Prepared for
Western Parkland City Authority (WPCA)
ABN: 84 369 219 084

AECOM

Bradfield Civil Design Report

State Significant Development Application

14-Nov-2021
Bradfield Stage 1A - First Building
Commercial-in-Confidence

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Bradfield Civil Design Report

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Client: Western Parkland City Authority (WPCA)

ABN: 84 369 219 084

Prepared by

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Prepared by Vivie Eccles & Chris Roberts

Reviewed by Gijs Roeffen

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
1	14-Nov-2021	For Submission	Gijs Roeffen / Principal Civil Engineer	

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Executive Summary

The new Bradfield City Centre is located within the Western Sydney Aerotropolis, complementing the metropolitan cluster of centres including Penrith, Liverpool and Campbelltown and will be a diverse, dynamic and sustainable global city precinct supporting a curfew free airport, delivering attractive places for workers, residents and visitors. It has the potential to deliver 50,000 – 60,000 jobs, leveraging the positive economic impact of the Western Sydney Airport, creating Greater Sydney's next global gateway.

The NSW government has committed to build the First Building which includes a high-tech facility for research institutions and industry to collaborate. Expected program is for the First Building to be delivered in 2023. Location will be close to the site of the future Metro station with the intent for the site to be serviced by the incumbent utility provider.

AECOM has been engaged to carry out the Civil Engineering Design to support the State Significant Development Application (SSDA) for the Stage 1A First Building concept proposal. The works will include sections of permanent road for access to First Building from Badgerys Creek Rd, temporary road to connect to Sydney Metro Station Box access track, advanced manufacturing research and development facility building with approximately 2000 m^2 GFA, public interface areas, temporary carpark and temporary onsite detention.

Source: Aerotropolis Precinct Planning Report

1.0 Introduction

1.1 Purpose of Report

This civil engineering design report provides advice on the design consideration for roads, earthworks, levels, intersections, stormwater and utilities. These have been prepared with consideration for the requirements set out in technical studies and standards already existing, which include:

- Liverpool Development Control Plan 2008 (Liverpool DCP 2008)
- Western Sydney Street Design Guidelines, September 2020 (WSSDG 2020)
- Draft Western Sydney Aerotropolis Development Control Plan 2021 Exhibited (DCP2)

1.2 Scope of Works

The works under this commission is to provide the necessary road and utility infrastructure for the construction and operation of the First Building.

Works external to the First Building lot include:

- Design of widened carriageway on southern side of the Sydney Metro Access Track to maintain future access between First Building and Badgerys Creek Road. Sydney Metro Access Track is anticipated to be decommissioned after construction of the Sydney Metro Station Box.
- Design of new permanent road with kerb and gutter in the north-south direction between Sydney Metro Access Track and First Building, along the west side of First Building lot.
- Design of temporary road with kerb and gutter in the east-west direction along the north side of First Building lot.
- Design of temporary road without kerb and gutter in the east-west direction on the northeast corner side of First Building lot to Sydney Metro Access Track.
- Design of new permanent road with kerb and gutter in the east-west direction along the south side of First Building lot.
- Design of associated permanent and temporary road drainage network.
- Concept Design of utilities (water, recycled water, gas, communications, and electrical) from Badgerys Creek Road to service First Building.

Works internal to the First Building lot include:

- Design of temporary drainage network to meet water quantity and quality requirements for the First Building lot. It is envisaged that First Building will discharge to regional detention pond in future.
- Concept Design of temporary Integrated Operating Pump (IOP) Station for First Building.
- Coordination of the carpark and site layout with other consultants.

1.3 Site Appreciation

The First Building lot is located to the east of Badgerys Creek Road, Bringelly, within the new Bradfield City Centre and west of the future Sydney Metro Aerotropolis Station. Access to the lot will be via new roadways connecting to the Sydney Metro Access Track.

The site is currently largely undeveloped grassland. The site generally slopes from west to east between 4% and 5% towards existing Moore Gully located approximately 600 m to the south, and eventually to Thompson’s Creek.

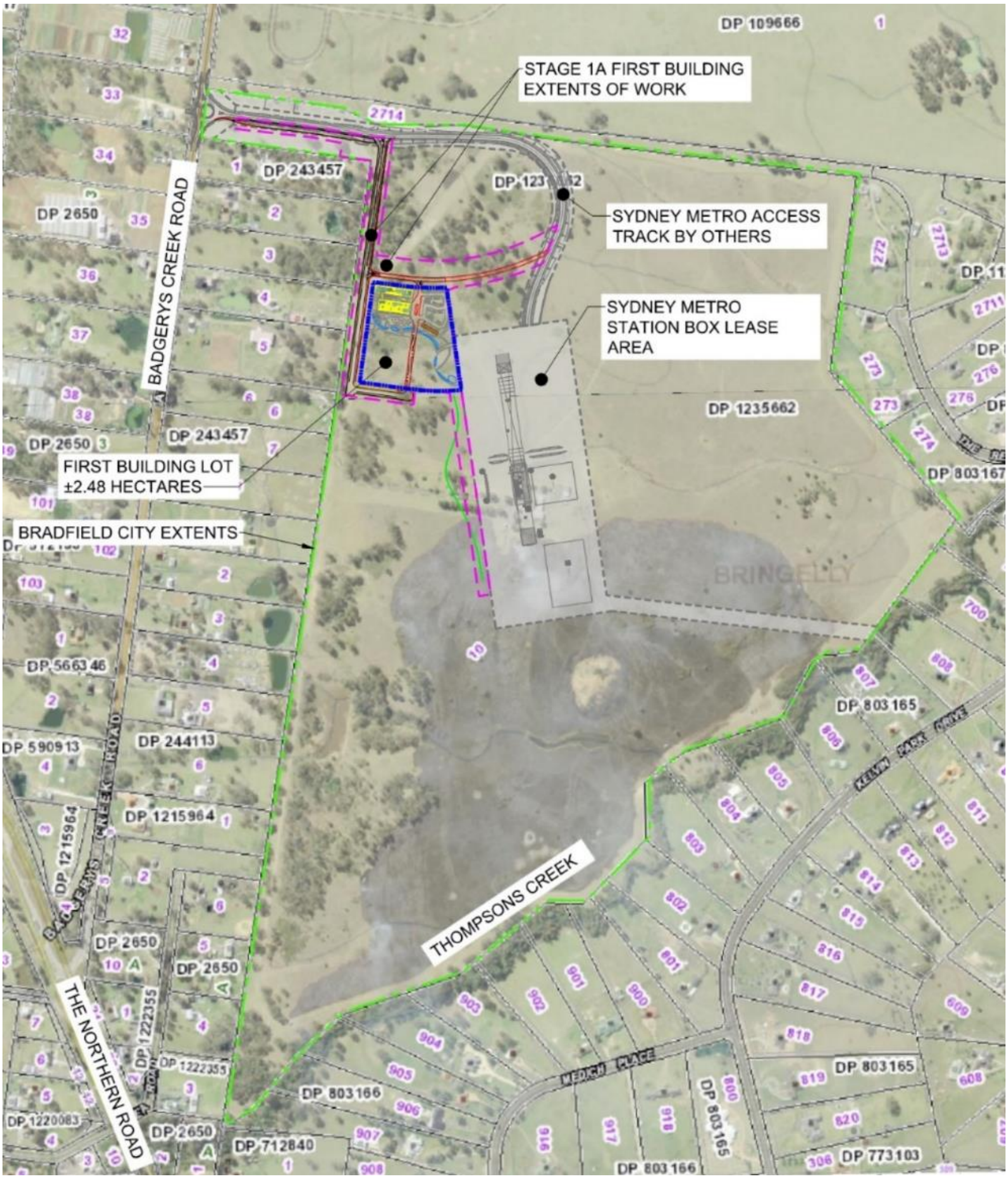

Figure 1 Bradfield City – Overall Site Location Plan (Aerial Image from Six Maps)

1.4 Reference Materials and Design Inputs

Below is a list of information, standards, codes and guidelines referenced during the design of the project.

Table 1.1 Reference Materials

Document Reference	Document Title
ARR 2019	Australian Rainfall and Runoff 2019
AS 1428.1:2009	Design for Access and Mobility – New Building Work

Document Reference	Document Title
AS 1742	Manual of Uniform Traffic Control Devices
AS 2890.1:2004	Parking facilities Part 1: Off-street car parking
AS 2890.2:2018	Parking facilities Part 2: Off-street commercial vehicle facilities
AS 2890.6: 2009	Parking facilities Part 6: off-street parking for people with disabilities
The Blue Book	Soils and Construction – Managing Urban Stormwater Volume 1
WS900098 EDM	Western Sydney Engineering Design Manual – DRAFT (Rev. PCG_02)
Liverpool DCP	Liverpool Development Control Plan 2008
Liverpool Design Specification	Liverpool City Council Development Design Specification, D1, Geometric Road Design (Urban and Rural), October 2003
DCP2	Draft Western Sydney Aerotropolis Development Control Plan 2021 (Exhibited)
NSW SOC	Guide to Codes and Practices for Streets Opening, 2018
WSSDG	Western Sydney Street Design Guidelines, Sept 2020

The following design inputs have been relied upon in developing the SSDA design.

Table 1.2 Design Inputs

Item	File Names	Author	Date Received
Survey	PR146456-DET_001a.12da	RPS	12 November 2020
Masterplan	Bradfield MP v1.5 2021.09.07.dwg	WPCA	08Sept 2021
Sydney Metro Access Track Design	- P0054028-0000-DR-DRAINAGE-COMBINED-20210805_AAR.DWG - P0054028-MOD-000_DR-DRAINAGE-COMBINED-20210805_AAR.12DA - P0054028-MOD-1000-RD-ROAD-MODEL_20210804.12da - P0054028-MOD-1000-RD-ROAD-MODEL_20210804.dwg - P0054028-REF-0000-UT-ABB-PLAN 3d.dwg - P0054028-REF-0000-UT-DES-PLAN 3d.dwg - P0054028-REF-0000-UT-SURV-PLAN 3d.dwg SMWSA-SMD-AEC-CE-DWG-003330.-.INF.-.01.zip	TfNSW	11 Aug 2021
Architectural Block Plan	015842_SiteLayoutDayOne_211026.dwg	Hassell Studio	26 Oct 2021

2.0 Roadworks, Earthworks, Levels Design

2.1 Design Criteria

The following design criteria have been adopted in the preparation of the civil design of the First Building:

Table 2.1 Design Criteria

Item	Standards	Adopted	Comment
Horizontal Alignment			
Posted Speed	TBD	40 km/h	Posted speed limit for Sydney Metro Access track is 40 km/h.
Design Speed	Liverpool City Council Design Spec D1.09	<u>Local Street</u> 40 km/h <u>Collector Street</u> 60 km/h	
Horizontal Curve	Liverpool City Council Design Spec Table D1.2(a)	<u>20 km/h Desired Speed</u> 10 m <u>40 km/h Desired Speed</u> 40 m <u>60 km/h Desired Speed</u> 80 m	
Minimum Lane/Median Width	Western Sydney Street Design Guidelines Table B.3	<u>High Street</u> - Travel lane width = 3.2m – 3.5m - Parking lane width = 2.0m – 2.4m	- 3m wide median provided south of Metro Access Track - 3.5m travel lane width provided at permanent road sections - 3m wide flex zone provided at proposed permanent road sections
		<u>Industrial Street</u> - Travel lane width = 3.5m - Parking lane width = 2.0m – 2.4m	
		<u>Retail Laneway</u> - Travel lane width = 3.2m – 3.5m - Parking lane width = 2.0m – 2.4m	- 4m travel lane width provided - 3m wide flex zone provided

<table>
<tr><th>Item</th><th>Standards</th><th>Adopted</th><th>Comment</th></tr>
<tr><td colspan="4">Horizontal Alignment</td></tr>
<tr><td rowspan="3">Design Vehicle</td><td rowspan="3">Western Sydney Street Design Guidelines Table B.3</td><td><u>High Street</u>
Rear-loaded: B85 Car
Front-loaded: 8.8m Service Vehicle</td><td rowspan="3">12.5m Single unit truck/bus used as garbage truck design vehicle</td></tr>
<tr><td><u>Industrial Street</u>
19m Prime Mover and Semi Trailer</td></tr>
<tr><td><u>Retail Laneway</u>
8.8m Service Vehicle</td></tr>
<tr><td rowspan="3">Check Vehicle</td><td rowspan="3">Western Sydney Street Design Guidelines Table B.3</td><td><u>High Street</u>
12.5m Single unit truck/bus</td><td rowspan="3">19m Prime Mover and Semi Trailer used as check vehicle for deliveries</td></tr>
<tr><td><u>Industrial Street</u>
25m B-Double</td></tr>
<tr><td><u>Retail Laneway</u>
11m Garbage Truck</td></tr>
<tr><td colspan="4">Vertical Alignment</td></tr>
<tr><td>Longitudinal Grade</td><td>Western Sydney Planning Partnership Engineering Design Manual Section 4.3.1 (table 7)</td><td>A general minimum gradient of 1.0 per cent should be adopted.

Absolute minimum of 0.5% can be accepted for short distances (up-to 50m)

<u>Local</u>
Desirable = 6.5%
Absolute maximum = 16 %

<u>Collector</u>
Desirable maximum = 6.5%
Absolute maximum = 16%</td><td>A minimum of 0.5% longitudinal gradient is adopted to align with future road networks in the overall Bradfield Masterplan and to avoid batters into the adjacent property.</td></tr>
<tr><td>Vertical Curve</td><td>Liverpool City Council Design Spec Table D1.3</td><td><u>Local</u>
Minimum VC = 25 m
Absolute minimum VC to be applied at road junctions only = 6 m

<u>Collector</u>
Minimum VC = 35 m</td><td>VC of between 8m and 10m is provided at intersections.</td></tr>
</table>

Item	Standards	Adopted	Comment
Horizontal Alignment			
		Absolute minimum VC to be applied at road junctions only = 12 m	
Cross Fall	Liverpool City Council Design Spec Section D1.15	Minimum 3% Maximum 4%	3% cross fall provided
Batters	Liverpool City Council Design Spec D1.16	Desirable minimum 3:1 Absolute minimum Cut 2:1 Fill 3:1 Rock batters ¼:1	Battters between 4:1 and 6:1 provided
Parking			
Accessible Car Parking	BCA 2010 Table D3.5 DCP2 Table 4	- Non-residential: 1% of all spaces	(2) DDA spaces provided
Number of Spaces	Defined by SCT Consulting	Defined by SCT Consulting	(50) 90-degree car park + (5) parallel parking provided
Parking Dimensions	Liverpool DCP 2008 Table 14	Medium Term Parking - Width = 2.5 m - Length = 5.4 m - Aisle Width = 5.8 m	

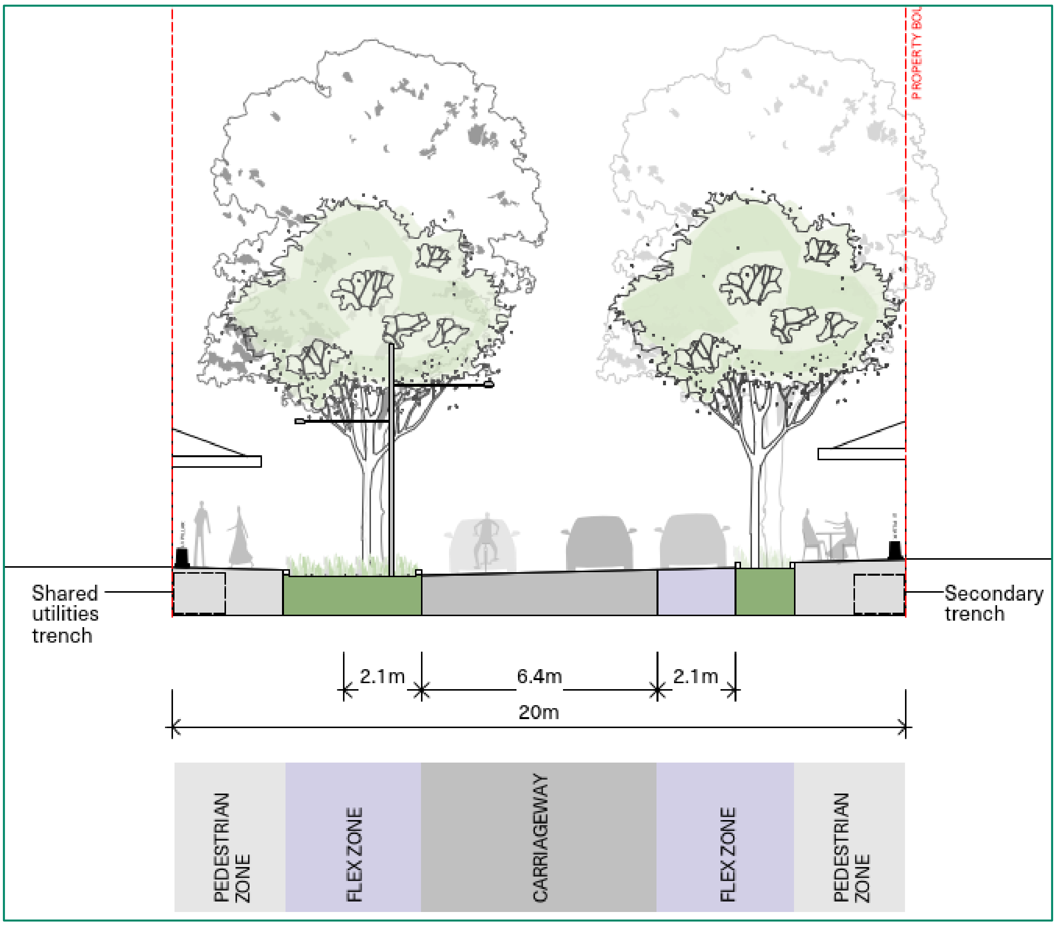

Figure 2 High Street - Commercial Centre (Source: WSSDG 2020)

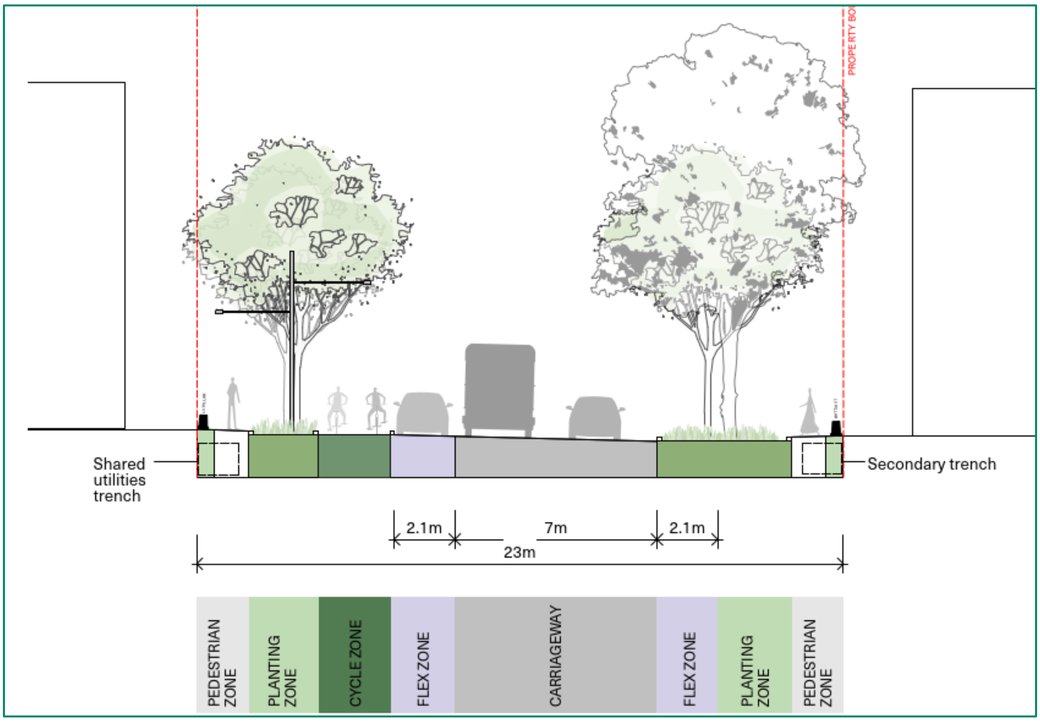

Figure 3 Industrial Street - Industrial and Commercial Precincts (Source: WSSDG 2020)

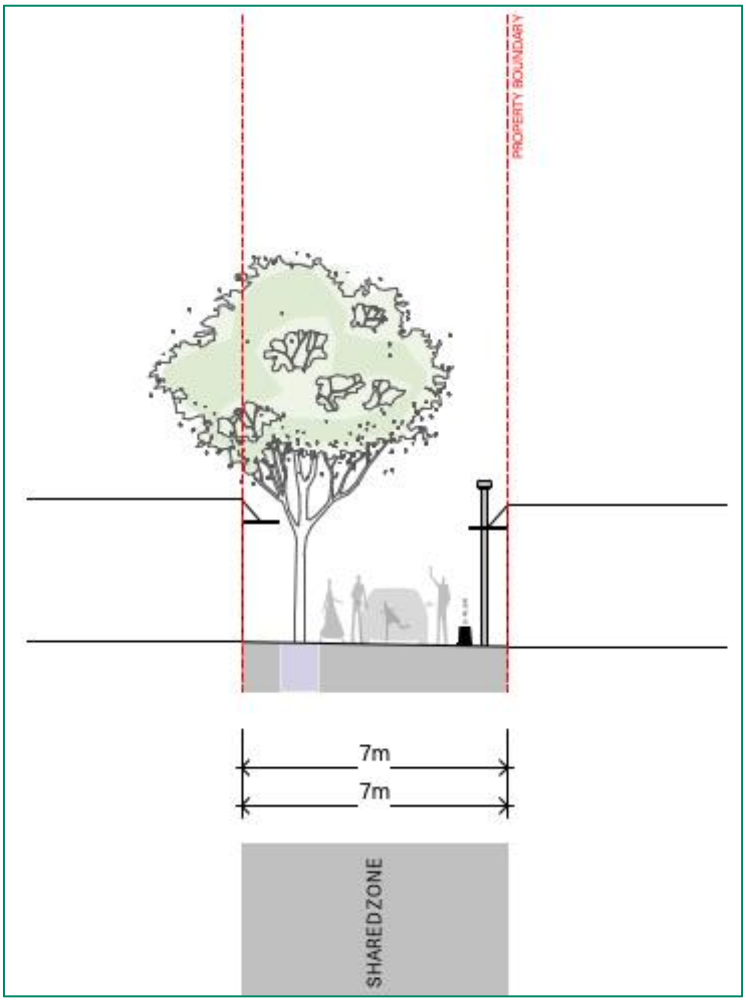

Figure 4 Retail Laneway - Commercial Centre (Source: WSSDG 2020)

2.2 Earthworks

Earthwork quantities i.e. cut / fill volumes for the Stage 1A proposed works have been calculated in 12d. Quantities are presented in Table 2.2:

The following assumptions have been adopted in developing this estimate:

- Unadjusted Earthwork quantities are finished surface to existing levels.
- Earthwork quantities are solid i.e. no allowance for bulking or shrinkage of spoil has been included;
- No allowance for removal of unsuitable material has been included in this estimate;
- No allowance for stripping of topsoil, existing flexible and concrete pavements, or removal of building slabs etc.;
- No allowance for excavation to allow installation of inground utilities;
- No allowance for spoil associated with building and/or structure foundations e.g. piles

Table 2.2 Stage 1A Cut / Fill Volumes

Type	Volume (m^3)
Unadjusted Cut	18,462
Unadjusted Fill	17,619
Net Cut	843

2.3 Swept Path Analysis

The internal road within First Building lot as well as the kerb returns for the new surrounding roads have been designed to cater for vehicle movements as listed in Table 2.1. Vehicle turn path analysis was carried out using Autodesk AutoCAD Vehicle Tracking software for design vehicle. Refer to sheets 60646285-SHT-01-1000-CI-0971 and 60646285-SHT-01-1000-CI-0972.

2.4 Sight Distance

2.4.1 Safe Intersection Sight Distance (SISD)

Safe Intersection Sight Distance (SISD) check in accordance with AGRD Part 4A Section 3.2.2 was undertaken for the intersection of MCB02 and MCA07.

$$SISD = \frac{D_T \times V}{3.6} + \frac{V^2}{254 \times (d + 0.01 \times a)}$$

Where

SISD = safe intersection sight distance (m)

D_T = decision time (s) = observation time + reaction time = 3s + 1.5s (AGRD Part 3 Table 5.2)

V = operating speed = 60 km/h

d = coefficient of deceleration = 0.36 (AGRD Part 3 Table 5.3)

a = longitudinal grade in direction of travel = +1.8%

SISD = 112 m

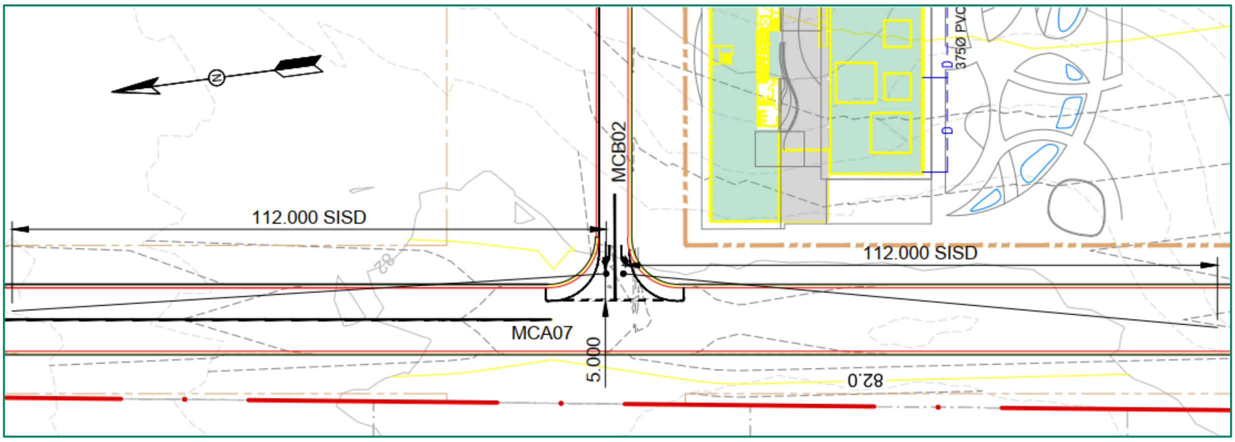

Figure 5 Safe Intersection Sight Distance - Plan

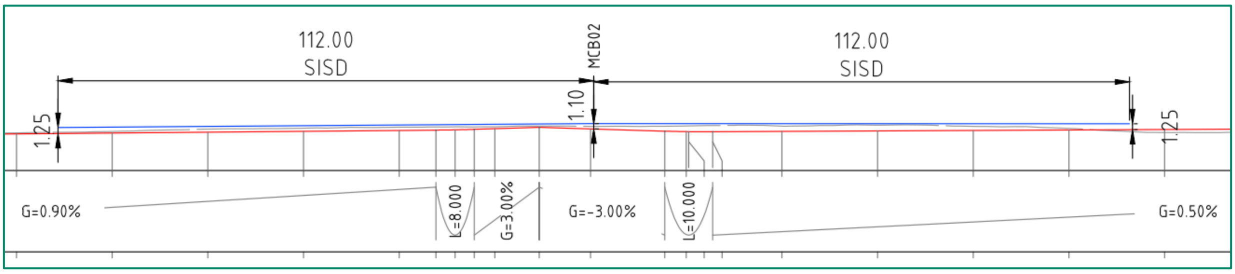

Figure 6 Safe Intersection Sight Distance - Profile

As shown on Figure 5 and Figure 6, safe intersection sight distance for operating speed of 60 km/h is provided with the current design.

3.0 Stormwater Management

3.1 Design Criteria

3.1.1 Statutory Requirements & Development Control Plans

LEP

Absent more detailed and dedicated Local Environment Planning for the Aerotropolis region, the planning constrains and requirements for the Liverpool LGA have been adopted in their stead.

Western Sydney Aerotropolis DCP 2021 (DRAFT)

To integrate into the future public domain, the provisions from the DRAFT WSA DCP 2021 Phase 2 (dated October 2021) have been considered in the concept stormwater management design with particular focus on:

- Part 2
  - Section 4: Stormwater, Water Sensitive Urban Design and Integrated Water Management
  - Section 9: Flooding and Environmental Resilience and Adaptability
- Part 3
  - Section 14: Benchmarks for larger Sites, Subdivisions or Master Planning

3.1.2 Qualitative & Quantitative Objectives

Qualitative and quantitative objects are as per those set out in the WSA DCP Phase 2 with particular interest in improving upon the water quality during post-development discharge as well as reducing flow volumes via attenuation to reduce future stormwater and flooding risks.

3.1.3 Constraints

Site specific constrains were not significant beyond the need to meet minimum gradients and coordination with allowable drainage line alignments due to super lot arrangement.

The significant design considerations and constraints included coordinating initial short term design and planning needs with long term permanent planning – including the transition between the two.

Based on this design philosophy AECOM created two models that were designed in parallel: one to cater for the First Building and another for the overall 'Master Plan'. Initial concept layouts were developed for the Master model to determine expected main drainage lines, discharge points, grading restrictions, flow concentrations and initial pipe sizing. A more detailed model was developed from this Master model for the First Building concept design that incorporated first stage road construction and the short term catchment disruptions.

The final design of the First Building model is thus considered an extract of the Master model, with considerations for future drainage requirements taken into account:

- Drainage line terminations are in line with future permanent works
- No drainage lines are constructed that solely serve short term needs, with the exception of minor stub pipes connected to drain to temporary basins
- Most surface inlet pits are utilised in the future permanent model, with pit lids being changed from surface inlet type to kerb inlets as needed.

3.2 Stormwater Model Parameters & Analysis

The stormwater management strategy aims to minimise and control the influence of rainwater on existing and new drainage networks. This is achieved by assessing the site for both hydrological and hydraulic performance of its existing networks, both overland and subsurface, and comparing the impacts of the proposed development and its introduction of new drainage systems via a quantitative analysis.

3.2.1 Hydrological Model

Hydrological analysis was undertaken using DRAINS, by assessing and modelling of sub-catchment areas with relation to impervious breakdown and recorded rainfall data for the area. The DRAINS model parameters are presented below in Figure 7.

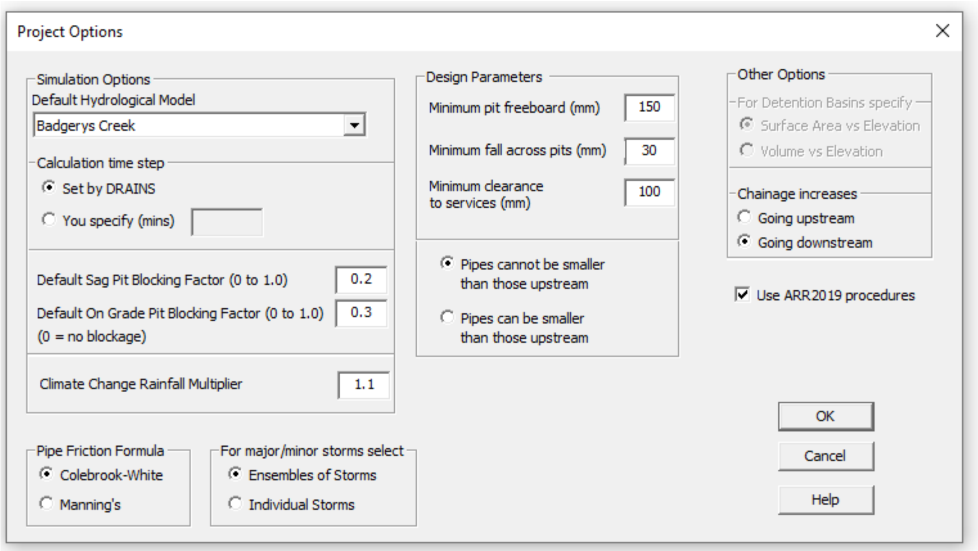

Figure 7 DRAINS model options (DRAINS)

The DRAINS model has been constructed utilising the ARR2019 procedure for ensemble of storms, with data obtained from ARR Data Hub.

Rainfall loss parameters used in the DRAINS model are presented below in Table 3.

Table 3 DRAINS Rainfall Loss Parameters

Parameter	Value
Impervious Depression Storage	1mm
Pervious Depression Storage	5mm
Soil Type	3
Antecedent Moisture Content	3

Impervious areas were designed based on assumed land use and with reference to WSA DCP Phase 2 on impervious requirements – an extract of which is presented below in Figure 8.

Urban typology	Lot requirements			Typology elements					
	Site Cover	Perviousness		Lot area		Streets (including plazas and urban public spaces adjacent to a street)		Open space (including parks, gardens, playgrounds, playing fields, and alike)	
				% of Overall Area	Perviousness	% of Overall Area	Perviousness	% of Overall Area	Perviousness
High-density mixed-use centre	60%	40%	Base scenario	50%	35%	35%	35%	15%	90%
			Alternative/ Parkland solution	58%	30%	32%	35%	20%	90%
Medium density mixed use centre	50%	50%	Base scenario	55%	50%	30%	35%	15%	90%
			Alternative/ Parkland solution	58%	35%	32%	38%	20%	90%
Employment – business, commercial and light industrial	60%	40%	Base scenario	55%	40%	30%	30%	15%	90%
			Alternative/ Parkland solution	55%	30%	30%	30%	20%	90%
Employment – Large format industrial	70%	30%	Base scenario	60%	30%	25%	35%	15%	90%
			Alternative/ Parkland solution	65%	15%	20%	35%	15%	90%

** The perviousness of a lot may be subsidised by other on-site detention and landscaping measures where it is not deemed acceptable or it is seen to be too onerous by a delegated authority for the site coverage to be reduced to meet the perviousness requirements. An example of this would be in a zero lot line opportunity (for a podium or attached built forms) in a centre, employment area or for an integrated development*

Figure 8 Site coverage and pervious percentages (WSA Draft DCP Phase 2 2021)

3.2.1.1 Catchment Analysis

Catchment analysis and sub-catchment breakdown is presented in Figure 9 below, showing major existing catchment directions draining to Moore Gully to the south, which is a tributary of Thompsons Creek further to the south and to the east.

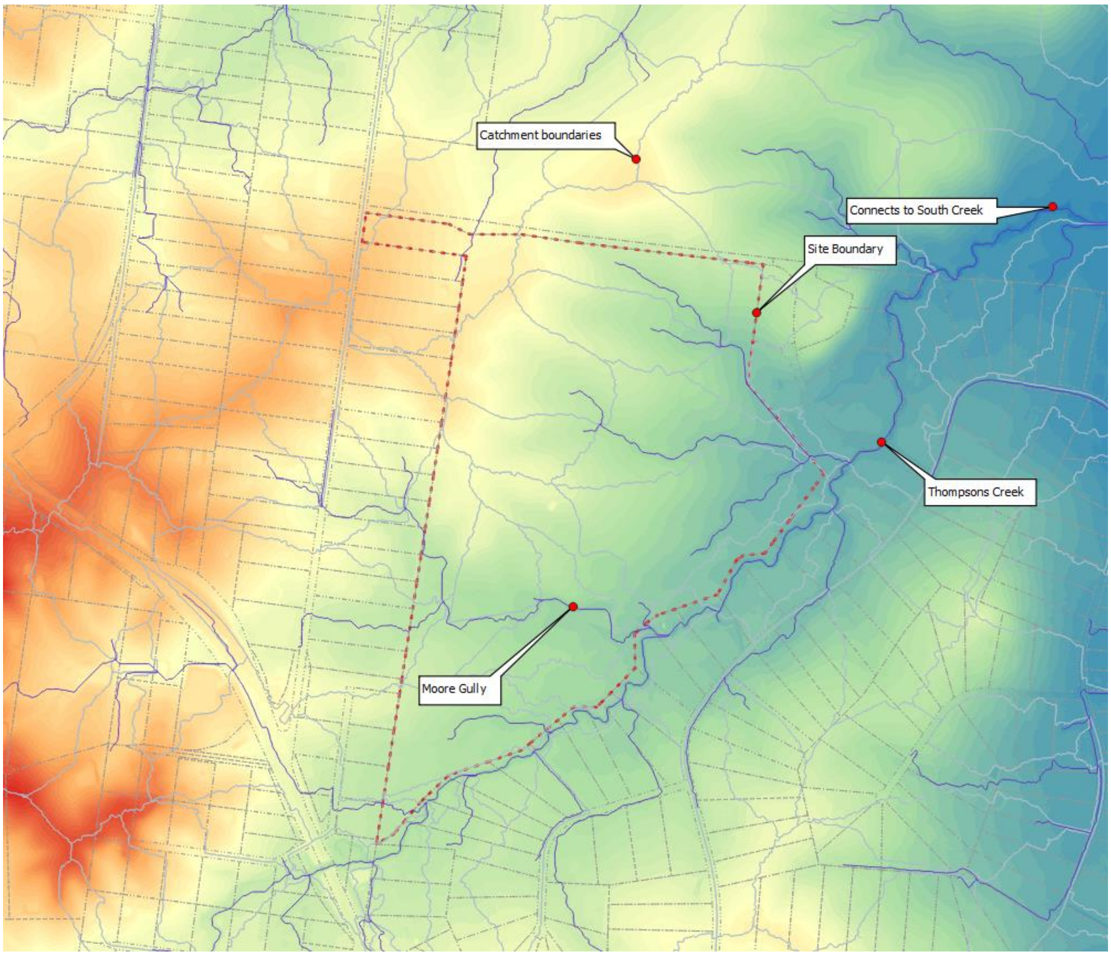

Figure 9 Existing major catchments & terrain

3.2.1.2 Rainfall Data

Rainfall data was obtained from the Bureau of Meteorology (BOM), with the IFD data and rainfall depths presented below in Figure 10 and Figure 11 respectively.

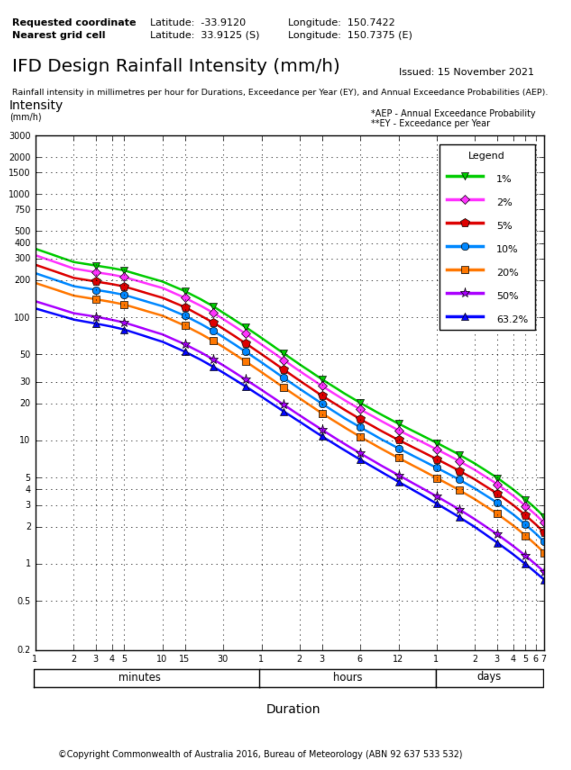

Figure 10 IFD Intensity Graph (BOM)

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	118	135	190	228	267	319	360
2 min	95.9	108	150	179	209	249	281
3 min	88.9	101	140	167	195	232	263
4 min	83.9	95.4	133	159	186	222	251
5 min	79.6	90.7	127	152	178	212	240
10 min	63.3	72.6	103	123	144	173	195
15 min	52.6	60.4	85.5	103	121	144	163
20 min	45.2	51.9	73.4	88.4	103	124	140
25 min	39.7	45.6	64.4	77.5	90.7	109	123
30 min	35.6	40.8	57.5	69.2	80.9	96.9	109
45 min	27.5	31.3	43.9	52.7	61.6	73.8	83.4
1 hour	22.7	25.8	35.9	43.1	50.3	60.2	68.1
1.5 hour	17.2	19.5	26.9	32.2	37.6	45.0	50.9
2 hour	14.2	16.0	22.0	26.3	30.6	36.6	41.5
3 hour	10.8	12.2	16.6	19.9	23.1	27.7	31.4
4.5 hour	8.35	9.39	12.8	15.2	17.8	21.3	24.1
6 hour	6.99	7.86	10.7	12.8	14.9	17.9	20.2
9 hour	5.48	6.17	8.46	10.1	11.8	14.2	16.0
12 hour	4.62	5.23	7.21	8.64	10.1	12.1	13.7
18 hour	3.65	4.15	5.80	6.98	8.19	9.83	11.1
24 hour	3.07	3.52	4.96	6.00	7.06	8.47	9.57
30 hour	2.68	3.08	4.39	5.33	6.28	7.53	8.49
36 hour	2.39	2.76	3.96	4.82	5.69	6.81	7.68
48 hour	1.98	2.29	3.33	4.07	4.82	5.76	6.49
72 hour	1.48	1.73	2.54	3.12	3.70	4.42	4.97
96 hour	1.19	1.39	2.04	2.51	2.99	3.56	4.00
120 hour	0.992	1.16	1.69	2.08	2.47	2.95	3.32
144 hour	0.850	0.988	1.43	1.76	2.09	2.50	2.81
168 hour	0.742	0.860	1.23	1.51	1.79	2.15	2.41

Figure 11 Rainfall Intensities, mm/hr (BOM)

3.2.2 Hydraulic Model

The hydraulic analysis was undertaken in DRAINS, by assessing a combination of subsurface pit and pipe drainage networks and surface flows via swales and storage basins. The aim of this analysis was to ensure the expected site rainfall runoff could be sufficiently managed, directed and controlled with the proposed stormwater drainage network while also minimising post-development runoffs to meet quantitative targets and performance objectives.

3.2.2.1 Drainage Network

The drainage network is composed of standard pit and pipe configurations as suitable for road trunk drainage systems and utilise standard RCP RRJ pipes and GKI pits where appropriate.

The First Building drainage network details are presented in the Appendix along with the accompanying DRAINS model file.

3.2.2.2 Overland Flows

Overland flows through developed areas are either managed with standard kerb and gutter or via constructed grass swales, sized to cater for major storm events and convey water to necessary discharge points.

Two swales direct temporary end of trunk drainage networks to the southern OSD basin with a third swale proposed for the outlet of the same basin, directing discharged water south towards Moore Gully and ensuring no stormwater flows onto the Metro Station box lease area.

3.3 On-site Detention

Post development stormwater discharges are attenuated via the use of temporary OSD basins for both the northern and southern discharge points.

Discharge comparison is provided for both the minor and major events – 10% AEP and 1% AEP respectively.

Temporary Basin 1 – (North)

With the partial road construction along the Metro Access Track and joining road, a large existing catchment collects at the trapped low point.

It is approximately 600 sqm at the top of the basin, with approximately 0.6m maximum depth.

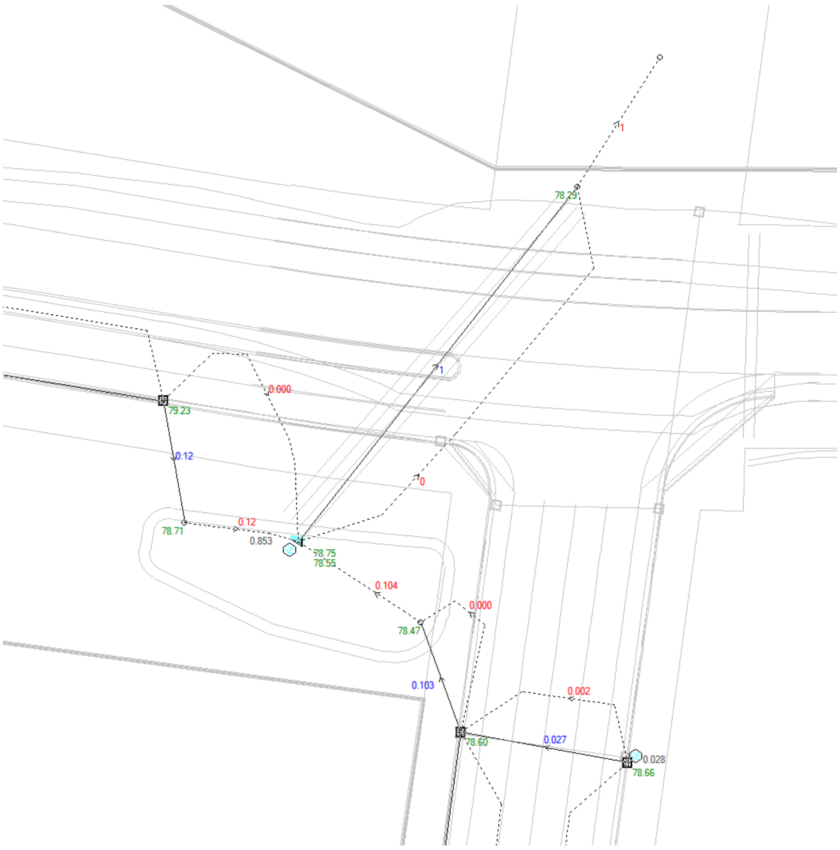

Figure 12 Northern temporary basin as modelled in DRAINS, 10% results showing

Four 600mm diameter stormwater pipes are proposed with the Metro Access Track design (by Metro) that have been extended in this proposed network, to allow for the expanded road width, and connect into the temporary basin.

No orifice control device is proposed as part of this design.

Discharge comparisons for Basin 1 location are presented in Table 4 for the minor storm only as Basin 1 is not sized to cater for the major storm events.

Table 4 Peak discharge comparison at Basin 1

AEP	Pre-Development Discharge (L/s)	Post-Development Discharge (L/s)
10%	907	1000
1%	1880	2060

<u>Temporary Basin 2 – (South)</u>

A second temporary basin is proposed in the south eastern corner of the First Building lot, with all local sub-catchments draining to it. This includes the building roof runoff and the road surface and subsurface discharge.

It is approximately 1200 sqm at the top of the basin, with approximately 1.6m maximum depth.

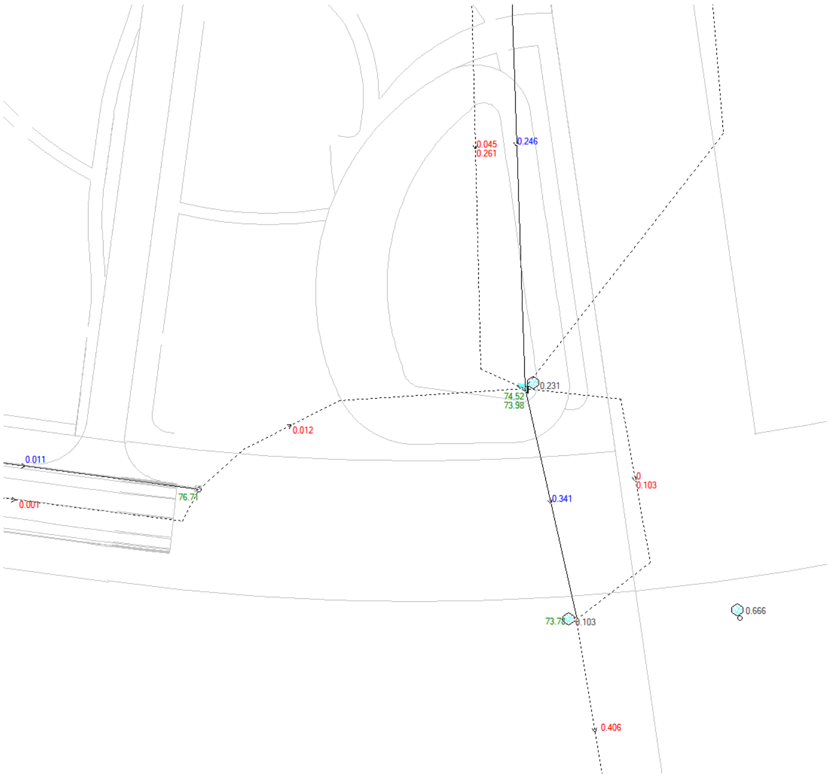

Figure 13 Southern temporary basin as modelled in DRAINS, 10% results showing

Road discharge to the basin is mostly overland via swales with partial redirect to the proposed GPT unit.

The building drainage will be connected to a 150kL rainwater tank intended for reuse facilities but is not modelled as OSD in this drainage network, instead the roof drainage is modelled as being directly piped to Basin 2.

No orifice control device is proposed as part of this design.

Discharge comparisons for Basin 1 location are presented in Table 5 for both the minor and major events.

Table 5 Peak discharge comparison at Basin 2

AEP	Pre-Development Discharge (L/s)	Post-Development Discharge (L/s)
10%	666	406
1%	1380	600

3.4 Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design aims to minimise the impacts of urban development on local and regional water quality while also promoting the reuse and alternative use of water in the stormwater system.

Water quality analysis was conducted for the First Building development, with the knowledge that the development is an initial stage of a larger future network and any proposed works need to be managed in both the short term while also allowing viability in the longer term, permanent master planning.

To provide assessment of the current site and proposed developments impact to water quality, a qualitative analysis was performed using MUSIC (by eWater - v6.3).

3.4.1 Site Characteristics

Pollutant concentrations for storm flow and base flow for different area designations are derived from Liverpool City Councils MUSIC-Link guidelines and are presented below in Table 6and Table 7 respectively.

Table 6 Storm Flow Stormwater Pollutant Concentrations

Land Use	Concentration (mg/L – log10)					
	TSS		TP		TN	
	Mean	SD	Mean	SD	Mean	SD
General Urban	2.15	0.32	-0.60	0.25	0.30	0.19
Residential	2.15	0.32	-0.60	0.25	0.30	0.19
Industrial	2.15	0.32	-0.60	0.25	0.30	0.19
Commercial	2.15	0.32	-0.60	0.25	0.30	0.19
Road Areas	2.43	0.32	-0.30	0.25	0.34	0.19
Roof Areas	1.30	0.32	-0.89	0.25	0.30	0.19

Table 7 Base Flow Stormwater Pollutant Concentrations

Land Use	Concentration (mg/L – log10)					
	TSS		TP		TN	
	Mean	SD	Mean	SD	Mean	SD
General Urban	1.20	0.17	-0.85	0.19	0.11	0.12
Residential	1.20	0.17	-0.85	0.19	0.11	0.12
Industrial	1.20	0.17	-0.85	0.19	0.11	0.12
Commercial	1.20	0.17	-0.85	0.19	0.11	0.12

WSA Draft DCP Phase 2 stormwater pollutant load reduction requirements are outlined below (as per PO2 of 4.3.2 WSA DCP Phase 2):

- 90% Gross Pollutants
- 90% Total Suspended Solids
- 80% Total Phosphorus
- 65% Total Nitrogen

Which are higher than Liverpools required reductions of 90% (GP), 85% (TSS), 65% (TP) and 45% (TN). The concept model produced for the First Building development has therefore adopted the WSA reduction targets.

3.4.2 Model Parameters

Model parameters were as those derived from the WSA Draft DCP Phase 2, Liverpool Councils MUSIC-Link guidelines and WaterNSWs *Using MUSIC in Sydney Drinking Water Catchment*.

3.4.3 Rainfall Data

The MUSIC model for the site utilised a 6-minute rainfall daily timestep as this presented with a more reliable data set for the specific site. Rainfall records were obtained from the BOM while timestep data was obtained from Liverpool City Council based on Rainfall Station 067035 (Liverpool, Whitlam centre).

3.4.4 Site Storage and Ponds

A 150kL rainwater harvesting tank is proposed to be connected to the First Building roof gutter system, with intention for stored water to be used for reuse facilities and irrigation. This structure has been modelled as a “Rainwater Tank” node.

The treatment train for the southern discharge catchment utilises a bioretention basin integrated into the proposed OSD basin nominated.

It is expected that most of the site stormwater discharge will enter the basin after first passing through the GPT treatment node, though not all of it is feasible to do so. The small fraction of water that will enter this basin untreated for general litter and larger sediments is approximately 2.5% of the total treatable discharge and is considered negligible for a treatment stage that is temporary, and as treatment targets are achieved despite the bypass of treatment.

3.4.5 Model Details and Performance

The proposed treatment train for the southern catchment was comprised of piped and overland flow directed to an inline GPT unit located on site that then discharged to an integrated bioretention/OSD basin before finally discharging from site along a grassed swale.

A significant portion of the road and upstream catchment was piped to a swale prior to connecting the GPT unit because of staging the pipe construction, however this was utilised to provide additional remedies to the treatment train.

A layout of the pre- and post-development MUSIC models are presented in Figure 14 below.

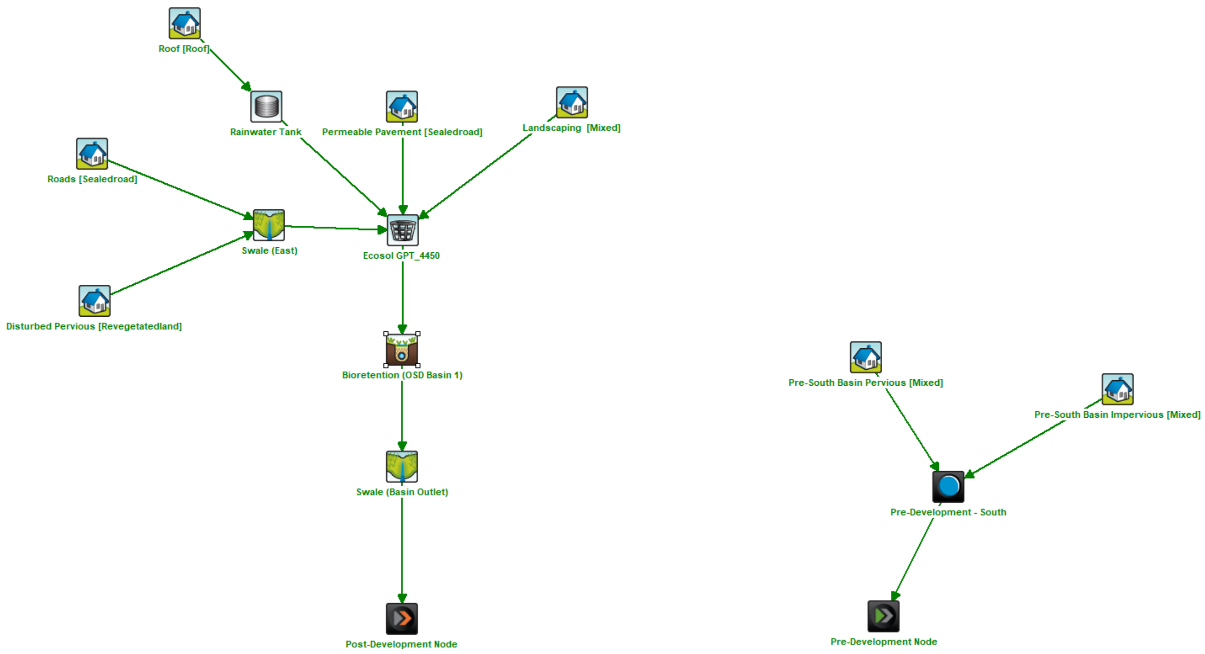

Figure 14 MUSIC model for pre- and post-development configurations

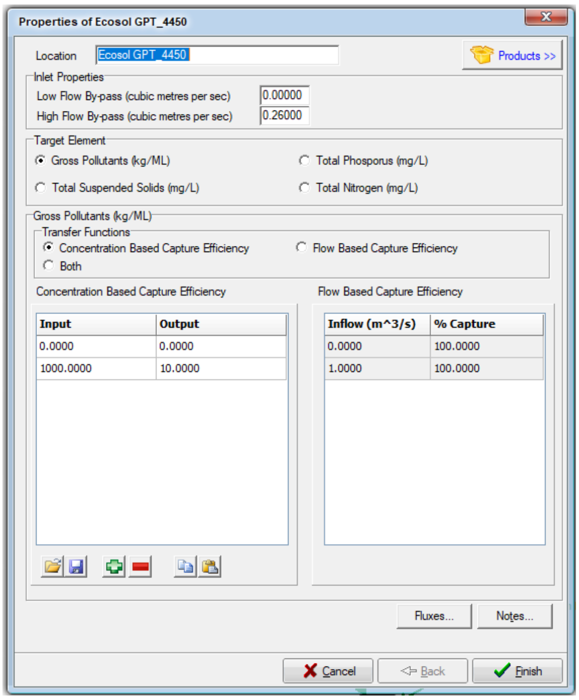

Figure 15 GPT used in the model

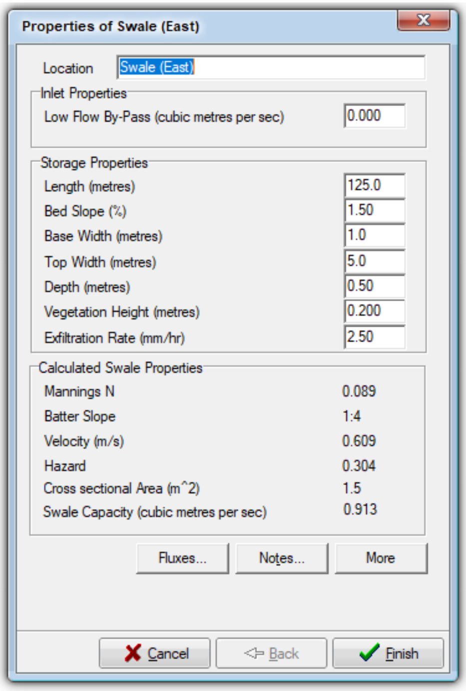

Figure 16 Typical swale properties

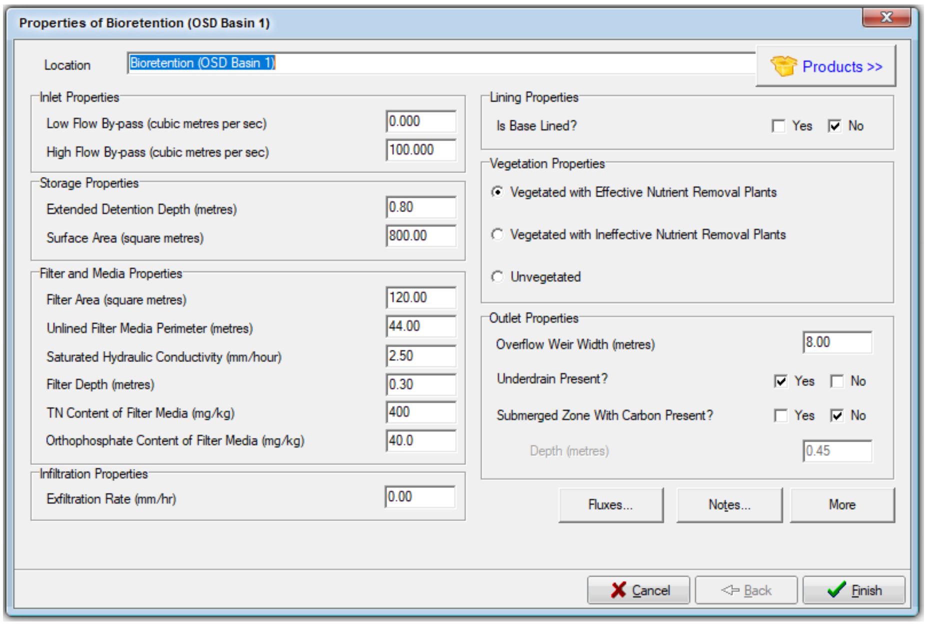

Figure 17 Bioretention basin integrated into the southern OSD basin

3.5 Assumptions and Further Works

Detailed design of the stormwater networks is to be refined to suit both the immediate performance needs as further details emerge in further detailed development of the site as well as meeting the potential performance needs of the larger master planning for the region.

Future planning is to also include the impacts and allowance for climate change tolerances – which are estimated to be approximately 10-15% additional to the rainfall data.

First Building concept and detailed design rely heavily upon assumptions of no further changes to the master plan layout as well as no drastic changes to DCP requirements in relation to performance targets, objectives or design criteria and restrictions such as land use impervious percentages.

4.0 Utilities Services

4.1 Existing and Proposed Services

A Dial Before You Dig request was undertaken for the site area which identified a range of services present in the vicinity of the project site. These are summarised in Table 4.1.

Table 4.1 Summary of Existing Services

Utility Service	Provider
Communications	RAAF, Telstra and NBN Co
Electrical	Endeavour Energy
Gas	Jemena
Potable Water	Sydney Water Corporation
Recycled Water	None existing; anticipated to be provided in future by Sydney Water Corporation
Sewer	Sydney Water Corporation

4.1.1 Communications

Many above ground communication assets are scattered around the Bradfield study area, varying from 3G to 4G cells and private transmit and receiver assets. Much of the communications network is mounted to Endeavour Energy's poles, while some are in a pit and duct system.

The following asset owners are made up of utility providers and private operators, the details of these assets are yet to be fully explored in any study available to date:

- Optus;
- Telstra;
- Vodaphone;
- NBN;
- RAAF; and
- Private (various land holders)

In accordance with WSSDG 2020, design requirements include:

- Ensure a depth of cover of 450mm in verge, 600mm in non-State roads, 1200mm in State roads;
- Ensure separation from adjacent utilities: 300mm from water and mains gas, 100mm from comms;
- Install a 100mm conduit for road crossings;
- Place NBN within Telstra pits and co-locate with Telstra network;
- Provide one distribution hub per 384 premises (new fibre-to the- kerb installations do not require large cabinets);
- Ensure a Max. 150m between distribution hub and premises; and
- Provide one pit per four premises: max. 250m between pits

Further coordination with utility providers is ongoing.

4.1.2 Electrical

Based on feasibility advice received from Endeavour Energy, supply to the “First Building” and AMRF is available from the Bringelly Zone Substation via the existing 11kV feeder X881 across the frontage of the Bradfield site along the western verge of Badgerys Creek Road.

Estimated loads for the first building consist of 0.266 MVA and 2 fast charging EV points. It is proposed to establish 11 kV HV underground to overhead transition at two existing poles on western verge of

Badgerys Creek Road and install underground 11 kV reticulation from the poles to a new padmount substation at property frontage within the First Building lot. Connection of load application to be confirmed with Endeavour Energy.

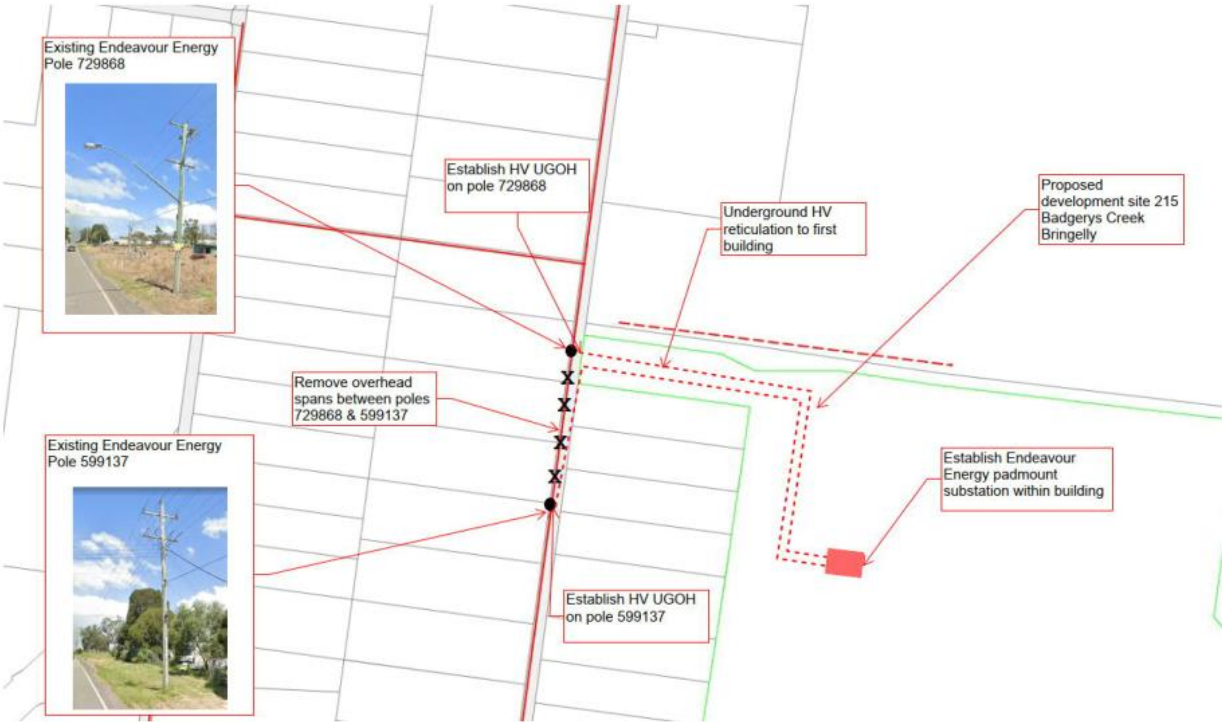

Figure 18 Proposed Electrical Scope of Works for First Building

In accordance with WSSDG 2020, design requirements include:

- Locate electricity conduits in verge;
- Ensure a depth of cover of 900mm to bottom of conduit for low voltage and 1100mm for high voltage; and
- Ensure a minimum 300mm separation from adjacent utilities.

4.1.3 Gas

The area is supplied with natural gas through connection to the Jemena Network. There is a limited distribution network in the area comprised a secondary main and a regulator that steps down from 1050kPa to 300kPa to service commercial customers in the immediate area of Badgerys Creek Rd. The existing gas infrastructure on the site has been identified based on Growth Infrastructure Compact #1, DBYD records and google street view. These indicate a network of gas mains within and adjacent to the site, in particular:

- 200mm ST 1050kPa secondary network servicing Badgerys Creek Rd;
- 110mm PE 300kPa distribution line; and
- Distribution Regulator Set

It is anticipated that extensions for the Bradfield gas network will be facilitated by the existing 300kPa 110mm PE line that runs south of the regulator on Badgerys Creek Rd and terminates a few hundred metres north of the Bradfield main centre. With the demand of the greater area and infrastructure, an extension and augmentation of the existing secondary high pressure steel network would be required accommodate the surrounding growth.

It is proposed to install a new gas main from existing gas main on Badgerys Creek Road to service the First Building.

In accordance with WSSDG 2020, design requirements include:

- Locate gas in verge, min. 1.2m from adjacent property boundary;
- Ensure a 600mm depth of cover;
- Ensure a 200mm horizontal separation from adjacent utilities; and
- Ensure services are parallel or perpendicular to adjoining property boundaries

4.1.4 Potable Water

There is an existing Sydney Water 150 DICL water main on the eastern verge of Badgerys Creek Road. Sydney Water Corporation (SWC) has advised that trunk network amplifications are currently being delivered to service growth in the wider Western Sydney Aerotropolis Growth Area (WSAGA). Trunk amplifications on Badgerys Creek Rd by FY2022 will provide sufficient network capacity to service the initial development in Bradfield.

Estimated demand for First Building based on GFA of 2,000 m^2 is 8.00 kL/day. Demand rates are consistent with Water System Planning Guideline (Sydney Water, Version 1, September 2014), Section 3, Table 3-3 for a proposed land use of Light Industrial 0.004 kL/ha/day. It is proposed to connect a new 150 water main from existing water main at Badgerys Creek Road to First Building for back-up water supply. Living Building certification is being pursued for First Building. Connection strategies still to be coordinated in further detail with Sydney Water.

4.1.5 Recycled Water

There is currently no existing recycled water infrastructure in the area. As a key element of Western Sydney's circular economy, the Upper South Creek Advanced Water Recycling Centre (AWRC) will produce recycled water for non-drinking water use within Bradfield. Trunk recycled water supply infrastructure will be staged and delivered in line with growth, with a key dependency on supply being the delivery of the AWRC by FY2026.

It is proposed to install a new 150 recycled water main to First Building for connection to future recycled water main at Badgerys Creek Road. In the interim, the new recycled water main to First Building will connect to the potable water supply. Connection strategies still to be coordinated in further detail with Sydney Water.

4.1.6 Sewer

There is currently no existing sewer infrastructure within the vicinity of the First Building lot. Sydney Water Corporation (SWC) has advised that First Building and Bradfield will be within the catchment of the Upper South Creek Advanced Water Recycling Centre (AWRC) which will have capacity to treat wastewater generated. Stage 1 construction of the AWRC is due to be delivered by FY2026 to align with the operation of the new Western Sydney Airport (WSA). The First Building IOP will be decommissioned after the sewer infrastructure is installed from First Building to AWRC.

Estimated demand for First Building based on GFA of 2,000 m2 is 0.063 L/s. Demand rates are consistent with the ADWF – 0.0021 L/s and Future Industrial areas 0.015 EP/m2 [Gravity Sewerage Code of Australia, WSA 02-2014- (Water Services Association, Version 3.1, 2014), Appendix C]. It is proposed to install an interim operating pump station (IOP) for the First Building in the temporary carpark area. Sewer is to be trucked out periodically. Connection strategies still to be coordinated in further detail with Sydney Water.

4.2 Shared Utility Trench

Proposed services for First Building will be in accordance with Western Sydney Street Design Guidelines 2020 (WSSDG 2020) for shared utility trenches.

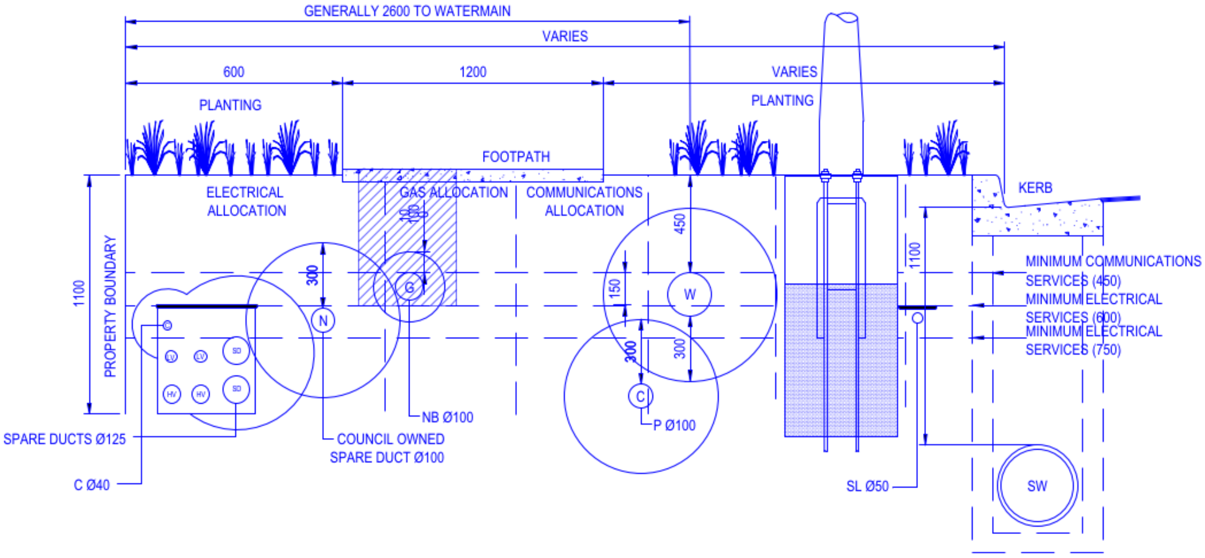

Figure 19 Indicative Shared Utilities Trench as shown in the Engineering Design Manual for Western Sydney (Source: ACOR)

4.3 Future Work

Coordination with utility providers to facilitate detailed design to service estimated demand for First Building is to be undertaken. In addition, allowance for future demands and Bradfield Masterplan should be considered.