Your ref
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File ref

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Andy Nixey
Principal Planner
Department of Planning & Environment
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19 July 2018

Dear Andy

Art Gallery of NSW Expansion Project – "Sydney Modern Project"
FPL and water quality targets – Request for dispensation

Arup is writing to the Department of Planning and Environment with regards to the stormwater and drainage works for the above-mentioned project. It is understood that the Department's standard conditions of consent for SSD for urban development projects requires that the following design standards be met:

> *"Stormwater and Drainage Works Design*
>
> *C1 Final design plans of the stormwater drainage systems, prepared by a qualified practicing professional and in accordance with the requirements of [insert relevant Council] shall be submitted to the certifier prior to issue of a Construction Certificate for below ground works OR commencement of any works [if Crown Building Works]. The hydrology and hydraulic calculations shall be based on models described in the current edition of Australian Rainfall and Runoff. "*

With regards to the requirements outlined by the City of Sydney's design guidelines, compliance with several aspects of Council's criteria remain challenging for the site. This includes water quality management and flood planning compliance to Art Gallery Road. Therefore, the Sydney Modern Project proposes alternate criteria be considered for these items based on the below information.

Water Quality Management

The design criteria for water quality treatment is in accordance with the City of Sydney's Development Control Plan (DCP) (December 2012). The DCP states the post development pollutant load reduction requirements as summarised in Table 1.

Table 1 – Pollution Reduction Targets (CoS DCP)

Pollutant	**Reduction Target (%)**
Gross Pollutants	90
Total Suspended Solids (TSS)	85
Total Phosphorus (TP)	65
Total Nitrogen (TN)	45

It is noted that Clause 11 of State Environmental Planning Policy (State and Regional Development) 2011 indicates DCPs do not apply to State Significant Development; nor do the SEARs issued for the project reference the DCP as a relevant requirement.

The treatment of stormwater runoff is intended to be achieved through a combination of rainwater harvesting and reuse, proprietary treatment devices and landscape treatment.

In undertaking the detailed design, it has been identified that a portion of the stormwater runoff from the proposed landscaping over the eastern distributor land bridge and the catchment draining to it, cannot meet the above treatment targets based on the existing site constraints. These constraints include:

- Existing shallow soil depth over the bridge structure (approximately 0.5m). This shallow depth prevents the installation of proprietary water quality treatment devices which are typically housed on oversized pits/chambers with treatment and pollutant storage at depths up to 2.5m below surface level. The ability to raise surface levels to accommodate the installation of devices is also restricted by the requirement not to exceed the loading of the existing land bridge structure. Installation downstream of the land bridge would be outside the project boundary.
- Intention to retain the existing land bridge subsoil cell drainage, pits and downpipes.

Figure 1 indicates the existing land bridge catchment (shown in red). The cyan sub-catchment is a proposed roof catchment which is intended to route through the building drainage network and be treated/ reused to achieve the required WQT targets. The remaining area (indicated in green) is the area in which the pollutant reduction targets outlined in Table 1 cannot be met. This catchment area includes the area over the land bridge and a catchment area which drains to it.

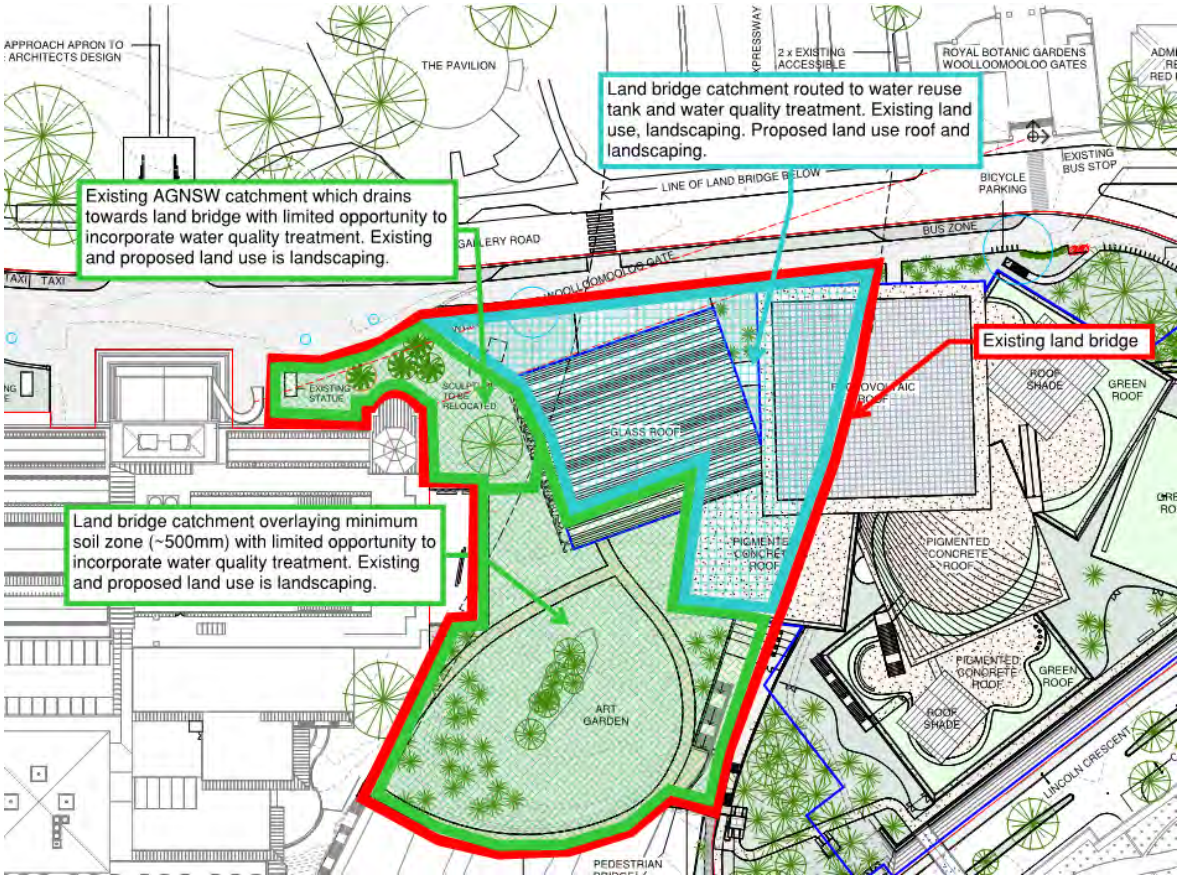


Figure 1 – Land Bridge Catchments

We note that the existing land bridge consists mostly of pervious landscaping. The 'green' sub-catchment area will be redeveloped in conjunction with the gallery expansion and the land use will remain as landscaping. Therefore, pollutant loads are not intended to worsen as a result of the development.

Due to the constraints imposed by the existing land bridge structure and on the basis that the land use of the area in question remains unchanged (landscaping) we request dispensation from having to achieve the stated WQT treatment targets for this sub-catchment of the site.

For information purposes we have included in Appendix A1 a memo outlining the water quality treatment which is currently proposed for the Sydney Modern Project site.

Flood Planning Compliance, Art Gallery Road

Art Gallery Road is located on the alignment of a topographic ridge line dividing two sub-catchments of the Woolloomooloo Catchment. The City of Sydney's *"Woolloomooloo Flood Study"* Final report, April 2016 prepared by WMAwater indicates that peak flood depths (as measured by depths ≥ 100mm) are not present in Art Gallery Road adjacent to the proposed site of the Sydney Modern Project for both the 1% AEP and PMF storm events. Refer to the Appendix A2 for copies of the Woolloomooloo flood maps. On this basis, it has been assumed that the site is located outside the floodplain.

The proposed gallery provides basement areas accessible from the Art Gallery Road building entrances. The City of Sydney's flood planning level (FPL) requirements are outlined in the *"Interim Floodplain Management Policy*", May 2014. The criteria for

basements located outside the floodplain are to provide a FPL "0.3m above the surrounding surface". This is typically measured from the gutter invert adjacent to the site.

The proposed gallery is located on a relatively steep site which falls away from the road/ ridgeline. It is the intention to address flood protection in the surface grading between the road and gallery. Achieving the 300mm threshold level cannot be achieved within the constraints of:

1. Building setback
2. DDA compliant grades
3. Tie in with existing road levels
4. Retention of the existing Art Gallery Road bridge
5. Proposed gallery finished floor levels

Within the above-mentioned constraints, a threshold level of 200mm above gutter invert level can be achieved. This will be provided by a combination of a 150mm high kerb and 1:40 verge grading for a 2m corridor from back of kerb.

In support of this proposal we have completed an analysis of the flows generated in Art Gallery Road upstream of the site and entry plaza. The upstream catchment area consists of the road and adjacent footpath/verge and is approximately 0.8ha. The indicative area is shown in Figure 2.

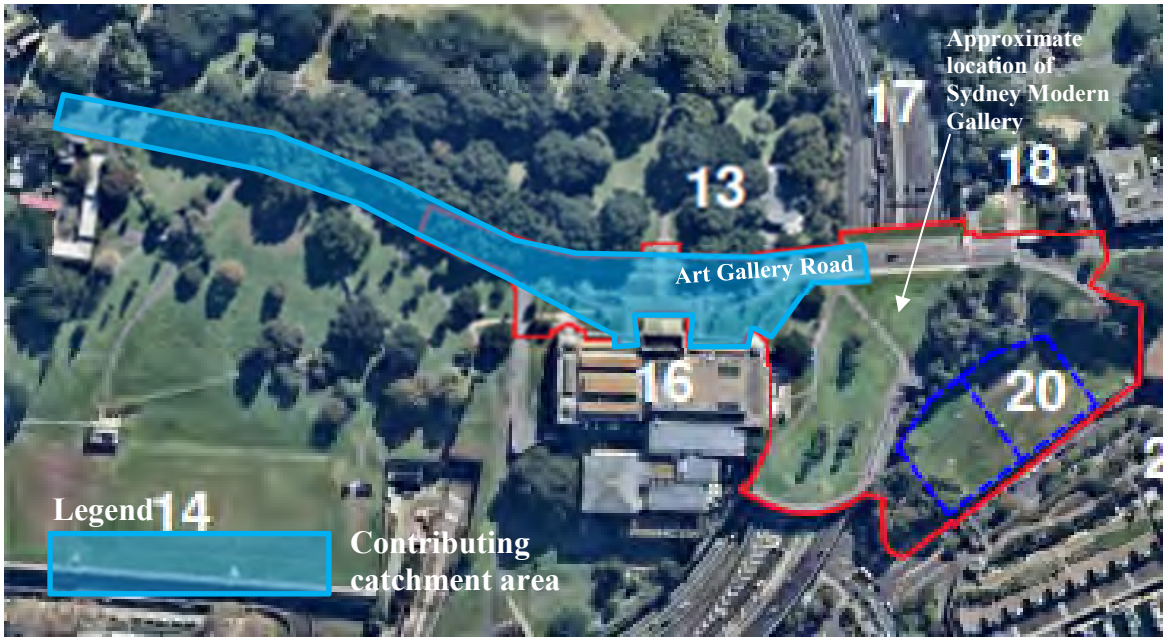


Figure 2 – Art Gallery Road Catchment Area

The runoff from this catchment is approximately 0.48m^3/s and 2m^3/s for the 1% AEP and PMF events respectively. Based upon a Manning's open channel flow assessment of the road cross section, the maximum flow depth in the existing road reserve is estimated at 105mm and 190mm, respectively for the 1% AEP and PMF events. These flow depths are considered conservative as they exclude any conveyance capacity of the in-ground pit and pipe network. The estimated depth of flow for both the 1% AEP and PMF event are below the proposed 200mm threshold level. Calculation results have been included in Appendix A3.

In addition to the 200mm threshold, it is proposed to provide:

1. Surface grading away from doors, where possible. Strip drains to be provided in front of doors where grading away cannot be achieved.
2. Strip drains to be provided around building perimeter façade where local runoff may accumulate
3. Internal threshold ramps of up to 150mm where levels permit (cannot be achieved at all door locations)

Based on the above described site conditions and anticipated runoff it is proposed that an alternate 200mm FPL be considered rather than 300mm and this be achieved through a combination of a 150mm kerb and 1:40 verge crossfall immediately behind the kerb.

We trust this assists in assessing the items in question. If any additional information is required, please contact the undersigned.

Yours sincerely

Karen Seeto
Associate

cc Daniel Griffin
Nicholas Wolff
Jane Fielding
John Whatmore
Ann Deng
SANAA

Appendix A

Water Quality Management and Flood Planning Levels

A1 Sydney Modern Project – Water Quality Treatment – MUSIC Modelling Memo

Memorandum

ARUP

To	Nicholas Wolff (AGNSW) Daniel Griffin (AGNSW)	Date	19 July 2018
Copies	Ann Deng (McGregor Coxall) Adrian McGregor (McGregor Coxall) Paul McAtomney (McGregor Coxall) Jane Fielding (Architectus) John Whatmore (Architectus) Jake Cherniayeff (Arup) Nick Howard (Arup)	Reference number	247039 - 70
From	Karen Seeto Pearl Elgindy Andrew Crouch	File reference	
Subject	Sydney Modern Project - Water Quality Treatment – MUSIC Modelling		

1 Introduction

The Sydney Modern Project site is located on the eastern edge of the Royal Botanical Gardens and the Domain, adjacent to Woolloomooloo Bay. The site is bounded by Art Gallery Road to the west, Lincoln Crescent to the east, the existing Art Gallery of NSW to the south and the Royal Botanical Gardens to the north. The development consists of a separate standalone building and surrounding landscape development, incorporating redevelopment of a disused RAN fuel bunker and landscape works over the Eastern Distributor land bridge. The Sydney Modern site boundary and location is shown in Figure 1.

Figure 1: Sydney Modern Project site locality plan

Memorandum

The purpose of this memorandum is to report on the stormwater quality treatment measures and results for the Sydney Modern Project.

2 Treatment Targets

Stormwater discharge water quality treatment targets for the site are summarised in Table 1. These targets are from the City of Sydney Development Control Plan (2012), Section 3, General Provisions.

Table 1 Pollution reduction targets

Pollutants	Reduction Requirements
Total Suspended Solids (TSS)	85%
Total Nitrogen (TN)	45%
Total Phosphorus (TP)	65%
Gross Pollutants	90%

3 Method of Assessment

Water quality modelling of the proposed treatment train was undertaken using MUSIC (Version 6.2), with MUSIC-link (Data Version 6.2) configured. MUSIC is a numerical modelling package capable of simulating pollutant loads and for conceptually sizing treatment measures. MUSIC software provides a numerical value of the total pollution generated by the catchment in kg/year for total suspended solids, total phosphorus, total nitrogen and gross pollutants. It then assesses the reduction in pollutants through the use of various treatment trains.

4 Stormwater Collection and Treatment

The proposed treatment methods and devices for Sydney Modern are summarised in this section of the memo. The proposed treatment devices are commonly used in Sydney and have been selected to meet Council's treatment targets. Approved equivalent devices may be considered if they are able to maintain adherence to the treatment objectives.

- **Buildings/Roof**

  Stormwater runoff from the roof (including trafficable plazas and landscaped areas) will be collected through the drainage system and stored within a combined retention and detention tank located in the basement. The runoff is proposed to pass through Stormwater360 Enviropod litter basket devices prior to discharging to the tank. The tank has a retention volume of 350m^3.

  - Retained water in the tank will be used for the cooling tower and irrigation. The demand for the cooling tower has been estimated as an average of 37.5 kL/day. The irrigation demand has been determined by irrigation consultants Hydroplan and input to MUSIC as a typical annual demand of 2850kL/year distributed using a monthly demand pattern.
  - Water that is not re-used will be discharged off-site into the local stormwater network.

- **Landscaped areas over fuel bunker**
  Stormwater runoff from the fuel bunker landscaped and trafficable areas will be pass through a Stormwater360 Enviropod litter basket prior to being discharged from the site. The location of this area is shown in Figure 2.

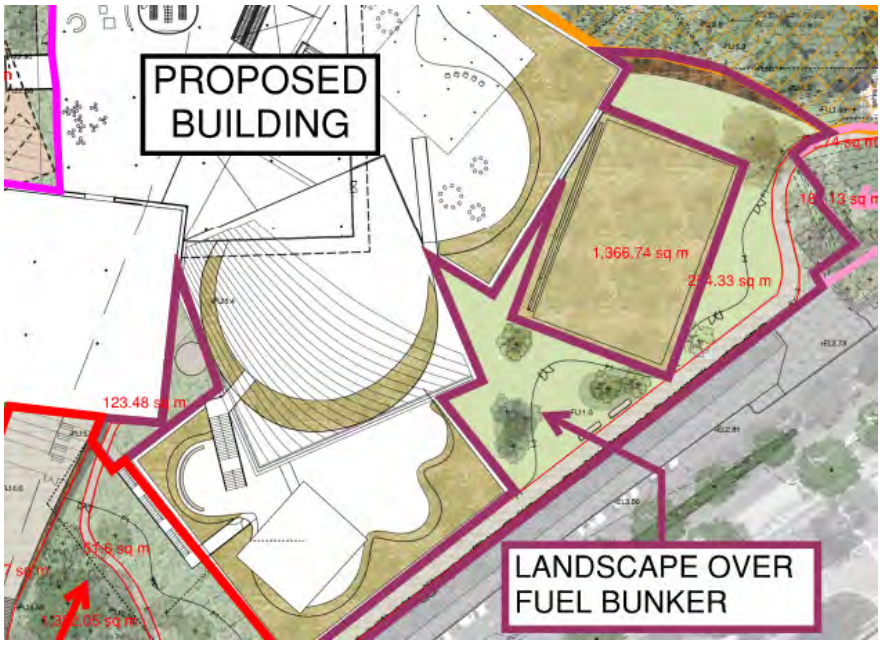


Figure 2 Location of landscaped area over the fuel bunker

- **South Landscaped Area**

  The location of the southern landscaped area is shown in red in Figure 3. Stormwater runoff from the southern landscaped regions will be directed to and collected in stormwater pits. Runoff from these areas will pass through Stormwater360 Enviropod litter basket and a pit fitted with two (2) Stormfilter cartridges for secondary stormwater treatment. As the location of the Stormfilter cartridges will be inaccessible by vehicles, maintenance of the device will be required through an industrial vacuum cleaner to remove accumulated debris with cartridges transported away on trolleys for flushing or replacement. Maintenance of these devices could be outsourced to an external maintenance contractor.

  A small portion of the southern landscaped area immediately adjacent to Lincoln Crescent will not be collected in the pit and pipe stormwater network due to existing site grading and will therefore bypass any treatment devices. This bypass sub catchment has been included in the MUSIC model.

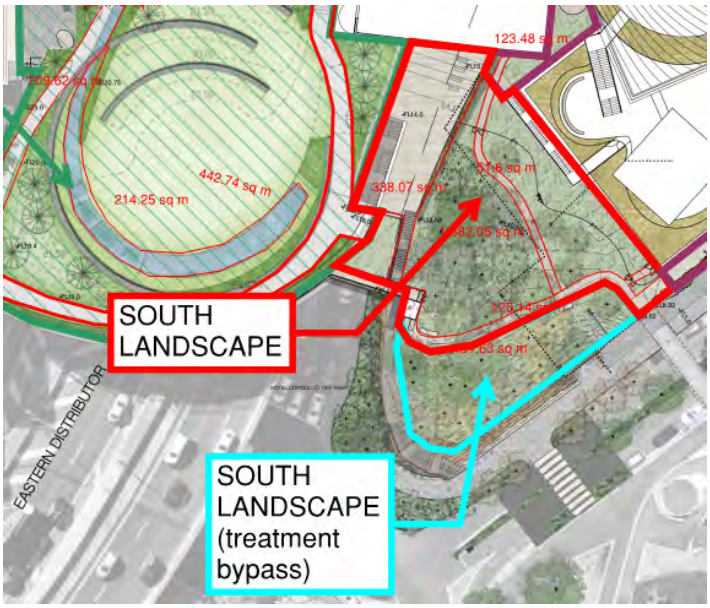


Figure 3 Location of south landscaped area

- **North Landscaped Area**

  The location of the northern landscaped catchment area is shown in Figure 4. Stormwater runoff from the northern landscaped regions will be directed to and collected in stormwater pits. Runoff from these areas will pass through Stormwater360 Enviropod litter basket and a pit fitted with three (3) Stormwater360 Stormfilter cartridges for secondary stormwater treatment. As the location of the Stormfilter cartridges will be inaccessible by vehicles, maintenance of the device will be required through an industrial vacuum cleaner to remove accumulated debris with cartridges transported away on trolleys for flushing or replacement. Maintenance of these devices could be outsourced to an external maintenance contractor.

  A small portion of the northern landscaped area immediately adjacent to Lincoln Crescent at the northernmost extent of the site will not be collected in the pit and pipe stormwater network and will therefore bypass any treatment devices. This bypass sub catchment has been included in the MUSIC model.

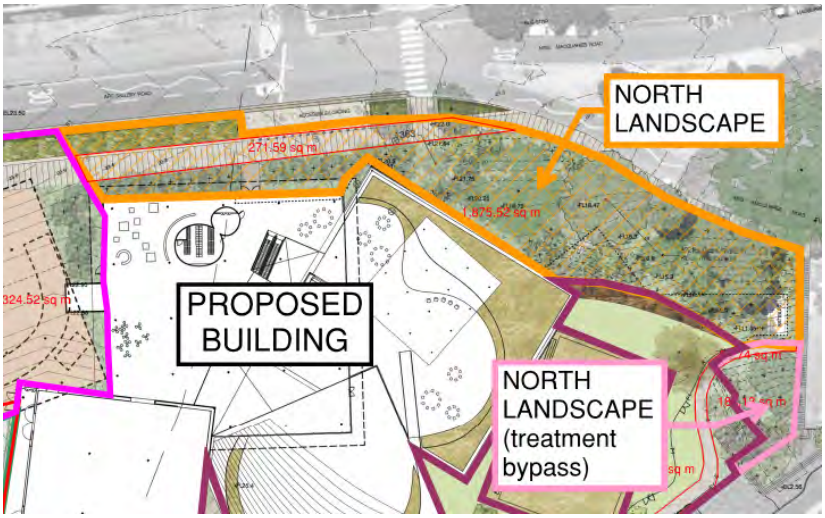


Figure 4 Location of north landscaped area

- **Existing Art Gallery of NSW drop off Area**

  The location of the existing Art Gallery of NSW drop off area is shown in Figure 5. Stormwater runoff from the Art Gallery of NSW drop off area combines with the runoff from Art Gallery Road and is collecting by the road drainage network. It is proposed that Stormwater360 Enviropod litter baskets are retrofitted in all existing stormwater pits provided and in all proposed pits. Further consideration should be given to the dimensions of these pits and the responsibility of maintenance of these proposed litter baskets. Runoff in this network will subsequently pass through a SPEL in-line Ecoceptor 4000 series gross pollutant trap which will provide secondary treatment to remove a portion of remaining suspended solids and nutrients from the stormwater. The position of this device is yet to be confirmed, however, it is proposed that it would be in the road verge or landscaped area adjacent to Art Gallery Road near the proposed Entry Plaza area.

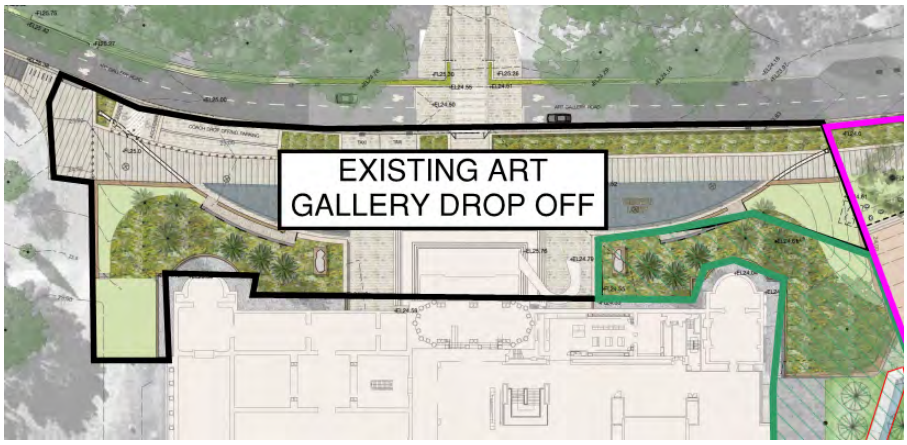


Figure 5 Location of existing art gallery drop off

- **Eastern Distributor Land Bridge**

  The location of the Eastern Distributor land bridge is shown in Figure 6. It is proposed that a section of the land bridge and the portion of the existing landscaped area at the Art Gallery of NSW that drains to the land bridge, are exempt from meeting Council's water quality targets. This has been proposed due to the constraints of the land bridge. The main constraint being the limited cover over the bridge structure which prevents installation of proprietary water quality treatment devices. It is noted that the area being considered does not change land use as a result of the development. It is to remain landscaping. Therefore, it would not be expected to change the water quality of stormwater runoff from these areas. These issues are discussed in further detail in Section 0.

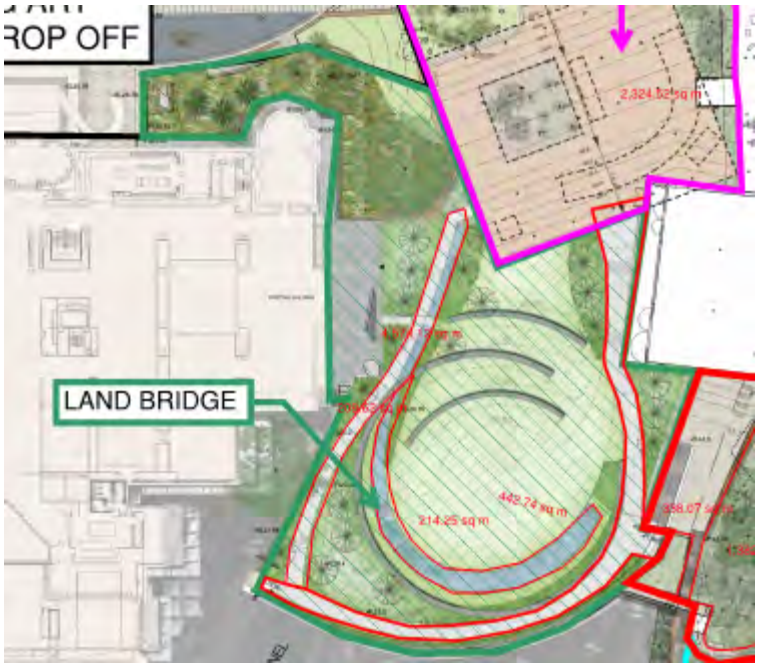


Figure 6 Location of Eastern Distributor land bridge

- **Mrs Macquaries Road Footpath**

  It is assumed that the site does not include the footpath or road areas along Mrs Macquaries Road adjacent to the site.

5 Assumptions and Exemptions

The following assumptions have been made in the preparation of the stormwater quality modelling and reporting:

- MUSIC modelling has been undertaken in accordance with guidance provided in the *"Draft MUSIC Modelling Guidelines for NSW"* (2010) and *"City of Sydney WSUD Technical Guidelines"* (2014).
- City of Sydney MUSIC-link (Data Version 6.3.1) has been configured for the project file using City of Sydney Clay Soil which adopts appropriate rainfall and evapotranspiration data for the site.
- Base and storm flow concentration parameters used are based on residential, and roof land use types have been adopted in the model using parameters outlined in Tables 3.9 and 3.10 of the NSW draft guidelines, and Table 8 of the CoS WSUD guidelines.
- The MUSIC model treatment nodes used for the Enviropod litter baskets and StormFilter cartridges were supplied by the product supplier, Stormwater360.
- The MUSIC model treatment node used for the in-line Ecoceptor 4000 series gross pollutant trap was supplied by the product supplier, SPEL.
- Catchment runoff and pollutant parameters have been allocated in the MUSIC model based on relevant modelling guidelines.

The following exemption is being sought.

- Exclude existing Eastern Distributor land bridge from MUSIC modelling.

Runoff from the existing Eastern Distributor land bridge drains to the east of the site. A portion of the existing Art Gallery of NSW forecourt and drop off area also drains to this area. The land bridge area is 3660m^2 while the size of the forecourt area that drains through the land bridge is approximately 1020m^2.

As-built drawings indicate that landscaping above the land bridge provides approximately 0.5m of soil cover above the roof slab. The overland and subsoil flows are captured through a series of Atlantis drainage cells, and on grade pits. The flow is discharged through down pipes. The thickness of the soil cover and loading limits on the bridge mean that there is limited opportunity for stormwater treatment through bioretention, proprietary products or other means in this area.

The proposed landscaping does not significantly change the depth of cover over the land bridge due to loading constraints. The expected change in the proportion of hardscape and landscape areas is minor. As the land will remain for pedestrian foot traffic use only, it is not expected that the quality of stormwater runoff from this area will significantly change from existing conditions.

Due to the location and fall of these area, limitations on loading of the land bridge and the minor nature of proposed changes to these areas, it is requested that these areas are exempted from Council's water quality targets.

6 Catchments and Treatment Train

The catchment areas can be divided into roof and landscape levels, as shown in Figure 7 and Figure 8.

Figure 7 Roof catchment

Figure 8 Landscape catchment areas

The subcatchment areas and impervious fractions modelled in MUSIC are summarised in Table 2.

Table 2 MUSIC model sub catchments

Sub catchment	Area (m^2)	Impervious Fraction
Land bridge	3663	24%
Entry Plaza	738	90%
South Landscape	1380	37%
South Landscape Treatment Bypass	435	0%
Fuel Bunker Landscape	1490	17%
North Landscape	1904	16%
North Landscape Treatment Bypass	184	14%
Existing AGNSW Forecourt Road	109	100%
Existing AGNSW Forecourt Ped Areas	2464	100%
Existing AGNSW Forecourt (South Site Bypass)	816	0%
Art Gallery Rd (Outside Boundary)	3552	100%
Existing AGNSW Forecourt to land bridge	1020	0%

The treatment train includes the following listed devices. Any alternate devices/ treatment methods would require need to meet equivalent treatment requirements.

- Rainwater Tank of $350m^3$ for cooling tower and irrigation uses
- Stormwater360, 200-micron Enviropods
- Stormwater360, StormFilter 460mm Cartridge Filters
- SPEL Ecoceptor 4000 series gross pollutant trap

Figure 9 shows the schematic from MUSIC of the treatment train.

Figure 9 MUSIC model

7 Results

Water quality treatment results from the MUSIC-link model, excluding the land bridge and upstream contributing sub catchment, are summarised in Table 3. These results show that the water quality targets outlined in the City of Sydney's Development Control Plan (2012), Section 3, General Provisions are met by the proposed development when the land bridge and upstream area is excluded.

Table 3 MUSIC model results excluding land bridge catchment

Pollutant	Source load (kg/yr)	Residual Load (kg/yr)	Reduction	Target Reduction	Target Achieved (Yes/No)
Total Suspended Solids	3270	474	85.4%	85%	Yes
Total Nitrogen	45.9	24.4	56.2%	45%	Yes
Total Phosphorus	5.64	2.32	65.1%	65%	Yes
Gross Pollutants	453	3.5	99.6%	90%	Yes

Table 4 includes a summary of the water quality treatment results from the MUSIC model, including the land bridge and upstream contributing sub catchment. Although these results do not meet Council's water quality targets for total suspended solids or total phosphorus, they do demonstrate a significant overall improvement in the quality of stormwater discharged from the site.

Table 4 MUSIC model results for whole site including land bridge catchment

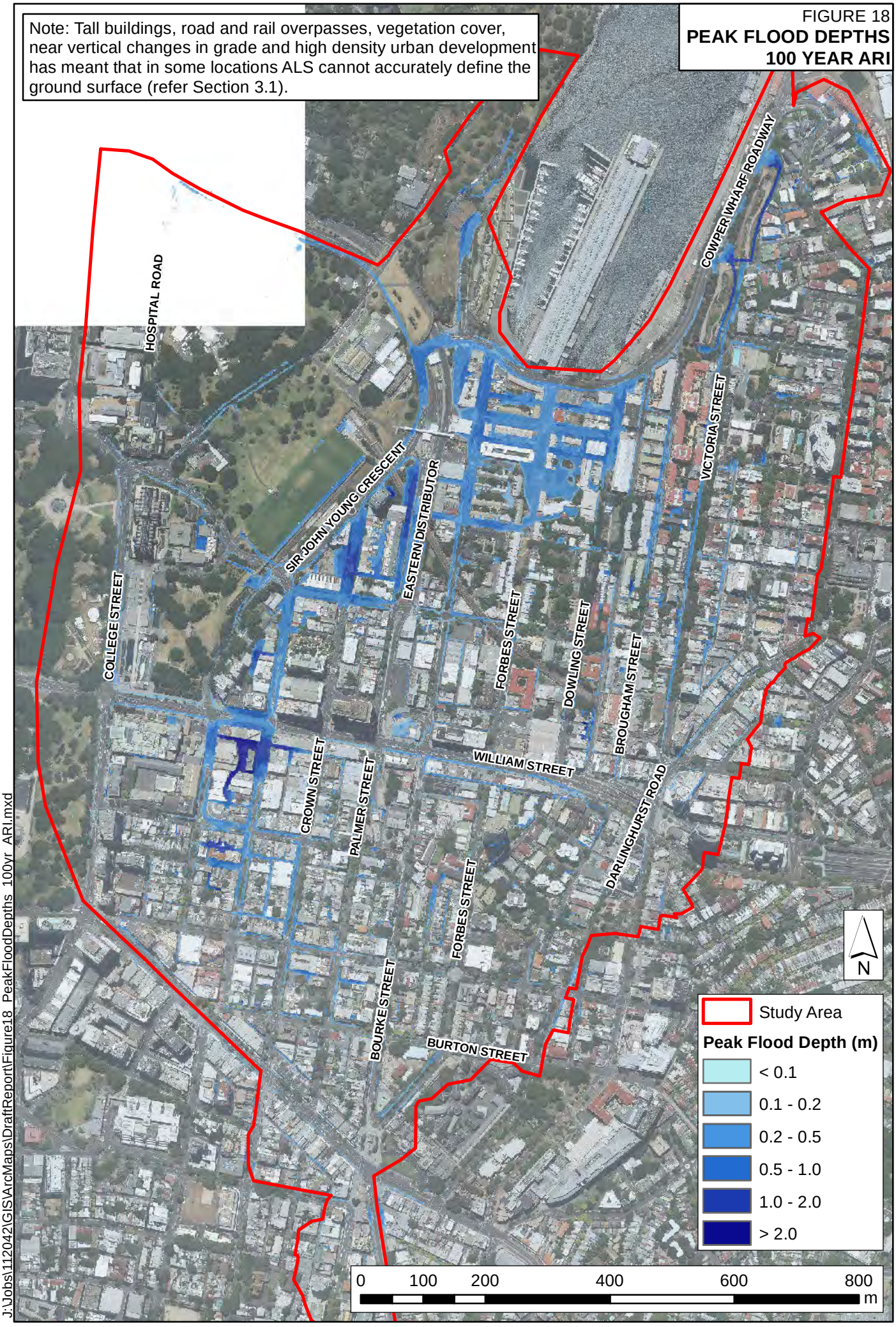
Pollutant	Source load (kg/yr)	Residual Load (kg/yr)	Reduction	Target Reduction	Target Achieved (Yes/No)
Total Suspended Solids	3730	934	74%	85%	No
Total Nitrogen	51.5	30.1	49.8%	45%	Yes
Total Phosphorus	6.4	3.08	57.1%	65%	No
Gross Pollutants	496	46.4	90.5%	90%	Yes

8 Conclusion

This memo has summarised the proposed stormwater runoff water quality treatment strategy for the proposed Sydney Modern Project. The MUSIC water quality modelling results presented demonstrate Council water quality treatment targets can be met through a combination of rainwater reuse, litter baskets and proprietary gross pollutant and nutrient removal devices. However, these results require an exemption to allow the exclusion of the existing Eastern Distributor land bridge catchment area and the area immediately upstream near the existing Art Gallery of NSW drop off. Exemption to exclude these areas is sought as only minor changes to the hardstand areas are

proposed for these areas, and there are limited opportunities for treatment due to loading constraints on the land bridge.

A2 1% AEP and PMF Flood Maps (source: "Woolloomooloo Flood Study" Final Report, April 2016)


Note: Tall buildings, road and rail overpasses, vegetation cover, near vertical changes in grade and high density urban development has meant that in some locations ALS cannot accurately define the ground surface (refer Section 3.1).
FIGURE 18
PEAK FLOOD DEPTHS
100 YEAR ARI
HOSPITAL ROAD
COWPER WHARF ROADWAY
VICTORIA STREET
SIR JOHN YOUNG CRESCENT
EASTERN DISTRIBUTOR
COLLEGE STREET
FORBES STREET
DOWLING STREET
BROUGHAM STREET
WILLIAM STREET
CROWN STREET
PALMER STREET
DARLINGHURST ROAD
FORBES STREET
BOURKE STREET
BURTON STREET
N
Study Area
Peak Flood Depth (m)
< 0.1
0.1 - 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 2.0
> 2.0
0
100
200
400
600
800
m
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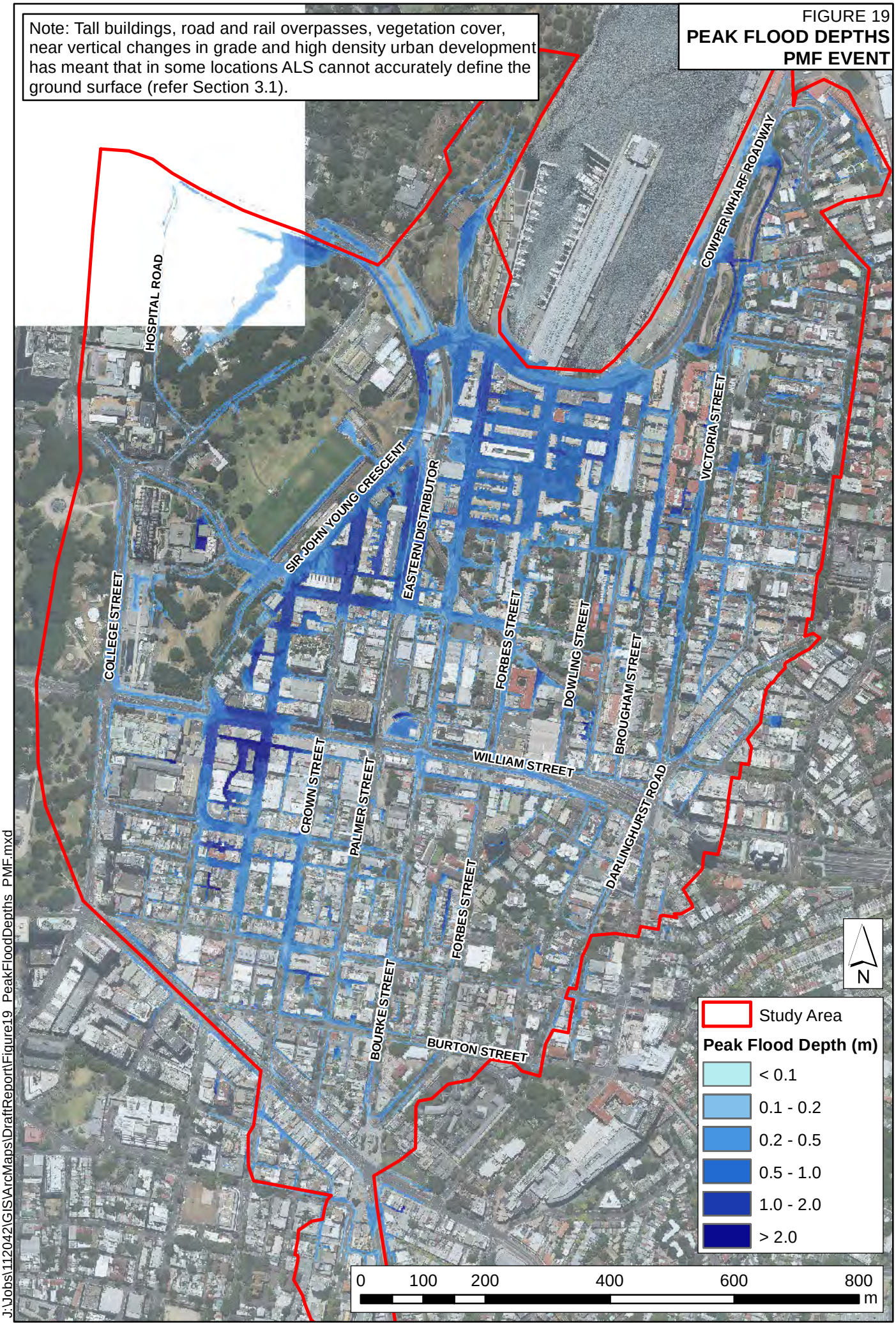
FIGURE 19
PEAK FLOOD DEPTHS
PMF EVENT
Note: Tall buildings, road and rail overpasses, vegetation cover, near vertical changes in grade and high density urban development has meant that in some locations ALS cannot accurately define the ground surface (refer Section 3.1).
HOSPITAL ROAD
COWPER WHARF ROADWAY
VICTORIA STREET
SIR JOHN YOUNG CRESCENT
EASTERN DISTRIBUTOR
COLLEGE STREET
FORBES STREET
DOWLING STREET
BROUGHAM STREET
WILLIAM STREET
CROWN STREET
PALMER STREET
DARLINGHURST ROAD
FORBES STREET
BOURKE STREET
BURTON STREET
N
Study Area
Peak Flood Depth (m)
< 0.1
0.1 - 0.2
0.2 - 0.5
0.5 - 1.0
1.0 - 2.0
> 2.0
0
100
200
400
600
800
m
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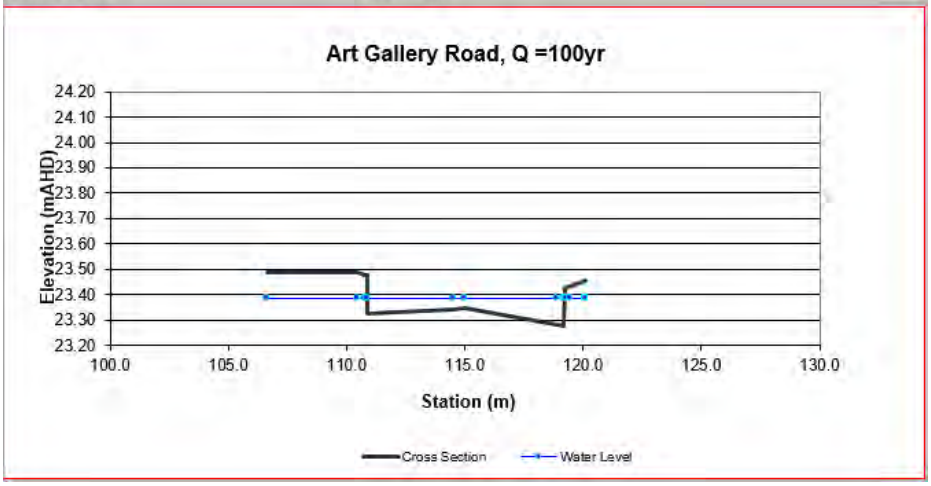
A3 Art Gallery Road Manning's Open Channel Flow Assessment

1% AEP

Q = 0.48 m^3/s

Flow depth = 104mm

Discharge Assumed =	0.480	m3/s	Calculate
Water Surface Level Assumed =	23.383	mAHD	
Channel Average Slope =	0.0084	m/m	
Average Velocity =	1.0	m/s	
Invert Level =	23.278	mAHD	
Flood Depth =	0.104	m	



PMF

Q = 1.99 m^3/s

Flow depth = 187mm

Discharge Assumed =	1.990	m3/s	Calculate
Water Surface Level Assumed =	23.466	mAHD	
Channel Average Slope =	0.0084	m/m	
Average Velocity =	1.7	m/s	
Invert Level =	23.278	mAHD	
Flood Depth =	0.187	m