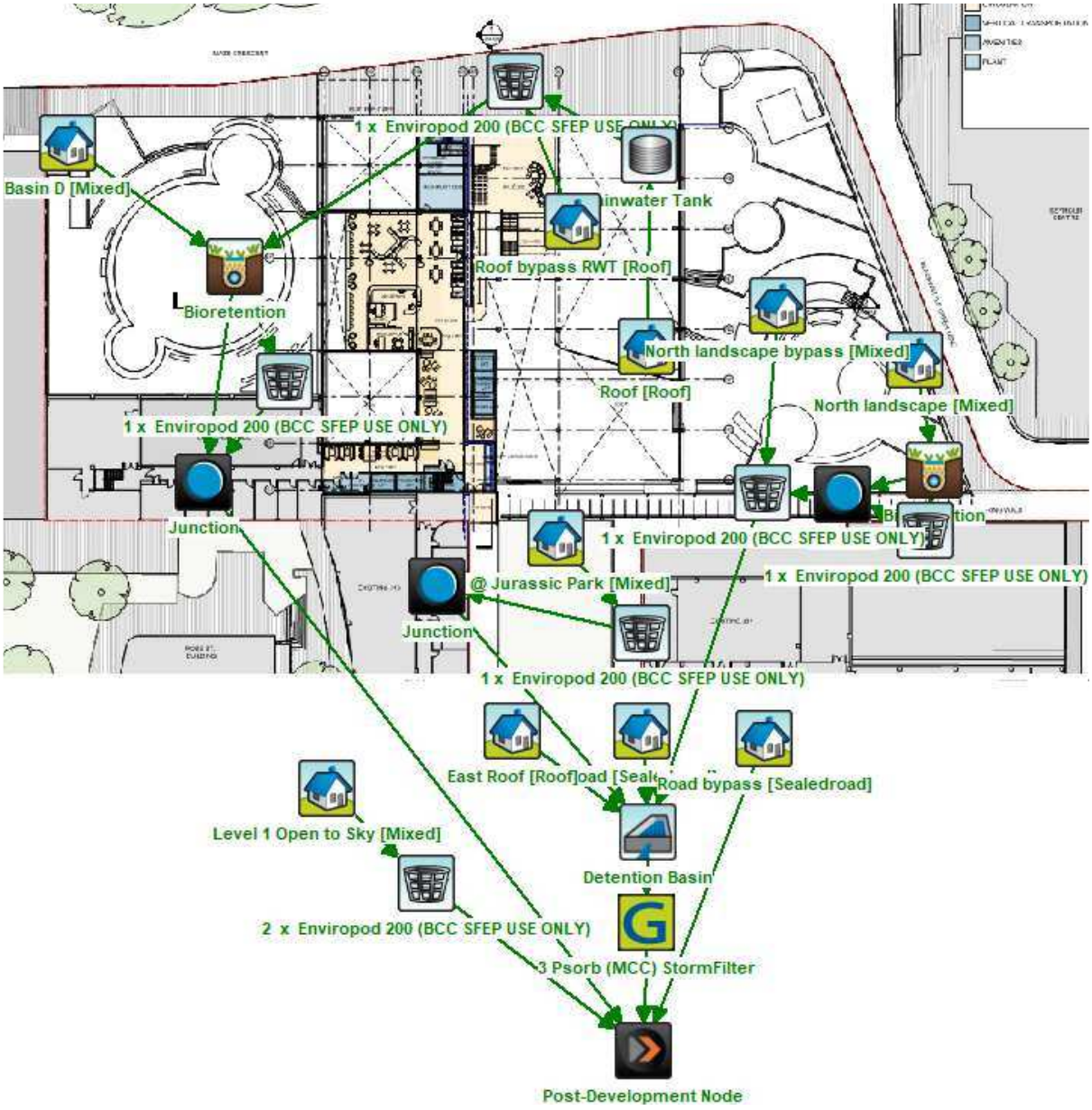
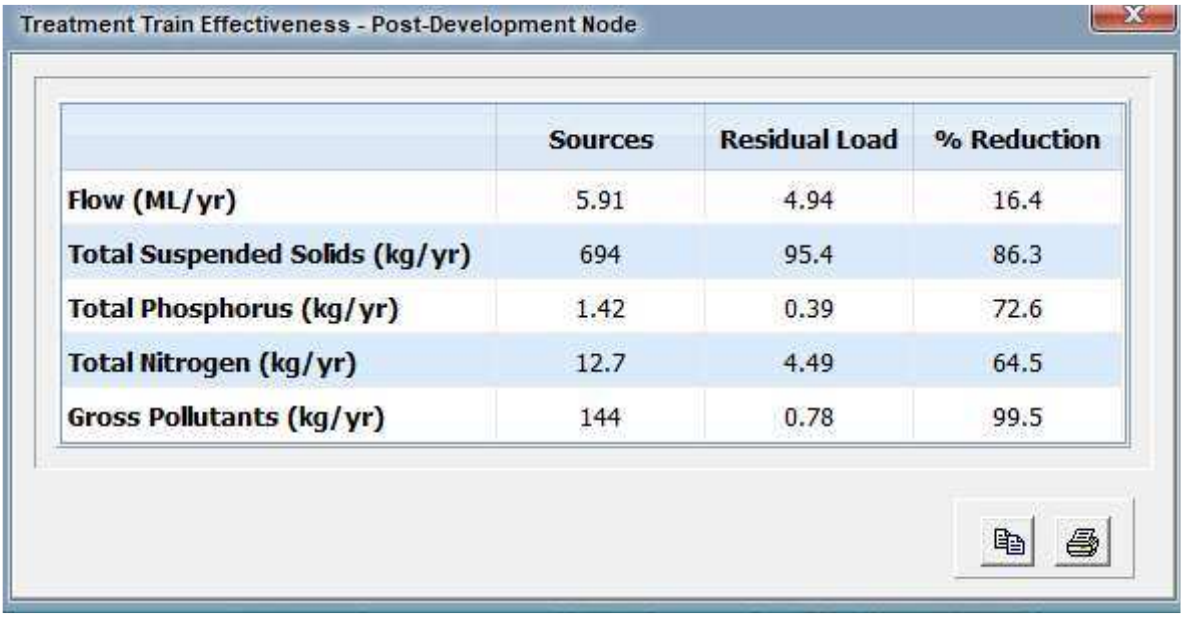


Figure 3-10 – Schematic Diagram of the Overall Music Model.

3.5.4. Water Quality Results

The results of MUSIC modelling show the pollutant reduction due to the overall proposed development. The comparison in actual pollutant loads is clearly shown in the Residual Load column. The results from the MUSIC model are shown as a screen shot below demonstrating that the City of Sydney pollution reduction criteria has been met.



	Sources	Residual Load	% Reduction
Flow (ML/yr)	5.91	4.94	16.4
Total Suspended Solids (kg/yr)	694	95.4	86.3
Total Phosphorus (kg/yr)	1.42	0.39	72.6
Total Nitrogen (kg/yr)	12.7	4.49	64.5
Gross Pollutants (kg/yr)	144	0.78	99.5

Figure 3-11: Overall Music model Results

3.6. Erosion and Sediment Control

A sediment and erosion control plan has been prepared in accordance with Landcoms Managing Urban Stormwater: Soils and Construction Volume 1 (the "Blue Book"). The erosion and sediment control measures have been designed to meet the requirements of the Blue Book – the Contractor will be responsible for confirming the design and phasing the installation of the measures to suit the construction staging.

Refer to Appendix A Sediment and Erosion Control Plan (Drawings K33-BON-CIV-SKT-C005-P1 and K33-BON-CIV-SKT-C006-P1)

3.7. Potential Future Design Changes

3.7.1. Lowering of the Loading Dock

As part of the new stores and loading dock, it may be a requirement to lower the ground level of the proposed new Loading Dock to meet operational requirements.

Should this be required, this will have civil impactions on this area mainly relating to the existing stormwater network including overland flows. This may require the relaying of the existing stormwater drainage network for a yet undetermined length downstream.

Further civil details of this can be provided once the direction of any changes to loading are provided.

3.8. Conclusion

It has been demonstrated that the development complies with City of Sydney Council's requirement in terms of water quantity and water quality. Water quality targets have been achieved through the use of a combination of stormfilters, enviropods, bioretentions and rainwater reuse. Post development flows have been demonstrated to be less than PSD values using a 200mm orifice in the flood detention basin D to attenuate flows. The development has no adverse flooding impact to adjacent properties and the flood modelling has been peer reviewed by GRC Hydro. Flooding to building entrances have been protected to the 1% AEP event.