BOREHOLELOG

SURFACE LEVEL: EASTING: 289665 NORTHING: 6236789 DIP/AZIMUTH: 90°/-

BORE No: GW4 **PROJECT No:** 192225.02 DATE: 24/2/2020 SHEET 1 OF 1

		Description	. <u>ಲ</u>		Sam	npling	&In:Situ:Testing		Well	
님	Depth (m)	of	raph Log	be.	pth	nple		Vate	Construction	
		Strata	0	тy	De	San	Comments	<u> </u>	Details	kOI
	- 0.1	TOPSOIL/Silty@LAY: brown, with rootlets	1/1/							
	-	Silty CLAY: Drown and grey	1/1					₹		0
	-		1/1/					3-21		000
	- 1		1/1					10-0		000
	-		1/1/							00
	-									000
	-		1/1/							00
										00
	-2		1/1/							00
	-									00
			1/1/							000
	-									000
	-3		1/1/							000
	-									000
	- 3.5 -	SHALE: Tpale brown and grey								000
	-									200
	-4								-4 [ bentonite	Ø
	-									
	-								[ ] [ ]	
	-									
	-5								-5	<u> </u>
	-									<u>=</u>
	-									3
	-								sand -	<u>=</u>
	-6	- becoming dark grey below 6.0m							-6	=
	-								screen	Ē
	-									<u>=</u>  :
	-7								-7	=[::]
	-									<u>=</u> [:
	-									<u>=</u> ::
	-									<u> </u>
	-8 8.0	Bore discontinued at 8.0m							8	
	-	-ilimitofinvestigation								
	-									
	-9								-9	

RIG: Comacchio GEO 405

CLIENT:

PROJECT:

LOCATION:

Boyuan Bringelly Pty Ltd

621 E705 The Northern Road, Cobbitty, NSW

Proposed Rezoning

DRILLER: Terratest

LOGGED: ERL

CASING:

TYPE OF BORING: SFA and rotary air blast WATER OBSERVATIONS: Groundwater observed whilst augering at 7 3m REMARKS: Location Coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND A Augerisample B Bulkisample BLK Blockisample C Core drilling D Disturbed sample E Environmental sample Gasisample Pistonisample Tube sample(Ximmidia.) Waterisample Wateriseep Waterievel G P U<sub>×</sub> W 

**Douglas Partners** Geotechnics | Environment | Groundwater



BOREHOLELOG

SURFACE LEVEL: EASTING: 289665 NORTHING: 6236789 DIP/AZIMUTH: 90°/-

BORE No: GW5 PROJECT No: 092225.02 DATE: 21/2/2020 SHEET 1 OF 1

Γ		Description	U		Sam	npling	&InSituTesting		Well	
	Depth	of	aphi -og	e	th	ple	Poculte 18	/ater	Constructio	'n
		Strata	0	Typ	Dep	Sam	Comments	>	Details	
Γ	0.05	TOPSOIL/Silty@LAY:@brown,with rootlets								
	-1 -1	SiltyICLAY:IIredibrowniandiorangeibrown -ibecomingIgreyIandIredImottledIbelow/3.0m SHALE:IIpaleIbrown						10-03-20	-1 grout -2 -3 bentonite -4 -4 -5 screen	
	-7 7.0	Boreidiscontinuediati7.0m - Ilimitiofiinvestigation								

RIG: Comacchio GEO 405

CLIENT:

PROJECT:

LOCATION:

Boyuan Bringelly Pty Ltd

621 E705 The Northern Road, Cobbitty, NSW

Proposed Rezoning

DRILLER: Terratest TYPE OF BORING: SFA and rotary air blast

LOGGED: ERL

CASING:

WATER OBSERVATIONS: No free groundwater observed whilst augering REMARKS: Location coordinates are in MGA94 Zone 56 Not bailed

SAMPLING & IN SITU TESTING LEGEND A Augerisample B Bulkisample BLK Blockisample C Core drilling D Disturbed sample E Environmental sample Gasisample Pistonisample Tube sample(Ximmidia.) Waterisample Wateriseep Waterievel G P U<sub>×</sub> W 

LEGEND PID Photo ionisation detector (ppm) PL(A) Point load axial test Is(50) (MPa) PL(D) Point load diametral test Its(50) (MPa) pp Pocket penetrometer (kPa) \$ Standard penetration test V Shear vane (kPa)



# Rock Descriptions

#### **Rock Strength**

Rock strength is defined by the Point Load Strength Index  $(Is_{(50)})$  and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index Is <sub>(50)</sub> MPa	Approximate Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	М	0.3 - 1.0	6 - 20
High	Н	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

\* Assumes a ratio of 20:1 for UCS to  $Is_{(50)}$ . It should be noted that the UCS to  $Is_{(50)}$  ratio varies significantly for different rock types and specific ratios should be determined for each site.

#### **Degree of Weathering**

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description	
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.	
Highly weathered HW		Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable	
Moderately weathered	MW	Staining and discolouration of rock substance has taken place	
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock	
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects	
Fresh	Fr	No signs of decomposition or staining	

#### **Degree of Fracturing**

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

## **Rock Descriptions**

#### **Rock Quality Designation**

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

RQD % =  $\frac{\text{cumulative length of 'sound' core sections} \ge 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$ 

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

#### **Stratification Spacing**

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes	
Thinly laminated	< 6 mm	
Laminated	6 mm to 20 mm	
Very thinly bedded	20 mm to 60 mm	
Thinly bedded	60 mm to 0.2 m	
Medium bedded	0.2 m to 0.6 m	
Thickly bedded	0.6 m to 2 m	
Very thickly bedded	> 2 m	

## Soil Descriptions

#### **Description and Classification Methods**

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

#### Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Туре	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Туре	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 - 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded a good representation of all particle sizes
- Poorly graded an excess or deficiency of particular sizes within the specified range
- Uniformly graded an excess of a particular particle size
- Gap graded a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soi	ls (>35% fine	s)
Term	Proportion	Example
	of sand or	
	gravel	
And	Specify	Clay (60%) and
		Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace
		sand

### In coarse grained soils (>65% coarse)

with clave or silts

5

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils	(>65%	coarse)
- with coarser fraction		

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with 'Mix of Soil and Cobbles/Boulders' with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

## Soil Descriptions

#### **Cohesive Soils**

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	Н	>200
Friable	Fr	-

#### **Cohesionless Soils**

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

#### Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil derived from in-situ weathering of the underlying rock;
- Extremely weathered material formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil deposited by streams and rivers;

- Estuarine soil deposited in coastal estuaries;
- Marine soil deposited in a marine environment;
- Lacustrine soil deposited in freshwater lakes;
- Aeolian soil carried and deposited by wind;
- Colluvial soil soil and rock debris transported down slopes by gravity;
- Topsoil mantle of surface soil, often with high levels of organic material.
- Fill any material which has been moved by man.

**Moisture Condition – Coarse Grained Soils** For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  - Soil tends to stick together. Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.

Soil tends to stick together, free water forms when handling.

#### **Moisture Condition – Fine Grained Soils**

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- 'Moist, dry of plastic limit' or 'w <PL' (i.e. hard and friable or powdery).
- 'Moist, near plastic limit' or 'w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- 'Moist, wet of plastic limit' or 'w >PL' (i.e. soils usually weakened and free water forms on the hands when handling).
- 'Wet' or 'w ≈LL' (i.e. near the liquid limit).
- 'Wet' or 'w >LL' (i.e. wet of the liquid limit).

#### Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thinwalled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

#### **Test Pits**

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the insitu soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

#### Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

#### **Continuous Spiral Flight Augers**

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

#### **Non-core Rotary Drilling**

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

#### **Continuous Core Drilling**

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

#### **Standard Penetration Tests**

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

 In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

15, 30/40 mm

## Sampling Methods

The results of the SPT tests can be related empirically to the engineering properties of the soils.

#### Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

## Symbols & Abbreviations

#### Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

#### **Drilling or Excavation Methods**

С	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

#### Water

$\triangleright$	Water seep
$\bigtriangledown$	Water level

#### Sampling and Testing

- Auger sample А
- В Bulk sample
- D **Disturbed sample** Е
- Environmental sample
- U<sub>50</sub> Undisturbed tube sample (50mm)
- Water sample W
- Pocket penetrometer (kPa) pp
- PID Photo ionisation detector
- ΡL Point load strength Is(50) MPa
- S Standard Penetration Test V Shear vane (kPa)

#### **Description of Defects in Rock**

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

#### **Defect Type**

В	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

#### Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h horizontal

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- vertical ٧
- sub-horizontal sh
- sub-vertical sv

#### **Coating or Infilling Term**

cln	clean
со	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

#### **Coating Descriptor**

са	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

#### Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

#### Roughness

ро	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

#### Other

fg	fragmented
bnd	band
qtz	quartz

## Symbols & Abbreviations

#### **Graphic Symbols for Soil and Rock**

#### General

o	

Asphalt Road base

Concrete

Filling

#### Soils



Topsoil	
Peat	

Clay

Silty clay

Sandy clay

Gravelly clay

Shaly clay

Silt

Clayey silt

Sandy silt

Sand

Clayey sand

Silty sand

Gravel

Sandy gravel

Cobbles, boulders

Talus

#### Sedimentary Rocks



#### **Metamorphic Rocks**

Slate, phyllite, schist

Quartzite

Gneiss

#### Igneous Rocks



Granite

Dolerite, basalt, andesite

Dacite, epidote

Tuff, breccia

Porphyry

	0002008		,	<i>4</i> 6		V	V	V	V					
(l/g/l)	C10-C36		•			<100	<100	<100	<100					
TRH	60-90									<10	<10	<10	<10	
	Benzo(a)pyrene		ı	0.1*		7	₹	∑	7					
	Fluoranthene					1.0*		<1	<1	<1	<1			
AH <sup>2</sup> (µg/l	Phenanthrene			0.6*		<1	<1	<1	<1					
Ľ	enecene		-	0.4		<1	<1	<1	<1					
	ənəlsritqsV	<b></b>		16		<1	<1	<1	<1					
	Sinc	-evels (GII	3000	80	2019	24	12	26	17					
	Νίςkel	stigation I	20	11	ptember 2	12	5	2	З					
	Mercury	Groundwater Inve	Groundwater Inve	1	0.06*	tesults -Se	<0.05	<0.05	<0.05	<0.05				
	อรอทธุญก <sub>ิ</sub> คิท			Ground	Ground	Ground		1,900		1,700	640	520	970	
(I/Brl)	реэд		10	3.4		<1	<1	<1	<1					
/y Metals (	Iron					100	45	<10	350					
Heav	Copper		2000	1.4		4	<1	2	æ					
	Chromium					50 <sup>a</sup>	50 <sup>a</sup>	<del>.</del>		<1	<1	<1	~1	
	muimbeD		2	0.2		0.3	<0.1	0.1	<0.1					
	Bromine					28,000	22,000	14,000	23,000					
	Arsenic		10	24 / 13 °		ß	2	~1	4					
			Nater	hwater										

All Chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment

Only those compounds for which GILs have been determined are included in the list

Given as Cr (VI)

Limit as below identification

As (III) and As (V) respectively

as m-Xylene

99% Level of protection adopted due to potential for bioaccumulation or to protect key species from chronic toxity

Corresponding to an unknown level of protection

not defined/ not analysed/ not applicable

ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, A NRMMC (2011) Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy. National Health and Medical Research Council, National Resource Management Minister Australia, Canberra



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#### **CERTIFICATE OF ANALYSIS 238591**

Client Details	
Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Erin Leslie
Address	18 Waler Crescent, Smeaton Grange, NSW, 2567

Sample Details					
Your Reference	92225.04, Cobbity SWP Prelim				
Number of Samples	8 water				
Date samples received	10/03/2020				
Date completed instructions received	10/03/2020				

#### **Analysis Details**

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details					
Date results requested by	17/03/2020				
Date of Issue	17/03/2020				
NATA Accreditation Number 2901. This document shall not be reproduced except in full.					
Accredited for compliance with ISO/IEC 17025 - Testing. Tests not covered by NATA are denoted with *					

#### **Results Approved By**

Josh Williams, Senior Chemist Loren Bardwell, Senior Chemist Priya Samarawickrama, Senior Chemist

#### Authorised By

Nancy Zhang, Laboratory Manager



vTRH(C6-C10)/BTEXN in Water								
Our Reference		238591-1	238591-2	238591-3	238591-4	238591-5		
Your Reference	UNITS	1	2	3	4	ТВ		
Date Sampled		10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020		
Type of sample		water	water	water	water	water		
Date extracted	-	12/03/2020	12/03/2020	12/03/2020	12/03/2020	12/03/2020		
Date analysed	-	12/03/2020	12/03/2020	12/03/2020	12/03/2020	12/03/2020		
TRH C <sub>6</sub> - C <sub>9</sub>	µg/L	<10	<10	<10	<10	<10		
TRH C <sub>6</sub> - C <sub>10</sub>	µg/L	<10	<10	<10	<10	<10		
TRH C <sub>6</sub> - C <sub>10</sub> less BTEX (F1)	µg/L	<10	<10	<10	<10	<10		
Benzene	µg/L	<1	<1	<1	<1	<1		
Toluene	µg/L	<1	<1	<1	<1	<1		
Ethylbenzene	µg/L	<1	<1	<1	<1	<1		
m+p-xylene	µg/L	<2	<2	<2	<2	<2		
o-xylene	µg/L	<1	<1	<1	<1	<1		
Naphthalene	µg/L	<1	<1	<1	<1	<1		
Surrogate Dibromofluoromethane	%	107	108	108	110	98		
Surrogate toluene-d8	%	99	98	100	100	98		
Surrogate 4-BFB	%	103	104	106	105	101		

vTRH(C6-C10)/BTEXN in Water		
Our Reference		238591-6
Your Reference	UNITS	TS
Date Sampled		10/03/2020
Type of sample		water
Date extracted	-	12/03/2020
Date analysed	-	12/03/2020
Benzene	µg/L	106%
Toluene	µg/L	103%
Ethylbenzene	µg/L	100%
m+p-xylene	µg/L	95%
o-xylene	µg/L	101%
Surrogate Dibromofluoromethane	%	104
Surrogate toluene-d8	%	101
Surrogate 4-BFB	%	102

svTRH (C10-C40) in Water									
Our Reference		238591-1	238591-2	238591-3	238591-4				
Your Reference	UNITS	1	2	3	4				
Date Sampled		10/03/2020	10/03/2020	10/03/2020	10/03/2020				
Type of sample		water	water	water	water				
Date extracted	-	12/03/2020	12/03/2020	12/03/2020	12/03/2020				
Date analysed	-	13/03/2020	13/03/2020	13/03/2020	13/03/2020				
TRH C <sub>10</sub> - C <sub>14</sub>	µg/L	<50	<50	<50	<50				
TRH C <sub>15</sub> - C <sub>28</sub>	µg/L	<100	<100	<100	<100				
TRH C <sub>29</sub> - C <sub>36</sub>	µg/L	<100	<100	<100	<100				
TRH >C10 - C16	µg/L	<50	<50	<50	<50				
TRH >C10 - C16 less Naphthalene (F2)	µg/L	<50	<50	<50	<50				
TRH >C <sub>16</sub> - C <sub>34</sub>	µg/L	<100	<100	<100	<100				
TRH >C <sub>34</sub> - C <sub>40</sub>	µg/L	<100	<100	<100	<100				
Surrogate o-Terphenyl	%	108	136	103	113				

PAHs in Water						
Our Reference		238591-1	238591-2	238591-3	238591-4	238591-7
Your Reference	UNITS	1	2	3	4	D1
Date Sampled		10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020
Type of sample		water	water	water	water	water
Date extracted	-	12/03/2020	12/03/2020	12/03/2020	12/03/2020	12/03/2020
Date analysed	-	13/03/2020	13/03/2020	13/03/2020	13/03/2020	13/03/2020
Naphthalene	µg/L	<1	<1	<1	<1	<1
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	<1	<1	<1	<1	<1
Phenanthrene	µg/L	<1	<1	<1	<1	<1
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Total +ve PAH's	µg/L	NIL (+)VE				
Surrogate p-Terphenyl-d14	%	107	101	78	96	91

PAHs in Water		
Our Reference		238591-8
Your Reference	UNITS	D2
Date Sampled		10/03/2020
Type of sample		water
Date extracted	-	12/03/2020
Date analysed	-	13/03/2020
Naphthalene	µg/L	<1
Acenaphthylene	µg/L	<1
Acenaphthene	µg/L	<1
Fluorene	µg/L	<1
Phenanthrene	µg/L	<1
Anthracene	µg/L	<1
Fluoranthene	µg/L	<1
Pyrene	µg/L	<1
Benzo(a)anthracene	µg/L	<1
Chrysene	µg/L	<1
Benzo(b,j+k)fluoranthene	µg/L	<2
Benzo(a)pyrene	µg/L	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1
Dibenzo(a,h)anthracene	µg/L	<1
Benzo(g,h,i)perylene	µg/L	<1
Benzo(a)pyrene TEQ	µg/L	<5
Total +ve PAH's	µg/L	NIL (+)VE
Surrogate p-Terphenyl-d14	%	89

HM in water - dissolved	HM in water - dissolved									
Our Reference		238591-1	238591-2	238591-3	238591-4	238591-7				
Your Reference	UNITS	1	2	3	4	D1				
Date Sampled		10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020				
Type of sample		water	water	water	water	water				
Date prepared	-	12/03/2020	12/03/2020	12/03/2020	12/03/2020	12/03/2020				
Date analysed	-	12/03/2020	12/03/2020	12/03/2020	12/03/2020	12/03/2020				
Aluminium-Dissolved	µg/L	370	30	10	10	10				
Arsenic-Dissolved	µg/L	3	2	<1	<1	2				
Bromine-Dissolved	µg/L	28,000	22,000	14,000	23,000	2,800				
Cadmium-Dissolved	µg/L	0.3	<0.1	0.1	<0.1	0.4				
Chromium-Dissolved	µg/L	<1	<1	<1	<1	<1				
Copper-Dissolved	µg/L	4	<1	7	3	<1				
Iron-Dissolved	µg/L	100	45	<10	350	<10				
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1				
Manganese-Dissolved	µg/L	1,700	640	520	970	500				
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05				
Nickel-Dissolved	µg/L	12	5	2	3	4				
Zinc-Dissolved	µg/L	24	12	26	17	24				

HM in water - dissolved		
Our Reference		238591-8
Your Reference	UNITS	D2
Date Sampled		10/03/2020
Type of sample		water
Date prepared	-	12/03/2020
Date analysed	-	12/03/2020
Aluminium-Dissolved	µg/L	10
Arsenic-Dissolved	µg/L	2
Bromine-Dissolved	µg/L	2,300
Cadmium-Dissolved	µg/L	0.1
Chromium-Dissolved	µg/L	<1
Copper-Dissolved	µg/L	<1
Iron-Dissolved	µg/L	20
Lead-Dissolved	µg/L	<1
Manganese-Dissolved	µg/L	600
Mercury-Dissolved	µg/L	<0.05
Nickel-Dissolved	µg/L	5
Zinc-Dissolved	µg/L	18

Miscellaneous Inorganics								
Our Reference		238591-1	238591-2	238591-3	238591-4			
Your Reference	UNITS	1	2	3	4			
Date Sampled		10/03/2020	10/03/2020	10/03/2020	10/03/2020			
Type of sample		water	water	water	water			
Date prepared	-	10/03/2020	10/03/2020	10/03/2020	10/03/2020			
Date analysed	-	10/03/2020	10/03/2020	10/03/2020	10/03/2020			
рН	pH Units	7.0	7.1	7.2	6.9			
Electrical Conductivity	μS/cm	29,000	24,000	20,000	25,000			

lon Balance					
Our Reference		238591-1	238591-2	238591-3	238591-4
Your Reference	UNITS	1	2	3	4
Date Sampled		10/03/2020	10/03/2020	10/03/2020	10/03/2020
Type of sample		water	water	water	water
Date prepared	-	11/03/2020	11/03/2020	11/03/2020	11/03/2020
Date analysed	-	11/03/2020	11/03/2020	11/03/2020	11/03/2020
Calcium - Dissolved	mg/L	210	230	130	160
Potassium - Dissolved	mg/L	31	30	33	23
Sodium - Dissolved	mg/L	5,400	4,900	4,200	5,200
Magnesium - Dissolved	mg/L	1,100	810	600	820
Hydroxide Alkalinity ( $OH^{-}$ ) as CaCO <sub>3</sub>	mg/L	<5	<5	<5	<5
Bicarbonate Alkalinity as CaCO <sub>3</sub>	mg/L	820	1,200	1,400	950
Carbonate Alkalinity as CaCO₃	mg/L	<5	<5	<5	<5
Total Alkalinity as CaCO₃	mg/L	820	1,200	1,400	950
Sulphate, SO4	mg/L	1,100	860	940	1,100
Chloride, Cl	mg/L	11,000	9,000	7,100	9,300

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
lnorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012/017	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS and/or GC-MS/MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.

QUALITY CONTR	ROL: vTRH(	C6-C10)/E	3TEXN in Water			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			12/03/2020	[NT]		[NT]	[NT]	12/03/2020	
Date analysed	-			12/03/2020	[NT]		[NT]	[NT]	12/03/2020	
TRH C <sub>6</sub> - C <sub>9</sub>	μg/L	10	Org-016	<10	[NT]		[NT]	[NT]	98	
TRH C <sub>6</sub> - C <sub>10</sub>	μg/L	10	Org-016	<10	[NT]		[NT]	[NT]	98	
Benzene	μg/L	1	Org-016	<1	[NT]		[NT]	[NT]	100	
Toluene	μg/L	1	Org-016	<1	[NT]		[NT]	[NT]	101	
Ethylbenzene	μg/L	1	Org-016	<1	[NT]		[NT]	[NT]	95	
m+p-xylene	μg/L	2	Org-016	<2	[NT]		[NT]	[NT]	97	
o-xylene	μg/L	1	Org-016	<1	[NT]		[NT]	[NT]	96	
Naphthalene	μg/L	1	Org-013	<1	[NT]		[NT]	[NT]	[NT]	
Surrogate Dibromofluoromethane	%		Org-016	104	[NT]		[NT]	[NT]	103	
Surrogate toluene-d8	%		Org-016	101	[NT]		[NT]	[NT]	99	
Surrogate 4-BFB	%		Org-016	103	[NT]		[NT]	[NT]	102	

QUALITY CON	ITROL: svTF	RH (C10-0	C40) in Water			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			12/03/2020	3	12/03/2020	12/03/2020		12/03/2020	
Date analysed	-			13/03/2020	3	13/03/2020	13/03/2020		13/03/2020	[NT]
TRH C <sub>10</sub> - C <sub>14</sub>	µg/L	50	Org-003	<50	3	<50	<50	0	133	[NT]
TRH C <sub>15</sub> - C <sub>28</sub>	µg/L	100	Org-003	<100	3	<100	<100	0	113	[NT]
TRH C <sub>29</sub> - C <sub>36</sub>	µg/L	100	Org-003	<100	3	<100	<100	0	116	[NT]
TRH >C <sub>10</sub> - C <sub>16</sub>	µg/L	50	Org-003	<50	3	<50	<50	0	133	
TRH >C <sub>16</sub> - C <sub>34</sub>	µg/L	100	Org-003	<100	3	<100	<100	0	113	[NT]
TRH >C <sub>34</sub> - C <sub>40</sub>	µg/L	100	Org-003	<100	3	<100	<100	0	116	
Surrogate o-Terphenyl	%		Org-003	108	3	103	107	4	107	[NT]

QUALIT	Y CONTROL	.: PAHs ir	n Water			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup,	RPD	LCS-W2	238591-2
Date extracted	-			12/03/2020	1	12/03/2020	12/03/2020		12/03/2020	12/03/2020
Date analysed	-			13/03/2020	1	13/03/2020	13/03/2020		13/03/2020	13/03/2020
Naphthalene	µg/L	1	Org-012/017	<1	1	<1	<1	0	98	110
Acenaphthylene	µg/L	1	Org-012/017	<1	1	<1	<1	0	[NT]	[NT]
Acenaphthene	µg/L	1	Org-012/017	<1	1	<1	<1	0	[NT]	[NT]
Fluorene	µg/L	1	Org-012/017	<1	1	<1	<1	0	94	110
Phenanthrene	µg/L	1	Org-012/017	<1	1	<1	<1	0	96	80
Anthracene	µg/L	1	Org-012/017	<1	1	<1	<1	0	[NT]	[NT]
Fluoranthene	µg/L	1	Org-012/017	<1	1	<1	<1	0	94	78
Pyrene	µg/L	1	Org-012/017	<1	1	<1	<1	0	88	82
Benzo(a)anthracene	µg/L	1	Org-012/017	<1	1	<1	<1	0	[NT]	[NT]
Chrysene	µg/L	1	Org-012/017	<1	1	<1	<1	0	140	84
Benzo(b,j+k)fluoranthene	µg/L	2	Org-012/017	<2	1	<2	<2	0	[NT]	[NT]
Benzo(a)pyrene	µg/L	1	Org-012/017	<1	1	<1	<1	0	88	90
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012/017	<1	1	<1	<1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	1	Org-012/017	<1	1	<1	<1	0	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	1	Org-012/017	<1	1	<1	<1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012/017	91	1	107	108	1	88	112

QUALITY CC	NTROL: HN	/l in water	- dissolved			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W4	238591-2
Date prepared	-			12/03/2020	1	12/03/2020	12/03/2020		12/03/2020	12/03/2020
Date analysed	-			12/03/2020	1	12/03/2020	12/03/2020		12/03/2020	12/03/2020
Aluminium-Dissolved	μg/L	10	Metals-022	<10	1	370	390	5	97	[NT]
Arsenic-Dissolved	µg/L	1	Metals-022	<1	1	3	3	0	96	[NT]
Bromine-Dissolved	μg/L	10	Metals-022	<10	1	28000	[NT]		96	[NT]
Cadmium-Dissolved	μg/L	0.1	Metals-022	<0.1	1	0.3	0.1	100	95	[NT]
Chromium-Dissolved	μg/L	1	Metals-022	<1	1	<1	<1	0	99	[NT]
Copper-Dissolved	μg/L	1	Metals-022	<1	1	4	4	0	104	[NT]
Iron-Dissolved	μg/L	10	Metals-022	<10	1	100	110	10	98	[NT]
Lead-Dissolved	μg/L	1	Metals-022	<1	1	<1	<1	0	103	[NT]
Manganese-Dissolved	μg/L	5	Metals-022	<5	1	1700	1700	0	94	[NT]
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	1	<0.05	<0.05	0	95	91
Nickel-Dissolved	μg/L	1	Metals-022	<1	1	12	12	0	99	[NT]
Zinc-Dissolved	μg/L	1	Metals-022	<1	1	24	23	4	97	[NT]

QUALITY CC	NTROL: HN	/l in water	- dissolved			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	238591-4
Date prepared	-			[NT]	3	12/03/2020	12/03/2020			12/03/2020
Date analysed	-			[NT]	3	12/03/2020	12/03/2020			12/03/2020
Aluminium-Dissolved	μg/L	10	Metals-022	[NT]	3	10	[NT]			[NT]
Arsenic-Dissolved	µg/L	1	Metals-022	[NT]	3	<1	[NT]			[NT]
Bromine-Dissolved	μg/L	10	Metals-022	[NT]	3	14000	14000	0		#
Cadmium-Dissolved	µg/L	0.1	Metals-022	[NT]	3	0.1	[NT]			[NT]
Chromium-Dissolved	μg/L	1	Metals-022	[NT]	3	<1	[NT]			[NT]
Copper-Dissolved	µg/L	1	Metals-022	[NT]	3	7	[NT]			[NT]
Iron-Dissolved	μg/L	10	Metals-022	[NT]	3	<10	[NT]			[NT]
Lead-Dissolved	µg/L	1	Metals-022	[NT]	3	<1	[NT]			[NT]
Manganese-Dissolved	μg/L	5	Metals-022	[NT]	3	520	[NT]			[NT]
Mercury-Dissolved	µg/L	0.05	Metals-021	[NT]	3	<0.05	[NT]			[NT]
Nickel-Dissolved	μg/L	1	Metals-022	[NT]	3	2	[NT]			[NT]
Zinc-Dissolved	µg/L	1	Metals-022	[NT]	3	26	[NT]		[NT]	[NT]

QUALITY COI	NTROL: Mis	cellaneou	is Inorganics			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			10/03/2020	[NT]		[NT]	[NT]	10/03/2020	
Date analysed	-			10/03/2020	[NT]		[NT]	[NT]	10/03/2020	[NT]
рН	pH Units		Inorg-001	[NT]	[NT]		[NT]	[NT]	101	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	106	[NT]

QUALI	TY CONTRC	L: lon Ba	lance			Du	plicate		Spike Re	covery %
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			11/03/2020	[NT]		[NT]	[NT]	11/03/2020	
Date analysed	-			11/03/2020	[NT]		[NT]	[NT]	11/03/2020	
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]		[NT]	[NT]	94	
Potassium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]		[NT]	[NT]	92	
Sodium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]		[NT]	[NT]	91	
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]		[NT]	[NT]	96	
Hydroxide Alkalinity (OH <sup>-</sup> ) as CaCO <sub>3</sub>	mg/L	5	Inorg-006	<5	[NT]		[NT]	[NT]	[NT]	
Bicarbonate Alkalinity as CaCO <sub>3</sub>	mg/L	5	Inorg-006	<5	[NT]		[NT]	[NT]	[NT]	
Carbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	[NT]		[NT]	[NT]	[NT]	
Total Alkalinity as CaCO <sub>3</sub>	mg/L	5	Inorg-006	<5	[NT]		[NT]	[NT]	104	
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]		[NT]	[NT]	108	
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]		[NT]	[NT]	106	

<b>Result Definiti</b>	ons
NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

<b>Quality Control</b>	ol Definitions
Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

#### Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

#### **Report Comments**

8 HM in water - dissolved - # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

UJECL NU.	92225.04			Suburb:	• • •	South Cr	reek West	t, Cobbit	To:	Enviro	ab	· · ·		
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Rev4/October2016



Envirolab Services Pty Ltd ABN 37 112 535 645 12 Ashley St Chatswood NSW 2067 ph 02 9910 6200 fax 02 9910 6201 customerservice@envirolab.com.au www.envirolab.com.au

#### SAMPLE RECEIPT ADVICE

Client Details	
Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Erin Leslie

Sample Login Details	
Your reference	92225.04, Cobbity SWP Prelim
Envirolab Reference	238591
Date Sample Received	10/03/2020
Date Instructions Received	10/03/2020
Date Results Expected to be Reported	17/03/2020

Sample Condition	
Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	8 water
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	15.7
Cooling Method	Ice
Sampling Date Provided	YES

Comments	
Nil	

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	Phone: 02 9910 6200
Fax: 02 9910 6201	Fax: 02 9910 6201
Email: ahie@envirolab.com.au	Email: jhurst@envirolab.com.au

Analysis Underway, details on the following page:



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Sample ID	vTRH(C6-C10)/BTEXN in Water	svTRH (C10-C40) in Water	PAHsin Water	HM in water - dissolved	Hq	Electrical Conductivity	Calcium - Dissolved	Potassium - Dissolved	Sodium - Dissolved	Magnesium - Dissolved	Hydroxide Alkalinity (OH-) as CaCO3	<b>Bicarbonate Alkalinity as CaC03</b>	Carbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulphate, SO4	Chloride, CI
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2	✓	✓	✓	~	✓	✓	✓	~	~	~	✓	✓	✓	~	✓	✓
3	✓	✓	✓	✓	✓	✓	✓	~	✓	~	✓	✓	✓	✓	✓	✓
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TS	1															
D1			~	✓												
D2			✓	✓												

The '\' indicates the testing you have requested. THIS IS NOT A REPORT OF THE RESULTS.

#### **Additional Info**

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.

Requests for longer term sample storage must be received in writing.

Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.

TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

# **Cobbitty Precinct**

1110

## Housing Needs and Economic Impact Assessment

BHL Group

September 2021



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Final v1.3	14 December 2022	Jacob Vince	Esther Cheong

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#### **BACKGROUND AND OVERVIEW**

The South Creek West (SCW) precinct has been identified as one of Greater Sydney's largest future greenfield precincts with potential for circa 30,000 new homes. BHL Group (the Proponent) are a landowner within the SCW release area, specifically Cobbitty Sub-Precinct 5 (referred to as Precinct 5).

The Proponent has commissioned various technical investigations to inform the precinct planning process for Precinct 5 in accordance with the new approach to precinct planning launched by DPE. Precinct 5 was identified as a 'Collaboration Precinct', which is a collaboration between Department of Planning and Environment (DPE) and Camden Council.

Similar to the previous Precinct Acceleration Protocol (PAP) process that has applied to the already rezoned precincts across the North West and South West Growth Areas, a draft Indicative Layout Plan (ILP) has been prepared for Precinct 5 and has guided the drafting of the proposed land uses and housing mix. Atlas Economics (Atlas) have been engaged to carry out a Housing Market Needs and Economic Impact Analysis to inform the precinct planning process for Precinct 5.

The findings of this Study were based on a previous ILP which considered the entirety of Sub-Precinct 5. The current ILP only incorporates Lots 2 & 4 in DP 1216380, Lot 2 in DP 1241819 and Lot 500 in DP 1231858 as shown in **Figure ES.1**.

#### Figure ES.1: Current ILP, Sub-Precinct 5



Source: BHL

The findings of this report remain relevant, providing a holistic assessment of the precinct to inform future development on the subject site. This report will be updated to reflect the refined ILP and any comments received following public notification.



#### **NEED FOR MORE HOUSING**

The location, strategic planning context and depth of infrastructure investment all jointly influence the role of the Precinct 5 in providing housing to support the growth of Greater Sydney's South West Region. For the purposes of this Study, the South West Region encompasses the Camden, Campbelltown and Liverpool LGAs.

#### **Population and Dwelling Projections**

Official population projections prepared by DPE were released in 2019. Revised projections which reflect the impact of COVID-19 on population growth were not available during the course of this Study. To reflect the impacts of the COVID-19 pandemic on population growth, DPE's 'Low Scenario' population projections have been relied upon in this Study. These projections suggest the South West Region will reach ~939,000 residents by 2041. This population is expected to require a total of some ~**341,000 dwellings** by 2041.

#### **Current Market Conditions**

Despite soft economic conditions over the course of 2020 due to the COVID-19-induced recession and the extended lockdowns across Greater Sydney through much of 2021, demand for housing across the South West Region (and broader Sydney region) has been significant. This has been primarily driven by record low interest rates and a raft of Commonwealth and NSW Government incentive programs implemented in 2020.

Active estates across the SWGA recorded some of the highest sales volumes on record in 2020, with total sales across the SWGA up 75% compared to 2019. In the first quarter of 2021, a total of just over 1,000 sales were recorded across the SWGA, representing the largest number of sales recorded in a single quarter in the SWGA. This unprecedented level of demand has resulted in strong price growth, with most estates unable to accommodate current demand levels.

A distinct two-tiered market has emerged since the onset of COVID-19 with a preference for detached housing product. However, this flight to traditional housing compared to smaller housing formats (i.e. townhouses, apartments) is not expected to persist over the medium to long-term. Housing affordability in Greater Sydney has deteriorated markedly over the past 12-months. These affordability pressures are already resulting in overflow demand for medium-density typologies in the SWGA, with medium-density typologies in areas such as Oran Park being met by strong market take-up.

#### **Existing Supply**

The following steps are taken to estimate the number of dwellings (as at Q4 2020) in the South West Region:

- 1. Adopt the 2016 Census dwelling counts as a starting point.
- 2. Sum dwelling completions for each LGA from September 2016 to December 2016 (the months prior to September 2016 are not included given the 2016 Census was conducted on 9 August 2016).
- 3. Sum the 2016 Census dwelling counts and DPE dwelling completions from September 2016 onwards to arrive at existing dwelling supply for December 2020.

Table ES.1 shows the process in estimating the total number of existing dwellings in the South West as at Q4 2020.

#### Table ES.1: Existing Dwelling Supply (December 2020), South West Region

Area	Census 2016		Existing Supply				
	Dwellings (a)	2016 <sup>1</sup>	2017	2018	2019	2020	(a+b)
Camden	26,197	1,048	2,841	2,409	2,276	2,009	36,780
Campbelltown	55,326	422	1,606	1,247	1,196	1,230	61,027
Liverpool	65,931	755	1,836	1,857	2,122	1,988	74,489
South West	147,454	2,225	6,283	5,513	5,594	5,227	172,296

Notes: 1 - Dwelling completions from September 2016-December 2016, 2 - Data is current to Q4 2020 Source: ABS (2017)/ Atlas/ DPE (2021b)

There are an estimated **~172,000 dwellings** across the South West Region as at Q4 2020. This will be an important starting point to assess the potential of the South West Region in meeting future housing demand.


### **Remaining Dwelling Need**

Based on future population and household growth in the South West Region, it is estimated that under DPE's Low Scenario population projections that there will be a need for approximately ~341,000 dwellings by 2041. The assessment of supply estimated that as at Q4 2020 there were about ~172,000 private dwellings across the South West Region.

By deducting the number of existing dwellings in the South West Region against the implied dwelling requirement for 2041, a Remaining Dwelling Need of ~169,000 dwellings are calculated. This is illustrated in **Figure ES.2**.

### Figure ES.2: Remaining Dwelling Need, South West Region



Source: Atlas

# FUTURE HOUSING SUPPLY

### Theoretical v Market Capacity

A common misconception is that if land is zoned for urban uses it will be developed. In practice, this can be far from reality as the development potential of land is collectively influenced by environmental, market or economic constraints that can together impede development. This is directly observable in certain precincts in the SWGA (e.g. Leppington, Austral) where despite being zoned for urban development, development as planned has not occurred.

The capacity of urban land for new development is two-fold: Planning Capacity and Market Capacity.

- **Planning (Theoretical) Capacity** refers to the physical ability of land to be developed, taking into account permissibility under the planning framework, environmental and infrastructure constraints and other factors.
- Market Capacity refers to issues of commercial viability whether pricing levels, market acceptance/ attitudes, development costs, etc. make development a commercial proposition, i.e. if development is financially feasible.

A supply audit has concluded that there is *Planning (Theoretical) Capacity* for some ~202,000 dwellings to be delivered across the South West Region. This is sufficient to meet the Remaining Dwelling Need of ~169,000 additional dwellings.

However, the Market Capacity of these 202,000 dwellings is *likely to be lower* once market and economic factors are considered.

### **Supply Forecasts**

To assess the likelihood of dwelling supply in the South West Region being able to meet projected housing demand, forecasts of future dwelling supply over the coming decades to 2041 is undertaken. To reflect the range of potential supply outcomes which could result over two decades to 2041, three forecast scenarios have been developed:

### • Scenario 1: Historical Growth

This scenario considers the quantum of new housing which could be delivered across the South West Region if future growth aligns with that observed in that past. Over the 2006-2020 period, average dwelling supply has been approximately ~3,600 dwellings per annum.

Accordingly, Scenario 1 assumes the South West Region will deliver 3,600 net additional dwellings per annum over 2021-2041, equating to a total of 74,550 new dwellings.



### • Scenario 2: Peak Growth

Scenario 2 assumes a significant greater level of sustained dwelling supply than observed historically. In 2017, new supply peaked at some ~6,300 dwellings before falling to 5,500-5,600 dwellings per annum in 2018 and 2019.

Scenario 2 assumes the South West Region could maintain peak supply of ~6,300 dwellings per annum over 2021-2041, delivering a total of 132,300 new dwellings.

### • Scenario 3: Low Growth

Scenario 3 assumes a lower growth scenario with dwelling supply falling below that historically observed, with just 3,000 dwellings delivered per annum across the South West over 2021-2041, equating to some 63,000 new dwellings.

Figure ES.3 illustrates the net additional supply that could be delivered under the three supply scenarios over 2021-2041.

Figure ES.3: Dwelling Supply Scenarios (2021-2041), South West Region



Source: Atlas

# **EXPECTED SUPPLY SHORTFALL**

After deducting the number of existing dwellings in the South West Region (to Q4 2020) from the implied dwelling requirement for 2041, a Remaining Dwelling Need of ~169,000 dwellings results. To meet Remaining Dwelling Need, some ~8,100 additional dwellings are needed per annum (on average) over the two decades to 2041.

Each year dwelling completions fall short of this annual need; unmet demand grows and exacerbates the housing shortfall.

Supply forecasts carried out indicate that between 3,000 dwellings (Low Growth Scenario) and 6,300 dwellings (Peak Growth Scenario) per annum could be delivered across the South West Region over the 2021-2041 period.

In each supply scenario, a significant housing shortfall is expected to occur. This is illustrated in Figure ES. 4.





Source: Atlas

# **ROLE FOR PRECINCT 5**

Supply forecasts identified a major shortfall in the amount of new housing required to meet projected housing demand across the South West Region to 2041. Whilst there is sufficient *theoretical dwelling capacity*, it is unlikely all land will be developed.

Landowner objectives, motivations and personal circumstances often misalign with development requirements and in precincts where ownership is highly fragmented, development take-up is often less than the theoretical capacity for dwellings. Accordingly, Precinct 5 is of critical importance to mitigate the forecast shortfall in housing supply. Each year dwelling completions fall short of the annual dwelling requirement need, unmet demand grows and makes the likelihood of supply matching future demand more challenging.

Beyond the important issue of housing supply, the location of Precinct 5 proximate the Western Sydney Aerotropolis is of strategic importance. Ensuring housing supply proximate one of Greater Sydney's largest planned employment precincts is delivered in timely and orderly fashion will be critical to the success of the Aerotropolis.

### **Draft Indicative Layout Plan**

A draft Indicative Layout Plan (ILP) has been which outlines the future role of Precinct 5 in addressing future housing demand. The draft ILP envisages a scheme with ~2,600 dwellings (across a mix of dwelling typologies) which will be supported by a small local village centre, ~40ha of open space, a future local school and a mix of other necessary infrastructure.

The economic impacts of delivering the draft ILP have been considered in an economic impact assessment.



# ECONOMIC IMPACT ASSESSMENT

Economic modelling estimates economic impacts of developing Precinct 5 *ahead of* its anticipated development post-2030.

### Take-Up by 2031

A high-level forecast of expected take-up of residential and non-residential uses within the 10-year modelling period has been carried out for the purposes of economic modelling. This forecast has been based on historic take-up rates observed elsewhere within the SWGA, current market conditions and the future economic outlook and suggests by 2031:

- The entirety of the residential dwellings (2,596 dwellings)
- Almost 14,500sqm of gross floor area within the future neighbourhood/village centre;
- The entirety of the land dedicated for service station uses.
- A new educational establishment (likely a primary school).

### Summary of Economic Impact Modelling

By bringing forward its rezoning and development, the Proposal is estimated to result in **a net increase in economic activity** during the construction phase through a mix of direct and indirect (flow-on) activity, including supporting ~5,476 full-time equivalent jobs (including 2,784 direct jobs):

When operational, the Proposal is estimated to result in an annual **net increase in economic activity** by 2031 with:

- **\$286.5 million** in output (including \$172.5 million in direct activity).
- \$140.4 million contribution to GRP (including \$81.9 million in direct activity).
- \$76.5 million in incomes and salaries paid to households (including \$49.4 million in direct income).
- 947 FTE jobs (including 592 FTE directly related to activity on the Site).

Additional local retail expenditure associated with the Proposal's 2,596 new residential dwellings are estimated to support significant economic activity through direct and flow-on impacts (per annum) by 2031, including 1,079 FTE jobs.

### **Other Economic Benefits**

In addition to the significant economic activity supported by development of the draft ILP, development of Precinct 5 within the next decade (as opposed to post-2031) would produce several other important economic and social benefits:

- **Supporting Housing Affordability:** The Proposal will provide some 2,596 new dwellings over the next 10 years at a range of price points. This increase in housing supply will support housing affordability for residents seeking accommodation in the South West Region, including the availability of rental accommodation.
- **Providing Significant Local Infrastructure:** The Proposal includes an allowance for ~40ha of open space in addition to civil/road and educational infrastructure to support the growth of the local community. This is intended to be provided at no-cost to government in line with the principles of the Precinct Acceleration Protocol (PAP) process.
- Increase in Rates and Taxation Revenues: Along with greatly increased economic activity, the Proposal will support significant taxation revenues to all levels of government including Council rates, payroll tax, stamp duty, and income tax.
- **Create a Buffer of Housing Supply:** As Precinct 5 is held in majority ownership, the issues of land fragmentation observed elsewhere across the SWGA are mitigated. In other rezoned precincts where land ownership is heavily fragmented, the timely supply of housing is not a given. The Proposal has the capacity to provide a buffer of housing supply which mitigates the timing risk observed elsewhere across the SWGA.

Overall, the Proposal is considered to have strong economic merit and could contribute significantly to the Camden economy. Furthermore, development of the Precinct 5 is also considered to have merit from a market perspective and its delivery will be critical for the South West Region to meet projected housing demand over the coming decade and towards 2041.

Importantly, the Proposal intends on delivering a broad range of local infrastructure at no cost to government.



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# 1. Introduction

# 1.1 Background

The South Creek West (SCW) precinct has been identified as one of Greater Sydney's largest future greenfield precincts with potential for circa 30,000 new homes. It is strategically located southwest of the future Western Sydney Airport and forms part of the larger South West Growth Area (SWGA).

Given the scale of SCW, the Department of Planning and Environment (DPE) has divided SCW into five precincts numbered 1 to 5. BHL Group (the Proponent) are a landowner within the SCW release area, specifically Cobbitty Sub-Precinct 5 (referred to as Precinct 5).

Comprising 303ha, Precinct 5 adjoins the Lowes Creek Maryland Precinct to the north which has recently been rezoned, the Pondicherry precinct to the east (currently being rezoned) and the growing suburb of Oran Park to the south. The Planning Proposal relates specifically to the Proponent's landholdings which is approximately 172 hectares of Precinct 5.

Figure 1.1 depicts the location of the Cobbitty Sub-Precinct 5 within the broader South Creek West Land Release Area.



### Figure 1.1: Cobbitty Sub-Precinct 5

Source: BHL

The Proponent has commissioned various technical investigations to inform the precinct planning process for Precinct 5 in accordance with the new approach to precinct planning launched by DPE. Precinct 5 was identified as a 'Collaboration Precinct', which is a collaboration between DPE and Camden Council.

Similar to the previous Precinct Acceleration Protocol (PAP) process that has applied to the already rezoned precincts across the North West and South West Growth Areas, a draft Indicative Layout Plan (ILP) has been prepared for Precinct 5 and has guided the drafting of the proposed land uses and housing mix. Atlas Urban Economics (Atlas) have been engaged to carry out a Housing Market Needs Analysis to inform the precinct planning process for Precinct 5.



# 1.2 Scope and Approach

Atlas are engaged to carry out a Housing Market Needs Analysis to understand the need and nature of demand for housing in Greater Sydney's South West region. It is from this analysis that of specific recommendations for Precinct 5 can be made to assist in the precinct planning process. Upon finalisation of an Indicative Layout Plan (ILP) for Precinct 5, the economic impacts of the proposed development are then modelled and quantified.

To meet the requirements of the brief, the following tasks have been undertaken:

### • Strategic Context

- Review relevant State and local planning documents and policies, including the Camden Local Strategic Planning Statement and draft Camden Local Housing Strategy.
- ° Carry out socio-demographic analysis for the South West region.

### • Market Appraisal

- ° Review historic market data to understand long-term demand for housing across the South West region.
- Carry out a market appraisal to understand the nature of market demand, including housing preferences, price points, purchaser profile and affordability thresholds in the South West region.
- ° Review the most recent NSW population, household and implied dwelling projections.
- Investigate the nature of housing supply and development activity in the South West region, including quantum, typologies and likely delivery timeframes.

### • Implications and Recommendations for the Cobbitty Sub-Precinct 5

- <sup>o</sup> Based the foregoing research and analysis, provide site-specific recommendations for Precinct 5 including:
  - Housing type and corresponding splits;
  - Residential density and corresponding splits;
  - Lot sizes.
- Recommend the likely delivery timeframes which could be expected for development.
- Economic Impact Assessment
  - Following finalisation of an ILP, estimate the economic impacts (direct and indirect/flow-on) that could result from the future redevelopment of Precinct 5 during and post-construction.

Over the course of Q2 and Q3 2022, the Proponent responded to a series of Request for Information (ROIs) from Council to assist in the assessment process. As part of this ROI process, Atlas was commissioned to provide further evidence to support the recommended housing mix adopted in the ILP. **This separate piece of advice is appended at Schedule 3.** 

### **1.3** Structure of the Study

The Study is structured in three parts:

- Part A (Strategic Context) considers the locational and strategic planning context of Precinct 5, planned and ongoing infrastructure projects and the socio-demographic profile of residents within the South West region. <u>The strategic and demographic analysis contained in Part A was carried out over the course of Q1 2021.</u>
- Part B (Housing Need) examines the economic and market drivers influencing demand and supply of housing in the South West and provides a series of housing yield recommendations for consideration in the development of the ILP. Population projection analysis, property market research and supply forecasting were carried out in Q1 2021.
- Based on the draft ILP, **Part C (Economic Impacts)** undertakes an economic impact assessment to ascertain the economic impacts of the future development of Precinct 5 against a no-intervention scenario to conclude whether the Proposal would deliver a net positive economic impact. <u>Economic impact modelling carried out in Part C was</u> undertaken in Q4 2022.



## **1.4** Assumptions and Limitations

Atlas acknowledges a number of limitations associated with the Study.

- At the time of writing, the fallout of the COVID-19-induced recession is still being understood. The true economic ramifications of the recession are yet to fully play out.
- Following extensive consultation with Council, the Proponent finalised an Indicative Layout Plan for Precinct 5 in Q4 2022. Economic impact modelling (Part C of this Study) was subsequently carried out in Q4 2022. No revisions to socio-economic profiling, market research or take-up analysis were made in Q4 2022.
- Data from third party sources is assumed to be correct and is not verified.
- Projections carried out by the NSW Government (DPE) are 'point in time' projections and were made prior to the onset of the COVID-19-induced recession.
- Desktop market research has been undertaken without physical site surveys and inspections.
- Specific assumptions related to economic impact modelling are detailed in Chapter 9.

Notwithstanding the above, all due care, skill and diligence has been applied to this Study as is reasonably expected.



# PART A: STRATEGIC CONTEXT



Research and analysis included Part A of this Study was carried out in Q1 2021.

# 2.1 Location

Precinct 5 is located within the Camden local government area (LGA) about 54km west of the Sydney CBD and approximately 27km south of the Penrith CBD. It is characterised by a mix of rural-residential and agricultural uses.

Precinct 5 is strategically located given its proximity to other emerging centres and employment areas. The largest of these is the future city of Bradfield (Western Sydney Aerotropolis) – a 11,200ha greenfield precinct being planned and developed around the future Western Sydney Airport. The Western Sydney Aerotropolis is being planned as a highly connected, technologically advanced city and is expected to accommodate 139,000 jobs. Other nearby centres include Oran Park Town Centre just 3km to the east and the emerging centre of Leppington around 10km north-east.

Precinct 5 is located within the South West Growth Area (SWGA) and forms part of the South Creek West Land Release Area. The SWGA is one of the largest greenfield release areas in Greater Sydney. The SWGA comprises 14 precincts and stretches across most of the Camden LGA with some precincts falling within the Liverpool and Campbelltown LGAs.

Figure 2.1 illustrates the location of Precinct 5 in the context of the broader region.

### Figure 2.1: Location Map



Source: Mecone

### The South West Region

Precinct 5 falls within the Greater Sydney's South West Region, which for the purposes of this Study refers to the Liverpool, Camden and Campbelltown LGAs.

The fastest growing area within Greater Sydney, the South West Region is characterised by a mix of established centres and neighbourhoods and emerging residential areas in traditionally peri-urban areas. This mix can be distinctly observed by location; established areas being located east of the M7 Motorway with emerging areas and peri-urban areas to the west.

### Figure 2.1: South West Region



Source: Atlas

## 2.2 Strategic Planning

### 2.2.1 State Planning Policy

### Greater Sydney Region Plan (2018)

The Greater Sydney Region Plan (the Region Plan) seeks to accommodate the needs of Sydney's growing population into a metropolis of three cities: Western Parkland City, Central River City and Eastern Harbour City, building on a vision where most residents live within 30 minutes of their jobs, education and health facilities.

The Region Plan delineates Greater Sydney into five districts; Western City District, Central City District and Eastern City District, Northern District and the Southern District.

The Region Plan outlines a series of planning priorities, objectives and actions for each District. Those of direct relevance to the Site are detailed in the Western City District Plan (GSC, 2018b).





### Western City District Plan

The Western City District Plan outlines the 20-year vision for growth and development in the Western City District. The Western City District is defined in the Greater Sydney Region Plan as comprising eight LGAs including Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly.

The entirety of the South West Region falls within the Western City District.

The District Plan outlines short and long-term housing targets for the Western City District in order to meet projected population growth. These include:

- Short-term Target (2016-2021): 39,850 additional dwellings (average of 7,970 dwellings per annum).
- Long-term Target (2016-2036): 184,500 additional dwellings (average of 9,225 dwellings per annum).

### 2.2.2 Local Planning Policy

### Camden Local Strategic Planning Statement (2020)

The Camden LSPS is the local planning policy linking the objectives and actions outlined in the District Plan with the Camden LGA. The Camden LSPS outlines the a 20-year vision for the Camden LGA, detailed with a set of planning priorities and actions organised into the themes of the District Plan.

The key priorities and actions of relevance to Precinct 5 include:

 Local Priority L1: Providing housing choice and affordability for Camden's growing and changing population

The LSPS recognises the significant role Camden is expected to play in accommodating population growth across Greater Sydney given much of the SWGA within the LGA. The South Creek West precinct is identified as a key source of housing supply for the LGA.

Local Priority L1 sets out a series of principles for housing growth across Camden. Key principles of relevance include:

- New greenfield housing growth is wholly contained within the SWGA;
- ° Release of new precincts in the SWGA are sequenced to align with infrastructure provision;
- The planned housing capacity for new precincts within the SWGA is sufficient to meet forecast demand;
- ° Housing growth is in line with the delivery of local and regional infrastructure.

A key action under Local Priority 1 was the finalisation of Local Housing Strategy to develop the vision and evaluation options for housing growth across the Camden LGA.

### • Local Priority P2: Creating a network of successful centres

Ensuring Camden has a strong network of local centres is a key component to delivering economic and social benefits to existing and future residents. In addition to the higher order centres of Narellan, Leppington, Camden and Oran Park, local and neighbourhood centres are critical to meeting the essential amenities and services to local residents.

The future development of Precinct 5 and broader South Creek West will be supported by a number of local and neighbourhood centres which support the Camden LGA's larger strategic centres.

### • Local Priority P4: Ensuring a suitable supply of industrial and urban services land

The critical role of industrial and urban services land in supporting local economy activity and employment across the Camden LGA is recognised in the LSPS.

A key action of Local Priority P4 is ensuring that new precincts within the SWGA contain an adequate supply of industrial and urban services land, with a focus on locating these areas close to transport corridors.



OUR GREATER SYDNEY 2056 Western City District Plan





### Camden Local Housing Strategy (2020)

The Camden Local Housing Strategy (LHS) establishes a strategic vision and plan for the delivery of housing across Camden over the coming 20-years and is a key action from the Camden LSPS (specifically Planning Priority L1).

Based on a series of population and household projections, the LHS sets a 10-year housing target (2016-2026) of between 10,000 and 12,500 dwellings. These dwellings will need to accommodate the quickly changing and ageing demographic of Camden. Accordingly, the draft LHS comprises five key Priorities to be addressed, each with their own set of objectives and actions, including:



- Priority 1: Providing housing capacity and coordinating growth with infrastructure
- Priority 2: Delivering resilient, healthy and connected communities
- Priority 3: Delivering the right housing in the right location
- Priority 4: Increasing housing choice and diversity
- Priority 5: Addressing housing affordability

The Priorities and associated objectives of direct relevance to Precinct 5 are considered below.

#### • Priority 1: Providing housing capacity and coordinating growth with infrastructure

The LHS identifies that there is some sufficient planning capacity to meet the 6-10-year housing target for the Camden LGA – a total planning capacity of some 16,694 dwellings was assessed compared to the target of 10,000 to 12,500 new dwellings by 2026.

Though not specifically identified as required to meet the 6-10-year housing target, the South Creek West precinct is recognised as an important part in meeting future housing demand beyond 2026.

Whilst acknowledging the need for more housing, the LHS notes the critical nexus between infrastructure and development. To improve the alignment between infrastructure servicing and precinct planning in the SWGA, the LHS recommends the development of a SWGA Structure Plan and Camden LGA SWGA Infrastructure Study.

### • Priority 3: Delivering the right housing in the right location

New housing across Camden LGA should promote walkability, support lively local centres and maximise investment into infrastructure. Priority 3 recognises the role of providing higher-density housing typologies proximate to local centres for these reasons.

Whilst demand for higher density typologies across Camden is not fully matured, the LHS recommends that master planning for future precincts and centres incorporating staging plans to allow for medium and high-density residential development to be developed over the course of a precinct or centre's development.

### • Priority 4: Increasing housing choice and diversity

Given the dominance of low-density housing typologies across Camden's housing market, increasing housing diversity is a key objective of the LHS. The demand for medium and higher-density typologies is expected to increase over the coming decades, driven by changing demographics, market preferences and affordability pressures.

Master plans should avoid delivering housing based on 'blanket' density controls but instead incorporate a mix of housing typologies at different densities to deliver a mix of distinct character areas within a precinct.

The various Priorities and objectives outlined in the draft LHS should be considered and adopted (where applicable) in future master plans for SWGA's remaining undeveloped precincts, including South Creek West.



# 2.3 Infrastructure Pipeline

The South West Region is poised to benefit from the significant level of government (Commonwealth, State and local) infrastructure investment currently being planned and delivered across the region. Largely centred around maximising the opportunity brought on by the future Western Sydney Airport, accessibility to and connectivity within the South West will greatly improve over the coming decade.

### Western Sydney Airport

The Western Sydney Airport (WSA) is a game-changer for the Western Sydney and broader NSW economy. Located some 15km to the north of Precinct 5, the \$5.3 billion airport is expected to be operational by 2026. The WSA is initially anticipated to service some 5 million passengers annually before doubling to 10 million annual passengers by 2031 (DIRD, 2016). By 2063, the WSA is expected to service some 82 million passengers per annum.

Air freight will be an important component of the WSA. It is anticipated to operate 24 hours, 7 days per week and will link Western Sydney industries with global markets. A master plan for the airport includes a large business precinct on-site that will be targeted at freight, logistics, transport and agribusiness activities.

The WSA will provide significant benefits for residents and business within the South West. Initial employment projections suggest the WSA will accommodate circa 28,000 direct and indirect jobs by the early 2030's (DIRD, 2016).

### Western Sydney Aerotropolis

Centred around the future WSA, the Western Sydney Aerotropolis (the Aerotropolis) is 11,200ha greenfield precinct being planned by the NSW Government as a shighly connected, innovative new city to be known as 'Bradfield'. In addition to a variety of major transport projects, the Commonwealth, NSW Government and Penrith and Liverpool Councils are investing heavily into digital, social and cultural infrastructure throughout the Aerotropolis (WSPP, 2020). Key projects will include:

- **Connectivity infrastructure**, including, *inter alia*:
  - High quality 5G radio cells integrated into buildings, public transport and other infrastructure.
  - $^\circ$   $\,$   $\,$  Wi-fi nodes and mesh networks for public access and sensor connection.
  - Fibre optic network to buildings and homes and data transfer from gateway devices.
  - Vehicle to Infrastructure (V2I) to communicate between road signs, traffic lights and connected autonomous vehicles (CAVs).
- Sensor infrastructure to assist in the management of infrastructure services, traffic and transport and public safety.
- **Communications infrastructure** such as digital signage and interactive smart screens in public places, smart poles and benches and smart road marking.
- A network of high-quality community centres, multi-purpose hubs, libraries and aquatic centres.
- An Integrated Health Hub (modern health facility).
- An internationally significant research/innovation, science, training and education area (including tertiary, Vocational Education and Training institutions and secondary school level).

The delivery of these infrastructure items is anticipated to be staged in accordance with the growth of the Aerotropolis.

### North South Rail Link and South West Rail Extension

The North South Rail Link (NSRL) is a major city shaping rail investigation corridor which has been proposed in the NSW Government's *Future Transport Strategy 2056* (Transport for NSW, 2018). The rail corridor will extend from Tallawong Metro Station (the western terminus on the recently completed Sydney Metro Northwest line) in Schofields to Macarthur in Campbelltown, via St Marys and the Western Sydney Airport.

The initial stage of the NSRL – Sydney Metro Greater West – will provide a direct link from the existing St Marys Train Station to the WSA and Western Sydney Aerotropolis. The \$11 billion rail link is scheduled for completion in 2026, aligning with the completion of the WSA and will feature five new metro stations including two within the future airport.



Additional stages will include Tallawong to St Marys via Marsden Park and the Western Sydney Aerotropolis to Macarthur via Oran Park and Narellan. Both these additional stages will likely be delivered post 2030 with further investigations to examine the potential for any potential station locations along either route.

The South West Rail Link Extension will connect the Sydney Metro Greater West metro line with the existing South West Rail Link at Leppington. Delivery of this extension is not anticipated until post-2030.



Figure 2.2: North South Rail Link (Initial Stages) and South West Rail Extension

Source: Transport for NSW

### Western Sydney Infrastructure Plan

The Western Sydney Infrastructure Plan is the key strategic road infrastructure plan for Western Sydney over the 2016-2016 period (RMS, 2016). Capitalising on \$3.6 billion in joint funding from the Commonwealth and NSW Governments to deliver a mix of new projects and major upgrades, a key objective of the Plan is to support and capitalise on the benefits of WSA, with an upshot being the drastically improved accessibility for precincts within the SWGA such as South Creek West.

Significant projects currently funded under the Plan with direct implications for Precinct 5 include:

### • The Northern Road Upgrade

A \$1.6 billion, 35km upgrade of The Northern Road from Narellan to Jamison Road in South Penrith. Being delivered across 6 stages, the first stage (Narellan to Peter Brock Drive, Oran Park) was completed in mid-2018.

Completed in December 2020, Stage 2 included a 11km of upgraded roadway featuring six lanes and six intersections, including a major interchange at The Northern Road and Bringelly Road. Precinct 5 bears a frontage to this section of the upgrade and will benefit from improved north-south travel times. Remaining stages are to be completed by 2022.



### • Bringelly Road Upgrade

A \$509 million, 10km upgrade of Bringelly Road is being delivered across two stages between Camden Valley Way at Leppington and The Northern Road at Bringelly. Part of the upgrade will involve increasing Bringelly Road from two lanes to a six-lane divided road through the future Leppington Town Centre with the remainder increasing to a four lane divided road with capacity for two additional lanes in the future. Both stages of the upgrade have been completed with Stage 1 completed in 2017 and Stage 2 completed in December 2020.

### • M12 Motorway

The \$1.25 billion, 14km M12 Motorway is proposed to connect the M7 Motorway near Cecil Hills to The Northern Road at Luddenham, providing direct access from the Sydney's existing Orbital Network to the Western Sydney Airport. The roadway is to be motorway grade with four lanes, potentially expanded to six lanes in the future. The new motorway is expected to be completed by 2024.

### **Outer Sydney Orbital**

The Outer Sydney Orbital (OSO) would comprise a 70km major motorway linking the Hills LGA in the north (Windsor Road) to the Camden LGA in the south (Hume Highway) with an associated freight rail line being considered to run parallel to the proposed motorway.

The project is expected to improve freight connectivity between metropolitan Sydney and regional NSW. Funding for early planning has been provided with technical studies currently being tabled; should the project receive Government endorsement completion would be post 2036.

Precinct 5 is located immediately east of the M12 Motorway corridor and would significantly benefit from future transport accessibility upon its completion.

### 2.4 Implications for Housing Demand

The location, strategic planning context and depth of infrastructure investment all jointly influence the role of Precinct 5 in providing housing to support the growth of the South West Region. Key implications of the overview undertaken in Chapter 2 of relevance the Proposal include:

- Precinct 5 forms part of the South Creek West Land Release Area, a major sub-precinct within the SWGA.
- Precinct 5 is located 15km south-west of the future Western Sydney Airport and city of Bradfield (Western Sydney Aerotropolis) a future city and employment hub planned to accommodate some 139,000 jobs.
- There is a whole-of-government (Commonwealth, State and local Councils) agenda to establish Bradfield as a highly connected and technologically advanced city.
- Significant infrastructure investment has dramatically improved accessibility to Precinct 5, namely the completion of The Northern Road (Stage 2) and Bringelly Road upgrades.
- Precinct 5 is ideally positioned proximate existing infrastructure corridors (North South Rail Link, Outer Sydney Orbital) which will significantly improve connectivity with Greater Sydney.
- The Camden Local Strategic Planning Statement recognises the role of South Creek West in addressing demand for housing over the coming decades.
- The draft Camden Local Housing Strategy (LHS) states there will be sufficient supply in Camden's existing zoned precincts to meet housing targets of 10,000-12,500 dwellings by 2026. This will be explored in Part B of this report.



# 3. Socio-Demographic Profile

# 3.1 Catchment Area

The basis of demographic analysis is the Australian Bureau of Statistics (ABS) Census. The ABS define a series of geographies known as Statistical Areas (SA) which vary in size and range from SA4s (large regions comprising multiple local government areas) to SA1s (often smaller than a suburb). Census data can be extracted based on these statistical areas to understand the socio-demographic profile of different areas at various scales.

For the purpose of analysing how the socio-demographic profile of the SWGA has evolved in recent years, a number of SA1 geographies have been identified where new housing development occurred over the 2011-2016 period. These SA1 geographies are identified as the 'Catchment Areas' and include Oran Park (comprising the Oran Park Town Estate), Turner Road (comprising the Gregory Hills Estate) and East Leppington (comprising the Willowdale and Emerald Hills estates).

This analysis is then benchmarked against SA2 geographies which generally align with the boundaries of the SWGA (referred to as the 'South West Catchment Area'). Benchmarking against the South West Region (Camden, Campbelltown and Liverpool LGAs) is also undertaken to understand how new residents in the SWGA differ from those in the broader LGAs.

### Figure 3.1: Catchment Areas for Demographic Analysis



Source: ABS/Open Street Map

The purpose of this analysis is to understand the socio-demographic profile of residents moving into new estates across the SWGA and how they compare to the broader South West region.

Whilst we note the chosen geographies do not align exactly with estate boundaries or the formal boundaries of the SWGA, the analysis is considered useful as a proxy to provide insight into the socio-demographic characteristics of households in the SWGA. Accordingly, the limitations of different boundary alignments of the data and catchment areas are acknowledged.



# 3.2 Demographic Profile

### 3.2.1 Historic Population Growth

The South West Catchment Area recorded significant population growth of 11.7% per annum (average) over the 2011-2016 Census period to reach almost 28,000 residents in 2016. The Catchment Areas were major contributors to this growth, accounting for about two thirds of the overall population growth in the South West Catchment Area.

The Liverpool LGA recorded the greatest overall level of population growth over 2011-2016 with an additional 4,384 residents each year (on average). This was closely followed by Camden with about 4,300 additional residents per year, noting that this rate of growth was significantly faster than the Liverpool LGA. By contrast, the Campbelltown LGA (which comprises a smaller component of the SWGA than either Liverpool or Camden) recorded lower levels of population growth.

 Table 3.1 shows historic population growth in the Catchment Areas over the 2011-2016 Census period.

Catchment Area	2011	2016	Average Anr	Average Annual Growth		
			%	No.		
Oran Park	13	3,407	206.7%	679		
Turner Road	17	3,077	183.4%	612		
East Leppington	333	1,532	35.7%	240		
South West Catchment Area	15,924	27,673	11.7%	2,350		
Camden LGA	56,726	78,220	6.6%	4,299		
Campbelltown LGA	145,969	157,007	1.5%	2,208		
Liverpool LGA	180,160	204,330	2.5%	4,384		

Table 3.1: Historic Population Growth (2011-2016), Catchment Areas

Source: ABS

In more recent times, the SWGA has continued to record significant rates of population growth. Since 2016, the SWGA has grown by some 19,300 people with an estimated resident population of 46,993 in 2020 (ABS, 2020). This reflects an average annual growth rate of 14.2%, or 4,830 additional residents per annum. By comparison, the Camden, Liverpool and Campbelltown LGAs recorded average annual growth of 8.4%, 2.7% and 3.1% respectively.

 Table 3.2 shows the most recent population growth in the SWGA and South West Region.

Table 3.2: Recent Population	Growth (2016-2019)	, SWGA and South West Region
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Catchment Area	2016	2017	2018	2019	2020	Average An	nual Growth
						%	No.
South West Catchment Area	27,673	31,625	36,041	41,281	46,993	14.2%	4,830
Camden LGA	78,220	87,146	94,159	101,437	107,806	8.4%	7,397
Campbelltown LGA	157,007	164,649	168,139	170,943	174,912	2.7%	4,476
Liverpool LGA	204,330	217,788	223,304	227,585	231,296	3.1%	6,742

Source: ABS

\*It is noted that the smallest geography at which the annual Estimated Resident Population release by the ABS is carried out at is Statistical Area 2. Accordingly, the Estimated Resident Population of the SA1 Catchment Areas is not provided.

### 3.2.2 Age Profile

The SWGA is characterised by a growing younger population, predominantly residents aged 34 years and younger. The proportion of this age cohort has grown strongly over the five years to 2016, whereas the proportion of residents aged 55 years and older has declined as a proportion of total residents.



### Table 3.3: Age Composition (2011-2016), Catchment Areas

Catchment Area	0-19 Years		20-34 Years		35-54 Years		55 Years and Older	
	2011	2016	2011	2016	2011	2016	2011	2016
Oran Park	26.3%	33.1%	22.7%	33.6%	30.8%	24.1%	20.2%	9.4%
Turner Road	26.7%	28.9%	18.7%	35.8%	25.1%	25.2%	29.5%	9.9%
East Leppington	29.1%	30.7%	18.3%	31.1%	31.2%	25.9%	21.3%	12.7%
South West Catchment Area	28.3%	28.2%	17.5%	23.8%	26.6%	25.5%	27.5%	22.5%
Camden LGA	31.7%	30.8%	19.4%	21.4%	29.3%	27.9%	19.6%	20.0%
Campbelltown LGA	29.9%	28.3%	21.7%	22.1%	27.1%	25.9%	21.4%	23.6%
Liverpool LGA	31.1%	29.9%	21.6%	21.7%	28.7%	27.8%	18.6%	20.6%

Source: ABS

Analysis of the age profiles over the 2011-2016 period indicates a number of key points, including:

- In Oran Park, Turner Road and East Leppington, the median age fell from 37 years to between 28 and 30 years old. The dominant age cohort in these estates is residents aged 20-49 years (51% to 57%), followed by children and adolescents aged 0-19 years (29%-33%). Strong growth in these age cohorts occurred across all three areas over the 2011-2016 period, illustrating the growing number of younger and middle-aged residents moving into the area.
- The South West Catchment Area is similarly dominated by residents aged 20 to 49 years, accounting for 44% of the local population. Children aged 0-19 years are the second largest cohort, accounting for around 30% of the resident population. The strongest growth recorded over the 2011-2016 period was observed in the 20-49 years age cohort.
- By contrast, the Camden, Campbelltown and Liverpool LGAs recorded an increase in the median age to 2016 with the number and proportion of residents aged 55 years and older rising steadily over the 2011-2016 period.

In summary, the Catchment Areas and South West Catchment Area is **becoming younger** compared to the broader South West Region. This is conceivably a result of younger couples and families moving into new estates across the South West.

Figure 3.2 illustrates the change in population composition in the three SA1 Catchment Areas over 2011-2016.

Figure 3.2: Age Composition (2011-2016), SA1 Catchment Areas



Source:ABS



### 3.2.3 Household Composition

In the South West Catchment Area, family households account for almost 80% of all households which is higher than family composition observed in both the Liverpool and Campbelltown LGAs (although slightly lower than that observed in the Camden LGA). The SA1 Catchment Areas comprise the highest proportion of families at around 85% of all households.

Over 2011-2016, the proportion of family households grew across the South West Catchment Area, particularly in Turner Road and East Leppington Catchment Areas. This directly contrasts with that observed in the Liverpool and Campbelltown LGAs, where the *proportion* of family households declined with the proportion of other households rising.

Catchment Area	Family Households		Lone Person Households		Group Households		Other Households	
-	2011	2016	2011	2016	2011	2016	2011	2016
Oran Park	80.6%	84.9%	14.5%	7.5%	0.0%	1.3%	4.8%	6.3%
Turner Road	78.3%	85.3%	3.8%	7.0%	0.0%	1.7%	17.9%	5.9%
East Leppington	75.5%	84.3%	9.2%	7.6%	5.1%	0.9%	10.2%	7.2%
South West Catchment Area	77.0%	78.3%	13.6%	12.5%	1.6%	1.6%	7.7%	7.6%
Camden LGA	81.3%	81.6%	14.1%	13.2%	1.8%	1.5%	2.9%	3.8%
Campbelltown LGA	76.2%	75.5%	18.0%	17.5%	2.1%	2.2%	3.7%	4.8%
Liverpool LGA	77.9%	77.1%	15.2%	14.6%	1.7%	1.6%	5.1%	6.6%

### Table 3.4: Household Composition (2011-2016), Catchment Areas

Source: ABS

### 3.2.4 Family Composition

Within the definition of 'family households', analysis shows that couple families with children are the largest family type within the South West Catchment Area, followed by couples with no children and one parent families. Compared to the broader South West Region, there is a higher proportion of couple with children families in the SA1 Catchment Areas. This again reflects the growing desirability of new estates within the South West Catchment Area for younger and middle-aged families with children.

Notably, the proportion of single parent households in the SA1 Catchment Areas declined over the 2011-2016 periods compared to the South West Region (where they generally rose as proportion of total households).

Catchment Area	Couple No Children		Couple with Children		One Parent Family		Other Family	
	2011	2016	2011	2016	2011	2016	2011	2016
Oran Park	47.1%	29.3%	37.3%	57.6%	15.7%	11.3%	0.0%	1.8%
Turner Road	35.9%	38.4%	54.3%	54.3%	9.8%	7.0%	0.0%	0.3%
East Leppington	21.9%	30.1%	63.0%	58.1%	15.1%	10.5%	0.0%	1.3%
South West Catchment Area	31.1%	32.9%	53.7%	54.1%	13.9%	11.7%	1.1%	1.3%
Camden LGA	30.0%	29.8%	54.9%	55.1%	14.1%	14.0%	1.0%	1.0%
Campbelltown LGA	27.5%	27.9%	48.6%	48.8%	22.3%	21.8%	1.6%	1.6%
Liverpool LGA	23.7%	23.2%	56.7%	57.0%	18.2%	18.2%	1.3%	1.5%

Table 3.5: Family Composition (2011-2016), Catchment Areas

Source: ABS

### 3.2.5 Education Levels

The new residents moving into the SA1 Catchment Areas are observed to be well-educated. As at 2016, the proportion of residents in the SA1 Catchment Areas who completed secondary schooling was well-above that observed in the broader South West Region.

Additionally, the proportion of residents in the SA1 Catchment Areas with some form of tertiary qualification is higher than the South West Region LGAs.



Catchment Area	Second	lary School	Post-School Qualifications					
	Completed	Not Completed	Post-Grad	Bachelor	Diploma	Certificate	None	
Census 2011								
Oran Park	33.8%	66.2%	2.1%	0.0%	8.9%	12.3%	28.8%	
Turner Road	38.1%	61.9%	0.0%	0.0%	10.6%	7.3%	28.9%	
East Leppington	31.6%	68.4%	0.0%	0.0%	6.5%	6.1%	24.9%	
Camden LGA	43.8%	56.2%	1.8%	1.1%	9.0%	8.1%	21.3%	
Campbelltown LGA	44.9%	55.1%	2.3%	0.8%	8.6%	7.1%	20.1%	
Liverpool LGA	52.0%	48.0%	2.1%	0.7%	10.0%	7.9%	17.6%	
Census 2016								
Oran Park	63.1%	36.9%	5.8%	1.1%	15.2%	11.0%	27.0%	
Turner Road	64.0%	36.0%	5.6%	1.6%	23.4%	17.1%	33.3%	
East Leppington	63.3%	36.7%	8.4%	1.9%	18.8%	13.3%	24.0%	
Camden LGA	50.4%	49.6%	6.0%	2.8%	22.7%	20.0%	47.4%	
Campbelltown LGA	51.4%	48.6%	8.4%	2.2%	23.8%	19.0%	46.0%	
Liverpool LGA	57.0%	43.0%	7.5%	2.0%	28.0%	21.3%	40.8%	

#### Table 3.6: Secondary School and Post-School Education (2011-2016), Catchment Areas

Source: ABS

### 3.2.6 Household Income and Housing Costs

Households in the newest estates of the South West Catchment Area are generally more affluent than households in the broader South West Region, earning between \$2,200 and \$2,400 per week compared to between \$1,450 to \$2,050 per week in the Camden, Campbelltown and Liverpool LGAs.

As a result of higher income levels, households in the SA1 Catchment Areas generally pay a lower amount of their median weekly income on mortgage payments. That said, the proportion of weekly income spent on rental payments is slightly higher than in nearby LGAs which is a function of higher market rents in newly established areas.

Interestingly, households in the Turner Road Precinct generally earn higher incomes than those in Oran Park and East Leppington. This aligns with market prices for new housing; higher prices typically achieved in the Gregory Hills precinct compared to Oran Park.

Catchment Area	9	SA1 Catchment Areas			South West Region			
	Oran Park	Turner Road	East Leppington	Camden	Campbelltown	Liverpool		
Weekly Household Income	\$2,240	\$2,387	\$2,224	\$2,043	\$1,458	\$1,550	\$1,750	
Monthly Mortgage (\$)	\$2,624	\$2,643	\$2,600	\$2,220	\$1,842	\$2,123	\$2,167	
Weekly Rent (\$)	\$540	\$560	\$555	\$460	\$350	\$370	\$440	
% of Income on Mortgage	27.0%	25.6%	27.0%	25.1%	29.2%	31.6%	28.6%	
% of Income on Rent	24.1%	23.5%	25.0%	22.5%	24.0%	23.9%	25.1%	

### Table 3.7: Household Income and Housing Costs (2016), Catchment Areas

Source: ABS

### 3.2.7 Housing Tenure

Households in the South West Catchment Area are typically homeowners- over 72% of households either owning their home outright or with a mortgage. This rate of home ownership generally aligns with that observed in the Camden LGA, although it is much higher than either the Campbelltown or Liverpool LGAs.

Interestingly, about a third of households in Oran Park and East Leppington are renting which is higher than the Camden LGA. This suggests investors were active in purchasing homes in these new precincts.



### Table 3.8: Housing Tenure (2016), Catchment Areas

	Owned Outright	Owned with a Mortgage	Rented	Other Tenure
Oran Park	8.4%	58.0%	32.6%	1.0%
Turner Road	8.3%	67.9%	23.1%	0.8%
East Leppington	10.7%	56.8%	31.7%	0.7%
South West Catchment Area	30.7%	41.7%	26.4%	1.2%
Camden LGA	24.7%	53.0%	20.9%	1.5%
Campbelltown LGA	24.9%	40.2%	33.4%	1.5%
Liverpool LGA	24.8%	41.2%	32.4%	1.5%

Source: ABS

### 3.2.8 Internal Migration

ABS data has been analysed to identify where the region's new residents in the Catchment Areas have relocated from. The most recent ABS data indicates where residents lived one and five years ago before the 2016 Census. Key findings include:

- In Oran Park, about 64% of residents lived in the Camden LGA one year prior to 2016, followed by Campbelltown LGA (8%) and Liverpool LGA (7%). In the five years prior, 21% of residents lived in Camden LGA, 18% lived in the Liverpool LGA, 17% lived in the Campbelltown LGA and 9% lived in the Fairfield LGA. Interesting, just over 5% had lived in another country the five years prior to 2016.
- In the Turner Road Catchment Area, about 64% of the population lived in the Camden LGA in the year prior to 2016. In the five years prior to 2016, 23% resided in the Liverpool LGA, 20% in the Campbelltown LGA, 19% in the Camden LGA and 9% in the Fairfield LGA. Similar to Oran Park, about 4% of residents had lived in another country 5 years prior 2016.
- In East Leppington, about 52% of residents lived in the Camden LGA in the year prior to 2016, followed by 24% in the Campbelltown LGA. In the five years preceding 2016, 33% resided in the Liverpool LGA, 20% in the Camden LGA, 9% in the Campbelltown LGA and 9% in the Fairfield LGA.

These sources of migration generally align with the broader South West Catchment Area, where the overwhelming majority of new residents relocating from the South-West Region.

**Figure 3.3** to **Figure 3.5** illustrate the patterns of internal migration in the three SA1 Catchment Areas in the five years prior to 2016.







Figure 3.3: Where Residents Used to Live 5 Years Ago (2016), Oran Park Catchment Area

Cobbitty Precinct | page 18

Source: ABS





Figure 3.4: Where Residents Used to Live 5 Years Ago (2016), Turner Road Catchment Area





Figure 3.5: Where Residents Used to Live 5 Years Ago (2016), East Leppington Catchment Area

### 3.2.9 Employment by Occupation

As at 2016, most residents in the Catchment Areas were employed as professionals, clerical and administrative workers and technicians and trade workers. A much higher proportion of white-collar workers (professionals, managers) reside within the Catchment Areas as compared to the broader LGAs of Liverpool, Camden and Campbelltown. This aligns with the higher incomes of residents within the Catchment Areas in comparison to the broader South West Region.

Occupation	Oran Park	Turner Road	East Leppington	Camden	Campbelltown	Liverpool
Manager	11.8%	12.8%	16.0%	13.0%	8.6%	10.2%
Professional	20.4%	20.1%	18.7%	18.2%	15.6%	17.4%
Technician/Trades Worker	15.4%	15.8%	14.2%	15.3%	14.2%	14.9%
Community/Personal Service Worker	8.9%	9.1%	8.3%	10.3%	11.5%	10.2%
Clerical and Administrative Worker	17.2%	17.7%	18.9%	16.8%	16.5%	16.5%
Sales Worker	10.4%	9.8%	9.1%	10.1%	9.9%	9.4%
Machinery Operators and Driver	7.9%	9.2%	8.1%	8.3%	12.1%	10.7%
Labourer	7.8%	5.6%	6.6%	7.8%	11.5%	10.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

### Table 3.9: Employment by Occupation (2016), Catchment Areas

Source: ABS

### 3.2.10 Where Residents Work

ABS journey to work data has been analysed to understand where residents in the Catchment Areas travel to work. This is an important indicator as proximity to employment is a well-known consideration for prospective purchasers of new housing. The main findings of the journey to work analysis include:

- In Oran Park, one fifth of all residents' work within the Camden LGA. This is closely followed by the Liverpool LGA (16% of residents) and Campbelltown LGA (11%). Other important areas include the Sydney LGA (8%), Fairfield (6%) and Parramatta and Blacktown (4% each respectively). Overall, almost 50% of residents work locally within the South West.
- In the Turner Road Catchment Area, approximately 16% of residents' work in the Camden LGA, closely followed by Liverpool (15%) and Campbelltown (12%). Notably, the Sydney LGA is also a major destination for employment with 12% of residents travelling there for work. Overall, 43% of residents in Turner Road work in the South West Region.
- In East Leppington, the Liverpool LGA is the largest destination for working residents at 16%. This is closely followed by Camden at 15% of all residents and the Sydney LGA at 12%. 10% of residents work in the Campbelltown LGA. The East Leppington precinct has the smallest proportion of local workers with 41% working in the South West Region.

These findings align with the South West Catchment Area, give most new residents have relocated from the South-West.

### 3.2.11 Household Occupancy Rates

As at 2016, the household occupancy rate (i.e. the average number of persons per household) in the South West Catchment Area was 3.18. This was slightly down from the occupancy rate of 3.24 recorded the five years prior in 2011. In the SA1 Catchment Areas, occupancy rates ranged from 3.13 in Oran Park, 2.99 in Turner Road and 3.03 in East Leppington.

The household occupancy rate in the South West Catchment Area aligns with that observed in the Camden and Liverpool LGAs, whereas the Campbelltown LGA has a smaller household occupancy rate.

### Table 3.10: Household Occupancy Rates (2011-2016), Catchment Areas

Catchment Area	2011	2016
Oran Park	2.79	3.13
Turner Road	3.58	2.99



Catchment Area	2011	2016
East Leppington	3.54	3.03
South West Catchment Area	3.24	3.18
Camden LGA	3.08	3.13
Campbelltown LGA	2.97	2.99
Liverpool LGA	3.19	3.25

Source: ABS

### 3.2.12 Dwellings

In 2016, a total of 147,360 dwellings were collectively recorded in the Camden, Campbelltown and Liverpool LGAs. Approximately 2,500 dwellings were delivered per annum over the 2006-2016 period (on average), with a much higher rate of growth recorded over the five years to 2016 as opposed to the 2011-2016 period.

Table 3.11 shows private dwelling growth across the South West Region over the 2006-2016 period.

LGA	2006	2011	2016	Avg. Annual Growth (No.)		
				2006-11	2011-2016	2006-16
Camden	16,969	19,343	26,187	475	1,369	922
Campbelltown	50,218	51,280	55,281	212	800	506
Liverpool	55,068	58,838	65,892	754	1,411	1,082
South West Region	122,255	129,461	147,360	1,441	3,580	2,511

#### Table 3.11: Private Dwelling Growth (2006-2016), South West Region

Source: ABS

### 3.3 Summary of Demographic Analysis

An understanding of the current and historical socio-demographic profile of residents in the South West Catchment Area is critical to planning for future housing demand in South Creek West. Of particular relevance is the demographic profile of residents in the Catchment Areas of Oran Park, Turner Road and East Leppington given they provide a useful barometer for the type of residents which could accommodated at Precinct 5.

Key findings from the socio-demographic analysis are as follows.

- Historically, the South West Catchment Area has being growing at an exponential rate with average annual growth of 11.7% (2,350 residents per annum) over 2011-2016. This pace of growth has continued in recent years, with an additional 13,600 residents recorded between 2016 and 2019 at an average annual rate of 14.3%.
- The South West Catchment Area is characterised as an area with young, family-oriented households with children and a much younger population compared to the broader South West Region.
- The new residents moving into the South West Catchment Area are also more educated and affluent than the broader South West Region, with higher proportions of residents being tertiary qualified with higher income levels.
- The overwhelming majority of residents moving into the South West Catchment Area's new housing estates are South West locals, having relocated from the Camden, Liverpool and Campbelltown LGAs.
- Most residents in the South West Catchment Area go to work in the surrounding South West Region, although a large proportion also commute to the Sydney LGA for employment.
- Households in the South West Catchment Area ear earn markedly higher incomes than residents in the broader South West Region as well as Greater Sydney.
- The average household size in the South West Region is 3.18 persons per dwelling (in 2016), generally aligning with that observed in the broader South West Region.



# PART B: HOUSING NEED



# 4. Population and Dwelling Projections

Research and analysis included Part B of this Study was carried out in Q1 2021.

A variety of factors influence the housing market though a key driver of demand for housing is population growth.

The outbreak of COVID-19 has significantly impacted national population growth due to the cessation of international migration. Capital cities – where international migration is a key source of population growth - the pause in international migration has had an even more significant impact.

This section considers anticipated population growth in the South West Region and its implication for housing.

### 4.1.1 Centre for Population Projections

In December 2020, the Australian Government's Centre for Population, working with the NSW Government, released population projections which have included adjustments for the impact of the COVID-19 pandemic and subsequent changes to migration policy. These projections are based over a 10-year period from 2020-21 to 2030-31.

These projections conclude that Greater Sydney is expected to grow by some 614,000 residents over the decade to 2020-2031. This compares with growth of almost 832,000 new residents which were expected in a pre-COVID-19 scenario. As such, this suggests Greater Sydney's population (by 2031) could be ~5% smaller due to the COVID-19 pandemic.

Figure 4.1 illustrates the Centre for Population's projections for Greater Sydney over the 2020-2031 period.



Figure 4.1: Centre for Population Projections (Greater Sydney), Central Scenario and Pre-COVID-19 Scenario

Source: Centre for Population (2020)

The Centre for Population's projections do not break down population growth across Greater Sydney at the LGA level. The most current population projections carried out at the LGA-level remain those prepared by the NSW Department of Planning, Industry and Environment (DPE), released in 2019.



### 4.1.2 DPE Population Projections

Official population projections in NSW are carried out by the NSW Department of Planning Industry and Environment (DPE).

DPE's Demography and Research Unit project population growth on a variety of demographic assumptions, including birth and fertility rates, mortality rates, migration levels and household formation patterns. These projections of population growth are divided by projected household occupancy rates to arrive at the number of dwellings impliedly required to accommodate the projected population.

The most recent population projections prepared by DPE were released in 2019. Three sets of population projections were made publicly available at a State, Capital City and LGA level:

- Main Series Projections: the NSW Government's 'central scenario' for population growth over the coming decades to 2041 and the standard set of population projections used in the State strategic and transport planning.
- **High Scenario Projections:** an alternative set of population projections based on higher levels of population growth compared to the Main Series.
- Low Scenario Projections: an alternative set of population projections based on lower levels of population growth compared to the Main Series.

As at the date of writing, the NSW Government's Main Series population projections remain the standard set of projections used in the NSW Government's Common Planning Assumptions to inform strategic planning and transport planning. However, it is understood that DPE are preparing an updated set of population projections to reflect the impact of the COVID-19 pandemic on local population growth at the LGA level.

Given the significant difference in population growth in Greater Sydney expected by the Centre for Population, this Study considers DPE's Low Scenario population projections to assess the need for more housing in the South West.

### Population Projections

Under the Main Series population projections, the South West Region was projected to increase by some ~544,000 residents over the coming decades to 2041, reaching a population of ~998,000 residents. This was to be largely driven by growth in the Liverpool and Camden LGAs who were expected to account for almost 84% of all new residents.

Under the Low Scenario, the South West Region is expected to grow by around ~485,000 residents by 2041, totalling a population of some ~939,000 residents. This is approximately ~59,000 (-11%) fewer residents than that anticipated in the Main Series. **Table 4.1** illustrates the Low Scenario and Main Series population projections for the South West Region.

Area	2016	2021	2026	2031	2036	2041	Change (2016-41)
Main Series							
Camden	80,264	127,647	153,299	180,071	236,255	307,727	227,463
Campbelltown	161,566	180,051	194,039	212,366	227,946	249,262	87,696
Liverpool	211,983	251,322	291,187	328,447	380,085	441,427	229,444
South-West Region	453,813	559,020	638,525	720,884	844,286	998,416	544,603
Low Scenario							
Camden	80,264	126,598	149,388	173,326	226,152	293,160	212,896
Campbelltown	161,566	177,965	187,975	202,764	214,464	231,484	69,918
Liverpool	211,983	248,599	282,896	314,818	360,415	414,629	202,646
South-West Region	453,813	553,162	620,259	690,908	801,031	939,273	485,460

### Table 4.1: Main Series and Low Scenario Population Projections (2016-2041), South West Region

Source: DPE (2019)

### Age Composition

The age profile of the South West Region is expected to gradually change over the coming decades with the proportion of residents aged 65 years and older rising considerably. This a broad trend with a gradually older population expected across Greater Sydney and NSW in general.



That said, the South West Region is expected to remain a major hub for young families with residents aged 14 years and younger expected to comprise around 39% of the population in 2041.





Source: DPE (2019b)

### 4.2 Household and Family Composition

Under the Main Scenario, the number of households in the South West Region was expected to increase by ~211,000 over the coming decades to 2041, reaching a total of to just over 375,000 households. Household projections were not included in the Low Scenario projection series.

Couples with children are expected to remain the largest household type over this period, although the proportion of couples with no children and lone person households is expected to progressively increase in the coming decades. This also contrasts with forecasts for select precincts in the GMGA, where couples with children are expected to grow markedly and increase their overall proportion of total households.

**Table 4.2** shows the projected household composition across the South West Region over the 2016-2041 period (as per the Main Scenario projection series).

Household Type	2016	2021	2026	2031	2036	2041	Change (2016-41)
Couple only	27,804	36,726	42,482	48,614	58,811	72,002	44,199
Couple with children	65,226	80,311	91,458	102,444	118,975	139,121	73,895
Single parent	21,555	26,444	30,626	35,088	41,035	48,339	26,785
Other family	6,942	8,571	9,729	10,957	12,914	15,325	8,383
Lone person	23,144	30,168	36,568	43,497	53,228	65,456	42,311
Group	2,391	2,957	3,340	3,740	4,438	5,383	2,992
Total Households	147,062	185,176	214,202	244,340	289,401	345,626	198,565

Table 4.2. Household	Composition	2016-2041)	South V	West Region
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Source: DPE (2019b)



## 4.3 Implied Dwelling Requirements

Under the Main Series, the South West Region was expected to require around ~362,000 dwellings over the coming decades to 2041. Unfortunately, implied dwelling requirements for DPE's Low or High Scenario population projections have not been made publicly available.

In order to estimate the quantum of dwellings required under the Low Scenario, the number of residents per dwelling in the Main Series projections have been analysed. This analysis is shown in **Table 4.3**.

Area		2016		2041		
	Dwelling Need	Population	Pop/Dw	Dwelling Need	Population	Pop/Dw
Camden	27,159	80,264	2.96	110,353	307,727	2.79
Campbelltown	57,591	161,566	2.81	95,256	249,262	2.62
Liverpool	69,556	211,983	3.05	156,776	441,427	2.82
Western City	154,306	453,813	2.94	362,385	998,416	2.76

### Table 4.3: Capita by Dwelling (Main Series; 2016, 2041), South West Region

Source: Atlas/DPE (2019)

Assuming these capita/dwelling ratios would remain consistent in the Low Scenario, these ratios have then been applied to the population projections in the Low Scenario to identify the potential number of dwellings required under the Low Scenario.

Applying these assumptions suggests that under the Low Scenario, the South West Region would require ~341,000 dwellings by 2041. This represents around 21,500 fewer dwellings by 2041 than under the Main Series.

**Table 4.4** shows the analysis applied to assess the potential dwelling need for the South West Region under the Low Scenario.

#### Table 4.4: Potential Dwelling Need (Low Scenario; 2016, 2041), South West Region

Area	Lo		Low Series (2041)			
	Population	Pop/Dwl	Dwelling Need	Population	Pop/Dwl	Dwelling Need
Camden	80,264	2.96	27,159	293,160	2.79	105,129
Campbelltown	161,566	2.81	57,591	231,484	2.62	88,462
Liverpool	211,983	3.05	69,556	414,629	2.82	147,258
Western City	453,813	2.94	154,306	939,273	2.76	340,849

Source: Atlas/DPE (2019)

As demonstrated in **Table 4.4**, some ~341,000 dwellings could be needed by 2041 period under the Low Scenario. This implied dwelling requirement of ~341,000 is a key metric in measuring the need for more housing across the South-West Region.



# 5.1 Economic Trends and Drivers

### Impacts of COVID-19 Shutdowns in Greater Sydney

As at September 2021, much of Greater Sydney remains in a temporary lockdown due to an outbreak of COVID-19. Social distancing initiatives aimed at slowing the spread of COVID-19 have included suspending most forms of retail, sports and recreation, construction and requiring most office-based work to be performed at home.

It is likely that the continued uptake of COVID-19 vaccines will allow an easing of restrictions to commence from October 2021. Whilst this is undoubtedly a positive step in recommencing the economic recovery, the economic ramifications of Greater Sydney's ~4-month lockdown are yet to be fully quantified. NSW Treasury have estimated each week of lockdown accounts for a loss in GDP of between \$700m and \$800m.

There is consensus amongst economists that the Greater Sydney lockdown and temporary shutdown orders in Greater Melbourne and Adelaide in July 2021 will result in Australia recording negative economic growth in Q3 2021.

### 5.1.1 Macroeconomic Indicators

Prior to the outbreak of COVID-19 across Greater Sydney and Greater Melbourne in June 2021, the Australian economy had appeared to have entered a recovery phase following the historic falls in economic output and employment during 2020 as a result of the COVID-19-induced recession. This was first and foremost driven by historically accommodative fiscal and monetary policy, principally the Commonwealth Government's JobKeeper and JobSeeker financial assistance packages and the record low cash rate of 0.1% set by the Reserve Bank of Australia (RBA).

Strong growth over the December 2020 quarter had resulted in the national economy being down just 1.1% compared to pre-COVID-19 levels. Household spending is rising, and unemployment is falling. Notably, house prices in Greater Sydney have reached record highs as low interest rates and a mix of Government incentives fuel purchaser activity and sentiment.

**Table 5.1** summarises some of the key economic indicators influencing housing demand across Australia and NSW at Q22021.

Indicator		Comment
~~~	National GDP to Grow by ~4.0%	The Australian economy is expected to experience growth in GDP of 4.0% in 2021 (RBA, 2021). Australian GDP rose by 0.7% over the June 2021 quarter, with GDP recording growth of 2.4% since the initial outbreak of COVID-19 in Q1 2020.
	Cash Rate at 0.1%	The Reserve Bank of Australia (RBA) has held the cash rate into 2021 and has continued with quantitative easing supply of money to assist debt and is unlikely to cut the cash rate below 0.1%. Recent commentary on the potential need for an increase in the cash rate to mitigate potential inflation have been repudiated by the RBA who do not expect an increase to the cash rate until 2023.
	Population Growth Slows to 0.5%	The Australian population grew by just 136,300 in the year to December 2020, representing growth of 0.5%. Over the quarter to September 2020, the population declined for the first time since WW1. Further declines are expected over 2021 should overseas migration restrictions be maintained.
<b>M</b>	Household Savings still at Historic Highs	Following a peak of almost 20% in mid-2020, the national household savings ratio was most recently recorded at 9.7% in June 2021. This remains well above the household savings rate recorded over the course of 2019 before the onset of the COVID-19 pandemic (3.7% to 6.1%).
	Unemployment at 4.6%	National unemployment has fallen to 4.6% in July 2021 following its peak of 7.5% in July 2020. That said, the underemployment rate grew by 0.4% to 8.3% in July 2021. In NSW, underemployment rose by 2.1% in the month to July 2021 as much of the state was impacted by lockdowns.
ア	Residential Construction Strong	Following a 20-year peak in October 2020, dwelling approvals fell in the month to July 2021 though are still up over 12% over the 12-month period. NSW recorded a softer dip in house approvals compared to the national average, though still remain at historical highs.
	Median House Prices at Record Highs	House prices have surged across Greater Sydney with the median house price of over \$1,000,000 surpassing the record high levels recorded at the peak of the residential property boom in 2017. Further price growth is anticipated over the course of 2021 given historic low interest rates.

### Table 5.1: Key Economic Indicators



Indicator		Comment
•••	Wages Rise by 1.5%	Wage growth across Australia was recorded at 1.7% over the 12-months to June 2021, with a 1.3% rise in the public sector and 1.9% rise in the private sector. Private wages in NSW grew by 2.0% over the year, with public wages up by 1.1%.

Source: Various – see References

### 5.1.2 Impact of COVID-19 Stimulus Packages

Following the outbreak of COVID-19 across Australia in Q1 2020, both the Commonwealth and NSW Governments implemented a broad range of economic stimulus and household/ business support packages aimed at limiting the economic and social damage caused by restriction measures. JobKeeper and JobSeeker proved critical to supporting household consumption over this period until their cessation in April 2021.

Many of these stimulus packages have had a significant impact on the NSW housing market. Some of these included:

- HomeBuilder Grant: The Commonwealth Government's HomeBuilder program provided eligible owner occupiers (including first home buyers) with a grant of \$25,000 or \$15,000 to build a new home or renovate an existing dwelling.
- **First Home Owner's Grant (New Homes):** The NSW Government provides a \$10,000 grant for eligible FHBs when purchasing a new home up to \$600,000 or a house and land package of up to \$750,000.
- **First Home Buyer Assistance Scheme:** The NSW Government waives stamp duty for FHBs when purchasing new properties of up to \$800,000, existing homes up to \$650,000 or vacant land up to \$400,000.
- First Home Loan Deposit Scheme (FHLDS): The Commonwealth Government's FHLDS has issued 10,000 places for eligible FHBs to enter the market with a 5% deposit, without paying lender's mortgage insurance.

In unison with historically low retail interest rates driven by the RBA's 0.1% cash rate, these stimulus packages have driven a surge in housing activity as represented by marked growth in new loan commitments, particularly owner occupiers.

Figure 5.1 illustrates the growth in new loan commitments across in NSW over the 20-months to March 2021.





Source: ABS (2021c,d)/Atlas/RBA (2021)

As demonstrated in **Figure 5.1**, new loan commitments in the lead up to Q1 2020 were tracking at a relatively consistent level. First home buyers generally accounted for ~20% of total loan commitments. Upon the outbreak of COVID-19 in March 2020, the number of loan commitments initially fell as lockdown measures and uncertainty impacted the market, though began to increase from June 2020.



Upon the release of the Commonwealth's Homebuilder stimulus package and the raft of other incentives offered by the NSW Government in July 2020, a marked uptick in new loan commitments to owner occupiers was observed. This uptick was assisted by a significant rise in household saving rates (approaching 20%) observed since the initial outbreak in March 2020.

A similar trend was observed across Australia, with a rise in the number of owner occupier loans observed post June 2020. In June 2020, owner occupiers accounted for 74% of all residential loans before rising to circa 76%-77% over the remainder of 2020 and peaking at just under 78% in January 2021. In NSW, owner occupier loans peaking in September 2020 with the number and proportion of investor loans increasing ever since.

# 5.2 Historical Market Activity

Sale prices are one of the principal indicators for housing demand over time. Over the decade to June 2021, house prices across the South West Region have risen on average by between 5.5% to 7.4% per annum (CoreLogic RP Data, 2021). This is broadly in line with Greater Sydney, where house prices have on average risen by 6.2% per annum since 2011.

A distinct hierarchy of housing values is observed across the South West Region. The Liverpool LGA records the highest median sale price at \$890,000, followed closely by Camden (\$860,000). Campbelltown records the lowest median house price within the region at \$732,000.

Median house price growth over the 12-months to June 2021 has varied significantly. In the Campbelltown LGA, median house prices have grown by over 12%, whereas Camden and Liverpool grew by 7.6% and 4.7% respectively. This reflects the 'lower base' from which house prices in Campbelltown grew from.

All LGAs recorded strong median house price growth over the past 3-months however, ranging from 3.8% to 5.1% (\$12,000 to \$45,000) in this short period. Notwithstanding, median house price growth in the South West Region has not been as marked as that witnessed across the broader Greater Sydney area in recent times, where house prices have risen by 14.4% in the year to June 2021.

 Table 5.2 shows the growth in median house prices across the South West Region.

LGA	Median Sale Price			Recent Changes in Median Sale Prices (%)			Long-Term Avg. Annual Growth (%)	
	June-2020	June-2021	2020-2021	2018-2021	2017-2021	2011-2021	2001-2021	
Camden	\$799,357	\$860,000	7.6%	2.3%	8.9%	5.5%	6.4%	
Campbelltown	\$651,854	\$732,000	12.3%	5.4%	20.6%	7.4%	7.0%	
Liverpool	\$850,205	\$890,000	4.7%	-0.6%	6.2%	5.8%	6.1%	
Greater Sydney	\$1,089,088	\$1,245,500	14.4%	12.6%	22.2%	6.2%	6.8%	

### Table 5.2: Median Sale Prices (Houses) by LGA, South West Region

Source: CoreLogic RP Data

In a similar trend to the housing market, most apartment markets across the South West Region recorded growth over the 12 months to June 2021. This growth has yet to result in apartment values returning to the highs recorded over the 2017-18 period, with LGAs such as Campbelltown and Liverpool still recording below-peak median apartment prices.

Over the 10-years to Q1 2021, apartment values across the South West have increased by between 5.9% and 7.0% per annum (on average). This rate of growth is greater than that recorded across Greater Sydney which averaged of 4.3%. Unlike the housing market, most LGAs across the South West Region have recorded nominal to negative unit price growth over the recent 3-month period, with change in values ranging from -1.7% (Camden LGA) to 2.9% (Campbelltown LGA).

 Table 5.3 shows the growth in median apartment prices across the South West Region.

### Table 5.3: Median Sale Prices (Units) by LGA, South West Region

LGA	Median Sale Price		Recent Changes in Median Sale Prices (%)			Long-Term Avg. Annual Growth (%)	
	June-2020	June-2021	2020-2021	2018-2021	2017-2021	2011-2021	2001-2021
Camden	\$491,676	\$511,000	3.9%	-7.8%	19.0%	7.0%	6.4%
Campbelltown	\$448,097	\$479,000	6.9%	<b>-</b> 2.3%	8.1%	6.3%	6.6%


LGA	Median S	ale Price	Recent Cha	nges in Median S	ale Prices (%)	Long-Term Avg. /	Annual Growth (%)
	June-2020	June-2021	2020-2021	2018-2021	2017-2021	2011-2021	2001-2021
Liverpool	\$507,317	\$520,000	2.5%	-4.7%	0.5%	5.9%	6.2%
Greater Sydney	\$736,378	\$760,000	3.2%	2.8%	4.2%	4.3%	4.9%

Source: CoreLogic RP Data

#### 5.2.1 Sales Volumes

Measuring the volumes of dwellings being offered for sale (i.e. listings) and the number actual sales recorded over any given time series is another useful barometer for housing demand. These indicators provide a further level of insight into housing demand beyond that which can be obtained from analysis of pricing data alone.

Over the 12 months to June 2021, all LGAs within the South West Region recorded a strong uptick in the number of house sales as market activity across Greater Sydney steadily improved. The number of listings in the Campbelltown and Liverpool LGAs also grew over this period, whereas the Camden LGA recorded a *decline* in the number of listings in June 2020-21 compared to June 2019-20. This lack of available supply is conceivably one of the contributing factors to the rapid increase in median house prices across the Camden LGA in recent months.

Table 5.4 shows listing and sales volumes for detached houses across the South West Region over 2019-2021.

#### Table 5.4: Sales Activity (2019-2021), South West Region

LGA		Listings			Sales	
	2019-20	2020-21	Change	2019-20	2020-21	Change
Camden	2,357	2,306	<b>-</b> 2.1%	2,272	3,060	25.3%
Campbelltown	1,835	2,189	19.3%	1,923	2,387	3.5%
Liverpool	1,979	2,164	9.3%	1,939	2,778	18.1%

Source: CoreLogic RP Data

#### 5.3 Demand for New Housing

The greenfield housing market (i.e. land and/or dwelling and land) is distinct from the established housing market in many respects. This section provides a summary of the greenfield housing market in the neighbouring SWGA and other select estates to provide insight into the nature of demand for new residential product proximate the Site.

#### 5.3.1 Sales Volumes

Sales data in Greater Sydney's North West and South West Growth Areas is tracked by DPE. This is useful in understanding demand for new housing proximate the Site. Sale data in the GMGA is not currently tracked by DPE.

In the four years to March 2021, a total of 10,600 sales were recorded in precincts which have been released in the SWGA at an average rate of 2,650 sales per annum. The greatest number of sales over this period was recorded in Oran Park at 2,500 sales, closely followed by East Leppington (2,300 sales) and Edmondson Park (1,600 sales).

Sales activity across the SWGA peaked over the course of 2020 and was amongst the most active years – a total of 2,800 sales were recorded over the 2020 period. This compares to approximately 1,600 sales over the course of 2019 and reflective of a 75% increase in sales volumes. This marked uptick in sales volumes is testament to the current market conditions buoyed by various government incentive schemes and record low interest rates.

In the first quarter of 2021, a total of just over 1,000 sales were recorded across the SWGA. This represents the largest number of sales recorded in a single quarter in the SWGA. An equally strong level of sales is expected in Q2 2021.





#### Figure 5.2: Sales Volumes (2016-Q1 2021), Released Precincts in South West Growth Area

Note: 2016 data available for Q3 and Q4 only Source: DPE (2021)

#### 5.3.2 Emerging Housing Typologies

Demand for housing Western Sydney and the SWGA has historically been focused on low-density, detached housing product. Whilst detached housing is still the preferred housing type for most purchasers, changing lifestyle preferences and rising housing affordability constraints have seen housing demand shift towards medium and higher-density housing.

#### Medium-Density Housing

Medium-density housing typologies (i.e. townhouses, villas) are increasingly being progressed across the SWGA. Market feedback suggests that the market for medium-density housing is driven by the fragility of housing affordability in the SWGA. In many instances, a difference of just \$10,000 can be the factor driving purchaser decisions.

In Oran Park, there are multiple townhouse developments being progressed. For instance, Villa World – Oran Park features a mix of 2, 3 and 4-bedroom, two-storey townhouses. Since October 2020, approximately 100 sales have been recorded with marketing agents noting demand has been primarily observed from owner occupier purchasers unable to afford land or house and land packages elsewhere across the SWGA.

Smaller releases in Cobbitty are also understood to be receiving strong market interest from owner occupier purchasers. Further north in Edmondson Park, two and three-storey townhouses are a key component of the 'Ed. Square' development and are achieving sale prices on par with house and land packages elsewhere across the SWGA.

#### Table 5.5: Snapshot of Medium-Density Residential Projects (Q2 2021), SWGA



Source: Atlas/Nearmap

#### High-Density Housing

Demand for high-density residential housing is beginning to build in some of Greater Sydney's Growth Areas as a result of housing affordability issues and changing lifestyle preferences. Over the past 2-3 years, this has begun to emerge across the SWGA and adjoining areas with some of the first apartment projects coming to market.

The largest apartment project in the SWGA to date has been the mixed-use development 'Ed Square' in Edmondson Park. 'Ed. Square' is a mixed-use development comprising 992 apartments and 892 terrace/town homes directly opposite the existing Edmondson Park train station. The retail component at Ed. Square (to be known as the Ed. Square Town Centre) is set to be significant with 25,000sqm of retail floorspace comprising a full-line supermarket, 'eat street' dining precinct and cinema complex. Stage 1 (367 units and town homes) of the development sold over the course of 2019 and attracted a strong mix of interest from FHBs, international investors and downsizers.

Prices achieved have been strong; one-bedroom apartments have achieved prices from \$500,000 whilst two-bedroom apartments have achieved prices from \$600,000 to \$650,000. These prices are testament to the growing acceptance of higher-density housing. Critically however, these strong prices reflect the high amenity that will be offered on-site and close proximity to an existing train station.

In **Oran Park**, the **'Metro Apartments'** immediately opposite Oran Park Town Centre commenced marketing in Q3 2020. The 6-storey residential flat building is set to comprise 53 apartments and is approximately 70% sold. Interest has been strong from both investors and first home buyers, with almost all buyers understood to be locals from the Camden and Campbelltown LGAs. One-bedroom units have achieved prices from \$465,000 to \$500,000, two-bedroom units from \$750,000 to \$600,000 and three-bedroom penthouses from \$790,000 to \$820,000.

Further south, the 100-unit development 'Somerset Rise' in Narellan commenced marketing in November 2020. Approximately 30% of apartments are understood to be sold, with all buyers being existing Narellan or Camden locals. Few investors have been observed to date, with owner occupiers being a mix of first home buyers and downsizers. Buying activity has been driven by a desire of buyers to remain living locally, with proximity to Narellan Town Centre a key factor.

#### 5.4 Implications for Housing Demand

Key findings from the analysis of housing demand across the South West Region are outlined in turn.

#### Historic Growth in South West Region

Following a softening in market conditions witnessed over 2018-2019, demand for housing across the South West Region over the course of 2020 and into 2021 has reached historic levels. Sales volumes of new housing in the SWGA have been amongst the highest on record and well above the historical average. New estates proximate Precinct 5 have also recorded significant levels of purchaser activity and interest, notably Oran Park.

#### Market Activity

Market activity in the major estates across the SWGA picked up significantly over 2020, buoyed by the lowest interest rates recorded on record and a raft of Commonwealth and NSW Government incentive programs for owner occupiers, particularly First Home Buyers. Significant demand is beginning to translate into escalating prices across almost all major estates.

The onset of the COVID-19 pandemic in 2020 has brought on a distinct preference for detached housing typologies with many buyers seeking larger housing formats to accommodate more time spent at home. However, this emerging trend has not impacted the persistent shift towards smaller lot sizes.

#### Detached Lots

Detached lots remain the preferred housing typology. Prospective purchasers are continuingly willing to accept smaller lot sizes in exchange for a detached housing product with 400sqm-450sqm understood as the current 'sweet spot' in the market given the affordability of such product.

#### • Attached Housing

Market acceptance for medium-density typologies continues to grow across the SWGA and other neighbouring markets. Market response to such product in Oran Park and Edmondson Park has been strong as demonstrated by swift take-up rates and prices comparable to some detached housing products.



#### • Apartments and Units

Some of the first apartment projects in the SWGA and adjoining areas have begun to emerge over the past 2-3 years. These projects have received good levels of interest, particularly from local buyers looking to enter the market at a more affordable price point or for lifestyle reasons.

#### Housing Affordability and Implications for Housing Demand

The significant growth in residential property values, primarily houses, across Greater Sydney over the past 6-months has returned the issue of housing affordability to the fore. House prices are expected to continue to rise over the course of 2021 given historically low interest rates are expected to remain in place for some time.

These pressures are expected to result in housing demand across the South West continue to shift towards more affordable housing typologies such as townhouses and apartments.

The next chapter examines the nature of housing supply in the South West Region.



### 6. Housing Supply

#### 6.1 Existing Supply

At the time of writing, there was no current count of existing private dwellings in the South-West Region. Accordingly, a combination of ABS Census (2016) and DPE dwelling completions data has been used to estimate the existing number of private dwellings in the South-West Region.

#### 6.1.1 Census Count

The most recent formal count of private dwellings in the South West Region was the 2016 Census. The number of private dwellings in the recorded as at the 2016 Census night (August 2016) is shown in **Table 6.1**.

LGA	Private Dwellings	Proportion of Total
Camden	26,197	17.8%
Campbelltown	55,326	37.5%
Liverpool	65,931	44.7%
South West Region	147,454	100.0%

Table 6.1: Private Dwelling Count (2016), South West

Source: ABS (compiled by .id)

As shown in **Table 6.1**, there were some 147,454 private dwellings recorded across the South West as at the 2016 Census.

#### 6.1.2 Recent Growth

Net dwelling completions across Greater Sydney's LGAs are monitored by the DPE Metropolitan Housing Monitor on a monthly basis. The Metropolitan Housing Monitor is current to Q4 2020.

Analysis of dwelling completions is useful for the purposes of this Study given it shows the rate of historical dwelling growth in the South West Region since the 2016 Census.

#### Metropolitan Housing Monitor

Over 2016-2020, ~27,350 dwellings were completed across the South West Region with an average completion rate of 5,500 dwellings per annum. Dwelling completions peaked in 2017 with almost 6,300 completions. Completions fell in 2018 and 2019 to circa 5,500-5,600 completions per annum, with completions again falling in 2020 to ~5,200.

The majority of completions in the South West Region have been recorded in the Camden LGA, where around 43% of new dwellings were delivered. This was followed by Liverpool (34%) and Campbelltown (23%). Approximately 73% of dwelling completions have been for one net dwelling completion ("detached").

Table 6.2 shows the number of dwelling completions across the South West Region (by LGA) over 2016-2020.



		אווא (בטבט נונ													
Area		2016			2017			2018			2019			2020	
	Detached	Multi-unit	Total	Detached	Multi-unit	Total	Detached	Multi-unit	Total	Detached	Multi-unit	Total	Detached	Multi-unit	Total
No. of Dwelling (	Completions														
Camden	2,166	162	2,328	2,585	256	2,841	2,191	218	2,409	2,184	92	2,276	1,845	164	2,009
Campbelltown	609	304	913	980	626	1,606	945	302	1,247	823	373	1,196	1,033	197	1,230
Liverpool	1,035	464	1,499	1,169	667	1,836	1,020	837	1,857	766	1,356	2,122	744	1,244	1,988
South West	3,810	930	4,740	4,734	1,549	6,283	4,156	1,357	5,513	3,773	1,821	5,594	3,622	1,605	5,227
Proportion of Dw	/elling Compl	letions													
Camden	93.0%	7.0%	100.0%	91.0%	9.0%	100.0%	91.0%	9.0%	100.0%	95.7%	4.3%	100.0%	91.8%	8.2%	100.0%
Campbelltown	66.7%	33.3%	100.0%	61.0%	39.0%	100.0%	75.8%	24.2%	100.0%	63.0%	37.0%	100.0%	84.0%	16.0%	100.0%
Liverpool	69.0%	31.0%	100.0%	63.7%	36.3%	100.0%	54.9%	45.1%	100.0%	34.0%	66.0%	100.0%	37.4%	62.6%	100.0%

100.0%

30.7%

69.3%

100.0%

32.6%

67.4%

100.0%

24.6%

75.4%

100.0%

24.7%

75.3%

100.0%

19.6%

80.4%

South West

Table 6.2: Dwelling Completions (2016 to O4 2020). South West Region

Notes:

"Detached" does not refer to the dwelling type (i.e. it does not refer to a freestanding dwelling). The term "detached" is used to denote the net number of dwellings. If a development results in one net dwelling completion (e.g. a two-unit development that demolishes one house), the net dwelling completion is categorised as "detached". "Multi-unit" refers to a net dwelling completion that is development results in two or more net dwellings (e.g. a three-unit development that demolishes one house), the net dwelling completion is categorised as "multi-"

unit".

Source: DPE (2021b)



#### 6.1.3 Calculating Existing Supply

The following steps are taken to approximate the existing number of dwellings (at 2020) in the South West Region:

- 1. Adopt the 2016 Census dwelling counts (total private dwellings) as a starting point.
- 2. Sum dwelling completions for each LGA from September 2016 to December 2016 (months prior to September 2016 are not included given the 2016 Census was completed on 9 August 2016).
- 3. Sum the 2016 Census dwelling counts and DPE dwelling completions from September 2016 onwards to arrive at existing dwelling supply for Q4 2020.

Table 6.3 shows the process in estimating the total number of existing dwellings in South West as at Q4 2020.

Area	Census 2016	DPE Dwelling Completions (b)					Existing Supply
	Dwellings (a)	2016 <sup>1</sup>	2017	2018	2019	2020	- (a+b)
Camden	26,197	1,048	2,841	2,409	2,276	2,009	36,780
Campbelltown	55,326	422	1,606	1,247	1,196	1,230	61,027
Liverpool	65,931	755	1,836	1,857	2,122	1,988	74,489
South West	147,454	2,225	6,283	5,513	5,594	5,227	172,296

Table 6.3: Existing Private Dwelling Supply (Q4 2020), South West Region

Notes: 1 - Dwelling completions from September 2016-December 2016, 2 - Data is current to Q4 2020 Source: ABS/ Atlas/ DPE (2021b)

Source: ABS/ Atlas/ DPE (2021b)

As calculated in **Table 6.3**, an existing supply of **~172,000** dwellings are identified in the South West Region. This will be an important starting point to assess the potential of South West Region to meet future housing demand.

#### 6.2 Planned Supply

There is a significant amount of housing that is being planned for in the South West Region. The majority of new housing to be delivered over the coming decades is well-known and planned in three main Growth Areas - Western Sydney Aerotropolis, South West Growth Area (SWGA) and Greater Macarthur Growth Area (GMGA). That said, there are also other precincts which are set to deliver a significant quantum of new housing (e.g. the Liverpool CBD).

This section identifies the various precincts which could deliver housing in the South West Region over the coming decades. This has involved investigating all known areas and regions where future housing is being planned, including Growth Areas, Planned Precincts and Investigation Areas.

#### 6.2.1 Areas Investigated

A review of planned housing supply across the South West Region has identified approximately 34 individual precincts. These individual precincts are mostly located within the SWGA, GMGA and Western Sydney Aerotropolis.

#### South West Growth Area

The SWGA is one of the largest greenfield release areas. The SWGA comprises 14 individual precincts and stretches across most of Camden LGA with some precincts falling within the Liverpool and Campbelltown LGAs. Initial planning identified a total planning (theoretical) capacity of around **108,000 dwellings** across the SWGA upon buildout.

Precinct release across the SWGA has been staged. Oran Park and Turner Road were first rezoned and released in 2007 with strong take-up and development across both precincts. This has largely been attributed to both precincts being held in single or majority ownership. Edmondson Park was rezoned and released in 2008 and has enjoyed similar success given the precinct was held in majority ownership.

Numerous other precincts (Catherine Field, East Leppington, Austral and Leppington North) were rezoned over the course of 2013-2014. Development in these precincts has been more tempered, particularly in Austral and Leppington North where small landholdings and fragmented land ownership patterns have presented difficulties for development.



More recently, the Lowes Creek Maryland and South Creek West precincts have been released for planning, though rezoning has yet to occur. Release of the precincts was initiated by landowners under Precinct Acceleration Protocol (PAP) process.





Source: Atlas

#### Western Sydney Aerotropolis

The Western Sydney Aerotropolis comprises some 11,200ha of land centred around the future Western Sydney Airport (WSA) and is planned to be one of Greater Sydney's largest economic hubs. The Aerotropolis is divided into nine precincts which will be released in two stages to align with the completion of the WSA in 2026. A series of initial precincts (Aerotropolis Core, Northern Gateway, Agribusiness) were rezoned in late-2020.

Planning for the Aerotropolis envisages the delivery of some 200,000 jobs and 60,000 new homes by 2026. Approximately 11,400 dwellings are planned for delivery in Stage 1.





Source: Atlas

Greater Macarthur Growth Area

The Greater Macarthur Growth Area (GMGA) is a major growth area in the Campbelltown and Wollondilly LGAs and comprises a mix of greenfield release areas (Menangle Park, Gilead, North Appin, West Appin) and urban renewal areas, incorporating the Glenfield to Macarthur Urban Renewal Corridor. With a total of 11 individual greenfield and urban renewal areas, planning for the GMGA has identified the potential for some 56,000 dwellings upon build-out.



Only three precincts within the GMGA are currently being progressed. The Menangle Park (~4,000 dwellings) and Gilead (1,250 dwellings – first stage) precincts received rezoning approval in 2019 with marketing expected to commence in 2020. The Leumeah precinct is the first precinct within the Glenfield to Macarthur Urban Renewal Corridor to be progressed for rezoning, with Campbelltown City Council progressing a rezoning of the precinct in early 2020.





Source: Atlas

#### **Liverpool City Centre**

The Liverpool City Centre is one of two metropolitan clusters within the Western City District and is a major commercial, civic, retail and residential hub within Sydney's South West. In 2018, the City Centre was rezoned B3 Commercial Core to B4 Mixed Use to facilitate high-density residential development. The Liverpool Place Strategy (2018) identified that the City Centre had the capacity to deliver an additional 18,800 dwellings based on the recently implemented planning controls.

There is a significant quantum of development activity underway in the Liverpool City Centre. As Liverpool grows in importance following the completion of the Western Sydney Airport and implementation of possible direct links (fast bus route), development activity is expected to further grow.

#### Table 6.7: Summary of Planned Supply, Liverpool City Centre



Source: Atlas



#### **Summary of Findings**

The following key observations are made:

- There is planned supply for some ~223,000 dwellings across the South West Region in some 34 individual precincts.
- After deducting the number of dwellings which have been delivered to date, there is a remaining capacity of about **202,100 dwellings**.
- The greatest quantum of planned supply is in the Liverpool and Camden LGAs.

Table 6.8. summarises the theoretical dwelling capacity of the South West Region by LGA.

#### Table 6.8: Planned Supply in Growth Areas and Planned Precincts, South West Region

LGA	Total Planned Supply	Remaining Planned Supply*
Camden	84,382	71,714
Campbelltown	39,230	36,749
Liverpool	99,271	93,646
South West Region	222,883	202,109
*after deducting dwellings alr	eady completed	

Source: Various – see References

A list of each Growth Area and Planned Precinct considered is contained in Schedule 1.

#### 6.3 Infrastructure Servicing Programme

The availability of essential services including water, sewerage and electricity is one of the key influencing factors of housing supply in the South West Region. This is given the significant number of Growth Areas in the Region which have not previously required services infrastructure given their existing uses (i.e. agricultural or rural uses).

#### Water and Sewerage

The development and management of water and sewerage infrastructure across the South West Region is principally managed by Sydney Water. The Sydney Water Growth Servicing Plan 2020-2025 (the Servicing Plan) outlines proposed timelines for delivery of new water and sewerage infrastructure across Greater Sydney's Growth Areas.

The Servicing Plan outlines the status of water and sewerage infrastructure for each precinct across the Growth Areas through five main categories: Regional Planning, Strategic Planning, Options Planning, Concept Design and Design and Deliver. These categories reflect the certainty on infrastructure planning and delivery timeframes.

Figure 6.1 illustrates the various planning stages for water and sewerage infrastructure as defined by Sydney Water.

Figure 6.1: Water and Sewerage Planning Stages, Sydney Water





Source: Sydney Water (2020)

A review of the Servicing Plan (2020) shows that water and sewerage infrastructure is only expected to be operational in some precincts across the Western City's Growth Areas in the short-term. Austral and Leppington North are expected to be serviced by 2023 which will facilitate approximately 50% of the 15,557 dwellings planned in both precincts. The Aerotropolis's Northern Gateway and Aerotropolis Core precincts are expected to be serviced by 2022/23. Menangle Park is expected to be serviced by 2023, facilitating delivery of the 4,000 dwellings proposed.

The key precincts expected to be serviced for drinking and wastewater in the medium-term are those within the Western Sydney Aerotropolis and many of Wilton's sub-precincts.

**Table 6.9** describes the status and expected delivery timeframes of drinking water and sewerage infrastructure in the SouthWest Region's various Growth Areas.

Drinkin	ıg Water	Waste Water		
Status	Delivery Timeframe	Status	Delivery Timeframe	
Options Planning	FY2022-23	<b>Options Planning</b>	FY2024	
Options Planning	FY2022-23	<b>Options Planning</b>	FY2024	
Strategic Planning	Unknown	Strategic Planning	Unknown	
Design and Deliver	FY2022-23	Concept Design	Unknown	
Design and Deliver	FY2022-23	Strategic Planning/ Concept Design	Unknown	
Concept Design	FY2023	Concept Design	Dec-2021	
Concept Design	FY2023	Concept Design Design and Deliver	Dec-2019 Dec <b>-</b> 2021 <b>-</b> 22	
Adequate existing capacity		Adequate existing	g capacity	
Adequate existing capacity		Adequate existing capacity		
Adequate exi	isting capacity	Adequate existing capacity		
Adequate exi	isting capacity	Adequate existing	g capacity	
Design and Deliver	Unknown	Concept Design	Unknown	
Strategic Planning	Unknown	Strategic Planning	Unknown	
Adequate existing	Adequate existing	Adequate existing capacity	Adequate existing	
Strategic Planning	Unknown	Strategic Planning	Unknown	
Strategic Planning	Unknown	Strategic Planning	Unknown	
Options Planning	FY2023	<b>Options Planning</b>	FY2023	
Concept Design	Unknown	Concept Design	Unknown	
Strategic Planning	Unknown	Strategic Planning	Unknown	
	Drinkin Status Options Planning Options Planning Strategic Planning Design and Deliver Design and Deliver Design and Deliver Concept Design Concept Design Concept Design Adequate ex Adequate ex Adequate ex Strategic Planning Strategic Planning Strategic Planning Concept Design	Drinkiry WaterStatusDelivery TimeframeOptions PlanningFY2022-23Options PlanningFY2022-23Strategic PlanningUnknownDesign and DeliverFY2022-23Design and DeliverFY2022-23Concept DesignFY2023Concept DesignFY2023Adequate existry capacityAdequate existry capacityAdequate existry capacityAdequate existry capacityAdequate existry capacityAdequate existry capacityAdequate existry capacityStrategic PlanningUnknownStrategic PlanningUnknownStrategic PlanningUnknownStrategic PlanningFY2023Options PlanningFY2023Concept DesignUnknown	Drinking WaterWaste Waste Was	

Table 69. Status o	f Drinking and	Waste Water	r Infrastructure	South We	st Region
Table 0.7. Status 0	T Drinking and	i vvasie vvale	i iiiiiasii uuture,	Journ Me	st negion

\*The Northern Gateway precinct has been excluded given it falls within the Penrith LGA

Source: Sydney Water (2019)

Maps illustrating the status and timing of water infrastructure across the Growth Areas are included at Appendix 1.

#### **Electricity**

The primary supplier of electricity network service provider in the South West Region is Endeavour Energy. Timing of upgrades to the existing network is aligned with the Sydney Water servicing plan. Upcoming upgrades to the network required to meet future residential and employment demand are outlined in the Endeavour Energy Growth Servicing Plan 2019-2024 and Distribution Annual Planning Report 2019.

Key projects required to facilitate residential growth in the South West Region include:



- The Menangle Park zone substation to support residential and employment growth in Menangle Park. Expected to be completed by 2021/2022. This will support the 4,000 dwellings planned.
- The South Leppington zone substation will be required to support residential development in the Leppington Town Centre/ Leppington precinct. Expected to be completed by 2021/2022. This is needed for the >9,000 dwellings planned.
- The Southern Macarthur 66kV Network to support broader electricity supply in the Macarthur and South West Region; expected to be progressively completed over 2023-2025. This will be needed to support the additional dwelling capacity (circa 17,000 dwellings) to be unlocked in the Glenfield to Macarthur Corridor.

Zone substations may require upgrading depending on development take-up (which is largely determined by water servicing timeframes) in Austral, Bringelly, North Catherine Fields, Rossmore, North Rossmore and Kemps Creek.

Maps of existing and proposed substations across the South West Region are appended at Appendix 2.

#### 6.4 Short-Term Dwelling Forecasts

The NSW DPE carries out 5-year housing supply forecasts at the suburb and local government area level for the Greater Sydney region. The forecast is based on several factors:

- The current development pipeline (including DAs under assessment, approved or under construction);
- Analysis of likely future development under current zoning and planning controls;
- Information from state and local government and industry; and,
- Factors reflecting the outlook for housing demand and market conditions.

The 2020 forecast (released in December 2020) has taken into consideration the impacts of the COVID-19 outbreak and includes three scenarios that respond to the uncertainty resulting from the pandemic. These include:

- Central Base Case: reflects the market conditions and demand factors at the time of the forecast in October 2020.
- **High Growth**: reflects a faster recovery and improving conditions that are more favourable to housing development.
- Low Growth: reflects a slower recovery and more subdued conditions that are less favourable to housing development

These forecasts are summarised in **Table 6.10**.

#### Table 6.10: DPE Supply Forecasts (2020-2025), South West Region

LGA	High Growth Scenario	Central Base Case Scenario	Low Growth Scenario
Supply Forecasts (Total)			
Camden	7,300	6,900	6,850
Campbelltown	4,800	4,550	4,400
Liverpool	8,000	7,200	6,200
South West Region	20,150	18,650	17,450
Supply Forecasts (Avg. Annual)			
Camden	1,460	1,380	1,370
Campbelltown	960	910	880
Liverpool	1,600	1,440	1,240
South West Region	4,030	3,730	3,490

Source: DPE (2020)

Under the Central Base Case Scenario, the South West Region is expected to deliver some 18,700 dwellings over the five years to 2025, averaging around 3,700 dwellings per annum.

Under each of the three scenarios, forecast dwelling growth is *lower* than that historically observed over the 2016-2020 period (4,700 dwellings to 6,300 dwellings per annum). This has implications for the capacity of the South West Region to meet dwelling projections in the coming decades to 2041.



#### 7.1 Remaining Dwelling Need

Based on future population and household growth in the South West Region, it is estimated that under DPE's Low Scenario population projections that there will be a need for approximately ~341,000 dwellings by 2041. The assessment of supply estimated that as at Q4 2020 there were about ~172,000 private dwellings across the South West Region.

By deducting the number of existing dwellings in the South West Region against the implied dwelling requirement for 2041, a Remaining Dwelling Need of ~169,000 dwellings is calculated.

Figure 7.1 illustrates the how the remaining dwelling need to 2041 was calculated for the South West Region.

#### Figure 7.1: Remaining Dwelling Need, South West Region



Source: Atlas

#### 7.2 Dwelling Supply Forecasts

#### 7.2.1 Theoretical v Market Capacity

A common misconception is that if land is zoned for urban uses it will be developed. In practice, this can be far from reality as the development potential of land is collectively influenced by environmental, market or economic constraints that can together impede development. This is directly observable in certain precincts in the SWGA (e.g. Leppington, Austral) where despite being zoned for urban development, development as planned has not occurred.

The capacity of urban land for new development is two-fold: Planning Capacity and Market Capacity.

- **Planning (Theoretical) Capacity** refers to the physical ability of land to be developed, taking into account permissibility under the planning framework, environmental and infrastructure constraints and other factors.
- **Market Capacity** refers to issues of commercial viability whether pricing levels, market acceptance/ attitudes, development costs, etc. make development a commercial proposition, i.e. if development is financially feasible.

It is Market Capacity which determines the quantum and speed of dwelling production and take-up.

Chapter 6 concluded that there is *Planning (Theoretical) Capacity* for some ~202,000 dwellings to be delivered across the South West Region. This is sufficient to meet the Remaining Dwelling Need of ~169,000 additional dwellings by 2041. However, the realisable amount of this ~202,000 dwellings (i.e. the Market Capacity) is *likely to be lower* once market and economic factors are considered.

#### 7.2.2 Supply Scenarios

To assess the likelihood of dwelling supply in the South West Region being able to meet projected housing demand, forecasts of future dwelling supply over the coming decades to 2041 is undertaken. These supply scenarios are carried out at the South West Region level.



Similar to DPE's Short Term Dwelling Forecasts (discussed in section 6.4), three forecast scenarios have been developed. These scenarios provide a range of supply outcomes for the South West Region and therefore reflect the broad range of demand and supply-side factors which influence development activity.

The three supply scenarios considered include:

#### • Scenario 1: Historical Growth

This scenario considers the quantum of new housing which could be delivered across the South West Region if future growth in on par with the past. Over the 2011-2016, the South West Region delivered a net additional supply of circa 3,500 dwellings per annum. Dwelling production quickened over the 2016-2020 period on the back of Greater Sydney's 2013-2018 housing boom, averaging at 5,500 dwellings per annum. Over the 2006-2020 period, average dwelling supply has been approximately ~3,550 dwellings per annum.

Accordingly, Scenario 1 assumes the South West Region will deliver 3,550 net additional dwellings per annum over 2021-2041, equating to a total of 74,550 new dwellings.

#### • Scenario 2: Peak Growth

Scenario 2 assumes a significant greater level of sustained dwelling supply than observed historically.

A significant uptick in new dwelling supply across the South West Region was observed over the 2016-2020 period. In 2017, new supply peaked at some ~6,300 dwellings before falling to 5,500-5,600 dwellings per annum in 2018 and 2019.

Scenario 2 assumes the South West Region could maintain peak supply of ~6,300 dwellings per annum over 2021-2041, delivering a total of 132,300 new dwellings.

#### • Scenario 3: Low Growth

Scenario 3 assumes a lower growth scenario with dwelling supply falling below that historically observed.

Over the 2006-2016 period, the South West Region delivered around 2,500 dwellings per annum. The Low Growth Scenario included in DPE's Short Term Dwelling Forecasts suggests the South West Region would deliver some 3,490 dwellings per annum over the 2020-2025 period.

Scenario 3 assumes that just 3,000 dwellings per annum will be delivered across the South West over 2021-2041, delivering some 63,000 new dwellings.

**Figure 7.2** illustrates the net additional supply that could be delivered across the South West Region over the 2021-2041 period under the three dwelling supply scenarios.

#### Figure 7.2: Dwelling Supply Scenarios (2021-2041), South West Region





Source: Atlas

#### 7.3 Housing Demand and Supply Forecasts

After deducting the number of existing dwellings in the South West Region (to Q4 2020) from the implied dwelling requirement for 2041, a Remaining Dwelling Need of ~169,000 dwellings results. To meet Remaining Dwelling Need, some ~8,100 additional dwellings are needed per annum (on average) over the two decades to 2041.

Each year dwelling completions fall short of this annual need; unmet demand grows and exacerbates the housing shortfall.

Supply forecasts carried out indicate that between 3,000 dwellings (Low Growth Scenario) and 6,300 dwellings (Peak Growth Scenario) per annum could be delivered across the South West Region over the 2021-2041. Accordingly, a shortfall in dwelling supply is anticipated to occur. This is depicted in **Figure 7.3**.

Figure 7.3: Housing Demand and Supply Forecasts, South West Region



Source: Atlas

The factors that influence housing supply capacity and housing demand were examined in Chapters 4 to 6. Dwelling completions across South West Region peaked in 2017 (~6,600 dwellings) commensurate with a peak in Sydney's housing market. Completions fell over 2018-2020 as market conditions softened.

Despite the economic uncertainty resulting from the COVID-19-induced recession in 2020 and subsequent lockdowns over the course 2021, Greater Sydney's residential market is beginning to return to the peaks of activity witnessed in 2017. Even still, dwelling completions will take time before they return to peak levels of 2017. Development activity is 'lumpy' in nature and will take time to re-mobilise.

Even under the Peak Growth Scenario (~6,300 dwellings per annum sustained to 2041), dwelling completions would be insufficient to meet the Remaining Dwellings Need of 169,000. A housing shortfall (36,700 dwellings) would still result.

There remains a significant amount of planned supply which is not expected to be delivered prior to 2041. If *all* of this planned supply was brought forward and delivered in the period to 2041, there would be sufficient capacity to meet projected demand. Owing to a variety of constraints (e.g. land ownership, environmental, development feasibility), this is considered unlikely.

The next Chapter considers the role Precinct 5 could play in addressing housing demand.



#### 8.1 Role of Precinct 5

Supply forecasts identified a major shortfall in the amount of new housing required to meet projected housing demand across the South West Region to 2041. Even though there may be sufficient *theoretical dwelling capacity*, it is unlikely all land will be developed.

Landowner objectives, motivations and personal circumstances often misalign with development requirements and in precincts where ownership is highly fragmented, development take-up is often less than the theoretical capacity for dwellings. Accordingly, Precinct 5 is of critical importance to mitigate the forecast shortfall in housing supply.

Beyond the important issue of housing supply, the location of Precinct 5 proximate the Western Sydney Aerotropolis is of strategic importance. Ensuring housing supply proximate one of Greater Sydney's largest planned employment precincts is delivered in timely and orderly fashion will be critical to the success of the Aerotropolis.

#### 8.2 Housing Mix and Yield

Market investigations have identified strong demand for dwellings in the various estates across the SWGA. Affordability issues in Greater Sydney's housing market in conjunction with shifting lifestyle preferences is seeing a continuing trend towards owner occupier purchasers favouring smaller, denser product.

Detached housing typologies remain the preferred product of choice for most prospective purchasers across the SWGA, though the popularity and acceptance of medium-density and high-density typologies is growing. This is directly observable in neighbouring precincts such as Oran Park and Edmondson Park.

#### 8.2.1 Target Densities

'Target density' controls are generally used in neighbouring precincts within the SWGA. Immediately north of the Precinct 5 in the Lowes Creek Maryland (LCM) precinct, the following density targets are applied in residential and mixed use zones:

- Low Density Band 1 10/ha to 20dw/ha.
- Low Density Band 2 20dw/ha to 25dw/ha.
- Medium Density Band 1 25dw/ha to 35dw/ha.
- Medium Density Band 2 35dw/ha to 60dw/ha.
- Mixed Use 35dw/ha to 60dw/ha.

Indicative lot sizes envisaged by density provisions in the Growth Centres Development Code are classified below:

- Townhouses, semi-detached and detached small dwellings (up to 350sqm).
- Detached medium dwellings (350sqm-450sqm).
- Detached large dwellings (450sqm).

Development at higher densities than the target density controls is permitted however the maximum number of dwellings is controlled by stipulated minimum lot sizes in each precinct. Higher density development is not anticipated to occur unless access to transport, employment and/or other services are available.

#### 8.2.2 Market Densities

Market investigations suggests that the trend towards smaller lot sizes and denser housing product which has been observed over the past decade is continuing amidst an enduring housing affordability issue. In particular, the market appears to be willing to compromise on lot size if a detached product can be secured.

Given this ongoing structural shift in demand, **Table 8.1** and **Table 8.2** outline potential market densities for Precinct 5. Detached product is still expected to be the dominant typology, a function of general market expectations.



Table 8.1 outlines the potential mix of housing typologies and their respective sizes which could be considered at Cobbitty.

Dwelling Type	Mix	x (%)	Density	(Dw/ha)
	Low	High	Low	High
Detached housing - Large	3%	5%	10,	/ha
Detached housing – Standard	37%	50%	10/ha	20/ha
Detached housing – Small	32%	39%	20/ha	25/ha
Medium-Density (Attached)	14%	16%	25/ha	35/ha
High-Density (Apartments)	2%	5%	35/ha	60/ha

Source: Atlas

Based on these development typologies and mixes and following extensive consultation with Council, a revised final indicative layout plan (the ILP) has been prepared. The ILP proposes five residential density bands to provide certainty on the quantum of dwellings which can be delivered throughout the precinct, though also enable flexibility in the distribution of different dwelling typologies. The density bands and their potential dwelling yields are summarised in **Table 8.2**.

Table 8.2: Residential Densities to Build-Out, Indicative Layout Plan

Dwelling Type	Density	(Dw/ha)	Yield	% of Yield
	Min	Max	_	
Environmental Living	10	10	8	0.3%
Low-Density Band 1	10	20	834	32.1%
Low-Density Band 2	20	25	1,177	45.3%
Medium-Density Band 1	25	35	477	18.4%
Village Centre (2-3 storey apartments)	35	60	100	3.9%
Total			2,596	100%

Source: BHL Group

#### 8.2.3 **Population Estimates**

On an overall basis, household occupancy rates in South West Region ranged from 3.0 to 3.3 persons per dwelling as at 2016. In the South West Catchment Area, a household occupancy rate of 3.2 persons per dwelling was assessed.

DPE projections for the South West Region suggest a declining household occupancy size over the coming decades to 2041 will be observed, aligning with a growing population of older, single residents. This is considered appropriate for the broader South West Region; however it is not expected to be reflective of greenfield areas such as Precinct 5 which are expected to continue to attract younger families with children.

Based on previous experience and industry standards, the following household occupancy rates are considered appropriate:

- 'Environmental Living 3.6 persons
- Low Density Band 1 3.4 persons
- Low Density Band 1 3.2 persons
- Medium Density Band 1 2.8 persons
- Village centre (units) 2.2 persons

 Table 8.3 applies the adopted household occupancy rates to the proposed dwelling yields to estimate resident population.



#### Table 8.3: Dwellings and Population, Precinct 5

Dwelling Type	Dwellings	Household Occupancy	Population
Environmental Living	8	3.6	29
Low-Density Band 1	834	3.4	2,836
Low-Density Band 2	1,177	3.2	3,766
Medium-Density Band 1	477	2.8	1,336
Village Centre (units)	100	2.2	220
Total	2,596	3.1	8,187

Source: Atlas

Application of the adopted household occupancy rates results in a resident population of 8,187 residents, equating to an average of 3.1 persons per dwelling. This is broadly consistent with the occupancy rates of 3.2 persons per dwelling observed across the South West Catchment Area (in 2016).

#### 8.3 Final Indicative Layout Plan

The revised final ILP for Precinct 5 (BHL'S Lands) envisages a mix of residential typologies, a local centre to support the local resident population, a riparian corridor and network of green spaces and a

The final draft ILP envisages the following yields and land uses:

- 75.7ha of residential land totalling 2,596 dwellings, including:
  - Environmental Living 1.2ha (comprising 8 dwellings).
  - Low Density Band 1 30.9ha (comprising 834 dwellings).
  - Low Density Band 1 33.6ha (comprising 1,177 dwellings).
  - Medium Density Band 1 10.0ha (comprising 477 dwellings)
- A 1.8ha local centre (including 100 dwellings), 1.8ha of land for service station uses and 1.9ha of land dedicated for education uses.
- Around 46.1ha of open space and riparian land.



#### Figure 8.1: Revised Final Indicative Layout Plan (December 2022), -Precinct 5 (BHL Lands)



Source: Urbis

The economic impacts which could result from the development of the land uses proposed in the ILP are considered next



# PART C: ECONOMIC IMPACTS



### 9. Economic Impact Assessment

Research and economic modelling carried out in Part C of this Study was undertaken in Q4 2022.

#### 9.1 Overview

This Chapter examines the economic activity and impacts that could be facilitated through progressing development of Precinct 5 during construction and ongoing upon completion.

The economic impacts are assessed at the Camden LGA level. An Input-Output model (including the development of specific regional Input-Output transaction tables) was developed to reflect the economic structure of the Camden LGA (see Schedule 2 for further detail).

Input-Output modelling describes economic activity through the examination of four types of impacts described in **Table 9.1**.

Indicator	Description
Output	The gross value of goods and services transacted, including the cost of goods and services used in the development and provision of the final product. Care should be taken when using output as an indicator of economic activity as it counts all goods and services used in one stage of production as an input to later stages of production, thus overstating economic activity.
Gross Product	The value of output after deducting the cost of goods and services inputs in the production process. Gross product (e.g. Gross Regional Product (GRP)) defines a net contribution to economic activity.
Incomes	The wages and salaries paid to employees as a result of the Project either directly or indirectly.
Employment	Employment positions generated by the Project (either full time or part time, directly or indirectly). Employment is reported in terms of Full-time Equivalent (FTE) positions or person-years.

#### Table 9.1: Economic Indicators

Source: Atlas

Input-Output modelling estimates show the impacts of direct spending in a particular industry as well as from Productioninduced impacts (Type I) or Consumption-induced impacts (Type II).

- **Production-induced impacts (Type I)** show the effects of industrial support from additional activities undertaken by supply chain industries increasing their production in response to direct spending.
- **Consumption-induced impacts (Type II)** estimate the re-circulation of labour income earned as a result of the initial spending through other industry impacts (or impacts from increased household consumption).

The estimates of economic impacts consider production and consumption-induced flow-on impacts. Type II impacts are commonly considered to overstate economic activity and therefore the types of flow-on impacts are reported separately.

#### 9.2 Modelling Approach

This Chapter seeks to understand the economic impacts of developing Precinct 5 prior to its anticipated development post-2030. Accordingly, economic modelling is based on a 10-year period (i.e. 2021-2031). It is not expected that Precinct 5 will be fully developed, or 'built out', within this period.

#### 9.2.1 Expected Take-Up over Modelling Period

A high-level forecast of expected take-up of residential and non-residential uses (as envisaged in the ILP's Preferred Scenario) within the 10-year modelling period has been carried out for the purposes of economic modelling.

This forecast has been based on historic take-up rates observed elsewhere in the SWGA, current market conditions and future economic outlook.

This high-level forecast suggests that by 2031 the following land uses will have been delivered:



- The entirety of the residential dwellings (2,596 dwellings)
- Almost 14,500sqm of gross floor area within the future neighbourhood/village centre;
- The entirety of the land dedicated for service station uses.
- A future educational establishment (anticipated to be a primary school).

Table 9.2 summarises the estimated take-up of different land uses within Precinct 5 over the 2021-2031 period.

#### Table 9.2: Estimated Take-up (2021-2031), Cobbitty Precinct

Land Use	Yield (GFA*/dwellings)	% Delivered	
Residential:	2,596	100%	
Local Centre	14,400sqm	80%	
Service Station Uses	5,400sqm	100%	
Education	15,200sqm	100%	

\*Gross floor area has been estimated for the purposes of economic modelling. Source: Atlas

#### 9.2.2 Base and Proposal Case

The economic impacts of developing Precinct 5 within the 10-year modelling period (i.e. the Proposal Case) is compared against the expected use of the Precinct up until 2031 without the Proposal (i.e. the Base Case):

- **Proposal Case:** Development of the draft ILP with the following yields delivered by 2031:
  - ° 2,596 new dwellings accommodating 8,352 residents.
  - A neighbourhood/village centre comprising 14,400sqm of GFA.
  - <sup>o</sup> Service station uses comprising 5,400sqm GFA.
  - A future educational establishment (anticipated to be a primary school).
- Base Case: Precinct 5 remains as undeveloped rural residential landholdings until the year 2031.

The economic impacts of the Proposal Case reflect the impacts which would be realised within the decade 2031 and if Precinct 5 was developed earlier than currently envisaged.

#### 9.2.3 Drivers of Economic Activity

To understand the economic impacts likely to result from the Proposal compared to the Base Case, it is necessary to distinguish economic impacts during the construction phase and those economic impacts that will be more permanent in nature following construction completion and operations commencement and stabilisation.

- **Construction Phase:** Construction activity will draw resources from and thereby generate economic activity in the Camden LGA as well as from outside the LGA. Assumptions are made on the proportion sourced from within and from outside the LGA. Construction activity is assessed for the Proposal Case only.
- **Operations Phase:** The Proposal is expected to generate ongoing economic/ operational activity through:
  - <sup>o</sup> Direct turnover generated by the 14,400sqm town centre.
  - Additional household expenditure within the Camden LGA generated through delivery of new housing.

Refer to Schedule 2 for a description of the drivers and assumptions that underpin the assessed economic impacts.



#### 9.3 Economic Activity and Impacts

Economic impacts arising in the Construction phase are estimated separately to the Operational phase. Construction impacts are expected to be short-term in nature and will conclude when development activity is completed.

#### 9.3.1 Construction Phase

The Proposal Case is projected to generate significant economic impacts for Camden LGA through construction activity. Cumulative total impacts to 2031 are estimated at:

- **\$2.4 billion** in output (\$1.5 billion directly).
- \$878.4 million contribution to GRP (\$455.9 million direct contribution).
- \$503.0 million in wages and salaries paid to local workers (\$293.3 million directly).
- **5,476** FTE jobs (2,784 direct FTE).

Table 9.3 summarises the estimated economic impacts during the construction phase in the Proposal Case.

#### Table 9.3: Construction Impacts in Camden LGA (Proposal Case)

Indicator	Output (\$M)	GRP (\$M)	Incomes (\$M)	Employment (FTE)
Direct	\$1,501.5	\$455.9	\$293.3	2,784
Production Induced	\$537.1	\$228.9	\$134.5	1,587
Consumption Induced	\$325.1	\$193.6	\$75.2	1,104
Total Impact	\$2,363.8	\$878.4	\$503.0	5,476

Note: Totals may not sum due to rounding. Source: Atlas

#### 9.3.2 Operational Phase

Following the completion of construction, the Proposal Case is estimated to support the following annual economic activity through direct and indirect (flow-on) impacts associated with operations on the Site<sup>1</sup> by 2031:

- **\$286.5 million** in output (including \$172.5 million in direct activity).
- \$140.4 million contribution to GRP (including \$81.9 million in direct activity).
- \$76.5 million in incomes and salaries paid to households (including \$49.4 million in direct income).
- 947 FTE jobs (including 592 FTE directly related to activity on the Site).

Table 9.4 summarises the estimated economic impacts during the operational phase in the Proposal Case.

#### Table 9.4: Operational Impacts in Camden LGA, Proposal Case (2031)

Indicator	Output (\$M)	GRP (\$M)	Incomes (\$M)	Employment (FTE)
Direct	\$172.5	\$81.9	\$49.4	592
Production Induced	\$62.7	\$28.0	\$15.2	181
Consumption Induced	\$51.4	\$30.6	\$11.9	175
Total Impact	\$286.5	\$140.4	\$76.5	947

Note: Totals may not sum due to rounding. Source: Atlas



<sup>&</sup>lt;sup>1</sup> Including impacts from dispersed employment (i.e. residents working from home).

#### 9.3.3 Household Expenditure

Compared to the Base Case, additional local retail expenditure associated with the Proposal's 2,596 new dwellings (by 2031) are estimated to support the following economic activity through direct and flow-on impacts (per annum):

- **\$230.4 million** in output (including \$151.0 million in direct activity).
- **\$131.7 million** in contribution to GRP (including \$88.4 million in direct activity).
- \$68.0 million in incomes and salaries paid to households (including \$48.7 million in direct activity).
- 1,079 FTE jobs (including 818 FTE jobs directly).

**Table 9.5** summarises the economic impacts associated with household retail spend in the Proposal Case. It should be noted that not all households residing in the development would be net new to the Camden LGA, and that a degree of double counting exists between the expenditure of residents and the operational impacts of the development (e.g. retail). Therefore, the household expenditure impacts should not be summed with the operational impact estimates considered earlier.

Indicator	Output (\$M)	GRP (\$M)	Incomes (\$M)	Employment (FTE)
Direct	\$151.0	\$88.4	\$48.7	818
Production Induced	\$33.7	\$16.1	\$8.7	106
Consumption Induced	\$45.7	\$27.2	\$10.6	155
Total Impact	\$230.4	\$131.7	\$68.0	1,079

Table 9.5: Household Retail Impacts in Camden LGA, Proposal Case (2031)

Note: Totals may not sum due to rounding. Source: Atlas

#### 9.4 Other Economic Benefits

In addition to the significant economic activity supported by the Proposal Case, development of Precinct 5 within the next decade (as opposed to post-2031) would produce several other important economic and social impacts and benefits compared to the Base Case. These include:

- **Supporting Housing Affordability:** The Proposal will provide some 2,596 new dwellings over the next 10 years at a range of price points. This increase in housing supply will support housing affordability for residents seeking accommodation in the South West Region, including the availability of rental accommodation.
- **Providing Significant Local Infrastructure:** The Proposal includes an allowance for ~40ha of public open space (sporting fields, local parks) in addition to civil/road and educational infrastructure to support the growth of the local community. This is intended to be provided at no-cost to government in line with the principles of the Precinct Acceleration Protocol (PAP) process.
- Increase in Rates and Taxation Revenues: Along with greatly increased economic activity, the Proposal will support significant taxation revenues to all levels of government including Council rates, payroll tax, stamp duty, and income tax.
- **Create a Buffer of Housing Supply:** As Precinct 5 is held in majority ownership, the issues of land fragmentation observed elsewhere across the SWGA are mitigated. In other rezoned precincts observed across the SWGA where land ownership is heavily fragmented, the timely supply of housing is not a given.

The Proposal has the capacity to provide a buffer of housing supply which mitigates the timing risk observed elsewhere across the SWGA.



#### 9.5 Summary of Findings

The development of Precinct 5 prior to its anticipated development post-2030 is shown to deliver positive economic impacts to the Camden LGA and the broader South West Region. Given it is held in majority ownership, its development could quickly become 'shovel-ready' and support the shortfall in housing supply expected over the medium to long-term whilst also alleviating pressure on housing affordability.

Compared with the Base Case, by bringing forward development of the Proposal, it is estimated to result in a net increase in economic activity during the construction phase through a mix of direct and indirect (flow-on) activity, including:

- **\$2.4 billion** in output (\$1.5 billion directly).
- \$878.4 million contribution to GRP (\$455.9 million direct contribution).
- \$503.0 million in wages and salaries paid to local workers (\$293.3 million directly).
- 5,476 FTE jobs (2,784 direct FTE).

When operational, the Proposal is estimated to result in an annual net increase in economic activity by 2031 with:

- **\$286.5 million** in output (including \$172.5 million in direct activity).
- **\$140.4 million** contribution to GRP (including \$81.9 million in direct activity).
- \$76.5 million in incomes and salaries paid to households (including \$49.4 million in direct income).
- 947 FTE jobs (including 592 FTE directly related to activity on the Site).

Additional local retail expenditure associated with the Proposal's 2,818 new residential dwellings which could be delivered by 2031 are estimated to support economic activity through direct and flow-on impacts (per annum), including:

- \$230.4 million in output (including \$151.0 million in direct activity).
- \$131.7 million in contribution to GRP (including \$88.4 million in direct activity).
- \$68.0 million in incomes and salaries paid to households (including \$48.7 million in direct activity).
- 1,079 FTE jobs (including 818 FTE jobs directly).

The economic impacts estimated in this chapter demonstrates the Proposal has economic merit, having the ability to contribute significantly to the Camden economy.

Development of Precinct 5 is also considered to have merit from a market perspective and its delivery will be critical for the South West Region to meet its dwelling need over the coming decade. Importantly, the Proposal intends on delivering a broad range of local infrastructure at no cost to government.



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# Schedules

#### SCHEDULE 1

## Planned Supply in South West Region

#### Table S1.1: Planned Supply, South West Region

Name	Original Planning Capacity	Current Planning Capacity
Camden LGA		
Camden Lakeside	1,200	1,200
El Caballo and Gledswood	860	860
Campbelltown LGA		
Glenfield	4,000	4,000
Macquarie Fields	340	340
Ingleburn	3,240	3,240
Minto	350	350
Leumeah	900	900
Campbelltown	3,600	3,600
Macarthur	4,700	4,700
Menangle Park	4,000	4,000
Gilead	15,100	15,100
Liverpool LGA		
Liverpool CBD	18,800	18,800
Middleton Grange	671	671
South West Growth Area		
Austral/Leppington North	17,350	15,725
Rossmore	2,500	2,500
Leppington Town Centre	9,000	9,000
Edmondson Park	6,000	2,000
Lowes Creek Maryland	6,983	6,983
Catherine Fields North	9,500	9,500
East Leppington	4,450	519
Catherine Fields	5,000	5,000
South Creek West	30,000	30,000
Pondicherry	2,500	2,500
Oran Park	7,540	1,440
Catherine Fields (Part)	3,229	2,131
Turner Road	4,020	-
Western Sydney Aerotropolis*		
North Luddenham	-	-
Kemps Creek	-	-
Badgerys Creek	-	-
South Creek	300	300
Aerotropolis Core	8,000	8,000
Dwyer Road	-	-
Rossmore	48,300	48,300

 $^{*}\mbox{Only}$  includes precincts within South West LGAs

Source: Various - see references



### **Economic Impact Modelling Assumptions**

Input-Output models are a method to describe and analyse forward and backward economic linkages between industries based on a matrix of monetary transactions. The model estimates how products sold (outputs) from one industry are purchased (inputs) in the production process by other industries.

The analysis of these industry linkages enables estimation of the overall economic impact within a catchment area due to a change in demand levels within a specific sector or sectors.

Impacts are traced through the economy via:

- Direct impacts, which are the first round of effects from direct operational expenditure on goods and services.
- Flow-on impacts, which comprise the second and subsequent round effects of increased purchases by suppliers in response to increased sales. Flow-on impacts can be disaggregated to:
  - Industry Support Effects (Type I) derived from open Input-Output models. Type I impacts represent the production induced support activity as a result of additional expenditure by the industry experiencing the stimulus on goods and services, and subsequent round effects of increased purchases by suppliers in response to increased sales.
  - Household Consumption Effects (Type II) derived from closed Input-Output Models. Type II impacts represent the consumption induced activity from additional household expenditure on goods and services resulting from additional wages and salaries being paid within the catchment economy.

The economic analysis considers the following four types of impacts.

#### Table S2.1: Economic Activity Indicators

Indicator	Description
Output	The gross value of goods and services transacted, including the cost of goods and services used in the development and provision of the final product. Care should be taken when using output as an indicator of economic activity as it counts all goods and services used in one stage of production as an input to later stages of production, thus overstating economic activity.
Gross Product	The value of output after deducting the cost of goods and services inputs in the production process. Gross product (e.g. Gross Regional Product (GRP)) defines a net contribution to economic activity.
Incomes	The wages and salaries paid to employees as a result of the Project either directly or indirectly.
Employment	Employment positions generated by the Project (either full time or part time, directly or indirectly). Employment is reported in terms of Full-time Equivalent (FTE) positions or person-years.
Courses Atlan	

Source: Atlas

#### **REGIONAL MODEL DEVELOPMENT**

Multipliers used in this assessment have been created using a regionalised Input-Output model derived from the 2018-19 Australian transaction table (ABS, 2021).

Estimates of gross industry production in the catchment area were developed based on the share of employment (by place of work) of the Catchment Area within the Australian economy (ABS, 2017a) using the Flegg Location Quotient and Cross Hauling Adjusted Regionalisation Method (CHARM). See Norbert (2015) and Kronenberg (2009) for further details.



#### MODELLING LIMITATIONS AND ASSUMPTIONS

Input-Output modelling is subject to a number of key assumptions and limitations (ABS, 2021):

- Lack of supply-side constraints: The most significant limitation of economic impact analysis using multipliers is the implicit assumption that the economy has no supply-side constraints. That is, it is assumed that extra output can be produced in one area without taking resources away from other activities, thus overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.
- **Fixed prices:** Constraints on the availability of inputs, such as skilled labour, require prices to act as a rationing device. In assessments using multipliers, where factors of production are assumed to be limitless, this rationing response is assumed not to occur. Prices are assumed to be unaffected by policy and any crowding out effects are not captured.
- Fixed ratios for intermediate inputs and production: Economic impact analysis using multipliers implicitly assumes that there is a fixed input structure in each industry and fixed ratios for production. As such, impact analysis using multipliers can be seen to describe average effects, not marginal effects. For example, increased demand for a product is assumed to imply an equal increase in production for that product. In reality, however, it may be more efficient to increase imports or divert some exports to local consumption rather than increasing local production by the full amount.
- No allowance for purchasers' marginal responses to change: Economic impact analysis using multipliers assumes that households consume goods and services in exact proportions to their initial budget shares. For example, the household budget share of some goods might increase as household income increases. This equally applies to industrial consumption of intermediate inputs and factors of production.
- Absence of budget constraints: Assessments of economic impacts using multipliers that consider consumption induced effects (type two multipliers) implicitly assume that household and government consumption is not subject to budget constraints.

Despite these notable limitations, Input-Output techniques provide a solid approach for assessing the direct and flow on economic impacts of a project or policy that does not result in a significant change in the overall economic structure.

#### DRIVERS OF ECONOMIC IMPACT

In order to understand the economic impacts likely to result from the Proposal, it is necessary to distinguish economic impacts during the construction phase and those economic impacts that will be more permanent in nature following construction completion and operations commencement.

- **Construction Phase:** Construction activity will draw resources from and thereby generate economic activity in the Camden LGA as well as from outside the LGA. Assumptions are made on the proportion sourced from within and from outside the LGA.
- **Operational Phase:** On completion of development, the Precinct is expected to generate ongoing economic/ operational activity through:
  - ° Direct turnover generated by the 14,400sqm town centre.
  - ° Additional household expenditure within the Camden LGA generated through delivery of new housing.

#### **Construction Phase**

For modelling purposes, construction costs (including contingency) for the Proposal Case were broken down into their respective Australia and New Zealand Standard Industrial Classification (ANZSIC) industries.

The breakdowns were developed based on the following assumptions by Atlas regarding the most appropriate ANZSIC industries for each activity.



#### Table S2.2: Construction Cost Allocation (including Contingency)

Item	\$M	ANZSIC
Residential	\$1,003.6	Residential Building Construction
Town Centre	\$33.1	Non-Residential Building Construction
Service Station Uses	\$12.4	Non-Residential Building Construction
Open Space	\$481.6	Heavy and Civil Engineering Construction
Roads	\$221.9	Heavy and Civil Engineering Construction
Education	\$34.9	Non-Residential Building Construction
Site Costs	\$35.8	Construction Services
Professional Fees	\$178.8	Professional, Scientific and Technical Services
Total Estimated Development Cost	\$2,002.1	-

Note: Totals may not sum due to rounding.

Source: Atlas

Of the above capital outlay, not all activity will be undertaken within the Camden LGA economy. It was assumed:

- Approximately 75% of the direct expenditure on construction-related (i.e. Non-Residential Building Construction and Construction Services) activity would be sourced from local businesses and labour. Of this:
  - Approximately 25% of purchases on goods and services (supply chain related activity) made by constructionrelated businesses sourced from outside the Camden LGA would be spent within the local economy (i.e., 25% of the Type I flow on activity associated with non-local construction companies is assumed to represent additional local activity in Camden LGA).
  - Approximately 5% of wages and salaries paid to construction-related workers sourced from outside the region would be spent on local goods and services, such as food and beverages (i.e. 5% of the Type II).

Only flow-on activity of locally sourced professional, scientific and technical services activity (50%) is included, as it is not anticipated professional, scientific and technical services businesses located outside of Camden LGA would purchase goods/ services locally.

#### **Operational Phase**

In order to model the economic impacts, operational employment levels for the economic activity occurring in the two scenarios were categorised into the ANZSIC industries which Atlas considered most appropriate.

Employment by industry estimates were converted to a direct output value using a multiplier based on the national transaction table (ABS, 2021). The resultant estimates of output were modelled as the direct activity associated with the Proposal Case.

Work Type	Estimated GFA (sqm)	GFA (sqm) / FTE	Estimated Jobs (FTE)	ANZSIC
Service Station Uses	5,400	150	34	Split across industrial sectors.
Town Centre	14,400	75	192	<ul> <li>Split across population serving sectors:</li> <li>Retail Trade</li> <li>Accommodation and Food Services</li> <li>Arts and Recreation Services</li> <li>Other Services</li> </ul>
Education	15,200	300	51	Primary and Secondary Education Services (including Pre-Schools and Special Schools)
Residential (dispersed employment) <sup>1</sup>	2,596 dwellings	-	313	Split as per the current Camden resident employment profile (ABS 2017a)
Total	93,850	-	592	-

#### Table S2.3: Operational FTE Allocation of Floorspace

Notes: Totals may not sum due to rounding. <sup>1</sup>Calculated as 2,794 dwellings less 2% vacancy rate times an average 1.5 FTE workers per dwelling times 7,5% working from home. This is potentially a conservative estimate given the rise of working from home arrangements post COVID-19.



#### Household Expenditure Supported

This section outlines the household expenditure that would be associated with the new dwellings proposed as part of the Proposal Case, and potential economic activity supported.

The household expenditure activity supported should not be combined with the impacts in the section above, as some of these impacts are likely to have already been captured in the assessment (e.g. some expenditure on retail and food and beverages by households is likely to spent at the retail and food and beverage outlets locating onsite).

This section is to understand specific economic activity supported in Camden LGA through household expenditure as its own separate analysis.

The ABS Household Expenditure Survey (ABS, 2017b) was used to identify the proportion of weekly household incomes that is spent across expenditure items in the Camden LGA. The fourth quintile of NSW residents was used to best represent the expenditure patterns of residents in the Camden LGA.

The household survey only contains household expenditure data, and individual residents must be converted to an equivalent number of households. This was achieved by applying the estimated number of dwellings (2,596 by 2031) and a vacancy rate of 2% (representative of the current rental market) resulting in 2,544 equivalent households residing within the development.

This data was converted to 2021 values (ABS, 2021), annualised and allocated into their respective ANZSIC industries. The breakdown to ANZSIC industries was developed based on assumptions by Atlas regarding the most appropriate ANZSIC industries for each activity.

**Table S2.4** shows the household expenditure estimates for the Camden LGA should Precinct 5 be redeveloped to accommodate 2,544 households (within the 2021-2031 forecast period).

ANZSIC	Total Annual Spend (\$M)	% Spent in LGA	Local Spend (\$M)
Ownership of Dwellings	\$47.0	50%	\$23.5
Retail Trade	\$47.4	75%	\$35.6
Food and Beverage Services	\$24.2	75%	\$18.2
Personal Services	\$12.5	75%	\$9.4
Other Services	\$17.4	75%	\$13.0
Telecommunication Services	\$7.9	25%	\$2.0
Road Transport	\$17.6	50%	\$8.8
Rail Transport	\$10.6	50%	\$5.3
Air and Space Transport	\$7.1	0%	\$0.0
Sports and Recreation	\$20.5	75%	\$15.4
Primary and Secondary Education Services	\$2.5	75%	\$1.9
Technical, Vocational and Tertiary Education Services	\$2.0	60%	\$1.2
Arts, Sports, Adult and Other Education Services	\$0.5	60%	\$0.3
Health Care Services	\$12.4	75%	\$9.3
Heritage Creative and Performing Arts	\$8.8	75%	\$6.6
Electricity Transmission, Distribution, On Selling and Electricity Market Operation	\$2.8	25%	\$0.7
Total	\$241.1	63%	\$151.0

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Table 52.4. Estimated Household	Experiance 5	apported, i it	posul cuse

Note: Totals may not sum due to rounding. Source: ABS (2017b), Atlas



SCHEDULE 3

Cobbitty Precinct 5 – Justification for Proposed Residential Densities (Atlas Economics, August 2022)





5 August 2022

Smita Sundarjee BHL Group

Sent via email: <a href="mailto:smita.sundarjee@bhlgroup.com.au">smita.sundarjee@bhlgroup.com.au</a>

Dear Smita

### **Re: Cobbitty Precinct 5 - Jusitification for Proposed Residential Densities**

This Addendum is intended to accompany the *Cobbitty Housing Needs and Economic Impact Assessment* prepared by Atlas Economics (June 2022) on behalf of BHL Group (BHL). The Addendum seeks to provide further justification for the proposed housing mix adopted in the Cobbitty Precinct 5 Indicative Layout Plan (ILP).

#### **Proposed Density Mix**

The proposed Cobbitty Precinct 5 ILP envisages a 12,500sqm neighbourhood centre, a new school and approximately 3,800 new dwellings with a focus on detached housing typologies.

The ILP provides for a mix of residential densities across the precinct, including larger environmental living lots, low-density lots, medium-density typologies and apartments (within the neighbourhood centre). The majority of dwellings fall are proposed to be zoned as R2 Low Density Residential, with densities ranging from 20-25 dwellings per hectare, equivalent to lot sizes of 270sqm to 340sqm.

The adopted density mix was premised on findings from the *Cobbitty Housing Needs and Economic Impact Assessment* (Atlas Economics, 2021). Market investigations found that the persistent trend towards smaller lot sizes and denser housing product observed over the past decade is continuing amidst an enduring housing affordability issue. Buyers have been demonstrating a distinct preference for smaller lots to enable construction of detached product at more affordable price points, with many purchasers also preferring to lower maintenance requirements of smaller lots. Market investigations also found demand for denser housing (townhouses, apartments) is also maturing across the South West (SWGA) Growth Area.

**Table 1** summarises the dwelling and density mix adopted in the Cobbitty Precinct 5 ILP against the dwelling densities and yield mixes recommended in the Cobbitty Housing Needs and Economic Impact Assessment.

Typology	Cobbitty ILP			Housing Needs and Economic Impact Assessment	
	Dwelling Density (dw/h	a) Avg. Lot Size	% of Yield	Dwelling Density (dw/ha)	% of Yield
Environmental Living	10	675	4%	10	3% <b>-</b> 5%
Low Density 1	20	338	47%	10-20	37% <b>-</b> 50%
Low Density 2	25	270	32%	20-25	32%-39%
Medium Density	35	193	14%	25-35	14%-16%
Local Centre	-	-	3%	35-60	2% <b>-</b> 5%

#### Table 1: Proposed Density Mix, Cobbitty Precinct 5 ILP

Source: BHL

As shown in **Table 1**, the dwelling densities and yield mix adopted in the Cobbitty Precinct ILP fall within the recommended range outlined in the *Housing Needs and Economic Impact Assessment*.

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#### **Issue of Housing Affordability**

Research and analysis carried out in the *Cobbitty Housing Needs and Economic Impact Assessment* was largely completed over the course of Q2 and Q3 2021. Much of the demographic analysis carried out in the Assessment was based on Census 2016, which was the most recent source of socio-economic data at the time.

Since completion of the *Assessment*, the first tranche of demographic data from Census 2021 has been released. A review of the Census 2021 demographic data suggests housing affordability has significantly deteriorated in the 5-years to 2021, with the proportion of households paying more than 30% of their household income on housing costs increasing markedly.

For instance, the proportion of homeowners paying more than 30% of their household incomes on mortgage repayments in the Camden LGA has risen from 12% in 2016 to over 18% in 2021. A much sharper increase in the rental market is observed, with the number of households spending 30% or more of weekly household incomes on rental repayments rising from 7.5% in 2016 to over 32% in 2021.

A similar trend has been observed across the broader South West Region (i.e. Campbelltown LGA, Liverpool LGA), where the proportion of households spending more than 30% of income on housing costs increasing to over 40% in some instances. This has implications for housing estates across the South West Growth Area given much of the buyer pool is from price-conscious couples and young families from these areas.

**Table 2** summarises the increase in households across the South West Region spending more than 30% of household incomeon housing costs over the 2016-2021 period.

Area	% of Households Spen Household Income on N	ding 30% or More of Aortgage Repayments	% of Households Spending 30% or More of Household Income on Rental Repayments	
	2016	2021	2016	2021
Camden LGA	12.1%	18.3%	7.5%	32.4%
Campbelltown LGA	10.4%	21.2%	12.8%	34.3%
Liverpool LGA	12.2%	23.0%	14.5%	41.2%
Greater Sydney	8.4%	19.8%	14.2%	35.3%

#### Table 2: Income Spent on Housing Costs (2016-2021), South West Region

Source: ABS Quick Stats

#### **Recent Market Movements**

Since completion of the research carried out in the *Assessment* in Q3 2021, dwelling prices across the South West Region have continued to rapidly escalate. In the 12-months to March 2022, median house prices in the Camden LGA grew by 31% alone, reaching just over \$1 million. The Liverpool LGA recorded a similar rate of growth (30%), whilst Campbelltown recorded median house price growth of 19%. This rate of growth has outpaced the broader Greater Sydney housing market.

Figure 1 illustrates recent changes in median house prices across the South West Region over the 2020-2022 period.







Looking forward, the outlook for Greater Sydney's housing market remains largely tied to further interest rate escalations. Higher borrowing costs and falls in consumer confidence will expectedly drag on the market, with all major banks anticipating falls in dwelling values across Greater Sydney over 2023. Whilst on 'the face of it' this could be considered positive from the perspective of improving overall housing affordability, it is important to recognise:

- The 'expensive' end of Sydney's housing market is more price responsive in market cycles recording the highest levels of growth during rising market periods and the largest falls during periods of market correction. The lower end of the market tends to fluctuate at lesser degree of variance.
- The driver behind falling property values higher interest rates increases the overall cost of borrowing. Whilst overall loan values may be lower, servicing costs can be similar (or higher) during periods of rising interest rates.
- Wages are yet to materially increase in line with rising inflation and interest rates, with real wages continuing to fall in Q2 2022.
- Greater Sydney is the second most unaffordable capital city in the developed world<sup>1</sup>. The current ratio of median house values to incomes is 13.3, with the average number of years to save a 20% house or apartment deposit being 18 years and 11 years respectively<sup>2</sup>. Significant and sustained falls in dwelling values would be needed to reverse this.

#### Lot Price Growth

Strong growth in residential land (lot) prices has also been observed in the past 12-18 months. The median land price in the Camden LGA was recorded at a record high of \$675,000 following growth of 65% since Q1 2020 (Pricefinder, 2022). This rate of growth was higher than that observed in both the Campbelltown and Liverpool LGAs which also recorded marked growth of 40% and 60% respectively.

Much of this growth is attributable to the boom in greenfield housing markets observed across much of NSW from Q1 2020, with record low interest rates and government stimulus measures (e.g. HomeBuilder, first home buyer grants, etc) aimed at mitigating the economic impact of the COVID-19 outbreak driving a major uptick in demand for residential land.

Figure 2 illustrates the growth in vacant land prices across the South West Region over the five years to Q1 2022.



Figure 2: Bi-Annual Median Land Price Growth (2020-2022), South West Region

Source: PriceFinder (2022)



<sup>&</sup>lt;sup>1</sup> International Housing Affordability Survey, Demographia (2022)

<sup>&</sup>lt;sup>2</sup> Housing Affordability Report May 2022, ANZ/CoreLogic (2022)
### **Development Response**

In response to escalating land prices and steep demand for greenfield housing, the development sector is increasingly providing for smaller lot sizes in new land releases. The median lot size in new land releases across Greater Sydney in 2021 was recorded at 362sqm – the smallest in Australia. Conversely, Sydney has the highest residential property values. There is a clear inverse relationship between overall housing cost and lot size provision.

The decline in median lot sizes over the past decade has not been limited to Greater Sydney, with lot sizes declining by 10% to 15% in Melbourne and South East Queensland over the 2016-2021 period respectively. Similarly, these trends are in direct response to sharp increases in overall housing values across Australia's east coast over this period.

Figure 3 illustrates the continual decline in median lot sizes across Australia's major capital cities over the 2011-2021 period.



Figure 3: Median Lot Sizes (2011-2021), Australian Capital Cities

Source: UDIA (2022)

Development is a customer-led market; housing supply directly responding to market need. The increasing delivery of small lot housing is in response to affordability constraints and preferences for low maintenance living.

This shift in market preference is directly reflected in take-up rates, the take-up of larger lots distinctly slower compared to the take-up of smaller lots across the South West and North West Growth Areas. Smaller detached lot product is the most quickly absorbed lot typology in new releases. Developers have accordingly responded in kind and progressively increased the proportion of smaller lots in new estates to meet demand.

### **Matters for Consideration**

The *Cobbitty Housing Needs and Economic Impact Assessment* recommended that Cobbitty Precinct 5 focus on the provision of smaller lots capable of accommodating detached housing typologies. This recommendation reflects market demand for smaller, more affordable lots across the SWGA where buyers are generally younger, price conscious couples and families.

It is understood that Camden Council have reviewed the ILP and raised a preference for larger lot sizes and have requested additional justification to support the proposed lot mix. We highlight the following factors:

• The SWGA greenfield housing market is primarily **driven by affordability**. Purchasers, particularly First Home Buyers, are more price conscious than buyers in other markets (e.g. North West Growth Area). The price difference between a 300sqm and 450sqm lot in the SWGA can be as much as \$200,000. This is beyond the borrowing capacity for many purchasers in the SWGA, particularly First Home Buyers.

Accordingly, increasing the number and proportion of larger lots at Cobbitty Precinct 5 (which invariably increases their price points) will lead to a greater number of prospective purchasers being 'priced out' of the market, particularly given deteriorating levels of housing affordability.



• Dwelling yields and mixes should directly **respond to market need.** Market investigations have indicated that across virtually all estates in the SWGA, smaller lot housing was the most popular lot size amongst purchasers. This preference was discussed in detail in the *Cobbitty Housing Needs and Economic Impact Assessment*. This shift in demand has been underway for almost a decade, as identified in earlier work carried out for the NSW Department of Planning and Environment (*Priority Growth Areas: SWGC Housing Market Needs Analysis*, AEC Group, 2015).

If market demand, reflected in both sale prices and take-up, for larger lot typologies was greater than that of smaller lots, new market entrants would move in to meet this gap. This has not occurred at scale, largely due to a market preference for smaller lot housing.

• Different housing typologies cater to different buyer cohorts. Larger lot subdivisions generally cater to wealthier, older families and/or retirees owing to their higher price points. For instance, recent releases at the large-lot estate 'Harrington Grove' in Harrington Park have achieved prices over \$1m for 700sqm lots. The buyer pool capable of affording these price points is limited, with purchasers generally being more affluent that typical purchasers in the South West Growth Area.

If market demand, reflected in both sale prices and take-up, for larger lot typologies was *greater* than that of smaller lots, new market entrants would move in to meet this gap. This has not occurred at scale due to:

- Lower levels of demand for larger lot product (i.e. 450sqm and larger);
- Constrained supply of developable land in the Growth Areas due to misalignment between land releases and infrastructure availability.
- **Developers are operating in a supply constrained market.** Not all rezoned precincts in Sydney's Growth Areas benefit from having immediate services infrastructure capacity or existing lot patterns that facilitate site amalgamation and development. This has resulted in a significant volume of zoned land remaining undeveloped (e.g. Austral). Accordingly, developers who have been able to secure large sites for development are seeking to deliver housing which can meet the majority of market demand.
- Larger lots reduce the ability for land to be used efficiency and meet housing supply targets. Given the historical challenges in converting theoretical housing supply to actual supply in the SWGA, maximising opportunities for efficient use of land is an important consideration. The *Cobbitty Housing Needs and Economic Impact Assessment* examines at length the significant housing supply shortfall likely to be observed across South West Sydney over the coming decades. Exacerbating this shortfall should be avoided where possible.

In summary, the findings and recommendations of the *Housing Needs and Economic Impact Assessment* remain relevant. Further deterioration in housing affordability across Greater Sydney over the past 12-months since completion of the *Assessment* provide further justification for the need to increase the supply of more affordable housing typologies.

As a significant site held in a majority ownership, Cobbitty Precinct 5 has the potential to play a role in meeting demand for housing in the South West Growth Area which has historically faced challenges converting zoned land into actual supply.

We trust the above is useful. Please contact the undersigned should you wish to discuss further.

Yours sincerely

Jacob Vince Senior Consultant T: 1300 149 151 E: jacob.vince@atlasurbaneconomics.com



# Appendices

APPENDIX 1

# Sydney Water Servicing Plans

# Figure A. 1: Greater Macarthur Region













Accurate as at 10 March 2021



Source: Sydney Water (2020)



South West Region

Accurate as at 10 March 2021



**Cobbitty Precinct** 

X Atlas







## Existing and Proposed Electricity Assets

Figure A. 3: Existing and Proposed Electricity Assets, Greater Macarthur Growth Area



Source: Endeavour Energy (2019)







New Zone Substation under construction

**Cobbitty Precinct** 





Figure A. 5: Existing and Proposed Electricity Assets, Western Sydney Aerotropolis

**Cobbitty Precinct** 

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### infrastructure & development consulting

### South Creek West Cobbitty Sub Precinct 5

Infrastructure Servicing Strategy

December 2022



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Project Number	19-047	Date	13 December 2022
Project Name	South Creek West – Cobbitty Sub Precinct 5	Status	Final
Client	BHL	Revision	E
Author	R. Higgisson	Reviewed	C. Avis



### **1** Introduction

This report summarises the investigations relating to the infrastructure delivery strategies for the development site at Cobbitty Sub Precinct 5 (Precinct 5). The site is located within the South Creek West Land Release Area and is yet to be rezoned for residential development.

The site will be developed into primarily low and medium density residential dwellings, with supporting social infrastructure such as parks, playing fields and a school. Existing site access is from The Northern Road on the eastern boundary.

This report outlines a potential strategy for the provision of utility services for the site. Specifically, this report will outline:

- Existing services within the vicinity of the site
- Current and planned projects
- Implications of the above and potential servicing strategies for the proposed development of the site

### Figure 1 - Site Boundary





### 2 The Site

### 2.1 Existing Site

The site is situated within the South Creek West Land Release Area (SCWLRA). The SCWLRA forms part of the South West Growth Area (SWGA). Given the scale of the release area, the Department of Planning and Environment (DPE) divided it into five distinct precincts numbered 1 - 5. The land to which this Planning Proposal relates to is referred to as Cobbitty Sub-Precinct 5, also known as Precinct 5. It totals approximately 170 hectares and is characterised by the existing rural residential and agricultural land uses and activities.

The Precinct was released by the Minister for Planning on 24 November 2017 for urban development. The release formally commenced the rezoning process for land within the precinct, including the subject site.

Precinct 5 is located within the south-west portion of the SCWLRA within the suburb of Cobbitty in the Camden LGA. The Precinct adjoins the Lowes Creek Maryland Precinct, which has recently been rezoned to the north, the Pondicherry precinct to the east which is in the process of being rezoned and the growing town centre and suburbs of Oran Park to the south.

Figure 2 illustrates the site boundaries of Precinct 5 and the SCWLRA.





Source: DPE (2021)



### 2.2 Proposal

BHL, as the major landholder in the precinct, seeks to initiate the preparation of a planning proposal for the rezoning of Precinct 5, consistent with the Draft Indicative Layout Plan (ILP). This is to facilitate the orderly redevelopment of Precinct 5 into a residential community.

The intended outcome of this Planning Proposal is to amend the current *State Environmental Planning Policy (Sydney Region Growth Centres) 2006* to facilitate the urban development of Precinct 5 as part of the South West Growth Centre and envisaged in the Greater Sydney Commission's Regional Plan and District Plan.

The Draft ILP has been prepared to support the planning proposal and precinct rezoning and has been informed by extensive specialist consultant studies. The site will comprise approximately 2,600 dwellings and a population of 8,000 people within a thriving community supported by:

- Easy access to jobs in the Western Sydney Aerotropolis
- Local shops, community uses and services, and proximity to the Oran Park Town Centre
- Over 23ha of open space, including 9ha of sporting fields and local parks
  - Open space typologies also include creeks, grasslands, playgrounds and other nature-based recreation areas
- Pedestrian and cycling connections including a central green corridor
- Prominent creeks and riparian areas that retain water in the local environment
- A future local school
- Integrated stormwater and services infrastructure that improve local amenity

The proposed new planning controls comprise amendments to *State Environmental Planning Policy (Sydney Region Growth Centres) 2006* and associated environmental planning instruments including the rezoning of the precinct to reflect land uses shown in the Draft ILP.

This Planning Proposal also seeks to introduce a site-specific Schedule to the *Camden Growth Centre Precincts Development Control Plan* to support the Precinct's development in accordance with the Draft ILP and supporting technical investigations.



### 2.3 Proposed Development

Precinct 5 will be rezoned to provide a mix of development typologies. A breakdown of the proposed development is provided in Table 1.

Table 1	-	Proposed	Yield
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Land Use	NDA (Ha)	Yield
Environmental Living (10 dw/ha)	0.82	8
Low Density 1 (20 dw/ha)	41.74	834
Low Density 2 (25 dw/ha)	47.11	1,177
Medium Density (35 dw/ha)	13.65	477
Mixed Use (Local Centre) (35-60 dw/ha)	N/A	100
Total	103.32	2,596

### Figure 3 – Cobbitty Sub Precinct 5 ILP





### 3 Water

### 3.1 Existing Network

The site is not currently serviced by the Sydney Water potable water network. Potable water infrastructure supplies existing rural properties within Rossmore and Leppington, and in newer development areas in Oran Park and Turner Road.

Two 24ML reservoirs will be constructed in the southern portion of the site to provide potable water supply to development in the surrounding area. Sydney Water are expected to deliver these reservoirs by 2024.

Sydney Water have recently constructed twin trunk mains which traverse the western side of The Northern Road. These trunk mains are 750mm and 600mm in diameter and will connect to the future Oran Park reservoirs, located at a high point within the Precinct, adjacent the southern site boundary as shown in Figure 4 below. This infrastructure has been planned for, and will have sufficient capacity to supply all proposed development on the site, as well as development to the north within the Lowes Creek Maryland Precinct.



### Figure 4 – Potable Water Network

Cobbitty Sub Precinct 5 Infrastructure Report



### 3.2 Sydney Water Growth Servicing Plan

Sydney Water's 2022 Growth Servicing Plan (GSP) outlines the servicing strategy to support planned growth in Greater Sydney up to 2027. The GSP indicates that infrastructure to support South Creek West is in the design and delivery phase, with limited existing trunk capacity available until Sydney Water delivered reservoirs are constructed by the 2024 financial year.

The GSP also identifies an area of high elevation along the southern portion of the site. The elevation contour (RL 116AHD) was plotted over the site to determine the development areas which may be impacted. This is shown in Figure 5.

As discussed above, the proposed reservoirs will be located in the south east part of the site, within the open space adjacent the site boundary. Based on the existing contours, the reservoirs are likely to be located at a minimum elevation of RL 136AHD, providing at least 20m elevation difference to the high elevation area shown below. It is likely that the delivery of these reservoirs will resolve any potential servicing constraint, however this will be confirmed with Sydney Water.



### Figure 5 – High Elevation Areas



### 3.3 Proposed Servicing Strategy

A high-level assessment was undertaken using the Water Supply Code of Australia (WSA) to determine the trunk infrastructure requirements to support the proposed development. This involved calculating the peak hourly demand to estimate the likely trunk main size required.

The maximum water demand rates were extracted from the WSA. These rates were used to determine the peak hour demand for each land use type. The results of this assessment are provided in Table 2.

Land Use	Max Demand Rate (kL/Day)	Unit	Peak Demand (L/s)
Low Density Residential (<30 dw/ha)	1.4	Per Dwelling	73.7
Medium Density Residential (30-60 dw/ha)	60	Per Net Ha	19.0
Apartments (within Local Centre)	0.8	Per Dwelling	1.9
School	90	Per 500 Students	2.1
Parks & Ovals	7	Per Ha	0.1
Total			96.7

### Table 2 - Proposed Water Demand Calculations

Based on the above assessment, a single 300mm diameter trunk main would be required to support the proposed development. This would be supplied in a series of between two and four connections to The Northern Road approximately 250-300mm in size.

As discussed in Section 3.1, it is expected the site will be supplied by the new Oran Park reservoirs. These reservoirs will be located adjacent the site boundary. Given the proximity of development to the proposed reservoirs, provision of potable water supply to the site is not expected to pose a constraint to development.

Sydney Water have provided a Feasibility Letter, which outlines servicing options for the site. The above strategy has been prepared based on the advice contained within this letter. A copy has been included in Appendix A of this report.









### 4 Sewer

### 4.1 Existing Network

The site and surrounding area are not currently serviced by the Sydney Water sewer network. Existing rural properties in the area utilise on-site septic tanks for sewage collection and disposal. Newer developments within the Oran Park, Harrington Park and Turner Road developments, located to the south east of Precinct 5, are serviced by the Sydney Water sewer network. Sewer from these developments is currently transferred to the West Camden Water Recycling Plant (WRP), located approximately 8km south west of the site.

The SWGA and Aerotropolis are set to undergo significant change over the coming years which will require large investment in utilities infrastructure. Relevant to the site are the Lowes Creek sewer pump station (SP1209) and the associated carrier mains (Lowes Creek Carrier, Maryland Carrier and Pondicherry Carrier). These works will, in time, ensure there is adequate capacity to support the proposed development as well as development within the adjacent precincts in Lowes Creek Maryland and Pondicherry.

All sewer from the proposed development will drain to SP1209. This pump station and the Lowes Creek Carrier will be delivered by Sydney Water in 2023/24, subject to funding approval. This pump station will service Pondicherry, Lowes Creek Maryland, South Creek West and parts of Catherine Field and Catherine Field North and will be sized to support all development in these Precincts.

The Lowes Creek and Maryland Carriers will be sized to support Precinct 5, as well as downstream development within Lowes Creek Maryland. The Pondicherry Carrier will be sized to support development within the catchment, including the eastern catchment of Precinct 5, Pondicherry and Greenways.

Ultimately, flows from SP1209 will be transferred to the Upper South Creek Advanced Water Recycling Centre (AWRC), located near the confluence of Badgerys Creek, Kemps Creek and South Creek, approximately 14km north of the site. Sydney Water have indicated that the Upper South Creek AWRC will be operational in line with the opening of the Western Sydney Airport, in 2026. The Upper South Creek AWRC is located a considerable distance from SP1209, and significant lead in infrastructure will be required to transfer flows from SP1209 to the AWRC. The delivery timeline for these lead-ins are currently unknown, however Sydney Water's Feasibility Letter suggests a connection from SP1209 to the AWRC will be available after 2026.

Until the required transfer mains are constructed, flows from SP1209 will be transferred to the West Camden WRP via SP1198 and SP1156. Sydney Water have indicated that SP1209 has capacity to cater for 4,000 dwellings until 2026. This capacity includes other developments within the catchment. Engagement with Sydney Water will continue throughout the next phase of the project to confirm the servicing strategy for the site.

The existing and planned trunk sewer infrastructure is shown in Figure 7.



### Figure 7 - Proposed Sewer Network





### 4.2 Sydney Water Growth Servicing Plan

Sydney Water's GSP indicates that trunk sewer infrastructure to support South Creek West is currently in the strategic planning phase. The GSP notes that the South Creek West Precinct has been released but not yet rezoned, and trunk infrastructure within the precinct will be delivered by developers in a staged fashion.

### 4.3 Sewer Catchments

The site falls into two sewer catchments, the western catchment drains to the Maryland Carrier and the eastern catchment drains to the Pondicherry Carrier. As discussed above, both carrier mains will discharge to SP1209. The sewer catchments are shown in Figure 8 and a summary of the required infrastructure for each catchment is provided in Table 3.

### Table 3 - Sewer Catchment Data

Catchment	Size (Ha)	Carrier	SPS
Western	138.0	Maryland Carrier	SP1209
Eastern	34.9	Pondicherry Carrier	SP1209



### Figure 8 - Sewer Catchments



### 4.4 Proposed Servicing Strategy

The site falls into two sewer catchments, both draining to the future SP1209. This pump station will transfer wastewater to the West Camden WRP for up to 10 years, depending on available capacity at the WRP and delivery of infrastructure connections to the north. Beyond this, wastewater within the SP1209 catchment will be transferred to the Upper South Creek AWRC.

The western catchment drains to SP1209 via the Maryland Carrier while the eastern catchment drains beneath The Northern Road to the Pondicherry Carrier. While Sydney Water will deliver SP1209 and Lowes Creek Carrier Section 1, they have indicated that both the Maryland and Pondicherry Carriers will need to be delivered by developers under a commercial agreement.

A high level assessment of the required trunk sewer infrastructure was undertaken using the Sewage Supply Code of Australia (SSA). The load on the sewer network is expressed in Equivalent Population (EP). The EP for each land use were extracted from the SSA. For residential uses, EP is expressed as a rate per dwelling and for non-residential uses, EP is expressed as a rate per hectare of development (gross). For schools the EP is related to the number of students. For the purpose of this assessment it has been assumed that the school site will accommodate 500 students, with an associated EP rate of 0.2/student.

The proposed land uses were split based on the catchments shown in Figure 8. The approximate total EP for each catchment was then calculated using the EP rates tabulated below.

Land Use	EP Rate	Eastern Catchment	Western Catchment	Total EP
Environmental Living (10 dw/ha)	3.5/dw	-	28	28
Low Density 1 (20 dw/ha)	3.5/dw	2,342	578	2,919
Low Density 2 (25 dw/ha)	3/dw	2,874	657	3,531
Medium Density (35 dw/ha)	3/dw	1,431	-	1,431
Mixed Use (Local Centre)	2.5/dw	250	-	250
School	100	94	-	94
Total		7,091	1,263	8,353

### Table 4 - Calculated Equivalent Population



Based on the above, a total equivalent population of 8,353 is expected within the site. Approximate trunk main sizing requirements have been determined for each catchment based on the above EP values. The Western Catchment will require the equivalent of a 375mm diameter trunk main, while the Western and Eastern Catchments will require a 225mm main.

As discussed above, the sizing of the downstream trunk carrier mains that will service the development are unknown at this stage. Given these mains will ultimately service a larger catchment outside the Precinct 5 site, it is likely the size of these mains will be significant. Lead-ins to these mains from the site could be achieved through single 375mm and 225mm diameter mains for each catchment, or through a series of smaller mains.

Sydney Water have provided a Feasibility Letter which outlines servicing options for the site. The above strategy has been prepared based on the advice contained within this letter. A copy has been included in Appendix A of this report.



### **5** Electricity

### 5.1 Existing Network

The site is located within the Endeavour Energy (EE) electrical supply zone. The closest zone substation (ZS) to the site is the Oran Park ZS, which has a firm capacity of 45MVA. The Oran Park ZS is connected to the Bringelly ZS, located 4.4km north of the site, via 132kV transmission lines which traverse the eastern side of The Northern Road. The Bringelly ZS has a firm capacity of 19MVA.

Endeavour Energy's Distribution Annual Planning Report (DAPR) estimates that the proposed development within the Maryland and Lowes Creek precinct will produce 11,000 lots and require an ultimate load of 44MVA. EE are planning on supplying early development within these precincts from the Oran Park and Bringelly ZS, however the existing high voltage network does not have sufficient capacity to supply the total expected demand within this precinct.

Endeavour Energy will construct two additional zone substations in the region to service the expected growth across the SWGA. Substations at Maryland and Catherine Park are expected to free up capacity at the Oran Park and Bringelly substations. The DAPR currently suggests both zone substations will be delivered in 2027, this information is current on 12 December 2022. The Maryland substation will be located adjacent The Northern Road, approximately 1km north of the site while the Catherine Park ZS will be located adjacent existing transmission lines on the eastern side of Oran Park, approximately 3km south east of the site.

Initial stages of development on the site will likely be supplied from the Oran Park ZS, with later stages of development potentially supplied from the Maryland substation, should there be insufficient capacity at Oran Park. The existing electrical network and proposed Maryland ZS are shown in Figure 9.









### 5.2 Proposed Servicing Strategy

Endeavour Energy undertook a high-level assessment of the proposed development in June 2022 based on a previous site layout and yield which included 44% more dwellings than the current proposed yield. A copy of this assessment is provided in Appendix A. The following servicing strategy was prepared for the proposed development site based on the previous yields.

EE have previously estimated the total load generated by the development to be approximately 18MVA, which would require 4-5 11kV feeders. Based on the reduction in dwellings from the time this advice was prepared, we would assume that 2-3 11kV feeders will be sufficient to supply development, however this will be confirmed with EE during the next phase of the project.

High voltage feeders can be installed gradually as development progresses. Generally, an 11kV feeder can support 800 – 1,400 dwellings, however this is dependent on the type of dwelling, the distance from the zone substation and other factors.

EE noted in their strategy that the site will be supplied via the Oran Park ZS and there is currently sufficient spare capacity to supply the whole development. Available spare capacity at the zone substation is expected to decrease over time, as new development connection applications are made. Should the demand generated by the development exceed the available spare capacity at the Oran Park ZS, then additional supply would be sourced from the future Maryland ZS. It is not expected that demand generated by the proposed development would exceed available supply at Oran Park ZS prior to the commissioning of the Maryland ZS in 2027.

New feeders will likely be constructed within the existing trench location on the eastern side of the road reserve in The Northern Road. Based on the current staging plan, it is anticipated a new feeder will be required every 3-4 years. Existing 11kV feeders and low voltage assets within the site boundary will be demolished and removed to support the proposed development.

It should be noted that spare capacity cannot be reserved for future development, and further network capacity investigations will need to be conducted when the formal connection of load application is submitted to EE in future.

Based on the above assessment, provision of electrical supply to the site is not expected to pose a constraint to development. Endeavour Energy's servicing strategy for the site has been included in Appendix A of this report.



### 6 Gas

The site is not currently serviced by the Jemena natural gas network. Gas infrastructure supplies dwellings within the Oran Park precinct, to the south of the site. Should the site require gas infrastructure, Jemena will support the demand generated by development as required. Generally, there will be little demand for gas infrastructure generated by non-residential development.

Should gas be required for the proposed development, it is likely trunk infrastructure will be extended from Oran Park to the site. Any gas servicing requirements for the site will be confirmed with Jemena during the next phase of the project.



### 7 Telecommunications

### 7.1 NBN

The site is currently serviced by NBN satellite technology which uses satellite signals to deliver broadband data. This is achieved via installation of a small antenna or dish on the roof of a home or business to transmit and receive data from a satellite orbiting the earth. This technology is generally used in rural areas with large distances between residential dwellings.

Fixed line technology is available within the Oran Park precinct. It is likely that fixed line technology can be extended to the site to supply future development. NBN Co. policy requires developers to provide pit and pipe infrastructure within the road reserve for all subdivisions. NBN assess each application request separately to negotiate commercial terms, however connection fees of up to \$600 and \$400 may apply to single dwelling units and multi dwelling units respectively. Please note these charges are subject to change.

### Figure 10 - NBN Coverage





### 7.2 Telstra 5G Network

Telstra have blanket handheld 4G coverage across the site. Rollout of Telstra's 5G network has commenced across the SWGA. Most of the site can already access 5G coverage, with a small portion near the southern boundary of the site not currently covered by the network. Figure 11 shows the existing 5G network coverage in purple. Future infrastructure rollout across the SWGA will be staged to match the pace of development. It is expected that 5G network coverage will extend across the whole site over the coming years.



### Figure 11 - Existing 5G Coverage



### 8 Conclusion

This report summarises the investigations relating to the infrastructure delivery strategies for the development site at Cobbitty Sub Precinct 5. Based on the assessments in this report, the proposed development can be adequately serviced by the infrastructure planned for the SCWLRA and greater SWGA. It is expected that this infrastructure can be delivered to align with the planned development timeline.



### **Appendix A – Authority Endorsement/Advice**


Case Number: 194137

6 December 2021

**Boyuan Holdings Limited** 

Dear Adam Carmody

# Re: Servicing of the proposed planning proposal at 657 The Northern Road, Cobbitty.

Thank you for your enquiry about the water-related servicing requirements for your proposed development at Lot 2 DP1216380 657 NORTHERN RD, Cobbitty.

The general information below, is provided to assist you in considering options for your site. The information is based on our system as of the date of this letter. The information below is as follows:

### Water:

- The development is located within the Narellan South water supply zone (WSZ) which has limited capacity to service growth.
- Drinking water servicing of the 3,800 lot development is required via the proposed Oran Park WSZ.
- The Oran Park reservoirs and associated infrastructure are currently programmed to be delivered in 2022/23. This delivery timeframe is subject to change.

### Wastewater:

The development is located within the Lowes Creek catchment and drains to proposed SP1209 via proposed Lowes Creek carrier section 1. Sydney Water plans to deliver these assets by 2023/24. This is subject to funding approval.

Stage 1 servicing of Lowes Creek catchment (SP1209) -

• SP1209 will transfer flow to West Camden Water Recycling Plant (WRP) via SP1198. Refer to attached locality plan.



- There is limited capacity within the West Camden wastewater network. SP1209 can only service up to 4,000 dwellings via transfer to West Camden wastewater network until about 2026.
  - The capacity for 4,000 lots, is for all developments draining to SP1209, including other developments.
- In addition to the Sydney Water delivered trunk infrastructure, precinct wastewater trunk
  mains are required to be extended from the Lowes Creek Carrier Section 1, to service this
  development. These trunk mains are required to be delivered by developers under
  commercial agreement with Sydney Water.
  - The developer will need to collaborate with any developers/landowners for construction and delivery timing of carriers required to be extended to this development.

Ultimate servicing of Lowes Creek catchment

• After 2026, Sydney Water plans to transfer SP1209 flows to the Upper South Creek (USC) Advanced Water Recycling Centre (AWRC). The AWRC is planned to be operational in 2025/26.

### **Recycled Water:**

- Recycled Water options to service South Creek West are actively being explored by Sydney Water.
- If you are interested in recycled water options to service the proposed development, please contact your account manager, Shaun Muir, to discuss.

If you have any further enquiries, or would like to accelerate your development, please phone me on 0477 995 349 or email shaun.muir@sydneywater.com.au to arrange to meet and discuss accelerating the servicing of your development area.

Yours sincerely

Shaun Muir Major Account Manager Developer Partnerships

### **Rachel Higgisson**

From: Sent: To: Cc: Subject: Louis Fernandes < Monday, 13 September 2021 12:03 PM Rachel Higgisson



Hoping all is well!

Asset Planning and Performance has prepared the following response to Cobbitty Development:

**RE: Cobbitty Development Site** 

- 1. The total site assessed load has been assessed to approximately 18MVA.
- 2. This development will require at least 4 -5 dedicated Feeders.
- 3. Feeders will require a minimum of 2 x cross-feeder ties plus 1 cross-zone tie (per feeder) in line with sound network planning reliability and security principles.
- 4. At present, there is enough total capacity at Oran Park ZS to supply the development. (Firm capacity constraints may require EE to implement future Major projects at the correct time).
- 5. This development will be supplied from Oran Park ZS via up to 4 5 dedicated feeders.
- 6. Feeders can be installed progressively as the development progresses over the proposed 10-year timeline.
- The Capacity Planner will allocate 11kV circuit breakers as needed. There are currently several spare circuit breakers, but this will reduce over time as other network and customer feeders are installed and there will be a requirement to double-terminate some feeders when spares are exhausted.
- 8. Due to expected cable congestion exiting Oran Park ZS, some initial HV cables may need to be 300 Cu XLPE and can then be reduced to 240 Cu XLPE at suitable point, until the first distribution substation. Further assessments will be required upon application.
- 9. **Note:** Endeavour Energy does not reserve capacity. Further network capacity investigations will need to be conducted when the formal connection of load application is submitted in the future.

Kind regards,

Louis Fernandes | Capacity Planner



Endeavour Energy acknowledges the traditional owners of country where we work and recognises their continuing connection to the land, waters and community. We pay our respects to the people, the cultures, and to the elders both past, present and emerging.





Report on Preliminary Site Investigation (Contamination)

Proposed Rezoning Sub-Precinct 5, South Creek West, NSW

> Prepared for Boyuan Bringelly Pty Ltd

> > Project 92225.04 December 2022



# **Douglas Partners** Geotechnics | Environment | Groundwater

## **Document History**

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\* Limited changed to incorporate changes to the site boundary

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Revision 3	1	0	Boyuan Bringelly Pty Ltd – Trent Argaet	

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		7 December 2022
Reviewer		7 December 2022



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## **Executive Summary**

Douglas Partners Pty Ltd (DP) has been engaged by Boyuan Bringelly Pty Ltd to complete this preliminary site investigation (contamination) (PSI) undertaken for a proposed rezoning for the site at Sub-Precinct 5, South Creek West, NSW (the site). The site is shown on Drawing 1, Appendix A.

The objective of the PSI is to assess the potential for contamination at the site based on past and present land uses and to comment on the need for further investigation and/or management with regard to any future proposed development. It is understood that the report will be used to support a rezoning application for the precinct.

The scope of the current investigation included a desktop study and site walkover to identify any potential areas of environmental concern (PAEC).

The site was found to be formerly and currently used as rural residential land with agricultural activities. A total of nine PAECs were identified across the site, consisting of:

- Potential ground disturbances and general fill
- Agricultural land use;
- Farm Dams;
- High voltage powerline towers;
- Access roads;
- Current and former buildings and structures;
- Vehicle Storage Area;
- Bulk earthworks surrounding and underlying current service station; and
- Timber Power Poles.

Based on the information presented above, the site has the potential for contamination due to the historical site uses. The presence or extent of potential contamination has not been fully confirmed. Further assessment of soil and groundwater at the site would be required to assess the presence, degree and extent of contamination and any remediation requirements associated with the potential contamination sources identified. Targeted investigations of all PAECs should be undertaken, in the form of a Detailed Site Investigation (DSI) to inform any future DA. The recommended further assessment should build on the information provided in this report with reference to National Environment Protection Council (NEPC, 1999) National Environment Protection Council (Assessment of Site Contamination) Measure 1999 (amended 2013) (NEPC, 2013). Further assessment should include intrusive investigations, sampling, analysis and assessment to assess land use suitability and to determine remediation requirements, if necessary.

A hazardous building survey is also recommended to identify any hazardous building materials prior to any maintenance or site redevelopment.

The PAECs encountered were typical for a rural residential site with agricultural activity. It is considered unlikely that any of the identified PAECs will present a major constraint to the proposed rezoning and that the site can be rendered suitable for any beneficial land use scenarios (e.g. residential), subject to further investigation and remediation, as required.



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# Report on Preliminary Site Investigation (Contamination) Proposed Rezoning Sub-Precinct 5, South Creek West, NSW

### 1. Introduction

Douglas Partners Pty Ltd (DP) has been engaged by Boyuan Bringelly Pty Ltd to complete this preliminary site investigation (contamination) (PSI) undertaken for a proposed rezoning for Sub-Precinct 5, South Creek West, NSW (the 'site'). The site is shown on Drawing 1, Appendix A.

It is noted that the previous versions of this PSI were completed with reference to a previous Indicative Layout Plan (ILP) which considered the entirety of Sub Precinct 5. The current ILP incorporates only Lots 2 and 4 in DP1216380, Lots 1 and 4 in DP1273487, and Lot 500 in DP1231858, as depicted in Drawing 1. As such, this report has been revised to exclude part Lot 45 in DP1104369 which is no longer within the current ILP.

The objective of the PSI is to assess the potential for contamination at the site based on past and present land uses and to comment on the need for further investigation and/or management with regard to any future proposed development. It is understood that the report will be used to support a rezoning application for the precinct.

This report must be read in conjunction with all appendices including the notes provided in Appendix B.

The following key guidelines were consulted in the preparation of this report:

- NEPC National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM] (NEPC, 2013);
- NSW DUAP/EPA. (1998). *Managing Land Contamination, Planning Guidelines, SEPP 55 Remediation of Land*. NSW Department of Urban Affairs and Planning/Environment Protection Authority; and
- NSW EPA Guidelines for Consultants Reporting on Contaminated Land (NSW EPA, 2020).

A preliminary geotechnical and salinity assessment as well as a Groundwater Investigation were also undertaken in conjunction with this PSI, with results presented in separate reports titled:

- Preliminary Geotechnical and Salinity Assessment, reference 92225.02.R.001.Rev0 (DP, 2021).
- Preliminary Geotechnical and Salinity Assessment, reference 92225.04.R.002.Rev0 (DP, 2021a).



## 2. Background

The following relevant environmental reports have been previously conducted on areas that encompass the site:

- DP Report on Land Capability and Contamination Assessment, Oran Park Precinct, Oran Park and Cobbitty (Project 40740) dated February 2007 for Growth Centres Commission (DP, 2007); and
- DP Report on Preliminary Site Investigation (Desktop Assessment), Precinct Acceleration Submission, 621 707 The Northern Road, Bringelly, NSW, Project 92225.00.R.001 Rev 1, dated December 2017 (DP, 2017) which was carried out for an area of approximately 317 ha which encompasses the current site.

DP (2017) was based wholly on a desktop review, including a review and incorporation of information presented in DP (2007) which included site walkovers of limited portions of the site. DP (2017) identified a total of 29 potential areas of environmental concern (PAEC) at the site (not all were located within the current site boundary) primarily associated with the following:

- Chemical storage and hazardous building materials within sheds and dwellings;
- Imported fill of unknown quantity and origin as marked by ground disturbances;
- Agricultural activities including the possible use of fertilizers, pesticides and herbicides; and
- Leaks and spills resulting from onsite use of machinery

DP (2017) recommended the following future investigations be carried out (in order):

- Site inspection;
- Preparation of a sampling plan with a view towards intrusive investigation;
- Investigate PAEC; and
- Carry out a Detailed Site Investigation (DSI).

The desktop assessment concluded that it was considered unlikely that any of the identified PAEC will present a major constraint to the proposed development and that the site can be rendered suitable for the proposed residential subdivision, subject to further investigation and remediation, as required.

### 3. Scope of Works

The works undertaken was as follows:

- A desktop investigation to determine potential areas of environmental concern (PAEC) for the site including:
  - o Review of previous reports;
  - o Review of aerial photographs to identify land uses and changes in the land that may indicate potential for contamination;
  - o A review of previous site ownership records including land title records archived at the Land Titles Office, historical records archived at local Libraries and historical societies;



- o Search on the Contaminated Land Register for Notices issued under the *Contaminated Land Management Act* 1997; and
- o NSW Office of Water groundwater bore search.
- Field mapping and site walkover assessment of the accessible areas of the site by an environmental engineer/scientist to identify any Potential Areas of Environmental Concern (PAEC);
- Review of geotechnical test pit logs;
- Development of a preliminary conceptual site model (CSM) incorporating all PAECs identified; and
- Preparation and provision of this PSI report detailing the findings of the assessment including comments on the risk and nature of potential contamination at the site, the sites suitability for the proposed rezoning and recommendations for further assessment, if required.

Some of the above scope has previously been completed in DP (2007) and DP (2017), said information will be incorporated or updated as necessary into this PSI.

### 4. Site Information

Site Address	Sub-Precinct 5, South Creek West, NSW		
Legal Description	Lot 2 in DP 1216380 on 705 The Northern Road, Bringelly;		
	Lot 4 in DP 1216380 on 657 The Northern Road, Bringelly;		
	Lot 1 in DP1273487 on 621 The Northern Road, Bringelly;		
	Lot 4 in DP1273487 on The Northern Road, Bringelly.		
	Part Lot 500 in DP 1231858 on 421D The Northern Road, Bringelly.		
Area	172.7 hectares (ha)		
Zoning	RU1 - Primary Production		
Local Council Area	Camden Council		
Current Use	Rural Residential land use. Predominantly used for the agistment of cattle.		
Surrounding Uses	<ul> <li>North: Rural agricultural land beyond which is a general waste recycling centre.</li> <li>East: The Northern Road beyond which is the rural agricultural land.</li> <li>South: Rural agricultural land, beyond which is residential.</li> <li>West: Rural agricultural land.</li> </ul>		

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## 5. Environmental Setting

Site Topography	The topography within the site is generally classifiable as undulating terrain. Elevations range from a topographical high-point of 154 m Australian Height Datum (AHD), on a ridgeline located in the south east portion of the site, to a topographical low-point of approximately 84 m AHD. The gradient generally rises towards both the west and the south at the site.
Soil Landscape	Reference to the Penrith 1:100,000 Soils Landscape Sheet indicates that the site is located on the residual Blacktown, the erosional Luddenham and alluvial South Creek soil landscape groups. Further details can be found in DP (2021).
Geology	Reference to the Penrith 1:100,000 Geological Sheet indicates that the site is underlain by both Bringelly Shale of the Wianamatta Group of Triassic age and Fluvial Sediments of Quaternary age. Further details can be found in DP (2021).
Acid Sulfate Soils	The published Atlas of Australian Acid Sulfate Soils mapping, compiled by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) indicates that the site has an extremely low probability of acid sulfate soil occurrence.
Surface Water	The landform dictates the alignment of a number of ephemeral water courses across the site, with numerous farm dams present within the site, located along the ephemeral water course alignments. Surface water is anticipated to flow towards the north along the ephemeral water courses towards Lowes Creek. 2 km to the north.
Groundwater	Groundwater is anticipated to flow beneath the surface along the same direction of the surface water towards Lowes Creek, the likely receiving surface water body for groundwater flow path. Given the local geology (ie: Bringelly Shale), the groundwater in the fractured rock beneath the site is anticipated to have low groundwater flow likely to be dominated by fracture flow with resultant low yields (typically < 1 L/s) in bores. Accordingly, there would be no significant potential beneficial uses of the shallow groundwater system.

### 6. Site History

### 6.1 Title Deeds

A historical title deed search was conducted as part of DP (2007). DP (2007) concluded that no potential areas of environmental concern (PAEC) were warranted for the site based on the review of title deeds.

### 6.2 Historical Aerial Photography

Historical aerial photographs were sourced from NSW Land and Property Information for the years 1947, 1961, 1970, 1984/1986 and 1994. Aerial photographs from 2005 to 2022 were sourced from MetroMap. Copies of the relevant aerial photographs are presented in Appendix D.



The first available historical aerial for the site, 1947, shows that the site was largely cleared of vegetation, with evidence of the site being used for agricultural uses, such as cattle grazing, including a number of farm dams and potential ground disturbances likely from the result of the ploughing of the land. The site has remained relatively unchanged since 1947 with some notable modifications including additional farm dams, high-voltage power line towers, access roads, additional structures (residential and sheds).

A review of available MetroMap 2021 and 2022 aerial photographs identified that a portion of the site just off The Northern Road has undergone bulk earthworks for the construction of a stub road for a new intersection and subsequently the construction of a service station, as well as a road being constructed on the south-east portion of the site.

Bulk earthworks, likely for the construction of residential subdivisions, appear to be present in the eastern and south eastern areas from the site. The surrounding land (excluding the eastern and south eastern areas from the site) have remained relatively unchanged since the 1947 aerial photograph, which showed generally cleared land, likely used for agricultural purposes, with some rural residential dwellings with the most significant changes observed included the upgrade of The Northern Road to the east, which was upgraded between 2016 and 2020, and the residential subdivisions appearing to the south and south east.

The PAECs that were identified from the aerial photographs are summarised in Section 9, below.

EPA Notices available under Section 58 of the Contaminated Lands Management Act (CLM Act) Database searched 1 July 2021	There were no records of notices for the site or adjacent sites.
Sites notified to EPA under Section 60 of the CLM Act Database searched 1 July 2021	The site and adjacent sites were not listed as a notified contaminated site.
Licences listed under Section 308 of the Protection of the Environment Operations Act 1997 (POEO Act) Database searched 1 July 2021	<ul> <li>There were no records issued to the site. However, licenses have been issued for the following properties within a 500 m radius of the site:</li> <li>The Northern Road and Bringelly Road Upgrade Stage 2, directly east of the site, had been issued a licence for land-base extractive activity, crushing, grinding or separating and road construction. The license was surrendered in March 2021 on the completion of the road;</li> <li>761, The Northern Road, Bringelly NSW (Hi-Quality Waste Management Pty Ltd) has been issued a licence to regulate waste storage, recovery of general waste and composting. It has also been issued a number of section 91 Clean up Notices for stockpiling of non-permitted waste (ie plastics); and</li> </ul>

### 6.3 Public Registers and Planning Records



• 769 The Northern Road, Bringelly NSW (W2R Organics Pty Ltd) has been issued a licence to regulate compositing activities.

### 6.4 Site History Integrity Assessment

The information used to establish the history of the site was sourced from reputable and reliable reference documents, many of which were official records held by Government departments/agencies. The databases maintained by various Government agencies potentially can contain high quality information, but some of these do not contain any data at all. A NSW SafeWork Dangerous Goods search was not undertaken due to the preliminary nature of the investigation. A Dangerous Goods search is completed to identify potentially hazardous substances that may be kept on site (such as chemical or fuel storage tanks) that may pose a potential contamination issue. Given that the site comprises rural residential land use it is unlikely that dangerous goods are held on site, notwithstanding, a Dangerous Goods Search should be conducted in future investigations for due diligence purposes.

In particular, aerial photographs provide high quality information that is generally independent of memory or documentation. They are only available at intervals of several years, so some gaps exist in the information from this source. The observed site features are open to different interpretations and can be affected by the time of day and/or year at which they were taken, as well as specific events, such as flooding. Care has been taken to consider different possible interpretations of aerial photographs and to consider them in conjunction with other lines of evidence.

### 6.5 Summary of Site History

The site history information suggests that the site has a history of being used for a combination of rural residential and agricultural uses since at least the 1940s. The site has been subject to very little relative changes over the site history with the exception of some additional access roads, structures, and small section of earthworks.

### 7. Site Walkover

### 7.1 Observations

A site walkover was undertaken of the site by an environmental engineer on 14 – 15 January 2020. The general site topography was consistent with that described in Section 5. The site history search and historical aerial review indicated a number of potential areas of environmental concern (PAECs), the purpose of the site walkover was the confirm the status of the identified PAECs, as well as identify any additional PAECs not identified during the site history search. At the time of the site walkover the following key site features pertinent to the PSI were observed:

• At the time of inspection, the site was overall consistent with the 2020 aerial photograph, the property appeared to be mainly used as rural residential property with the large balance of the site consisting of grassed paddocks with scattered vegetation and numerous farm dams;



- There were various structures on the site, mainly concentrated to the central portion of the site including residential buildings, sheds, garages and stables/shelters;
- Numerous timber power poles were observed across the site;
- Evidence of fly tipping and/or filling (potential asbestos pipe and bricks) within a drainage line in the north-east portion of the property described as Part Lot 500 DP 1231858; and
- Fragments of brick and building materials on the slope to the north of the residence on the property described as Lot 4 DP 1216380 MetroMap imagery from 2009, which shows several dozen stockpiles with an approximate combined footprint of 190 m<sup>2</sup>. It is unclear if the stockpiles were removed or spread across site prior to becoming grassed over.

The findings of the site walkover have been incorporated into the PAECs as presented in Section 9 and a selection of site photographs is provided in Appendix E:

A review of a June 2022 aerial photograph indicates that the site has remained relatively unchanged since the completion of site walkover with the exception of the area just off The Northern Road which has undergone bulk earthworks for the construction of a new intersection and the construction of a service station (refer Section 6.2 and Drawing 2).

### 8. Review of Geotechnical Test Pit Logs

A review of DP (2021) test pit and bore hole logs was conducted to identifying any additional PAEC. Fill was only identified in one location (TP108) which included brick fragments, roof tiles, metal and concrete. The remainder of the 15 test pits and five boreholes did not identify any fill or signs of contamination, with the soil profile typically noted to be topsoil overlying natural silty clays with shale or sandstone bedrock underlying. The test pit logs are included in Appendix F, together with notes defining classification methods and descriptive terms.

### 9. Potential Areas of Environmental Concern

Based on the results of DP (2017), site history search and subsequent site walkover, 10 PAEC categories were identified, as summarised in Table 4, below, and their locations shown on Drawing 2, Appendix B.

PAEC #	ldentified from	Brief Description	Potential Environmental Concern	
1	APs Potential Ground disturbances.		Areas of ground disturbance indicating potential impacted surface soil or possible filling.	
2	1947 AP	Agricultural land use	Application of pesticides and herbicides.	
3	APs	Farm Dams	Fill may have been imported for the construction of the dam walls	

### Table 4.: Summary of Identified Potential Areas of Environmental Concern in the site



PAEC #	ldentified from	Brief Description	Potential Environmental Concern	
4	APs	High voltage powerline towers	Impacted surface soils/possible filling during construction of towers	
5	APs	Access roads	Fill may have been imported for the construction of the access roads, as well as potential leaching of chemicals from any asphalt into the underlying material.	
6	APs	Current and former buildings and structures	Potential hazardous building materials were used in structures. Potentially impacted surface soils from construction and demolition of structures.	
7	1984/1986 AP	Vehicle Storage Area	Potential vehicle spills or leak impacting surface soils.	
8	2015 and 2021, 2022 AP	Bulk earthworks	Imported fill material and potential impact to surface soils from heavy machinery from the construction of a fill platform in 2015 and then further bulk earthworks and construction of a service station in 2021/2022. However, given the service station is <1 year old It is considered to have a low potential for contamination.	
9	APs and Site walkover	Timber power poles	Leaching of timber treatment chemicals from power poles has potential to impact the adjacent soils.	

Notes:

AP

= Aerial Photograph(s).

## **10. Preliminary Conceptual Site Model**

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future i.e.: it enables an assessment of the potential source – pathway – receptor linkages (complete pathways).

### Potential Sources

Based on the current investigation, the following potential sources of contamination and associated contaminants of potential concern (COPC) have been identified.

- S1: Ground Disturbance and Fill: Associated with ground disturbances (i.e.: levelling, placement of fill, demolition of former and current buildings on the site and high voltage powerlines and bulk earthworks) and general filling observed in dams;
  - CoPC include metals (arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn)), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylene (BTEX), polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), phenols and asbestos.



- S2: Agricultural land use:
  - CoPC include OCP, OPP and metals. DP notes that earlier agricultural activities identified (i.e. in the 1940s aerials) CoPC would not include OCP and OPP as they were not widely adopted during that period.
- S3: Buildings and structures (including potentially stored chemicals and vehicle storage area):
   o CoPC include metals, TRH, BTEX, PAH, OCP, phenols, PCB and asbestos.
- S4: Timber Power Poles:
  - o CoPC include metals, TRH, BTEX and PAH.

### **Potential Receptors**

The following potential human receptors have been identified:

- R1: Current and future site users;
- R2: Future construction and maintenance workers; and recreational users; and
- R3: Adjacent site users (rural residential).

The following potential environmental receptors have been identified:

- R4: Surface water (On site dams and South Creek);
- R5: Groundwater; and
- R6: Terrestrial ecology.

### **Potential Pathways**

The following potential pathways have been identified:

- P1: Ingestion and dermal contact;
- P2: Inhalation of dust and/or vapours;
- P3: Surface water run-off;
- P4: Lateral migration of groundwater providing base flow to water bodies;
- P5: Leaching of contaminants and vertical migration into groundwater; and
- P6: Contact with terrestrial ecology.

### Summary of Potentially Complete Exposure Pathways

A 'source–pathway–receptor' approach has been used to assess the potential risks of harm being caused to human or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways (potential complete pathways). The possible pathways between the above sources (S1 to S6) and receptors (R1 to R6) are provided in Table 5.



Source	Transport Pathway	Receptor	Risk Management Action
S1: Ground	<ul><li>P1: Ingestion and dermal contact</li><li>P2: Inhalation of dust and/or vapours</li></ul>	<ul> <li>R1: Current and future site users</li> <li>R2: Future construction and maintenance workers;</li> </ul>	
Disturbance and Fill S2: Agricultural land	P2: Inhalation of dust and/or vapours	R3: Adjacent site users [Rural residential].	An intrusive investigation is recommended to
use S3: Buildings and structures S4: Timber Power	P3: Surface water run-off P4: Lateral migration of groundwater providing base flow to water bodies	R4: Surface water bodies [On site dams and South Creek];	assess possible contamination including testing of the soils and
Poles	P5: Leaching of contaminants and vertical migration into groundwater	R5: Groundwater; and	groundwater.
	P6: Contact with terrestrial ecology	R6: Terrestrial ecology.	
S3: Buildings and structures	<ul> <li>P1: Ingestion and dermal contact.</li> <li>P2: Inhalation of dust and/or vapours.</li> <li>P3: Surface water run-off.</li> <li>P6: Contact with terrestrial ecology.</li> </ul>	<ul> <li>R1: Current and future site users.</li> <li>R2: Construction and maintenance workers (during any site. redevelopment).</li> <li>R6: Terrestrial ecology.</li> </ul>	Hazardous building survey to identify any hazardous building materials prior to any site redevelopment.

### Table 5: Summary of Potentially Complete Exposure Pathways

### **11. Conclusions and Recommendations**

The scope of the current investigation included a desktop study and a site walkover. The site was found to be formerly and currently used as rural residential land with agricultural activities. A total of nine PAECs were identified across the site requiring further investigation. The identified PAEC were as follows:

- PAEC 1 Potential ground disturbances and general fill;
- PAEC 2 Agricultural land use;
- PAEC 3 Farm Dams;
- PAEC 4 High voltage powerline towers;
- PAEC 5 Access roads;
- PAEC 6 Current and former buildings and structures;



- PAEC 7 Vehicle Storage Area;
- PAEC 8 Bulk earthworks surrounding and underlying the recently constructed Service Station; and
- PAEC 9 Timber Power Poles

Based on the information presented above, the site has the potential for contamination due to the historical site uses. The presence or extent of potential contamination has not been fully confirmed. Further assessment of soil and groundwater at the site would be required to assess the presence, degree and extent of contamination and any remediation requirements associated with the potential contamination sources identified. Targeted investigations of all PAECs should be undertaken, in the form of a Detailed Site Investigation (DSI) to inform any future development applications. Prior to redevelopment a site walk over must be undertaken on the portions of the site which were not accessed during this investigation to confirm the mapping.

With respect to site contamination, the recommended further assessment should build on the information provided in this report with reference to National Environment Protection Council (NEPC, 1999) National Environment Protection Council (Assessment of Site Contamination) Measure 1999 (amended 2013) (NEPC, 2013). Further assessment should include intrusive investigations, sampling, analysis and assessment to assess land use suitability and to determine remediation requirements, if necessary. A hazardous building survey is also recommended to identify any hazardous building materials prior to any demolition or maintenance.

The PAECs encountered were typical for a rural residential site with agricultural activity. It is considered unlikely that any of the identified PAECs will present a major constraint to the proposed rezoning and that the site can be rendered suitable for any beneficial land use scenarios (e.g. residential), subject to further investigation and remediation, as required.

### 12. References

- NEPC. (2013). National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]. Australian Government Publishing Services Canberra: National Environment Protection Council.
- NSW DUAP/EPA. (1998). *Managing Land Contamination, Planning Guidelines, SEPP 55 Remediation of Land*. NSW Department of Urban Affairs and Planning / Environment Protection Authority.
- NSW EPA. (2020). *Guidelines for Consultants Reporting on Contaminated Land*. Contaminated Land Guidelines: NSW Environment Protection Authority.

### 13. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 621 - 705 The Northern Road, Cobbitty in accordance with DP's proposal MAC180379.P.001.Rev1 dated 9 February 2021. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Boyuan Bringelly Pty Ltd for this project only and for the purposes as described in the report. It should



not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the environmental components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints (as discussed above), or to vegetation preventing visual inspection and reasonable access. It is therefore considered possible that HBM, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

### **Douglas Partners Pty Ltd**

# Appendix A

Drawings 1 and 2





# Appendix B

About this Report



#### Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

### Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

### **Borehole and Test Pit Logs**

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

#### Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

 In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

### Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

# About this Report

#### **Site Anomalies**

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

### Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

#### **Site Inspection**

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

# Appendix C

Site History documentation



657-705 THE NORTHERN ROAD BRINGELLY 2556



# **Property Details**

Address:	657-705 THE NOR BRINGELLY 2556	THERN ROAD
Lot/Section /Plan No:	2/-/DP1216380	4/-/DP1216380
Council:	CAMDEN COUNC	IL

## Summary of planning controls

Planning controls held within the Planning Database are summarised below. The property may be affected by additional planning controls not outlined in this report. Please contact your council for more information.

Local Environmental Plans	Camden Local Environmental Plan 2010 (pub. 28-2-2019)
Land Zoning	RU1 - Primary Production: (pub. 3-9-2010)
Height Of Building	9.5 m
Floor Space Ratio	NA
Minimum Lot Size	40 ha
Heritage	NA
Land Reservation Acquisition	NA
Foreshore Building Line	NA
Local Provisions	Wildlife Buffer Zone
	Wind Turbine Buffer Zone
Obstacle Limitation Surface	230.5-230.5

## **Detailed planning information**

### State Environmental Planning Policies which apply to this property

State Environmental Planning Policies can specify planning controls for certain areas and/or types of development. They can also identify the development assessment system that applies and the type of environmental assessment that is required.

- State Environmental Planning Policy (Affordable Rental Housing) 2009: Land Application (pub. 31-7-2009)
- State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004: Land Application (pub. 25-6-2004)



# 657-705 THE NORTHERN ROAD BRINGELLY 2556

- State Environmental Planning Policy (Concurrences and Consents) 2018: Land Application (pub. 21-12-2018)
- State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017: Land Application (pub. 1-9-2017)
- State Environmental Planning Policy (Exempt and Complying Development Codes) 2008: Land Application (pub. 12-12-2008)
- State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004: Land Application (pub. 31-3-2004)
- State Environmental Planning Policy (Infrastructure) 2007: Land Application (pub. 21-12-2007)
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007: Land Application (pub. 16-2-2007)
- State Environmental Planning Policy (Primary Production and Rural Development) 2019: Land Application (pub. 28-2-2019)
- State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017: Subject Land (pub. 25-8-2017)
- State Environmental Planning Policy No 19—Bushland in Urban Areas: Land Application (pub. 24-10-1986)
- State Environmental Planning Policy No 21—Caravan Parks: Land Application (pub. 24-4-1992)
- State Environmental Planning Policy No 33—Hazardous and Offensive Development: Land Application (pub. 13-3-1992)
- State Environmental Planning Policy No 36—Manufactured Home Estates: Land Application (pub. 16-7-1993)
- State Environmental Planning Policy No 50—Canal Estate Development: Land Application (pub. 10-11-1997)
- State Environmental Planning Policy No 55—Remediation of Land: Land Application (pub. 28-8-1998)
- State Environmental Planning Policy No 64—Advertising and Signage: Land Application (pub. 16-3-2001)
- State Environmental Planning Policy No 65—Design Quality of Residential Apartment Development: Land Application (pub. 26-7-2002)
- State Environmental Planning Policy No 70—Affordable Housing (Revised Schemes): Land Application (pub. 31-5-2002)
- Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997): Land Application (pub. 7-11-1997)
- Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997): Sub Catchment Boundaries (pub. 7-11-1997)
- Sydney Regional Environmental Plan No 9—Extractive Industry (No 2—1995): Land Application (pub. 15-9-1995)



657-705 THE NORTHERN ROAD BRINGELLY 2556

## Other matters affecting the property

Information held in the Planning Database about other matters affecting the property appears below. The property may also be affected by additional planning controls not outlined in this report. Please speak to your council for more information

1.5 m Buffer around Classified Roads	Classified Road Adjacent
Bushfire Prone Land	Vegetation Buffer
	Vegetation Category
Local Aboriginal Land Council	THARAWAL
Regional Plan Boundary	Greater Sydney
Special Infrastructure Contributions	Western Sydney Growth Centres SIC



621 THE NORTHERN ROAD COBBITTY 2570



# **Property Details**

Address:	621 THE NORTHE 2570	ERN ROAD COBBITTY
Lot/Section /Plan No:	1/-/DP1241819	2/-/DP1241819
Council:	CAMDEN COUNC	IL

## Summary of planning controls

Planning controls held within the Planning Database are summarised below. The property may be affected by additional planning controls not outlined in this report. Please contact your council for more information.

Local Environmental Plans	Camden Local Environmental Plan 2010 (pub. 28-2-2019)
Land Zoning	E4 - Environmental Living: (pub. 25-9-2020)
	R1 - General Residential: (pub. 28-2-2019)
	RU1 - Primary Production: (pub. 3-9-2010)
Height Of Building	16 m
	9 m
	9.5 m
Floor Space Ratio	NA
Minimum Lot Size	1000 m²
	125 m²
	40 ha
Heritage	NA
Land Reservation Acquisition	NA
Foreshore Building Line	NA
Local Provisions	Wildlife Buffer Zone
	Wind Turbine Buffer Zone
Obstacle Limitation Surface	230.5-230.5



# 621 THE NORTHERN ROAD COBBITTY 2570

Greenfield Housing Code Area

Complying Development Code: <u>https://www.planningportal.nsw.gov.au/greenfield-housing-code</u>

Building type: 1-2 storey homes, residential alterations and additions

Development consent authority: Council or accredited certifier

Note: Applications which meet all relevant requirements in the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 may be approved within 20 days. Exclusions may apply.

https://legislation.nsw.gov.au/#/view/EPI/2008/572/full

## **Detailed planning information**

## State Environmental Planning Policies which apply to this property

State Environmental Planning Policies can specify planning controls for certain areas and/or types of development. They can also identify the development assessment system that applies and the type of environmental assessment that is required.

- State Environmental Planning Policy (Affordable Rental Housing) 2009: Land Application (pub. 31-7-2009)
- State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004: Land Application (pub. 25-6-2004)
- State Environmental Planning Policy (Concurrences and Consents) 2018: Land Application (pub. 21-12-2018)
- State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017: Land Application (pub. 1-9-2017)
- State Environmental Planning Policy (Exempt and Complying Development Codes) 2008: Land Application (pub. 12-12-2008)
- State Environmental Planning Policy (Exempt and Complying Development Codes) 2008: Subject Land (pub. 6-5-2018)
- State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004: Land Application (pub. 31-3-2004)
- State Environmental Planning Policy (Infrastructure) 2007: Land Application (pub. 21-12-2007)
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007: Land Application (pub. 16-2-2007)
- State Environmental Planning Policy (Primary Production and Rural Development) 2019: Land Application (pub. 28-2-2019)
- State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017: Subject Land (pub. 25-8-2017)



# 621 THE NORTHERN ROAD COBBITTY 2570

- State Environmental Planning Policy No 19—Bushland in Urban Areas: Land Application (pub. 24-10-1986)
- State Environmental Planning Policy No 21—Caravan Parks: Land Application (pub. 24-4-1992)
- State Environmental Planning Policy No 33—Hazardous and Offensive Development: Land Application (pub. 13-3-1992)
- State Environmental Planning Policy No 36—Manufactured Home Estates: Land Application (pub. 16-7-1993)
- State Environmental Planning Policy No 50—Canal Estate Development: Land Application (pub. 10-11-1997)
- State Environmental Planning Policy No 55—Remediation of Land: Land Application (pub. 28-8-1998)
- State Environmental Planning Policy No 64—Advertising and Signage: Land Application (pub. 16-3-2001)
- State Environmental Planning Policy No 65—Design Quality of Residential Apartment Development: Land Application (pub. 26-7-2002)
- State Environmental Planning Policy No 70—Affordable Housing (Revised Schemes): Land Application (pub. 31-5-2002)
- Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997): Land Application (pub. 7-11-1997)
- Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997): Sub Catchment Boundaries (pub. 7-11-1997)
- Sydney Regional Environmental Plan No 9—Extractive Industry (No 2—1995): Land Application (pub. 15-9-1995)

### Other matters affecting the property

Information held in the Planning Database about other matters affecting the property appears below. The property may also be affected by additional planning controls not outlined in this report. Please speak to your council for more information

1.5 m Buffer around Classified Roads	Classified Road Adjacent
Bushfire Prone Land	Vegetation Buffer
	Vegetation Category
Local Aboriginal Land Council	THARAWAL
Regional Plan Boundary	Greater Sydney
Special Infrastructure Contributions	Western Sydney Growth Centres SIC



421D THE NORTHERN ROAD COBBITTY 2570



# **Property Details**

Address:	421D THE NORTHERN ROAD COBBITTY 2570
Lot/Section /Plan No:	500/-/DP1231858
Council:	CAMDEN COUNCIL

## Summary of planning controls

Planning controls held within the Planning Database are summarised below. The property may be affected by additional planning controls not outlined in this report. Please contact your council for more information.

Local Environmental Plans	Camden Local Environmental Plan 2010 (pub. 28-2-2019)
Land Zoning	E4 - Environmental Living: (pub. 25-9-2020)
	R1 - General Residential: (pub. 28-2-2019)
	RU1 - Primary Production: (pub. 3-9-2010)
Height Of Building	16 m
	9 m
	9.5 m
Floor Space Ratio	NA
Minimum Lot Size	1000 m²
	40 ha
Heritage	NA
Land Reservation Acquisition	NA
Foreshore Building Line	NA
Local Provisions	Wildlife Buffer Zone
	Wind Turbine Buffer Zone
Obstacle Limitation Surface	230.5-230.5



# 421D THE NORTHERN ROAD COBBITTY 2570

Greenfield Housing Code Area

Complying Development Code: <u>https://www.planningportal.nsw.gov.au/greenfield-housing-code</u>

Building type: 1-2 storey homes, residential alterations and additions

Development consent authority: Council or accredited certifier

Note: Applications which meet all relevant requirements in the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 may be approved within 20 days. Exclusions may apply.

https://legislation.nsw.gov.au/#/view/EPI/2008/572/full

## **Detailed planning information**

## State Environmental Planning Policies which apply to this property

State Environmental Planning Policies can specify planning controls for certain areas and/or types of development. They can also identify the development assessment system that applies and the type of environmental assessment that is required.

- State Environmental Planning Policy (Affordable Rental Housing) 2009: Land Application (pub. 31-7-2009)
- State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004: Land Application (pub. 25-6-2004)
- State Environmental Planning Policy (Concurrences and Consents) 2018: Land Application (pub. 21-12-2018)
- State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017: Land Application (pub. 1-9-2017)
- State Environmental Planning Policy (Exempt and Complying Development Codes) 2008: Land Application (pub. 12-12-2008)
- State Environmental Planning Policy (Exempt and Complying Development Codes) 2008: Subject Land (pub. 6-5-2018)
- State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004: Land Application (pub. 31-3-2004)
- State Environmental Planning Policy (Infrastructure) 2007: Land Application (pub. 21-12-2007)
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007: Land Application (pub. 16-2-2007)
- State Environmental Planning Policy (Primary Production and Rural Development) 2019: Land Application (pub. 28-2-2019)
- State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017: Subject Land (pub. 25-8-2017)



# 421D THE NORTHERN ROAD COBBITTY 2570

- State Environmental Planning Policy No 19—Bushland in Urban Areas: Land Application (pub. 24-10-1986)
- State Environmental Planning Policy No 21—Caravan Parks: Land Application (pub. 24-4-1992)
- State Environmental Planning Policy No 33—Hazardous and Offensive Development: Land Application (pub. 13-3-1992)
- State Environmental Planning Policy No 36—Manufactured Home Estates: Land Application (pub. 16-7-1993)
- State Environmental Planning Policy No 50—Canal Estate Development: Land Application (pub. 10-11-1997)
- State Environmental Planning Policy No 55—Remediation of Land: Land Application (pub. 28-8-1998)
- State Environmental Planning Policy No 64—Advertising and Signage: Land Application (pub. 16-3-2001)
- State Environmental Planning Policy No 65—Design Quality of Residential Apartment Development: Land Application (pub. 26-7-2002)
- State Environmental Planning Policy No 70—Affordable Housing (Revised Schemes): Land Application (pub. 31-5-2002)
- Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997): Land Application (pub. 7-11-1997)
- Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997): Sub Catchment Boundaries (pub. 7-11-1997)
- Sydney Regional Environmental Plan No 9—Extractive Industry (No 2—1995): Land Application (pub. 15-9-1995)

### Other matters affecting the property

Information held in the Planning Database about other matters affecting the property appears below. The property may also be affected by additional planning controls not outlined in this report. Please speak to your council for more information

Bushfire Prone Land	Vegetation Category
Local Aboriginal Land Council	THARAWAL
Regional Plan Boundary	Greater Sydney
Special Infrastructure Contributions	Western Sydney Growth Centres SIC



689 THE NORTHERN ROAD BRINGELLY 2556



# **Property Details**

Address:	689 THE NORTHERN ROAD BRINGELLY 2556
Lot/Section /Plan No:	45/-/DP1104369
Council:	CAMDEN COUNCIL

## Summary of planning controls

Planning controls held within the Planning Database are summarised below. The property may be affected by additional planning controls not outlined in this report. Please contact your council for more information.

Local Environmental Plans	Camden Local Environmental Plan 2010 (pub. 20-8-2021)
Land Zoning	RU1 - Primary Production: (pub. 20-8-2021)
Height Of Building	9.5 m
Floor Space Ratio	NA
Minimum Lot Size	40 ha
Heritage	NA
Land Reservation Acquisition	NA
Foreshore Building Line	NA
Local Provisions	13 km
	30 km
	8 km
Obstacle Limitation Surface	230.5-230.5
Riparian Lands and Watercourses	Riparian Area

# **Detailed planning information**

### State Environmental Planning Policies which apply to this property

State Environmental Planning Policies can specify planning controls for certain areas and/or types of development. They can also identify the development assessment system that applies and the type of environmental assessment that is required.

• State Environmental Planning Policy (Affordable Rental Housing) 2009: Land Application (pub. 31-7-2009)


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## 689 THE NORTHERN ROAD BRINGELLY 2556

- State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004: Land Application (pub. 25-6-2004)
- State Environmental Planning Policy (Concurrences and Consents) 2018: Land Application (pub. 21-12-2018)
- State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017: Land Application (pub. 1-9-2017)
- State Environmental Planning Policy (Exempt and Complying Development Codes) 2008: Land Application (pub. 12-12-2008)
- State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004: Land Application (pub. 31-3-2004)
- State Environmental Planning Policy (Infrastructure) 2007: Land Application (pub. 21-12-2007)
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007: Land Application (pub. 16-2-2007)
- State Environmental Planning Policy (Primary Production and Rural Development) 2019: Land Application (pub. 28-2-2019)
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- State Environmental Planning Policy No 21—Caravan Parks: Land Application (pub. 24-4-1992)
- State Environmental Planning Policy No 33—Hazardous and Offensive Development: Land Application (pub. 13-3-1992)
- State Environmental Planning Policy No 36—Manufactured Home Estates: Land Application (pub. 16-7-1993)
- State Environmental Planning Policy No 50—Canal Estate Development: Land Application (pub. 10-11-1997)
- State Environmental Planning Policy No 55—Remediation of Land: Land Application (pub. 28-8-1998)
- State Environmental Planning Policy No 64—Advertising and Signage: Land Application (pub. 16-3-2001)
- State Environmental Planning Policy No 65—Design Quality of Residential Apartment Development: Land Application (pub. 26-7-2002)
- State Environmental Planning Policy No 70—Affordable Housing (Revised Schemes): Land Application (pub. 31-5-2002)
- Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997): Land Application (pub. 7-11-1997)
- Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997): Sub Catchment Boundaries (pub. 7-11-1997)
- Sydney Regional Environmental Plan No 9—Extractive Industry (No 2—1995): Land Application (pub. 15-9-1995)

This report provides general information only and does not replace a Section 10.7 Certificate (formerly Section 149)



# Property Report

689 THE NORTHERN ROAD BRINGELLY 2556

### Other matters affecting the property

Information held in the Planning Database about other matters affecting the property appears below. The property may also be affected by additional planning controls not outlined in this report. Please speak to your council for more information

1.5 m Buffer around Classified Roads	Classified Road Adjacent
Bushfire Prone Land	Vegetation Buffer
	Vegetation Category
Local Aboriginal Land Council	THARAWAL
Regional Plan Boundary	Greater Sydney
Special Infrastructure Contributions	Western Sydney Growth Centres SIC

This report provides general information only and does not replace a Section 10.7 Certificate (formerly Section 149)

Number	Name	Location	Туре	Status	Issued date
1606411		Northern Road and Bringelly Road Upgrade Stage 2, BRINGELLY, NSW 2556	s.80 Surrender of a Licence	Issued	22-Mar-21
20864	ACCIONA INFRASTRUCTURE PROJECTS AUSTRALIA PTY LTD	Northern Road and Bringelly Road Upgrade Stage 2, BRINGELLY, NSW 2556	POEO licence	Surrendered	09-Dec-16
1553513	ACCIONA INFRASTRUCTURE PROJECTS	Northern Road and Bringelly Road Upgrade Stage 2 BRINGELLY NSW 2556	s 58 Licence Variation	Issued	04-Jul-17
1333313	ACCIONA INFRASTRUCTURE PROJECTS	Northern Road and Bringelly Road Upgrade		155000	04 501 17
1572213	AUSTRALIA PTY LTD	Stage 2, BRINGELLY, NSW 2556	s.58 Licence Variation	Issued	04-Dec-18
11539	CLEAN & GREEN ORGANICS PTY LTD	2556 2517 The Northern Road, BRINGELLY, NSW	POEO licence	Issued	18-Oct-01
3085765587	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	Penalty Notice	Withdrawn	
3085765596	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	Penalty Notice	Withdrawn	
11233	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	POEO licence	Issued	18-Oct-00
1005 105		761 The Northern Road, BRINGELLY, NSW			10.14 04
1035465	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556 761 The Northern Road, BRINGELLY, NSW	s.58 Licence Variation	Issued	19-Mar-04
1095376	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.58 Licence Variation	Issued	17-Feb-09
1099072	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	s.58 Licence Variation	Issued	31-Mar-09
1111306	HI-OLIALITY WASTE MANAGEMENT PTY I TO	761 The Northern Road, BRINGELLY, NSW	s 91 Clean I In Notice	Issued	10-Feb-10
1111500		761 The Northern Road, BRINGELLY, NSW		155464	1010010
1111684	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556 761 The Northern Road, PRINCELLY, NSW	s.91 Clean Up Notice	Issued	09-Mar-10
1112249	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556 261 The Northern Road, BRINGELLY, NSW	s.110 Variation of Clean Up Notice	Issued	10-Mar-10
1112260	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.58 Licence Variation	Issued	21-Jun-10
1118231	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	s.58 Licence Variation	Issued	20-Aug-10
		761 The Northern Road, BRINGELLY, NSW			
1121730	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556 761 The Northern Road, BRINGELLY, NSW	s.58 Licence Variation	lssued	11-Feb-11
1503776	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.96 Prevention Notice	Issued	09-Mar-12
1507951	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	s.110 Variation of Prevention Notice	Issued	17-Aug-12
3085767576	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	Penalty Notice	Issued	18-Dec-12
1504950	HI-OLIALITY WASTE MANAGEMENT PTY I TO	761 The Northern Road, BRINGELLY, NSW	s 79 Suspension of a Licence	lssued	10-lan-13
1304330		761 The Northern Road, BRINGELLY, NSW		155464	10 Juli 15
1532259	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.58 Licence Variation	Issued	13-Aug-15
1546630	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556 251 The Northern Road, BRINGELLY, NSW	s.91 Clean Up Notice	Issued	16-Nov-16
3085782563	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	Penalty Notice	Issued	08-Jun-17
2095702501		761 The Northern Road, BRINGELLY, NSW	Popalty Notico	Issued	09 Jup 17
3083782381	HI-QUALITY WASTE MANAGEMENT FIT LTD	761 The Northern Road, BRINGELLY, NSW		issueu	08-Juli-17
3085782572	HI-QUALITY WASTE MANAGEMENT PTY LTD		Penalty Notice	Issued	08-Jun-17
1554407	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	31-Aug-17
1556796	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	s.110 Variation of Clean Up Notice	Issued	18-Sep-17
1557957	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	s.110 Variation of Clean Up Notice	Issued	25-Oct-17
1563262	HI-OLIALITY WASTE MANAGEMENT PTY I TO	761 The Northern Road, BRINGELLY, NSW 2556	s 110 Variation of Clean Un Notice	Issued	29-Mar-18
1563297	HEQUALITY WASTE MANAGEMENT PTY I TO	761 The Northern Road, BRINGELLY, NSW	s 58 Licence Variation	lisued	03-Apr-18
1303297	THE QUALITY WASTE MANAGEMENT FIT LID	761 The Northern Road, BRINGELLY, NSW		133424	02-Whi-19
1563465	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556 761 The Northern Road, BRINGELLY, NSW	s.58 Licence Variation	Issued	05-Apr-18
1563830	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	20-Apr-18
1565460	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	s.110 Variation of Clean Up Notice	Issued	05-Jun-18
1572231	HI-QUALITY WASTE MANAGEMENT PTY LTD	761 The Northern Road, BRINGELLY, NSW 2556	s.110 Variation of Clean Up Notice	Issued	27-Nov-18

		761 The Northern Road, BRINGELLY, NSW			
1576537	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	01-Mar-19
		761 The Northern Road, BRINGELLY, NSW			
1578978	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	13-May-19
		761 The Northern Road, BRINGELLY, NSW			
1581395	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	10-Jul-19
		761 The Northern Road, BRINGELLY, NSW			
1585698	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	07-Jan-20
		761 The Northern Road, BRINGELLY, NSW			
1593192	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	31-Mar-20
		761 The Northern Road, BRINGELLY, NSW			
1594779	HI-QUALITY WASTE MANAGEMENT PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	20-May-20
		769 The Northern Road, BRINGELLY, NSW			
1028105	VOLK HOLDINGS PTY LTD	2556	s.91 Clean Up Notice	Issued	23-Jun-03
		769 The Northern Road, BRINGELLY, NSW			
1033769	VOLK HOLDINGS PTY LTD	2556	s.91 Clean Up Notice	Issued	09-Jan-04
		769 The Northern Road, BRINGELLY, NSW			
1096898	VOLK HOLDINGS PTY LTD	2556	s.58 Licence Variation	Issued	19-Jan-09
		769 The Northern Road, BRINGELLY, NSW			
1101429	VOLK HOLDINGS PTY LTD	2556	s.58 Licence Variation	Issued	01-Jul-09
		769 The Northern Road, BRINGELLY, NSW			
1103296	VOLK HOLDINGS PTY LTD	2556	s.91 Clean Up Notice	Issued	25-Aug-09
		769 The Northern Road, BRINGELLY, NSW			
1107272	VOLK HOLDINGS PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	22-Oct-09
		769 The Northern Road, BRINGELLY, NSW			
1128831	VOLK HOLDINGS PTY LTD	2556	s.91 Clean Up Notice	Issued	10-Jun-11
		769 The Northern Road, BRINGELLY, NSW			
1500694	VOLK HOLDINGS PTY LTD	2556	s.110 Variation of Clean Up Notice	Issued	28-Oct-11
		769 The Northern Road, BRINGELLY, NSW			
3085770811	VOLK HOLDINGS PTY LTD	2556	Penalty Notice	Issued	21-May-13
		769 The Northern Road, BRINGELLY, NSW			
1519975	VOLK HOLDINGS PTY LTD	2556	s.58 Licence Variation	Issued	18-Feb-14
		769 The Northern Road, BRINGELLY, NSW			
1538776	W2R ORGANICS PTY LTD	2556	s.58 Licence Variation	Issued	13-Apr-16
		769 The Northern Road, BRINGELLY, NSW			
3173527794	W2R ORGANICS PTY LTD	2556	Penalty Notice	Issued	24-May-19
		769 The Northern Road, BRINGELLY, NSW			
1527358	W2R PTY LTD	2556	s.58 Licence Variation	Issued	18-Mar-15
		769 The Northern Road, BRINGELLY, NSW			
1535116	W2R PTY LTD	2556	s.58 Licence Variation	Issued	19-Feb-16
		769 The Northern Road, BRINGELLY, NSW			
3085779080	W2R PTY LTD	2556	Penalty Notice	Issued	30-May-16

Background

A strategy to systematically prioritise, assess and respond to notifications under Section 60 of the Contaminated Land Management Act 1997 (CLM Act) has been developed by the EPA. This strategy acknowledges the EPA's obligations to make information available to the public under Government Information (Public Access) Act 2009.

When a site is notified to the EPA, it may be accompanied by detailed site reports where the owner has been proactive in addressing the contamination and its source. However, often there is minimal information on the nature or extent of the contamination.

After receiving a report, the first step is to confirm that the report does not relate to a pollution incident. The Protection of the Environment Operations Act 1997 (POEO Act) deals with pollution incidents, waste stockpiling or dumping. The EPA also has an incident management process to manage significant incidents (https://www.epa.nsw.gov.au/reporting-and-incidents/incident-management).

In many cases, the information indicates the contamination is securely immobilised within the site, such as under a building or carpark, and is not currently causing any significant risks for the community or environment. Such sites may still need to be cleaned up, but this can be done in conjunction with any subsequent building or redevelopment of the land. These sites do not require intervention under the CLM Act, and are dealt with through the planning and development consent process. In these cases, the EPA informs the local council or other planning authority, so that the information can be recorded and considered at the appropriate time (https://www.epa.nsw.gov.au/your-environment/contaminated-land/managing-contaminated-land/role-of-planning-authorities).

Where indications are that the contamination could cause actual harm to the environment or an unacceptable offsite impact (i.e. the land is 'significantly contaminated'), the EPA would apply the regulatory provisions of the CLM Act to have the responsible polluter and/or landowner investigate and remediate the site. If the reported contamination could present an immediate or long-term threat to human health NSW Health will be consulted. SafeWork NSW and Water NSW can also be consulted if there appear to be occupational health and safety risks or an impact on groundwater quality.

As such, the sites notified to the EPA and presented in the list of contaminated sites notified to the EPA are at various stages of the assessment and remediation process. Understanding the nature of the underlying contamination, its implications and implementing a remediation program where required, can take a considerable period of time. The list provides an indication, in relation to each nominated site, as to the management status of that particular site. Further detailed information may be available from the EPA or the person who notified the site.

The following questions and answers may assist those interested in this issue.

#### Frequently asked questions

#### Why does my land appear on the list of notified sites?

Your land may appear on the list because:

the site owner and/or the polluter has notified the EPA under section 60 of the CLM Act
 the EPA has been notified via other means and is satisfied that the site is or was contaminated.

If a site is on the list, it does not necessarily mean the contamination is significant enough to regulate under the CLM Act.

#### Does the list contain all contaminated sites in NSW?

No. The list only contains contaminated sites that EPA is aware of. If a site is not on the list, it does not necessarily mean the site is not contaminated.

The EPA relies on responsible parties and the public to notify contaminated sites.

#### How are notified contaminated sites managed by the EPA?

There are different ways the EPA can manage notified contaminated sites. Options include:

regulation under the CLM Act, POEO Act, or both

notifying the relevant planning authority for management under the planning and development process
 managing the site under the Protection of the Environment Operation (Underground Petroleum Storage Systems) Regulation 2014.

There are specific cases where contamination is managed under a tailored program operated by another agency (for example, the Resources & Geoscience's Legacy Mines Program).

#### What should I do if I am a potential buyer of a site that appears on the list?

You should seek advice from the seller to understand the contamination issue. You may need to seek independent contamination or legal advice.

The information provided in the list is indicative only and a starting point for your own assessment. Land contamination from past site uses is common, mainly in urban environments. If the site is properly remediated or managed, it may not affect the intended future use of the site.

#### Who can I contact if I need more information about a site?

You can contact the Environment Line at any time by calling 131 555 or by emailing info@environment.nsw.gov.au.

#### List of NSW Contaminated Sites Notified to the EPA

#### Disclaimer

The EPA has taken all reasonable care to ensure that the information in the list of contaminated sites notified to the EPA (the list) is complete and correct. The EPA does not, however, warrant or represent that the list is free from errors or omissions or that it is exhaustive.

The EPA may, without notice, change any or all of the information in the list at any time.

You should obtain independent advice before you make any decision based on the information in the list.

The list is made available on the understanding that the EPA, its servants and agents, to the extent permitted by law, accept no responsibility for any damage, cost, loss or expense incurred by you as a result of:

any information in the list; or

- any error, omission or misrepresentation in the list; or
   any malfunction or failure to function of the list:
- 4. without limiting (2) or (3) above, any delay, failure or error in recording, displaying or updating information.

Site Status	Explanation
Under assessment	The contamination is being assessed by the EPA to determine whether regulation is required. The EPA may require further information to complete the assessment. For example, the completion of management actions regulated under the planning process or <i>Protection of the Environment Operations Act 1997</i> .
Under Preliminary Investigation Order	The EPA has issued a Preliminary Investigation Order under s10 of the <i>Contaminated Land Management Act 1997</i> , to obtain additional information needed to complete the assessment.
Regulation under CLM Act not required	The EPA has completed an assessment of the contamination and decided that regulation under the <i>Contaminated Land Management Act 1997</i> is not required.
Regulation being finalised	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the <i>Contaminated Land Management Act 1997</i> . A regulatory approach is being finalised.
Contamination currently regulated under CLM Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the Contaminated Land Management Act 1997 (CLM Act). Management of the contamination is regulated by the EPA under the CLM Act. Regulatory notices are available on the EPA's Contaminated Land Public Record.
Contamination currently regulated under POEO Act	Contamination is currently regulated under the Protection of the Environment Operations Act 1997 (POEO Act). The EPA as the appropriate regulatory authority reasonably suspects that a pollution incident is occurring/ has occurred and that it requires regulation under the POEO Act. The EPA may use environment protection notices, such as clean up notices, to require clean up action to be taken. Such regulatory notices are available on the POEO public register.
Contamination being managed via the planning process (EP&A Act)	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. The contamination of this site is managed by the consent authority under the <i>Environmental Planning and Assessment</i> <i>Act 1979</i> (EP&A Act) planning approval process, with EPA involvement as necessary to ensure significant contamination is adequately addressed. The consent authority is typically a local council or the Department of Planning and Environment.
Contamination formerly regulated under the CLM Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation under the Contaminated Land Management Act 1997 (CLM Act). The contamination was addressed under the CLM Act.
Contamination formerly regulated under the POEO Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed under the <i>Protection of the Environment Operations Act 1997</i> (POEO Act).
Contamination was addressed via the planning process (EP&A Act)	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed by the appropriate consent authority via the planning process under the <i>Environmental Planning and Assessment Act</i> 1979 (EP&A Act).
Ongoing maintenance required to manage residual contamination (CLM Act)	The EPA has determined that ongoing maintenance, under the Contaminated Land Management Act 1997 (CLM Act), is required to manage the residual contamination. Regulatory notices under the CLM Act are available on the EPA's Contaminated Land Public Record.

Suburb	SiteName	Address	ContaminationActivityType	ManagementClass	Latitude	Longitude
BRANXTON	Former Service Station Branxton	Part of 70 Maitland STREET	Service Station	Contamination currently regulated under CLM Act	-32.65631582	151.3516243
BRANXTON	Branxton Wastewater Treatment Works	2151 New England HIGHWAY	Other Industry	Regulation under CLM Act not required	-32.66069944	151.3625572
BREWARRINA	Dowell's Fuel	39 Doyle STREET	Service Station	Regulation under CLM Act not required	-29.96152786	146.8612561
BRIGHTON-LE-SANDS	Shell Service Station Brighton Le Sands & adjacent land	2 General Holmes DRIVE	Service Station	Contamination formerly regulated under the CLM Act	-33.9579214	151.1578665
BRIGHTON-LE-SANDS	Cook Park	General Holmes DRIVE	Service Station	Contamination formerly regulated under the CLM Act	-33.9581072	151.1579572
BROADMEADOW	Former Industrial Site	16 Broadmeadow ROAD	Service Station	Regulation under CLM Act not required	-32.91444096	151.7300112
BROADMEADOW	Nineways Broadmeadow Coles Express SS	Corner Brunker Road and Lambton ROAD	Service Station	Regulation under CLM Act not required	-32.92511185	151.7364247
BROADMEADOW	2 Georgetown Road, Broadmeadow NSW 2292	2 Georgetown ROAD	Metal Industry	Under assessment	-32.912288	151.732211

### Search results

Your search for:Suburb: BRINGELLY

#### did not find any records in our database.

If a site does not appear on the record it may still be affected by contamination. For example:

- Contamination may be present but the site has not been regulated by the EPA under the Contaminated Land Management Act 1997 or the Environmentally Hazardous Chemicals Act 1985.
- The EPA may be regulating contamination at the site through a licence or notice under the Protection of the Environment Operations Act 1997 (POEO Act).
- Contamination at the site may be being managed under the <u>planning</u> process.

More information about particular sites may be available from:

- The <u>POEO public register</u>
- The appropriate planning authority: for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act.

See What's in the record and What's not in the record.

If you want to know whether a specific site has been the subject of notices issued by the EPA under the CLM Act, we suggest that you search by Local Government Area only and carefully review the sites that are listed.

This public record provides information about sites regulated by the EPA under the Contaminated Land Management Act 1997, including sites currently and previously regulated under the Environmentally Hazardous Chemicals Act 1985. Your inquiry using the above search criteria has not matched any record of current or former regulation. You should consider searching again using different criteria. The fact that a site does not appear on the record does not necessarily mean that it is not affected by contamination. The site may have been notified to the EPA but not yet assessed, or contamination may be present but the site is not yet being regulated by the EPA. Further information about particular sites may be available from the appropriate planning authority, for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act. In addition the EPA may be regulating contamination at the site through a licence under the Protection of the Environment Operations Act 1997. You may wish to search the POEO public register.

For business and industry ~

1 July 2021

For local government ^

### Contact us

131 555 (tel:131555)

Online (https://yoursay.epa.nsw.gov.au/epa-website-feedback)

info@epa.nsw.gov.au (mailto:info@epa.nsw.gov.au)

EPA Office Locations (https://www.epa.nsw.gov.au/about-us/contact-us/locations)

Accessibility (https://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/help-index) Disclaimer (https://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/disclaimer) Privacy (https://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/privacy) Copyright (https://www.epa.nsw.gov.au/about-us/contact-us/website-service-standards/copyright) in (https://au.lin environmentprotectiony autl⊡rity-(https://w/ttper//w/

Find us on

Refine Search

Search Again

To search for a specific site, search by LGA (local government area) and carefully review all sites listed

... more search tips

# Appendix D

**Historical Aerials** 



















# Appendix E

Site Photographs



Photo 1 - General Site Photograph



Photo 2 - General Site Photograph



	Site Photographs	PROJECT:	92225.04
ers	Preliminary Site Investigation	PLATE No:	1
dwater	621 - 705 The Northern Road, Cobbitty	REV:	0
	CLIENT: Boyuan Bringelly Pty Ltd	DATE:	Jul-20



Photo 4 - Observed Fly Tipping



Site Photographs	PROJECT:	92225.04
Preliminary Site Investigation	PLATE No:	2
621 - 705 The Northern Road, Cobbitty	REV:	0
CLIENT: Boyuan Bringelly Pty Ltd	DATE:	Jul-20



Photo 5 - Potential ACM Pipe

	Site Photographs	PROJECT:	92225.04	
<b>Douglas Partners</b> Geotechnics   Environment   Groundwater	Preliminary Site Investigation	PLATE No:	3	
	621 - 705 The Northern Road, Cobbitty	REV:	0	
	CLIENT: Boyuan Bringelly Pty Ltd	DATE:	Jul-20	

# Appendix F

Logs

**BOREHOLE LOG** 

SURFACE LEVEL: EASTING: 290132 NORTHING: 0237715 DIP/AZIMUTH: 90°/-

BORE No: GW1 **PROJECT** No: 192225.02 DATE: 21/2/2020 SHEET 1 OF 1

### Sampling & In Situ Testing Description Well Graphic Water Depth Log Sample 뉟 Construction of Depth Type Results & Comments (m) Strata Details 0.05 TOPSOIL/Silty CLAY: brown, with rootlets Silty CLAY: pale grey and brown grout NO00000000 2 3 3.0 -3 bentonite SHALE: pale grey and brown 4 - 4 5 - 5 sand screen ₹ 10-03-21 6 6 7 7.1 Bore discontinued at 7.1m - limit of investigation 8 - 8 9 - 9

RIG: Comacchio GEO 405

DRILLER: Terratest

LOGGED: ERL

CASING:

TYPE OF BORING: SFA and rotary air blast WATER OBSERVATIONS: No free groundwater observed whilst augering

Boyuan Bringelly Pty Ltd

621 I705 The Northern Road, Cobbitty, NSW

Proposed Rezoning

CLIENT: **PROJECT:** 

LOCATION:

**REMARKS:** Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND A AugeriSample B Bulkisample BLK Blockisample C Coreidrilling D Disturbedisample E Environmentalise G P U<sub>x</sub> W Waterievel Environmental sample

 
 LECEND

 PID
 Photo/ionisation detector (ppm)

 PL(A) Point load axial test Is(50) (MPa)

 PL(D) Point load diametral test Is(50) (MPa)

 pp
 Pocket penetrometer (kPa)

 S
 Standard penetrationitest

 V
 Shear vane (kPa)
 Gasisample Pistonisample Tubeisample(ximmidia.) Waterisample Wateriseep



BOREHOLELOG

BORE No: GW2 PROJECT No: 92225.02 DATE: 21/2/2020 SHEET 1 OF 1

			Description	. <u>0</u>		Sam	npling	In Situ Testing	Τ.	Well	
Ъ	De (I	epth m)	of	Graph Log	ype	epth	mple	Results &	Water	Constructio	n
		0.05	Strata		·	ă	Sa	Comments		Details	
	-	0.00	VIOPSOIL/Silty/CLAY: brown, with rootlets	1/1	1						
		2.5	TOPSOIL/Silty:CLAY:::brown.iwith:rootlets       Silty:CLAY:::brange:brown:and:grey   SHALE::::pale:grey, possibly:some:sandstone Bore:discontinued:at:7.1m -:limit:of:investigation						10-03-21	grout - -2 -2 -2 -3 -4 -4 -4 -4 -5 -5 -5 -5 -6 -6 -6 -7	
	- 8 									-9	

RIG: Comacchio GEO 405

CLIENT:

PROJECT:

LOCATION:

Boyuan Bringelly Pty Ltd

621 3705 The Northern Road, Cobbitty, NSW

Proposed Rezoning

DEA Candifeter (Circlinet

LOGGED: ERL

CASING:

TYPE OF BORING: SFA and rotary air blast

**WATER OBSERVATIONS:** No free groundwater observed whilst augering **REMARKS:** Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

 SAMPLING & INST UI

 A Augerisample
 G Gasisample

 B Bukisample
 P istonisample

 BLK Blockisample
 U, Tube sample (x

 C Core drilling
 W Waterisample

 D Disturbedisample
 F

 E Environmental sample
 T Waterilevel

ESTINGL	LEGE	ND
	PID	Photo ionisation detector (ppm)
	PL(A)	Point load axial test 1s(50) (MPa)
mmīdia.)	PL(D)	Point load diametral test (\$0) (MPa)
	pp	Pocket penetrometer (kPa)
	S	Standard penetration test
	V	Shear vane (kPa)



**BOREHOLE LOG** 

SURFACE LEVEL: EASTING: 289923 NORTHING: 6237057 BORE No: GW3 **PROJECT** No: 192225.02 DATE: 24/2/2020 SHEET 1 OF 1

### DIP/AZIMUTH: 90°/-Sampling & In Situ Testing Well Description Graphic Water Depth Log Sample 뉟 Construction of Depth Type Results & Comments (m) Strata Details 0.05 \TOPSOIL/Silty CLAY: brown, with rootlets Silty CLAY: red brown and grey mottled -becoming grey and orange mottled below 0.5m grout 2 2 000000 3 - 3 A 3.5 SHALE: pale brown 10-03-21 bentonite 4 4 5 - 5 sand 6 -6 screen 7.7 Bore discontinued at 7.7m - limit of investigation 8 - 8 9 - 9

RIG: Comacchio GEO 405

DRILLER: Terratest TYPE OF BORING: SFA and rotary air blast

Boyuan Bringelly Pty Ltd

621 I705 The Northern Road, Cobbitty, NSW

Proposed Rezoning

CLIENT: **PROJECT:** 

LOCATION:

LOGGED: ERL

CASING:

WATER OBSERVATIONS: No free groundwater observed whilst augering

**REMARKS:** Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND A AugeriSample B BulkiSample BLK Blockisample C Coreidrilling D Disturbedisample E Environmentalise G P U<sub>x</sub> W Water see Waterievel Environmental sample

Gasisample Pistonisample Tubeisample(ximmidia.) Waterisample

 LEGEND

 PID
 Photo/ionisation detector((ppm)

 PL(A)
 Point load axial test Is(50) (MPa)

 PL(D)
 Point load diametral test Is(50) (MPa)

 pp
 Pocket penetrometer (kPa)

 S
 Standard penetration(test

 V
 Shear vane (kPa)



BOREHOLELOG

SURFACE LEVEL: EASTING: 289665 NORTHING: 6236789 DIP/AZIMUTH: 90°/-

BORE No: GW4 **PROJECT No:** 192225.02 DATE: 24/2/2020 SHEET 1 OF 1

		Description	. <u>ಲ</u>		Sam	npling	&In:Situ:Testing		Well	
님	Depth (m)	of	raph Log	be.	pth	nple		Vate	Construction	
		Strata	0	тy	De	San	Comments	Ĺ	Details	kOI
	- 0.1	TOPSOIL/Silty@LAY: brown, with rootlets	1/1/							
	-	Silty CLAY: Drown and grey	1/1					₹		0
	-		1/1/					3-21		000
	- 1		1/1					10-0		000
	-		1/1/							00
	-									000
	-		1/1/							00
										00
	-2		1/1/							00
	-									00
			1/1/							000
	-									000
	-3		1/1/							000
	-									000
	- 3.5 -	SHALE: Tpale brown and grey								000
	-									200
	-4								-4 [ bentonite	Ø
	-									
	-								[ ] [ ]	
	-									
	-5								-5	<u> </u>
	-									<u>=</u>
	-									3
	-								sand -	<u>=</u>
	-6	- becoming dark grey below 6.0m							-6	=
	-								screen	Ē
	-									<u>=</u>  :
	-7								-7	=[::]
	-									<u>=</u> [:
	-									<u>=</u> ::
	-									<u> </u>
	-8 8.0	Bore discontinued at 8.0m							8	
	-	-ilimitofinvestigation								
	-									
	-9								-9	

RIG: Comacchio GEO 405

CLIENT:

PROJECT:

LOCATION:

Boyuan Bringelly Pty Ltd

621 E705 The Northern Road, Cobbitty, NSW

Proposed Rezoning

DRILLER: Terratest

LOGGED: ERL

CASING:

TYPE OF BORING: SFA and rotary air blast WATER OBSERVATIONS: Groundwater observed whilst augering at 7 3m **REMARKS:** Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND A Augerisample B Bulkisample BLK Blockisample C Core drilling D Disturbed sample E Environmental sample Gasisample Pistonisample Tube sample(ximmidia.) Waterisample Wateriseep Waterievel G P U<sub>×</sub> W 

**Douglas Partners** Geotechnics | Environment | Groundwater



BOREHOLELOG

SURFACE LEVEL: EASTING: 289665 NORTHING: 6236789 DIP/AZIMUTH: 90°/-

BORE No: GW5 PROJECT No: 092225.02 DATE: 21/2/2020 SHEET 1 OF 1

Γ		Description	U		Sam	npling	&InSituTesting		Well	
	Depth	of	aphi -og	e	th	ple	Poculte 18	/ater	Constructio	'n
		Strata	0	Typ	Dep	Sam	Comments	>	Details	
	0.05	TOPSOIL/Silty CLAY: brown, with rootlets								
	-1 -1	Silty:CLAY:::red:brown:and:orange:brown -:becoming:grey:and:red:mottled:below/3.0m SHALE:::pale:brown						10-03-20	-1 grout -2 -3 bentonite -4 -4 -5 screen	
	-7 7.0	Boreidiscontinuediati7.0m - Ilimitiofiinvestigation								

RIG: Comacchio GEO 405

CLIENT:

PROJECT:

LOCATION:

Boyuan Bringelly Pty Ltd

621 E705 The Northern Road, Cobbitty, NSW

Proposed Rezoning

DRILLER: Terratest TYPE OF BORING: SFA and rotary air blast

LOGGED: ERL

CASING:

WATER OBSERVATIONS: No free groundwater observed whilst augering REMARKS: Location coordinates are in MGA94 Zone 56 Not bailed

SAMPLING & IN SITU TESTING LEGEND A Augerisample B Bulkisample BLK Blockisample C Core drilling D Disturbed sample E Environmental sample Gasisample Pistonisample Tube sample(ximmidia.) Waterisample Wateriseep Waterievel G P U<sub>×</sub> W 

LEGEND PID Photo ionisation detector (ppm) PL(A) Point load axial test Is(50) (MPa) PL(D) Point load diametral test Its(50) (MPa) pp Pocket penetrometer (kPa) \$ Standard penetration test V Shear vane (kPa)



# CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 I 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 90 mAHD EASTING: 289823 NORTHING: 6237792

PIT No: 101 PROJECT No: 192225.02 DATE: 13/2/2020 SHEET 11 10F 11

		Description		blic g	Sampling & In Situ Testing								
R	Dep (m	oth 1)	of Strata	Graph Log	Type	Depth	ample	Results⊺& Comments	Water	Dyi	namic Pe (blows 🛛	netromet per 150m	er⊡est m) 20
- <del>6</del> - - -	- - -		TOPSOIL/Silty@LAY@I: @brow, trace@ravel@and.sand, rootlets in top 0.1m, w <pl< td=""><td></td><td></td><td></td><td>0</td><td></td><td></td><td>-</td><td></td><td></td><td></td></pl<>				0			-			
-	- - -	0.4	Silty CLAY CI: grey, brown, yellow and red mottled, trace gravel and sand, w <pl, hard<="" td=""><td></td><td></td><td>0.5</td><td></td><td></td><td></td><td>-</td><td></td><td>Ļ</td><td><b>–</b></td></pl,>			0.5				-		Ļ	<b>–</b>
68	- - - - - -				D	0.9 1.0		pp:≥400		- 1 -			• • • • • •
	- - -	1.4	SiltyICLAYICI: IIgreyIandIredIbrown, ItraceIsandstone gravel, W <pl, ihard<="" td=""><td></td><td>Dx2</td><td>1.5</td><td></td><td>pp⊵≥400</td><td></td><td>-</td><td></td><td></td><td></td></pl,>		Dx2	1.5		pp⊵≥400		-			
- 88	-2		~-becoming grey below 1.7m		D	2.0		pp:≢!300		-2		• • • •	• • • •
	-	2.2	SANDSTONE: []brown, [with itron staining, ]bw [to]medium strength, [highly][to]moderately][weathered		D	2.5				-			
87			Pitidiscontinued at 2.6m - refusation tow to medium strength sandstone							-3		• • • •	• • • • •
	-												
	-									-		•	•
-98	-4									-4		•	•
	-									-		•	• • • • • • • • • • • • • • • • • • • •
	-5									-5		*	* * * *
	- - -									-			
84	-6									-6			
	-									-		*	•
	- - -									-			•
- 83-	-7 - -									-7 - -		• • • •	• • • •
	-												
82	- 8									-8		•	•
	- - -									-		•	• • • • • • • • • • • • • • • • • • • •
81	-9									-9		•	•
	-									-		•	•
	- - -									-		•	•

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

#### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND											
А	Augerisample	G	Gasisample	PID	Photo ionisation detector (ppm)							
в	Bulkisample	Р	Pistonisample	PL(A)	Point load axial test is(50) (MPa)							
BLK	Block sample	U,	Tube sample (x mm dia )	PL(D)	Point load diametral test (50) (MPa)							
С	Core drilling	Ŵ	Watersample	pp	Pocket penetrometer (kPa)							
D	Disturbed sample		Waterseep	S	Standard penetration test							
Е	Environmental sample	E.	Waterieve	V	Shear vane (kPa)							



# CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 I 705 The Northern Road, Cobbitty, NSW

SURFACE LEVEL: 188 mAHD EASTING: 1290291 NORTHING: 16237683 PIT No: 102 PROJECT No: 192225.02 DATE: 13/2/2020 SHEET 11 10F 11

Γ			Description	<u>.</u>	Sampling & In Situ Testing			Dumomio@enotromotor/Toot						
R	D (	epth (m)	of Strata	Graph Log	Type	Depth	ample	Results <b>⊺&amp;</b> Comments	Wate	Dyna	amic Po (blows	enetro per 15	meter( 50mm)	] est
-20	-		TOPSOIL/Silty CLAY CI: brown, trace gravel, rootlets in	M			05				Ē		:	<u>;</u> 1
	-	0.4	Silty CLAY CI: Ted brown, trace fronstone gravel, w <pl, hard<="" td=""><td></td><td>D</td><td>0.5</td><td></td><td>pp⊵400</td><td></td><td></td><td></td><td></td><td></td><td></td></pl,>		D	0.5		pp⊵400						
87	- 1				D/B	1.0		pp⊵¥400		-1			•	•
	-				D	1.5		pp!≥400						•
86	-2	1.8	Silty CLAY CI: grey and red brown mottled, trace		D	2.0		pp. <b>∋</b> I300		-2				•
	-					25		2217/300						
						2.5		pp = 1300						•
85	-3	3.0	Pitīdiscontinuedīatī3.0m - Ilimitīof investigation		—D—	-3.0-				-3 -	:		•	• • • •
	-													
84	-4									-4				
-	- - -													•
83	-5									-5			•	
-	-												•	•
-	-													•
-18	-7									-7				
-	-												•	
80	-8									-8				
62	- 9									-9				
														•

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

**REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND											
А	Augersample	G	Gasisample	PID	Photo ionisation detector (ppm)							
в	Bulkisample	Р	Piston sample	PL(A)	Point load axial test ls(50) (MPa)							
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	) Point load diametral test ls(50) (MPa)							
С	Core drilling	Ŵ	Water sample	pp	Pocket penetrometer (kPa)							
D	Disturbed sample		Waterseep	S	Standard penetration test							
E	Environmental sample		Water level	V	Shear vane (kPa)							





# CLIENT:Boyuan Bringelly Pty 11tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 195 mAHD EASTING: 1290561 NORTHING: 16237693

PIT No: 103 PROJECT No: 192225.02 DATE: 13/2/2020 SHEET 11 10F 11

	Description		<u>.</u>	Sampling & In Situ Test		In Situ Testing				
R	Depti (m)	h of Strata	Graph Log	Type	Depth	Sample	Results⊧& Comments	Wate	DynamiclPenetrometer∐ est (blowstper⊡50mm) 5 10 15 20	
8	-	TOPSOIL/Silty CLAY CI: Torown, trace rootlets in top	M							
-		5.3 0.1111, WARL Silty CLAY CI: Fred brown and grey mottled, frace gravel and sand, WARL, hard		Dx2	0.5					
- 16	- - - 1			D	1.0					
		SANDSTONE: fine grained, grey, low strength, moderately weathered		Dx2	1.5					
		becoming brown, low to medium strength, moderately weathered								
-6	-2 2	PitIdiscontinued at 2.0m - Tefusal on low to medium strength sandstone	L	—D—	-2.0-				2	
	-									
-66	-3								-3	
F	-									
-	-4									
	-									
-66	-5								5	
	-									
	-									
-88	-6									
	-									
- 88	-7								7	
	-									
	-									
18	-8								-8	
	- - -									
	-9								9	
-	-									
	-									

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

#### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND											
А	Augerisample	G	Gas sample	PID	Photo ionisation detector (ppm)							
в	Bulkisample	Р	Piston sample	PL(A	) Point load axial test ls(50) (MPa)							
BLK	Blockisample	U,	Tube sample (xmmidia)	PL(C	) Point load diametral test (50) (MPa)							
С	Core drilling	Ŵ	Water sample	pp`	Pocket penetrometer (kPa)							
D	Disturbed sample		Waterseep	S	Standard penetration test							
E	Environmentalisample		Water level	V	Shear vane (kPa)							



# CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 I 705 The Northern Road, Cobbitty, NSW

### **SURFACE LEVEL**: **194** mAHD **EASTING**: **1289871 NORTHING**: **16237343**

PIT No: 104 PROJECT No: 92225.02 DATE: 3/2/2020 SHEET 1 0F 1

			Description	<u>.0</u>		San	npling	&In Situ Testing		_				
님	Dej (n	pth n)	of	Graph Log	<b>Type</b>	Depth	ample	Results & Comments	Wate	Dynamic (blov	Penetron	neter⊡est 0mm)		
8			TOPSOIL/Silty/CLAV/CL/With/rootlets/in/top/0.1m W/SL				õ			5	10 1			
	-	0.2	Silty CLAY CI: brown, trace gravel and sand, w <pl, hard<="" td=""><td></td><td>Dx2</td><td>0.5</td><td></td><td>npi&gt;400</td><td></td><td></td><td></td><td></td></pl,>		Dx2	0.5		npi>400						
93	- - - -1	0.6	Silty:CLAY:Cl: ::red:brown:and:grey:mottled,:trace:gravel and isand,:m <pl,:hard< td=""><td></td><td>D</td><td>1.0</td><td></td><td>PP (2 100</td><td></td><td>- - - -1</td><td></td><td></td></pl,:hard<>		D	1.0		PP (2 100		- - - -1				
	-		-/becoming/more/arev/with/depth/below/1.7m		Dx2	1.5								
92	-2				D	2.0				-2				
-	- - -		- becoming extremely weathered below/2.8m		Dx2	2.5		pp!≥400		- · · · · · · · · · · · · · · · · · · ·				
<u>1</u> 2	-3	3.0	Pitidiscontinued at 3.0m	<u>x +/ +/</u>		-3.0-			1	-3 :				
	-		-limitofünvestigation											
- 06	- 4 - 4 									-4				
68										-5				
- 88	- 6									-6				
	-													
	- - - -													
	- 8									- 8				
	-													
1 1 1 1 1	-9									-9				
-	- - -													

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND											
A	Augerisample	G	Gas sample	PID	Photo ionisation detector (ppm)							
в	Bulkisample	Р	Piston sample	PL(A)	) Point load axial test ls(50) (MPa)							
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D	) Point load diametral test (50) (MPa)							
С	Core drilling	Ŵ	Water sample	pp	Pocket penetrometer (kPa)							
D	Disturbed sample		Water seep	S	Standard penetration test							
Е	Environmental sample	ETT	Waterlievel	V	Shear vane (kPa)							



# CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 I 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 197 mAHD EASTING: 1290287 NORTHING: 16237383

PIT No: 105 PROJECT No: 192225.02 DATE: 13/2/2020 SHEET 11 00F 11

		Description	Description .ല Sampling &dn:Situ⊡esting									
Ч	Depth (m)	of	raph Log	be	pth	aldı	Results⊺&	Natel	Dyn	amic Pene (blows per	trometer⊡ ⊡150mm)	est
		Strata	U	Ty	De	San	Comments	-	5	10	15 2	20
Ē	- 0.2	TOPSOIL/Silty CLAY CI: Drown, with rootlets in top 0.1m,	ЮŽ									: 
ŧ		Silty CLAY CI: Thrown frace gravel and sand w <pl fard<="" td=""><td></td><td></td><td>0.35</td><td></td><td>pp⊵¥400</td><td></td><td></td><td></td><td></td><td>· ·</td></pl>			0.35		pp⊵¥400					· ·
E	- 0.0	Silty CLAY CI: red brown, trace gravel and sand, w <pl,< td=""><td>1/1/</td><td></td><td>0.5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></pl,<>	1/1/		0.5							
ŧ,		hard										
E.	-1		1/1/		1.0							
ŧ	-											
ŧ	-		1/1/	Dx2	1.5		pp⊵≱400					:
E	-											
-56	-2		1/1/	D	2.0				-2	•		
Ē	- 2.2	SANDSTONE: fine grained, pale grey and brown, with										:
ŧ	- 2.5	Pitidiscontinued at 2 5m		-Dx2-	-2.5-							:
Ē	Ē	-refusation low to medium strength sandstone										
-2	-3								-3	•		
ŧ	-											:
E												
ŧ	-											
-8	-4								4			
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-8	- 5								-5	•		
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

#### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND											
A	Augersample	G	Gasisample	PID	Photo ionisation detector (ppm)							
в	Bulkisample	Р	Piston sample	PL(A)	Point load axial test is(50) (MPa)							
BLK	Blocksample	U,	Tube sample (x mm dia.)	PL(D	Point load diametral test (50) (MPa)							
С	Core drilling	Ŵ	Watersample	pp	Pocket penetrometer (kPa)							
D	Disturbed sample		Waterseep	S	Standard penetration test							
E	Environmental sample	E.	Waterlevel	V	Shear vane (kPa)							



# CLIENT:Boyuan Bringelly Pty 11tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

SURFACE LEVEL: 95 mAHD EASTING: 290542 NORTHING: 6237417 PIT No: 106 PROJECT No: 92225.02 DATE: 3/2/2020 SHEET 1 0F 1

Γ		Description	<u>.</u>	Sampling&In/Situ/Testing							
Я	Depth (m)	of Strata	Graph Log	Type	Depth	ample	Results⊺& Comments	Wate	Dynamic (blow	Penetrometer 's per 150mm)	est
8	0.15	TOPSOIL/Silty CLAY CI: brown, trace gravel and sand,	$\gamma \gamma$			0)					
	-	\with rootlets in itop 0.05m, w <pl, hard<="" td=""><td></td><td>Dx2</td><td>0.5</td><td></td><td>pp⊵≯400</td><td></td><td></td><td></td><td></td></pl,>		Dx2	0.5		pp⊵≯400				
Ē	-	sand, w <pl, hard<="" td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td></pl,>									1
-2	-1		1/1/	D	1.0				-1		
Ē	-	-becoming red grey mottled below 1.2m			4 5						
Ē		-becoming grey, red, yellow mottled below 1.6m			1.5						•
-66	- 1.9 -2	SHALE :::mid grey, with iron staining, low strength, highly to moderately weathered, Bringelly Shale		D	2.0				-2		•
ŀ	-			Dx2	2.5						
ŀ	-	-ThecomingTextremelyTweathered below 2.8m							-		
-66	-3 3.0	Pit discontinued at 3.0m		—D—	-3.0-				-3 :	: :	:
È	-	-tlimittofiinvestigation									
È	-										
-5	- 4								-4		
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-6	-5								-5		•
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-68	-6								-6		
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-88	-7								-7		
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RIG: John Deere 315SE backhoe 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

**REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND										
А	Augersample	G	Gasisample	PID	Photo ionisation detector (ppm)						
в	Bulkisample	Р	Piston sample	PL(A)	Point load axial test Is(50) (MPa)						
BLK	Blocksample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test is(50) (MPa)						
С	Core drilling	W	Watersample	pp	Pocket penetrometer (kPa)						
D	Disturbed sample		Waterseep	S	Standard penetration test						
Е	Environmentalisample	ET	Waterlevel	V	Shear vane (kPa)						



**Douglas Partners** Geotechnics | Environment | Groundwater

# CLIENT:Boyuan Bringelly Pty LtdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 102 mAHD EASTING: 289782 NORTHING: 6237116

PIT No: 107 PROJECT No: 192225.02 DATE: 13/2/2020 SHEET 11 10F 11

			Description	ic.	Samplingt&IntSitutTesting		L	Duranis Developments Test		
R	De  (n	pth n)	of Strata		Log Type Depth		Sample	Results <b>t&amp;</b> Comments		Dynamici Penetrometerii est (blowsīper⊡150mm) 5 10 15 20
1	-	0.0	TOPSOIL/Silty©LAY©l: trace rootlets in top 0.05m,	XX			- 0,			
-	-	0.2	W <pl Silty CLAY CI: Ired brown and grey mottled, becoming more grey with depth, trace ironstone and sandstone</pl 		Dx2	0.5				
101	- - 1 -		bands, w<₽L		D	1.0				-1
-	-				Dx2	1.5				
1001	-2	2.1	SANDSTONE: Time arained arey becoming more brown		D	2.0				-2
-	- - -		with depth, with iron staining, low strength, highly to moderately weathered		Dx2	2.5				
-66	-3	30			_n_	-30-				
F	-	0.0	Pit discontinued at 3.0m		5	0.0				
Ē	Ē									
F										
-86	-4									4
F	-									
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	- 5									-5
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-%	-6									-6
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-56	-8									-8
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66	-9									-9
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RIG: John Deere 315SE backhoe 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND										
A	Augerisample	G	Gas sample	PID	Photo ionisation detector (ppm)						
в	Bulkisample	Р	Piston sample	PL(A)	) Point load axial test ls(50) (MPa)						
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D	) Point load diametral test (50) (MPa)						
С	Core drilling	Ŵ	Water sample	pp	Pocket penetrometer (kPa)						
D	Disturbed sample		Water seep	S	Standard penetration test						
Е	Environmental sample	ETT	Waterlievel	V	Shear vane (kPa)						



# CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 I 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 105 mAHD EASTING: 290158 NORTHING: 6237146

PIT No: 108 PROJECT No: 192225.02 DATE: 13/2/2020 SHEET 11 10F 11

Γ			Description of Strata		Samplir			ing&InSituTesting				
R	Depti (m)	oth ו)			Type	Depth	Sample	Results⊺& Comments	Wate	bynamiciPenetrometeril est (blowsīper⊡50mm) 5 10 15 20		
105	-		FILL/SiltyICLAYICI: Iwith rootlets in topI0.1m, trace gravel and anthropogenics comprising brick fragments, roof tiles, pipe, inetal, concrete, w <pl< td=""><td></td><td> </td><td>0.5</td><td>0,</td><td>pp\≥400</td><td></td><td></td><td>2</td><td><u> </u></td></pl<>		 	0.5	0,	pp\≥400			2	<u> </u>
104	- 1 - 1 	0.8	Silty CLAY CI: medium plasticity, red brown, trace gravel, with sandstone bands, w <pl, td="" thard<=""><td></td><td>D</td><td>0.9 1.0</td><td></td><td></td><td></td><td>- - - - -</td><td></td><td></td></pl,>		D	0.9 1.0				- - - - -		
103	2				Dx2	1.5 2.0		ppi≥400		-2		
Ē	Ē			1/1/								
	-	2.4	SANDSTONE: If ine grained, brown and grey, with fron staining, very low to low strength, highly to moderately weathered		Dx2	2.5						
102	-3	3.0	Pitidiscontinued[ati3.0m		—D—	-3.0-				-3		
	-		- limit of investigation									
101	- 4									-4		
-	-											
66												
- 86	-7									-7		
-	-											
- 16	-8									-8		
	-											
96	-9									-9		
-	-									-		

RIG: John Deere 315SE backhoe 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND										
A	Augerisample	G	Gasisample	PID	Photo ionisation detector (ppm)						
в	Bulkisample	Р	Pistonsample	PL(A)	Point load axial test is(50) (MPa)						
BLK	Block sample	U,	Tube sample (x mm dia )	PL(D)	Point load diametral test (50) (MPa)						
С	Core drilling	Ŵ	Watersample	pp	Pocket penetrometer (kPa)						
D	Disturbed sample		Water seep	S	Standard penetration test						
E	Environmentalisample	ET	Waterlevel	V	Shear vane (kPa)						


### CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE 1 EVEL: 1104 mAHD EASTING: 290395 NORTHING: 6236925

PIT No: 109 PROJECT No: 192225.02 DATE: 13/2/2020 SHEET 11 10F 11

		Description	<u>.</u>		San	npling	&In Situ Testing					
님	Depth (m)	of	Graph Log	Type	Depth	ample	Results <b>t&amp;</b> Comments	Water	Dynamic (blow	Penetrom /s per 150	ieter⊡est )mm)	
4	_			·		õ			5	$\frac{10}{2}$	20	
ŧ	- 0.3	w <pl< td=""><td></td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td>— į</td></pl<>		1							— į	
ŧ	-	Silty CLAY CI: Tbrown, Trace Gravel, Tw <pl, td="" thard<=""><td></td><td>Dx2</td><td>0.5</td><td></td><td>pp⊵≯400</td><td></td><td>ļ :</td><td>: :</td><td>÷</td></pl,>		Dx2	0.5		pp⊵≯400		ļ :	: :	÷	
F	-	-becoming red brown, very stiff below 0.6m										
Ea	-1		1/1/		10					: :		
Ę	-				1.0							
ŧ	-		1/1/							: :		
F	-			Dx2	1.5				-	: :	÷	
E	-	-becoming red brown arey mottled below 1.8m	1/1/	{	1.8		pp ≠ 350					
101	-2		1/1/	D	2.0				-2	: :	÷	
ŧ	-	SANDSTONE: fine grained, grey and brown, with fron										
ŧ	-	Starning, 1999 Buchgar, 11g ny to incontactly incontrol of		Dx2	2.5					: :		
E									E :	: :	÷	
ĻΣ	-3 3.0	-becoming extremely weathered with depth			-3.0-					<u> </u>		
Ę	-	Pit/discontinued/at/3.0m							-	: :	:	
ŧ	-									: :		
E										: :	:	
Ł	-									:		
Ļ	-4								-4	: :	:	
F	-									: :		
E	-									: :	:	
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-66	-5								-5	: :		
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND											
A	Augersample	G	Gasisample	PID	Photo ionisation detector (ppm)							
в	Bulkisample	Р	Piston sample	PL(A	) Point load axial test ls(50) (MPa)							
BLK	Blocksample	U,	Tube sample (x mm dia.)	PL(D	) Point load diametral test (50) (MPa)							
С	Core drilling	Ŵ	Watersample	pp	Pocket penetrometer (kPa)							
D	Disturbed sample		Waterseep	S	Standard penetration test							
E	Environmental sample	ĒT	Waterlievel	V	Shear vane (kPa)							



### CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 I 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 105 mAHD EASTING: 289712 NORTHING: 6236938

PIT No: 10 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 10 0F 11

Γ				Description	<u>.0</u>		San	pling	&In Situ Testing						
R		ept (m)	h	of	Graph Log	Type	Depth	ample	Results⊺& Comments	Water	Dyna	amic Pe (blows P	er15⊅ ⊅er	neter⊡ i0mm) 	Гest
104		0.	05	TOPSOIL/Silty@LAY@L:@brown,@raceTootlets,@v <pl Silty@LAY@L:@brown,@v<pl,hard Silty@LAY@L:@medium@high@lasticity,Ted/brown@and grey,@ellow@mottled,@ith@ronstone@ravel,@v<pl,hard, residual</pl,hard, </pl,hard </pl 			1.0	S	pp⊧>400						
103	2	1	2.1	Silty:CLAYICH: Thigh plasticity, pale grey, with firon staining (red and yellow), with very low to low strength siltstone bands, (extremely weathered siltstone, residual) SILTSTONE: Tpale brown and grey, with iron staining, with clay seams, very low to low strength, moderately to slightly weathered							-2			· · · · · · · · · · · · · · · · · · ·	
102	70-3	3	3.0	-inoiclay/seams/below/2.7m Pitidiscontinued/at/3.0m -limitiof/investigation	· _ · -									- - - - - - - - - - - - - - - - - - -	· · · · ·
	- 4										-4			· · · · · · · · · · · · · · · · · · ·	•
	2 5										-5				
	- 6 										-6				
	- 7 - 7 										-7				
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND											
A	Augerisample	G	Gas sample	PID	Photo ionisation detector (ppm)							
в	Bulkisample	Р	Piston sample	PL(A)	) Point load axial test ls(50) (MPa)							
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D	) Point load diametral test (50) (MPa)							
С	Core drilling	Ŵ	Water sample	pp	Pocket penetrometer (kPa)							
D	Disturbed sample		Water seep	S	Standard penetration test							
Е	Environmental sample	ETT	Waterlievel	V	Shear vane (kPa)							



### CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 I 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 113 mAHD EASTING: 290167 NORTHING: 6236793

PIT No: 11 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 1 0F 1

			Description	<u>.</u>		Sam	npling	In Situ Testing	-	Dimensio Denetrometer Test			
님	Dept (m)	h	of Strata	Graph Log	Type	Jepth	ample	Results & Comments	Wate	Dyn	amictPen (blowstpe	er 150m	ter⊡est nm)
13	- 1	11		$\nabla x$			S			;			20
Ł			Silty CLAY CI Thrown frace gravel w <pl td="" thard<=""><td>1/1/</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td><u> </u></td><td>Ţ.</td></pl>	1/1/	1							<u> </u>	Ţ.
-	- (	0.4	Silty CLAY CI: medium to high plasticity, orange brown, trace fronstone and siltstone gravel, hard		Dx2	0.5							
112	- - -1				D/B	1.0				-1			
-	-				Dx2	1.5							
111	-2				D	2.0				-2			
	-		- becoming grey and orange/red mottled, with siltstone (possible sandstone) bands (possible extremely weathered siltstone)			25				-			
	-		weathered Bitstone/		DX2	2.5							
₽₽	-3 :	3.0	Pit discontinued at 3.0m		-D-	-3.0-				-3	:		•
	-		-limit of investigation										
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100	-4									-4	÷	÷	•
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RIG: John Deere 315SE backhoe 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND											
A	Augerisample	G	Gas sample	PID	Photo ionisation detector (ppm)							
в	Bulkisample	Р	Piston sample	PL(A)	) Point load axial test ls(50) (MPa)							
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D	) Point load diametral test (50) (MPa)							
С	Core drilling	Ŵ	Water sample	pp	Pocket penetrometer (kPa)							
D	Disturbed sample		Water seep	S	Standard penetration test							
Е	Environmental sample	ETT	Waterlievel	V	Shear vane (kPa)							



### CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 I 705 The Northern Road, Cobbitty, NSW

SURFACE LEVEL: 111 mAHD EASTING: 290414 NORTHING: 6236752 PIT No: 12 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 1 0F 1

		Description	<u>.0</u>		Sam	npling 2	In Situ Testing		Denomic Denotes and a Test			
뉟	Depth	of	aph Log	e	th	ple	Reculte &	Vate	Dy	namic Pe (blows)	netrometer per 150mm	⊤est )
		Strata	ତି –	Typ	Dep	Sam	Comments	>		5 10	15	20
Ē	0.0	TOPSOIL/Silty CLAY CI: Trace rootlets, w <pl< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td><td>L</td><td></td><td></td></pl<>							-	L		
Ē	E 0.	3 Silty CLAY CI: w <pl, hard<="" td=""><td></td><td>}</td><td></td><td></td><td></td><td></td><td>E</td><td></td><td>Ĺ</td><td>-i</td></pl,>		}					E		Ĺ	-i
Ē	- 0.	Silty/CLAY/CI; medium/to/high/plasticity,/brown,/w <pl,< td=""><td></td><td>_Dx2_</td><td>0.5</td><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td></pl,<>		_Dx2_	0.5				-			
Ę	-	Silty CLAY CH: Thigh plasticity. red brown and grey	1/1/		0.9				-			÷
Ę	-1 -	mottled, becoming grey with depth, w <pl, hard<="" td=""><td>1/1/</td><td>D</td><td>1.0</td><td></td><td></td><td></td><td>-1</td><td>:</td><td>:</td><td>÷</td></pl,>	1/1/	D	1.0				-1	:	:	÷
Ē	[ 1	1							Ē			÷
Ē	- '' -	SILTSTONE: Ipale grey and brown, with iron staining, with clay seams, llow strength, highly weathered		Dx2	1.5				-			
ŧ	-		· — ·						-		•	-
Ļ	-2			D	2.0				-2			
Ē	-								Ē	: :		÷
E	[			Dx2	2.5				[			÷
ŧ	-		<u> </u>	-					-	: :	-	÷
19	-3 3.		• •	—D—	-3.0-				3			:
Ē		Pitidiscontinued at 3,0m							Ľ			
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E	-								-4	: :	:	÷
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106	-5								-5			÷
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

**REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND												
А	Augersample	G	Gasisample	PID	Photo ionisation detector (ppm)								
в	Bulkisample	Р	Piston sample	PL(A)	Point load axial test Is(50) (MPa)								
BLK	Blocksample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test is(50) (MPa)								
С	Core drilling	W	Watersample	pp	Pocket penetrometer (kPa)								
D	Disturbed sample		Waterseep	S	Standard penetration test								
Е	Environmentalisample	ET	Waterlevel	V	Shear vane (kPa)								



### CLIENT:Boyuan Bringelly Pty 11tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 114 mAHD EASTING: 289676 NORTHING: 6236773

PIT No: 13 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 1 0F 1

			Description	<u>.</u>		Sam	npling	&In Situ Testing					
님	De	pth	of	aph -og	e	Ę	<u>b</u> e	Poculte №	/ater	blows per 150mm)			est
		,	Strata	<u>ں</u>	Typ	Dep	Sam	Comments	5	5	10	15 2	20
17	-	0.05	TOPSOIL/Silty CLAY Cl: brown, trace rootlets, w <pl< td=""><td></td><td></td><td></td><td>- 0,</td><td></td><td></td><td>- Ĺ</td><td><u> </u></td><td>:</td><td>:</td></pl<>				- 0,			- Ĺ	<u> </u>	:	:
F	-	0.2	Silty©LAY©I: brown, w <pl, hard<="" td=""><td>1/1/</td><td></td><td></td><td></td><td></td><td></td><td></td><td>i L</td><td><u> </u></td><td>: 1</td></pl,>	1/1/							i L	<u> </u>	: 1
Ē	Ē		Silty CLAY CI: medium to high plasticity, orange brown,		Dx2	0.5							
ŧ	È.		w <pl, fiard<="" td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></pl,>										
13	-1		ironstone gravel below 0.7m	/1/1/	D	1.0				-1	÷	:	:
Ē	Ē											-	
E	-			/1/1/	Dx2	15						:	
ŧ	ŀ	1.6	Silty CLAY CI: medium to high plasticity, pale brown and		DAL	1.0							
F~	F_		grey, with iron staining, with siltstone (possible sandstone)	/1/1/									
E	-2 -		weathered			2.0					÷	:	
E	Ē			1/1/									
ŧ	-		-becoming more grey, banding decreasing, hard below	1/1/	Dx2	2.5					÷	:	:
ŧ	-		Z.TIII										
Ę	-3	3.0	-ibanding increasing below 2.8m	442	—D—	-3.0-				3	<u> </u>	:	:
E	Ē		-Ilimitofilinvestigation										•
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND											
A	Augerisample	G	Gas sample	PID	Photo ionisation detector (ppm)							
в	Bulkisample	Р	Piston sample	PL(A)	) Point load axial test ls(50) (MPa)							
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D	) Point load diametral test (50) (MPa)							
С	Core drilling	Ŵ	Water sample	pp	Pocket penetrometer (kPa)							
D	Disturbed sample		Water seep	S	Standard penetration test							
Е	Environmental sample	ETT	Waterlievel	V	Shear vane (kPa)							



### CLIENT:Boyuan Bringelly Pty 1 tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 148 mAHD EASTING: 289750 NORTHING: 6236549

PIT No: 14 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 1 0F 1

		Description	<u>.</u>	Sampling & In Situ Testing							
	Dept (m)	m) of	Log	be	pth	nple	Results⊺&	Natel	Dynamic⊡ (blow	Penetrometer⊡est /siper150mm)	
0		Strata	0 U	Τγ	De	San	Comments	[	5	10 15 20	
<b>1</b>	- - - - -	0.6 SANDSTONE: Ifine to medium grained, low to medium		D	0.5						
		0.9 strength, highly to slightly weathered, horizontally bedded, Bringelly Shale Pitfdiscontinued at 0.9m - refusal on medium strength sandstone		D	-0.9-				-1		
146	- 2								-2		
145	- 3								-3		
144	4								-4		
143											
142									6		
141									-7		
140	- 8								-8		
136	≦⊢9 - - - - - - - -								-9 		

RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAMPLING & IN SITU TESTING LEGEND												
А	Augersample	G	Gas sample	PID	Photo ionisation detector (ppm)								
в	Bulkisample	Р	Piston sample	PL(A	) Point load axial test 1s(50) (MPa)								
BLK	Blocksample	U,	Tube sample (xmmidia)	PL(D	Point load diametral test ls(50) (MPa)								
С	Core drilling	Ŵ	Watersample	pp`	Pocket penetrometer (kPa)								
D	Disturbed sample		Waterseep	S	Standard penetration test								
E	Environmentalisample	ET	Waterlievel	V	Shear vane (kPa)								



### CLIENT:Boyuan Bringelly Pty 11tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 119 mAHD EASTING: 289628 NORTHING: 6236536

PIT No: 15 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 1 0F 1

			Description			Sam	npling	&In Situ Testing				
님	De   De	pth n)	of	rapt Log	be	pth	nple	Results &	Nate	Dynamic (blov	vs per 150	neter⊡ est 0mm)
6		,	Strata	U	Τy	De	San	Comments	-	5	10 15	5 20
Ę	F	0.05	TOPSOIL/Silty@LAY@L: tracefronstonegravel and	1/1/	1					- :		
Ē	Ē	0.4	Silty CLAY CI: Trace fronstone gravel, w <pl, hard<="" td=""><td></td><td>Dv2</td><td>0.5</td><td></td><td></td><td></td><td></td><td></td><td>•</td></pl,>		Dv2	0.5						•
ŀ	-		Silty CLAY Cl: brown, trace ironstone gravel, w <pl, hard,<="" td=""><td>1/1/</td><td></td><td>0.0</td><td></td><td></td><td></td><td>-</td><td></td><td></td></pl,>	1/1/		0.0				-		
18	-1	1.0	residual			1.0				-1		
Ę	-		Silty CLAY CH: Thigh plasticity, brown and grey mottled,									
E	E		traceironstone and sandstone bands, w <pl, bard,="" residual<="" td=""><td>1/1/</td><td>Dx2</td><td>1.5</td><td></td><td></td><td></td><td></td><td></td><td></td></pl,>	1/1/	Dx2	1.5						
Ē	È				]							
117	-2	1.9	SANDSTONE: fine grained, pale brown, firon staining,		D	2.0				-2	: :	•
Ē	Ē		with fironstone gravel, flow strength, highly to slightly weathered. Bringelly Shale									-
ŧ	F				Dx2	2.5				- :		
Ē	Ē											•
116	-3	3.0	Pititiccontinued at 3 0m		_D_	-3.0-				- :	<u>:</u> : :	; ;
ł	-		-timitofinvestigation							-		•
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115	-4									-4		
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114	-5									-5		•
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAME	PLING	& IN SITU TESTING	LEGE	ND
A	Augerisample	G	Gas sample	PID	Photo ionisation detector (ppm)
в	Bulkisample	Р	Piston sample	PL(A)	) Point load axial test ls(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D	) Point load diametral test (50) (MPa)
С	Core drilling	Ŵ	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample		Water seep	S	Standard penetration test
Е	Environmental sample	ETT	Waterlievel	V	Shear vane (kPa)

□ Sand Penetrometer AS1289.6.3.3 ⊠ Cone Penetrometer AS1289.6.3.2

### CLIENT:Boyuan Bringelly Pty 11tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 131 mAHD EASTING: 289922 NORTHING: 6236441

PIT No: 116 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 11 OF 11

		Description	. <u>ല</u>		Sam	pling	&In Situ Testing			
씸	Depth (m)	of Strata	Graph Log	Type	Jepth	ample	Results⊺& Comments	Wate	DynamicI (blow	Penetrometer∐est siper150mm)
5	- 0.4	- TOPSOIL/Silty/CLAY/Cl: Tbrown.ftrace@ravel.twith	7			S			-	
ŧ	- 0.1	rootlets, w <pl, stiff<="" td=""><td>1/1/</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></pl,>	1/1/							
-	- 0.1	Silty CLAY CI: Imedium to high plasticity, orange brown, slightly mottled, with angular siltstone gravel (colluvium), w <pl. stiff<="" td=""><td></td><td>Dx2/B</td><td>0.5</td><td></td><td></td><td></td><td></td><td></td></pl.>		Dx2/B	0.5					
130	- - 1 -	SILTSTONE: pale brown and grey, with clay seams, very low to low strength, highly to slightly weathered		D	1.0				-1	
	- - -	-with clay seams, becoming low strength below 1.0m	· _ · ·	Dx2	1.5					
E	-									
129	-2		·	D	2.0				-2	
Ē	-									
ŀ	-			Dx2	2.5				- :	
Ē	- 2	-becoming low to medium strength at 2.6m								
128	-3	Pitidiscontinued at 2.8m		D	3.0				-3	
Ē										
ŧ	-									
Ē	-									
127	-4								-4	
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAME	PLING	& IN SITU TESTING	LEGE	ND
A	Augerisample	G	Gas sample	PID	Photo ionisation detector (ppm)
в	Bulkisample	Р	Piston sample	PL(A)	) Point load axial test ls(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D	) Point load diametral test (50) (MPa)
С	Core drilling	Ŵ	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample		Water seep	S	Standard penetration test
Е	Environmental sample	ETT	Waterlievel	V	Shear vane (kPa)



### CLIENT:Boyuan Bringelly Pty 11tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 125 mAHD EASTING: 290014 NORTHING: 6236427

PIT No: 17 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 1 0F 1

			Description	ic.		Sam	pling	&In Situ Testing	L.	Description	
Ъ	De (n	pth n)	of	Log	/pe	epth	nple	Results &	Wate	(blowstper150mm)	
52			Strata		Γ	Ď	Sar	Comments		5 10 15 20	
Ē	-	0.1	TOPSOIL/SiltyICLAYICI: brown, fissured, with rootlets, //trace.gravel.(colluvium), w <pl< td=""><td>1/1/</td><td></td><td></td><td></td><td></td><td></td><td></td></pl<>	1/1/							
ŀ	-	0.6	Silty CLAY CI: Brown, fissured, trace SR ironstone and SA siltstone gravel (colluvium), w <pl< td=""><td></td><td></td><td>0.5</td><td></td><td></td><td></td><td></td></pl<>			0.5					
54	- 1	10	Silty CLAY CI: orange brown, fissured, trace ironstone			~0.7 0.9					
	-		Silty CLAY CI: medium to high plasticity, orange brown and grey mottled, trace SR siltstone gravel, w <pl, residual<="" td=""><td></td><td>D</td><td>1.1</td><td></td><td></td><td></td><td></td></pl,>		D	1.1					
Ē	Ē	1.7	-veryflowftormediumistrength/band/belowf1.5m	1/1/	DXZ	1.5					
123	-2	2.0	ClayeyISILTIML: Tale grey and orange mottled, friable, with very low to low strength siltstone seams, w <pl (extremely weathered siltstone)</pl 		D	2.0				2	
	- - -		SILTSTONE: pale orange and brown, with iron staining, low to medium strength, moderately to slightly weathered, Bringelly Shale	· _ · · _	Dx2	2.5					
F∾	F.	2.8	-becoming medium Strength below 2.7m								
12	-3		Pitidiscontinued at 2.8m -1imitiofiinvestigation								
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E <sup>2</sup>	Ē										
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAM	PLING	& IN SITU TESTING	LEGE	END
A	Augersample	G	Gasisample	PID	Photo ionisation detector (ppm)
в	Bulkisample	Р	Piston sample	PL(A	) Point load axial test ls(50) (MPa)
BLK	Blocksample	U,	Tube sample (x mm dia.)	PL(D	) Point load diametral test (50) (MPa)
С	Core drilling	Ŵ	Watersample	pp	Pocket penetrometer (kPa)
D	Disturbed sample		Waterseep	S	Standard penetration test
E	Environmental sample	ĒT	Waterlievel	V	Shear vane (kPa)



### CLIENT:Boyuan Bringelly Pty 11tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 117 mAHD EASTING: 290123 NORTHING: 6236402

PIT No: 118 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 11 OF 11

			Description	. <u>e</u>		Sam	pling	&In Situ Testing	L .			
R	04   ي )   -	epth m)	of	Log	be	oth	ple	Results⊺&	Vate	Dyna	amic Penetroi (blows per 15	meter⊔est 60mm)
~	_	,	Strata	G	Ty	De	San	Comments	<b>_</b>	5	10 1	5 20
F	-	0.2	TOPSOIL/Silty:CLAY:CI: brown, with rootlets:to:0.1m,	ДŽ,						- <b>L</b>		
È	Ē		Silty CLAY CL Tred brown and grev mottled. frace gravel.		02	0.5						
F	Ē		w <pl, hard,="" residual<="" stiff="" td="" to="" very=""><td>1/1/</td><td>0,2</td><td>0.5</td><td></td><td></td><td></td><td></td><td><u>፡</u> ነ</td><td></td></pl,>	1/1/	0,2	0.5					<u>፡</u> ነ	
- 4		0.9	SILTSTONE: The letter wand the literature with a low the same			10						
Ę			very low to low strength, moderately to slightly weathered,	· · ·		1.0				[	•	
È	-		Bringelly[Shale	· _ · ·		4.5					•	
Ē	Ē			· _ · ·	DX2	1.5						
- u				· _ · ·							•	
Ę	2		-becoming low to medium strength, no clay seams below	• — • •	D	2.0					•	
ŀ	÷		2.00	· _ · ·								
Ē	Ē				Dx2	2.5						
ŀ.	+										•	
F	= - 3 [	3.0	Pit discontinued at 3.0m		—D—	-3.0-				-3		
ŀ	÷		-1imitTofinvestigation									
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAM	PLING	& IN SITU TESTING	LEGE	ND
A	Augerisample	G	Gasisample	PID	Photo ionisation detector (ppm)
в	Bulkisample	Р	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia )	PL(D)	Point load diametral test ls(50) (MPa)
С	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample		Water seep	S	Standard penetration test
E	Environmentalisample	ET	Waterlevel	V	Shear vane (kPa)

□ Sand Penetrometer AS1289.6.3.3 ⊠ Cone Penetrometer AS1289.6.3.2

### CLIENT:Boyuan Bringelly Pty 11tdPROJECT:Proposed RezoningLOCATION:621 = 705 The Northern Road, Cobbitty, NSW

### SURFACE LEVEL: 113 mAHD EASTING: 290301 NORTHING: 6236517

PIT No: 19 PROJECT No: 92225.02 DATE: 4/2/2020 SHEET 1 0F 1

		Description	<u>.</u>		Sampling & In Situ Testing					amia Panatramatar Taat		
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RIG: John Deere 315SE backhoe - 450mm toothed bucket

LOGGED: ERL

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

### **REMARKS**:

	SAME	PLING	& IN SITU TESTING	LEGE	ND
Α	Augerisample	G	Gasisample	PID	Photo ionisation detector (ppm)
в	Bulkisample	Р	Piston sample	PL(A)	Point load axial test is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test ls(50) (MPa)
С	Core drilling	Ŵ	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample		Waterseep	S	Standard penetration test
E	Environmental sample	Ē	Water level	V	Shear vane (kPa)



### Rock Descriptions

### **Rock Strength**

Rock strength is defined by the Point Load Strength Index  $(Is_{(50)})$  and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index Is <sub>(50)</sub> MPa	Approximate Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	М	0.3 - 1.0	6 - 20
High	Н	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

\* Assumes a ratio of 20:1 for UCS to  $Is_{(50)}$ . It should be noted that the UCS to  $Is_{(50)}$  ratio varies significantly for different rock types and specific ratios should be determined for each site.

### **Degree of Weathering**

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

### **Degree of Fracturing**

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

### **Rock Descriptions**

### **Rock Quality Designation**

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

RQD % =  $\frac{\text{cumulative length of 'sound' core sections} \ge 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$ 

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

### **Stratification Spacing**

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

### Soil Descriptions

### **Description and Classification Methods**

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

### Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Туре	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Туре	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 - 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded a good representation of all particle sizes
- Poorly graded an excess or deficiency of particular sizes within the specified range
- Uniformly graded an excess of a particular particle size
- Gap graded a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)		
Term	Proportion Example	
	of sand or	
	gravel	
And	Specify	Clay (60%) and
		Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace
		sand

### In coarse grained soils (>65% coarse)

<ul> <li>with clays or silts</li> </ul>	6	
Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In	coarse	grained soils	(>65%	coarse)
- \	vith coa	rser fraction		

Term	Proportion of coarser	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with 'Mix of Soil and Cobbles/Boulders' with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

### Soil Descriptions

### **Cohesive Soils**

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	Н	>200
Friable	Fr	-

### **Cohesionless Soils**

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

### Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil derived from in-situ weathering of the underlying rock;
- Extremely weathered material formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil deposited by streams and rivers;

- Estuarine soil deposited in coastal estuaries;
- Marine soil deposited in a marine environment;
- Lacustrine soil deposited in freshwater lakes;
- Aeolian soil carried and deposited by wind;
- Colluvial soil soil and rock debris transported down slopes by gravity;
- Topsoil mantle of surface soil, often with high levels of organic material.
- Fill any material which has been moved by man.

**Moisture Condition – Coarse Grained Soils** For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  - Soil tends to stick together. Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.

Soil tends to stick together, free water forms when handling.

### **Moisture Condition – Fine Grained Soils**

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- 'Moist, dry of plastic limit' or 'w <PL' (i.e. hard and friable or powdery).
- 'Moist, near plastic limit' or 'w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- 'Moist, wet of plastic limit' or 'w >PL' (i.e. soils usually weakened and free water forms on the hands when handling).
- 'Wet' or 'w ≈LL' (i.e. near the liquid limit).
- 'Wet' or 'w >LL' (i.e. wet of the liquid limit).

### Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thinwalled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

### **Test Pits**

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the insitu soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

### Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

### **Continuous Spiral Flight Augers**

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

### **Non-core Rotary Drilling**

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

### **Continuous Core Drilling**

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

### **Standard Penetration Tests**

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

 In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

15, 30/40 mm

### Sampling Methods

The results of the SPT tests can be related empirically to the engineering properties of the soils.

### Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

### Symbols & Abbreviations

### Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

### **Drilling or Excavation Methods**

С	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

### Water

$\triangleright$	Water seep
$\bigtriangledown$	Water level

### Sampling and Testing

- A Auger sample
- B Bulk sample
- D Disturbed sample
- E Environmental sample
- Undisturbed tube sample (50mm)
- W Water sample
- pp Pocket penetrometer (kPa)
- PID Photo ionisation detector
- PL Point load strength Is(50) MPa
- S Standard Penetration Test
- V Shear vane (kPa)

### **Description of Defects in Rock**

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

### **Defect Type**

В	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

### Orientation

9

The inclination of defects is always measured from the perpendicular to the core axis.

- h horizontal
- v vertical
- sh sub-horizontal
- sv sub-vertical

### Coating or Infilling Term

cln	clean
со	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

### **Coating Descriptor**

са	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

### Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

### Roughness

ро	polished
ro	rough
s	slickensided
sm	smooth
vr	very rough

### Other

fg	fragmented
bnd	band
qtz	quartz

### Symbols & Abbreviations

### **Graphic Symbols for Soil and Rock**

### General

٥	

Asphalt Road base

Concrete

Filling

### Soils



Topsoil

Peat

Clay

Silty clay

Sandy clay

Gravelly clay

Shaly clay

Silt

Clayey silt

Sandy silt

Sand

Clayey sand

Silty sand

Gravel

Sandy gravel

Cobbles, boulders

Talus

### Sedimentary Rocks



### Metamorphic Rocks

Slate, phyllite, schist

Quartzite

Gneiss

### Igneous Rocks



Granite

Dolerite, basalt, andesite

Dacite, epidote

Tuff, breccia

Porphyry





### South Creek West Precinct 5 Public School Yond Transport Assessment

23 Nov 2022 | Rev 2.0



<b>Project details</b>				
Project number:	SCT_00264			
Document name:	South Creek West Precinct 5 P	ublic School Rapid T	ransport	. Assessment
Client:	BHL Group	A	BN:	92 608 897 963
Prepared by:	SCT Consulting Pty. Ltd.	A	BN:	53 612 624 058
Information	Name	Position		Signature
Author:	Jonathan Busch	Associate Director		92B
Reviewer:	Andy Yung	Director		A
Authoriser:	Andy Yung	Director		AA
Version	Date	Details		
1.0	18 Nov 2022	Draft		
2.0	23 Nov 2022	Draft for stakehold	er review	

CT Consulting PTY LTD (SCT Consulting)





Executive Summary

### Purpose

- SCT Consulting was engaged by BHL Group to prepare a Rapid Transport Assessment (RTA) for a potential primary school within the South Creek West Cobbitty Precinct (Precinct 5).
- The school's location in relation to the broader precinct is shown in the figure.
- The RTA will support Schools Infrastructure's assessment of the school's viability in that location as well as informing the town centre design.





South Creek West Precinct 5 Public School Rapid Transport Assessment



Recommended investments

Mode	<b>Recommended infrastructure</b>	
Bus	<ul> <li>Bus stops with 400m spacing on all sub-arterial and collector roads in the precinct</li> </ul>	Peod
Cycle	75 bicycle/scooter parking spaces	Area under separate
Transport encouragement	Cycle training Quarterly bike repair Ride2School Day	ownership and will progress via a separate process.
Intersection & crossings	<ul> <li>Zebra crossing on collector road at the main entrance of the school signalised intersection at the subarterial and collector road intersection adjacent to the local centre if justified by warrants.</li> </ul>	UPON PUL CONTRACTOR
These investments wo funding as part of a fu	uld be further evaluated by SINSW for uture business case process.	Dick Johnson Drie

South Creek West Precinct 5 Public School Rapid Transport Assessment





### Table of Contents





## Plans on Strategies







### Camden Council LSPS 2040

- Camden LGA population set to grow by almost 200% between 2016 to 2036.
- South Creek West is identified in as a 'Future Urban' area. Agricultural land is targeted to change through State Government led growth precincts with substantial housing growth.
- South Creek West has a 30,000 planned housing capacity. Surrounding employment, environment, culture, and recreation uses will support housing.
- Future east-west and north-south connecting roads to Leppington and Oran Park, respectively.
- Outer Sydney Orbital (M9) will pass west of South Creek West and will provide a link between the Western Sydney Airport and future employment.
- Proposed train line east of South Creek West will connect Oran Park and Leppington to Western Sydney Airport.





## Draft Indicative Layout Plan

- The figure shows the latest Indicative Layout Plan (ILP)
- The proposed school is adjacent to the local centre and is accessible via a sub-arterial road.
- The precinct is still undergoing planning and studies are currently being undertaken to develop a South West Growth Area plan.







Potential Future Road Connection

Road - Sub-arterial (4 lanes Road - Sub-arterial (2 lanes

Road - Collecto

Online Wet Basin / Water Body

Existing House to be Retained

Online Dry Basin

Road - Local

School (Education

Medium Density Band 1 (25 to 35 dw/ha)

Open Space (Powerline

Playing Field Drainage

Open Space

Low Density Band 2 (20 to 25 dw/ha)

Local Centre

Service Station

Water Tower

# South Creek West Precinct land ownership

- The proposed school catchment covers the extent of the South Creek West Precinct.
- The precinct is being progressed by several proponents concurrently.
- Area  $oldsymbol{O}$  is the land part of this planning proposa
- Area (2) is under separate ownership and will progress via a separate process.
- Area (3) has been rezoned as part of the Lowes Creek Maryland Precinct.
- The landowners of  $\mathbf{2}$  has requested that this planning proposal not detail components within their land, which may change as they progress.
- However, assumptions needed to be made for the purposes of this school, which covers both areas.
- The layout for area **2** was determined based on historical information. It is noted that this may change as planning progresses.





South Creek West Precinct 5 Public School Rapid Transport Assessment







# South Creek West Precinct 5 Public School

- Precinct 5 is located within a greenfield site that is predominantly zoned primary production.
- SINSW confirmed the enrolment numbers (1,000 students) and boundary, which includes a portion of the Lowes Creek Maryland Precinct (north-east corner).
- No roads are built within the precinct. Future road networks were updated based on the provided draft indicative layout plans, draft pedestrian and cycling network, and the DCP for Lowes Creek Maryland Precinct.





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### Road network

- No roads have been built within the enrolment boundary.
- Arterial: The Northern Road (existing)
- Sub-arterial: east-west connection to The Northern Road and a southern connection within the precinct
- Collector: to service the residential developments within the precinct







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## Walking & Cycling Catchment

- Students were randomly distributed in QGIS based on density categories as there are no existing students.
- The distribution was based on the land use zoning within the draft ILPs and the Lowes Creek Maryland DCP. It also considered the densities of the different residential land uses.
- The proportion of students within walking distance to school:
- o 400m 4%
- o 800m 20%
- o 1200m 58%



South Creek West Precinct 5 Public School Rapid Transport Assessment



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# Public transport routes and service - Future

- No existing public transport within the enrolment boundary.
- There is further uncertainty about the future network as concurrent planning is being undertaken for surrounding land use changes and transport projects.
- To maximise the potential of the public transport network, the future sub-arterial and collector road networks are considered bus capable.
- One bus stop is assumed every 400m along bus capable roads.
- The proportion of students within walking distance to bus stops:
- o 400m 96%
- 800m 100%

Consulting



SCT Consulting, OpenStreetMap contributors



 All students fall within the exclusion zone and will not be eligible for subsidised travel.



South Creek West Precinct 5 Public School Rapid Transport Assessment


## Catchment analysis

- SINSW provided a school enrolment of 1,000 students.
- Assessment of number of students under each catchment is based on actual distances on the path.
- Bus stops every 400m are assumed on the bus capable roads.
- With 58% of students within 1,200m of the school, the site has potential for a more sustainable mode share than typical greenfield locations.

Catchment	Number of students	% of students
- 400m	41	4%
100 – 800m	159	16%
300 – 1200m	375	38%
<ul> <li>1200m from school &amp; 400m from a bus stop</li> </ul>	398	40%
<ul> <li>1200m from school &amp; more than 400m from a bus stop</li> </ul>	27	2%



Mode share forecast - base case

	Noți	onal	Actu	a				tion		
Catchment	(as the c	row flies)	d uo)	ath)	יממוכורט			5		
	#	8	#	⊳%	number	Walk	Bicycle	Bus	Car	share set to 84%
1-400m	135	14%	41	4%	41	70%	%0			private vehicle
400-800m	433	43%	159	16%	159	30%	5%			based on surveys of
800-1,200m	384	38%	375	38%	375	10%	10%	%0		comparable primary
0-1,200m (up to 15 min walk)	952		575							schools
Not eligible for SSTS	1000		1000							
Eligible for SSTS	0		6							
Located within 400m buffer of a bus stop	957		715							
Located within 800m buffer of a bus stop	1000		988	7						
>1200m from school and within 400m buffer of a school bus stop	30	3%	398	40%	398	%0	%0	%0		
>1200m from school and not within 400m buffer of a school bus stop	18	2%	27	3%	27	%0	%0	%0		
Assumptions			Pr	oiecte	ad number	114	45	С	841	

- Bus stops are delivered every 400m on sub-arterial roads - Walk to school day & other typical curriculum

84% 80% 5% Projected mode share 11%

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	Noti	onal	Actu	0	afaranca		Alloco	tion.		The forecast
Catchment	(as the c	row flies)	od no)	ິ <del>ແ</del>				5		
	#	8	#	%	number	Walk	Bicycle	Bus	Car	
1-400m	135	] 4%	41	4%	41	70%	%0			students would tit
400-800m	433	43%	159 1	6%	159	30%	5%	2%		comfortably on
800-1,200m	384	38%	375 3	38%	375	10%	10%	8%		about 2 buses
0-1,200m (up to 15 min walk)	952		575							
Not eligible for SSTS	1000		1000							
Eligible for SSTS	0		0							
Located within 400m buffer of a bus stop	957		715							noi every service will bo fillod
Located within 800m buffer of a bus stop	1000		988	7						
>1200m from school and within 400m buffer of a	30	3%	398 4	%0t	398	%0	%0	12%		
>1200m from school and not within 400m buffer of a school bus stop	18	2%	27	3%	27	<b>炎</b> 0	%0	10%		
Assumptions			Pro	ojecte	d number	114	45	84	757	
Bus stops are delivered every 400m on sub-arterial ro	oads		Project	ed m	ode share	11%	5%	8%	76%	

#### Assumptions

- Bus stops are delivered every 400m on sub-arterial roads

76%

Projected mode share 11%

- Walk to school day & other typical curriculum

- Roundabout on sub-arterial and collector intersection

- 3 school bus routes



South Creek West Precinct 5 Public School Rapid Transport Assessment

# Mode share forecast – stretch case

	Nofi	onal	Ach		Poference			tion		Cycle training and cycle
Catchment	(as the c	row flies)	d uo)	ath)						, harbing is expected to
	#	%	#	⊳%	number	Walk	Bicycle	Bus	Car	
1-400m	135	14%	41	4%	41	70%	5%			reda to 110% on
400-800m	433	43%	159	16%	159	35%	10%	2%		contidence with students
800-1,200m	384	38%	375	38%	375	15%	15%	8%		also walking on days
0-1,200m (up to 15 min walk)	952		575							when they don't ride.
Not eligible for SSTS	1000		1000							
Eligible for SSTS	0		0							
Located within 400m buffer of a bus stop	957		715							
Located within 800m buffer of a bus stop	1000		988	7						
>1200m from school and within 400m buffer of a school bus stop	30	3%	398	40%	398	%0	%0	12%		
>1200m from school and not within 400m buffer of a school bus stop	18	2%	27	3%	27	%0	%0	10%		
Assumptions			P	oject	ed number	141	74	84	702	
- Bus stops are delivered every 400m on sub-arterial ro	oads		Projec	cted n	node share	14%	7%	8%	20%	

#### Assumptions

- Bus stops are delivered every 400m on sub-arterial roads

- Walk to school day & other typical curriculum
  - 3 school bus routes
- cycle to school training program & abundant cycle parking



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Scenario	Explanation	Assumptions
Base case	Proposal conditions	<ul> <li>Bus stops are delivered every 400m on sub- arterial roads</li> <li>Walk to school day &amp; other typical curriculum</li> </ul>
Moderate case	Improvements to public transport services	Same as base case • Additional 3 school bus routes
Stretch case	Longer term changes	Same as moderate case <ul> <li>Cycle to school training program</li> <li>75 bicycle parking spaces</li> </ul>



### Mode share splits

	Ŵ	alk	C	cle	Bu	SL	U	ŭ
scenario	#	%	#	%	#	%	#	%
Base case	114	11%	45	5%	0	%0	841	84%
Moderate case	114	11%	45	5%	84	8%	757	76%
Stretch case	141	15%	74	7%	84	8%	702	70%

- Reference to trip generation surveys and mode share percentages for Dapto Public School and Kurnell Public School were taken. Both schools have public and active transport initiatives that correspond with reasonable cycle, walking and public transport mode shares.
- 22-25% of trips to shopping centres are 'linked' (pg 54). Hence the adjacent location of the school and town The Small Suburban Shopping Centres - Trip Generation Surveys Analysis Report indicates that approximately centre will support reduced traffic generation and increased demand for short walking trips. •





## Concept layout review

- Positives:
- Appropriate crossing location at main entrance of school
- Bus stops at front of school near primary entrance provide priority and convenience to public transport
- Shared parking with open space represents opportunity for infrastructure efficiency
- A Kiss 'n drop has generous storage prior to impacting on sub-arterial road
- Walking connection to town centre supports linked trips and reduces car demands
- Issues:
- Proximity of multiple car park entrances to roundabout could cause sight line issues. Driveway access locations could be refined in next stage of planning.





## Concept design considerations

- Standards have not been reviewed for the concept plan – this would occur during design phase.
- Zebra crossing on the western leg of the roundabout for safer crossing.
- 2 Shift western school gate to align with K&D location
- Need for safe and weather appropriate route identified from kiss 'n drop to school gate to the northrecommend footpath on southern boundary of playing field

#### Summary comments:

School Com Route

and the

Route

- The layout provides a good frontage to the new northsouth road, with pedestrian priority crossings and bus stops.
- Potential shared kiss 'n drop arrangement supports efficient use of space.
- There is queuing room from kiss 'n drop facilities before impacting on the sub-arterial road network.







# Infrastructure investment details

04

### Public transport

- Reference was made to Dapto Public School, which we have used as a benchmark. Dapto Public School has a relatively small catchment as well and has three school bus routes.
- ~40% of students live >1200m away from school.
- Although students in the proposed school will not be eligible for subsidized travel, a proportion of students may consider traveling by school bus if made convenient to them.
- Three school bus routes are proposed 1, 2, and 3.



South Creek West Precinct 5 Public School Rapid Transport Assessment



## Kiss 'n drop spaces required

- Kiss 'n drop requirements estimated using M/M/C queue theory
- Assumed 1.7 students per car
- 90% arrival during the peak period
- Assumed 2 minutes to locate child and leave (pick up usually poorest performing)
- Queue lengths are reported based on the 95<sup>th</sup> percentile worst scenario
- Mode shift is most effective form of queue management
- A minimum of 17 bays is recommended to mitigate queueing
- The concept plan illustrates the potential for 88 spaces, which is more than enough to result in zero queuing. This should be optimised based on parking demands for the playing field, sustainable travel objectives and kiss 'n drop queuing requirements.

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**COBBITTY SUB PRECINCT 5: RETAIL DEMAND ANALYSIS** 

Prepared for BHL Group December 2022

#### arty) in respect of any loss suffered or incurred as a stated in the Report) necessarily assumes that, as at COVID-19 Outbreak within a short space of time and that it will have a lasting impact. Clearly, the COVIDcarefully consider when relying on the report and the elates and the business sector to which they belong However, it is not possible to ascertain with certainty not materially impacted the Australian economy, the that informs and supports it is current as at the date asset(s) and any associated business operations to mpacting the Report Content, but only to the extent unprecedented event. It is possible that the market he date of this report, the COVID-19 Outbreak has officers, employees and agents) expressly disclaim To the maximum extent permitted by law, Urbis (its associated business operations to which the report associated business operations to which the report could be (or has been) materially impacted by the relates or the Australian economy more broadly is (unless otherwise specifically stated in the Report) The Report Content and the data and information Any Report Content addressing the impact of the 19 Outbreak is an important risk factor you must which the report relates and the Report Content. ndirect, to any person (including the Instructing nformation used to support the Report Content. that such impact is not reflected in the data and of this report and (unless otherwise specifically all liability and responsibility, whether direct or at this time how the market and the Australian unsupported by specific and reliable data and COVID-19 Outbreak on the asset(s) and any conditions applying to the asset(s) and any esult of the COVID-19 Outbreak materially economy more broadly will respond to this nformation and must not be relied on. Report Content.

The data and information that informs and supports our opinions, estimates, surveys, forecasts, projections, conclusion, judgments, assumptions and recommendations contained in this report (Report Content) are predominantly generated over long periods, and is reflective of the circumstances applying in the past. Significant economic, health and other local and world events can, however, take a period of time for the market to absorb and to be reflected in such data and information. In many instances a change in market thinking and actual market conditions as at the date of this report may not be reflected in the data and information used to support the Report Content.

The recent international outbreak of the Novel Coronavirus (COVID-19), which the World Health Organisation declared a global health emergency in January 2020 and pandemic on 11 March 2020, is causing a material impact on the Australian and world economies and increased uncertainty in both local and global market conditions.

he impact it will have more broadly on the Australian sectors, such as the retail, hotel and tourism sectors, performance now and potentially into the future. For unknown and it is difficult to predict the quantum of example, Shopping Centre operators are reporting March 2020, the COVID-19 Outbreak is materially economy and how long that impact will last. As at particularly in centres that ordinarily experience a COVID-19 Outbreak on the Australian real estate are already reporting material impacts on trading economic growth expectations. Some business The effects (both directly and indirectly) of the mpacting global travel, trade and near-term market and business operations is currently material reductions in foot traffic numbers, high proportion of international visitors.

Cobbitty Retail Demand Analysis

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13/12/2022

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Site Overview and Strategic Context	7
Retail Hierarchy and Supply Analysis	7
Retail Trade Area	15
Demand Analysis and Recommendations	18

ey Findings	Indicative Centre Comp	osition		Table E.1
BHL Group is a major landholder in Sydney's		GLA (SQ.M)	% OF TOTAL GL/	INDICATIVE NO. OF TENANTS
south West Growth Area (SWGA). BHL Group's landholding comprises a 173-hectare portion of	Supermarket	4,000	53%	~
Cobbitty Sub Precinct 5 (subject site). BHL Group seeks to initiate the preparation of a	Mini-Major	400	5%	1 (e.g. chemist, liquor)
Planning Proposal for the rezoning of Precinct 5,	Retail Specialties	1,500	20%	See Table 4.3
consistent with the Draft Indicative Layout Plan (ILP). This is to facilitate the orderly redevelopment	Total Retail	5,900	78%	
of Precinct 5 into a residential community. Urbis have been engaged to assess the future demand for retail floorspace in Precinct 5, and ensure the master plan allows for sufficient retail	Non Retail	1,600	22%	7-8 (e.g. gyms, medical centre / suites, and local financial services)
and services to meet the needs of the future	Total Centre	7,500	100%	
Drawing on the subject site's supportable quantum of retail floorspace and Urbis' extensive database of successful shopping centres, we have outlined an indicative centre composition in Table F 1	Source: Urbis Shopping Centre Benchr	marks 2021		- - -
As shown in the table we recommend the subject	Indicative Retail Specia	ulty Mix		Table E.2
site accommodate a supermarket based shopping		GLA (SQ.M)	% OF GLA	INDICATIVE NO. OF TENANTS
centre with a total GLA of $\sim$ (, 200 sq.111. This centre would be anchored by a single full line	Food Retail	200	13%	1-2 (e.g. bakery, butcher, seafood)
supermarket, supported by 400 sq.m of mini-major floorsnace (notentially a large chemist or lignor	Food Catering	400	27%	4-6 (e.g. take-away, casual dining)
store) and 1,500 sq.m of retail specialty floorspace	Apparel	200	13%	2
(reter Table E.2 for recommended mix). In addition to the 5 פווו איי of retail floorsnace	Homewares	150	10%	2
we recommend a further 1,600 sq.m of non-retail	Leisure/General	200	13%	2 (e.g. newsagents, florist, giftshop)
floorspace be provided in the centre. Our recommended floorspace and centre	Retail Services	350	23%	4-6 (e.g. dry cleaners, hairdresser, massage, key-cutter, optometrist)
composition is indicative for the purposes of	Total Retail Specialities	1,500	100%	15-20
retail floorspace analysis will be required to inform any subsequent Development Applications.	Source: Urbis Shopping Centre Benchn	marks 2021		

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**EXECUTIVE SUMMARY** 

**Key Findings** 

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Cobbitty Retail Demand Analysis

13/12/2022

#### INTRODUCTION

- BHL Group is a major landholder in Sydney's South West Growth Area (SWGA). BHL Group's landholding comprises a 173-hectare portion of Cobbitty Sub Precinct 5 (subject site), which is, in turn, located within the South Creek West (SCW) release area.
- As one of 14 precincts in the broader SWGA, the SCW release area has been earmarked for the delivery of jobs and housing over the next 30+ years.
- BHL Group therefore seeks to initiate the preparation of a Planning Proposal for the rezoning of Precinct 5, consistent with the Draft Indicative Layout Plan (ILP). This is to facilitate the orderly redevelopment of Precinct 5 into a residential community.
- To ensure the master plan allows for sufficient retail and services to meet the needs of the future resident, worker and visitor population, Urbis have been engaged to assess the future demand for retail floorspace in Precinct 5.
  - Our report is structured as follows:
- Section 1 Site Overview and Strategic Context
- Section 2 Retail Hierarchy and Supply Analysis
- Section 3 Retail Trade Area
- Section 4 Demand Analysis and Recommendations.

## **1.0 SITE OVERVIEW AND STRATEGIC** CONTEX

### SUBJECT SITE OVERVIEW

#### Key Findings

- The subject site comprises a portion of an area known as the Cobbitty Sub Precinct 5, situated in the South West Growth Area (SWGA).
- Environment Plan 2010, and accommodates a mix of rural residential and agricultural land The site is currently zoned RU1 Primary Production under the Camden Local uses and activities.
- housing and non-residential uses on the site, BHL Group is leading the development of a To enable the structured delivery of new precinct-wide master plan.
- The site benefits from frontage and access to south-east and Lowes Creek Maryland in the north. The site's connections to The Northern The Northern Road to the east, in addition to Road specifically will provide easy access to future road connections to Oran Park in the the future Western Sydney Airport and Aerotropolis, and South-West Sydney.
- north, Pondicherry to the east (in the process of and commercial uses delivered over the last 10 rezoned Lowes Creek Maryland precinct to the well-underway with significant residential, retail east. The development of Oran Park is already being rezoned) and Oran Park in the south-Surrounding land uses include the recently years, and further growth planned.
- within the SCW release area, are anticipated to uses are currently situated north-east and west Low intensity agricultural and rural residential of the subject site but, given their location transition to residential uses over time.

# Cobbitty Sub Precinct 5: BHL Landholding – Indicative Layout Plan



13/12/2022

### STRATEGIC CONTEXT

#### Key Findings

- broader SWGA (overleaf), the SCW release area has been earmarked for the delivery of release area. As one of 14 precincts in the The subject site is located within the SCW obs and housing over the next 30+ years.
- VSW Department of Planning and Environment collaboration between private landholders, the area is divided by the Lowes Creek Maryland Bringelly and parts of Cobbitty. However, the The SCW release area extends south from Precinct which has been planned through Greendale Road, encompassing much of (DPE) and Camden Council.
- dwellings and significant open space to service an ultimate population of 20,420 residents. The (overleaf) will likely deliver a Local Centre, The Lowes Creek Maryland Precinct Plan combined primary and high school, 7,000 precinct has recently been rezoned.
- The opening of the Airport in 2026 is expected The Western Sydney Airport and Aerotropolis immediately north of the SCW release area. to be a major catalyst for growth in the area. is also currently under construction
- Aerotropolis Core" accommodating a broad mix of land uses is planned to be situated between To ensure the full potential of the Airport is leveraged, a new Strategic Centre "The the Airport and SCW release area.

0 0 0

This Strategic Centre, the Airport and the wider Aerotropolis will be serviced by a new Metro ine which is also planned to extend south to Oran Park and Macarthur, and east to -eppington.

#### Strategic Context



Source: Urbis

## **STRATEGIC CONTEXT – PLANNED PRECINCTS**



Lowes Creek Maryland Precinct ILP (Final)



Cobbitty Retail Demand Analysis

Page 10

Source: NSW DPE

### **2.0 RETAIL HIERARCHY AND SUPPLY ANALYSIS**

<ul> <li>The stating call in the charact and theractyrity in the charact and and and and and and and and and and</li></ul>						
<ul> <li>The ossing retain network and herrerchy in the intervaling retain network and herrerchy in the intervaling retain appropriate trade area area and anon propriet trade area area area area area area area</li></ul>	Key Findings	Centre Hierarchy				Figure 2.1
<ul> <li>As shown in Figure 2.1, there are three types of the strength framework that are relevant to South Strategic Planning framework that are subject site which are subject site which are subject site which are relevant or related Strategic Planning framework that are constrated strategic Planning framework that are subject site which are relevant or related Strategic Planning framework that are subject site which are subject site which are subject site which are relevant or related Strategic Planning framework that are relevant to subject site which are subject site which are relevant strategic Centre Planning framework that are relevant to subject site which are relevant strategic Planning framework that are relevant strategic Planning framework that are relevant to subject strategic Planning framework that are relevant strategic Planning framework that are</li></ul>	<ul> <li>The existing retail network and hierarchy in the surrounding area is a key consideration in defining an appropriate trade area and assessing the demand and need for retail floorspace at the subject site.</li> </ul>	METROPOLITAN CLUSTER	CE	ATEGIC NTRE		LOCAL Centre
- Metropolitan Clusters     Bradileid     Eppington     ComPark       - Local Centres     - Local Centres     - Local Centres     - Local Centres     - Carnes Hill       - Local Centres     - Local Centres     - Local Centres     - Local Centres     - Carnes Hill       - Local Centres     - Local Centres     - Local Centres     - Local Centres     - Carnes Hill       - Local Centres     - Local Centres     - Local Centres     - Carnes Hill     - Carnes Hill       - Tables of the subject site which a substantial quantum of retail quantum of retail quantum of retail quantum of retail construction and retail Carnes Hill and Oran Park     - Carnes Hill     - Carnes Hill       - Sabown in Table 2.1, Narellan is currently the existing centre who of retail GLA.     - Suborn Park     - Carnes Hill     - Carnes Hill       - Sabown in Table 2.1, Narellan is currently the existing centres with or a substantial quantum of retail GLA.     - Centres     - Centres     - Centres       - Sabown in Table 2.1, Narellan is currently the constance of these existing centres with or a not retail GLA.     - Centres     - Centres     - Centres     - Centres       - Harrington Park     - Centres     - Centres     - Centres     - Centres     - Centres     - Centres       - Harrington Park     - Centres     - Centres     - Centres     - Centres     - Centres     - Centres       - Harrington Park	<ul> <li>As shown in Figure 2.1, there are three types of centre within the Greater Sydney Strategic Planning framework that are relevant to South- West Sydney:</li> </ul>		1		1	•
• Local Centres.       Liverpod       Marcelian       Marcelian       Cannes Hill         • These different centre categories vary in their intended scale and mix of land uses.       • Liverpod       Marcelian       Cannes Hill         • There are currently three existing centres with one and point and the addy provide subject site intended scale and mix of land uses.       Campbelltown       Harrington Park         • There are currently three existing centres with over the land Oran       Source: NSW DFE; Greater Sydney Commission       Farthere       East Source         • Se shown in Table 2.1. Narellan is currently the existing centres with over 70,000 s.m. of retail GLA.       Source: NSW DFE; Greater Sydney Commission       Farthere       Table 2.1         • Outoo s.m. of retail GLA.       Harrington Park       Natol Farthere       East Source       Table 2.1         • Outoo s.m. of retail GLA.       However, the closest existing centre to the subject site is Oran Park which currently the evert the closest existing centre to the subject site is Oran Park which currently the subject site is Oran Park       Nateliny       Table 2.1         • Outoous shown the substand of this centre which is detailed       Image: Centre 1.6, 30.00       Image: Centre 1.6, 30.00       Image: Centre 1.6, 30.00         • Outoo set of this existing centre which is detailed       Image: Centre 1.6, 30.00       Image: Centre 1.6, 30.00       Image: Centre 1.6, 30.00       Image: Centre 1.6, 30.00         • Camp Par	<ul> <li>Metropolitan Clusters</li> <li>Strategic Centres</li> </ul>	Bradfield	Lepi	pington		Oran Park
	- Local Centres.	Liverpool	Na	rellan		Carnes Hill
<ul> <li>There are currently three existing centres which attain a 15 km radius of the subject site which attain a 15 km radius of the subject site which are nuture of the subject site which are nuture of the subject site which are substantial quantum of retail Grams and Oran Park.             </li> <li>A show in Table 2.1, Narellan is currently the forms of the subject site of the subject site is Oran Park which currently subject site is Oran Park which currently be volved by a Wolworth's supermarket. A major expansion is proposed for this centre which is detailed.             </li> <li>However, the closest existing centre to the subject site is Oran Park which currently be volved by a Wolworth's supermarket. A major expansion is proposed for this centre which is detailed.             </li> <li>Mander Hill Mander Mande</li></ul>	<ul> <li>These different centre categories vary in their intended scale and mix of land uses.</li> </ul>	Cambbelltown-			Har	rrington Park
Inforspace – Narellan, Carnes Hill and Oran       Existing centres with over       Table 2.1         As shown in Table 2.1, Narellan is currently the largest of these existing centres with over 70,000 sq.m of retail GLA.       Existing Centres       Imagest of these existing centres with over 800 sq.m of retail GLA.       Imagest of these existing centres with over 800 sq.m of retail GLA.       Imagest of these existing centres with over 800 sq.m of retail GLA.       Imagest of the closest existing centre to the subject site is Oran Park which currently Narellan       Imagest of the closest existing centre to the vick of the closest existing centre to the subject site is Oran Park which currently Narellan       Imagest of the closest existing centre to the vick of the vick	<ul> <li>There are currently three existing centres within a 15 km radius of the subject site which already provide a substantial quantum of retail</li> </ul>	Macarthur Source: NSW DPE; Greater Sydney C	iommission.			1
• As shown in Table 2.1, Narellan is currently the largest of these existing centres with over 70,000 sq. m of retail GLA.       Table 2.1         • However, the closest existing centre to the subject site is Oran Park which currently subject site is Oran Park which currently is provides 9,800 sq. m of retail GLA anchored by a Woolworths supermarket. A major expansion is proposed for this centre which is detailed.       Nanellan       RETAIL       Itable 2.1         • However, the closest existing centre to the subject site is Oran Park which currently a woolworths supermarket. A major expansion is proposed for this centre which is detailed.       Nanellan       Strategic Centre       70,000       6 km       3 x DDS         • Modworths supermarket. A major expansion is proposed for this centre which is detailed.       Cannes Hill       Local Centre       16,350       13 km       Woolworths         • Oran Park       Oran Park       Local Centre       9,800       3 km       Woolworths	floorspace – Narellan, Carnes Hill and Oran Park.					
70,000 op.m of retail GLA.       RETAIL       DISTANCE FROM         70,000 op.m of retail GLA.       NAME       CENTRE TYPE       GLA (SQ.M)       SUBJECT SITE (KM)       MAJOR TENANTS         • However, the closest existing centre to the subject site is Oran Park which currently subject site is Oran Park which currently provides 9,800 sq.m of retail GLA anchored by a Woolworths supermarket. A major expansion is proposed for this centre which is detailed cance which is detailed overleaf.       Name       3 x DDS       3 x DDS         0 cannes High       Narellan       Local Centre       70,000       6 km       2 x Supermarkets         0 cannes High       Cannes High       Local Centre       16,350       13 km       Woolworths         0 can Park       Dran Park       Local Centre       9,800       3 km       Woolworths	<ul> <li>As shown in Table 2.1, Narellan is currently the largest of these existing centres with over</li> </ul>	Existing Centres				Table 2.1
subject site is Oran Park which currently provides 9,800 sq.m of retail GLA anchored by a Woolworths supermarket. A major expansion is proposed for this centre which is detailed overleaf. 0,000 6 km 3 x DDS 2 x Supermarkets 2 x Supermarkets 2 x Supermarkets 2 x Supermarkets 2 x ODS 2 x	<ul> <li>70,000 sq.m of retail GLA.</li> <li>However, the closest existing centre to the</li> </ul>	NAME	<b>CENTRE TYPE</b>	RETAIL GLA (SQ.M)	DISTANCE FROM Subject site (KM)	MAJOR TENANTS
is proposed for this centre which is detailed Carnes Hill Local Centre 16,350 13 km Big W Woolworths overleaf. Oran Park Local Centre 9,800 3 km Woolworths	subject site is Oran Park which currently provides 9,800 sq.m of retail GLA anchored by a Woolworths supermarket. A maior expansion	Narellan	Strategic Centre	70,000	6 km	3 x DDS 2 x Supermarkets
Oran Park Local Centre 9,800 3 km Woolworths	is proposed for this centre which is detailed overleaf.	Carnes Hill	Local Centre	16,350	13 km	Big W Woolworths
		Oran Park	Local Centre	9,800	3 km	Woolworths

Source: Urbis, PCA Shopping Centres Online

13/12/2022

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#### **Key Findings**

- firm supply pipeline are also key considerations In addition to the existing retail network and hierarchy, the planned centres network and assessing the demand and need for retail in defining an appropriate trade area and floorspace at the subject site.
- to the subject site. These centres vary in scale As shown in Table 2.2, thirteen future centres have been identified by DPE in close proximity but are all within the early planning stage.
- 100,000 sq.m, 25,000 sq.m and 20,000 sq.m of The Leppington Strategic Centre, Austral Local -ocal Centre have been flagged as the largest Centre and Lowes Creek Maryland Precinct of the planned centres, with potential for retail floorspace, respectively.
  - these three centres as it is a Strategic Centre. provide a greater quantum of floorspace than However, it is likely Bradfield will ultimately
- While the majority of centres in the surrounding an additional ~24,700 sq.m of retail floorspace area are still in early planning, there are three (refer Table 2.3) which are expected to deliver approved retail developments in the pipeline by 2025.
- expected to deliver a new Discount Department Store (DDS), two mini majors, a dining hall and Podium – Stage 2 is the most significant and is Of these approved developments, Oran Park other retail specialties by 2024.

#### Planned Centres

Planned Centres			Table 2.2
NAME	SUBURB	RETAIL GLA (SQ.M)	STAGE
Leppington Strategic Centre	Leppington	100,000	Early Planning
Austral Local Centre	Austral	25,000	Early Planning
Austral Village Neighbourhood Centre	Austral	8,000	Early Planning
Eighth Avenue Neighbourhood Centre	Austral	8,000	Early Planning
Gurner Avenue Centre	Austral	8,000	Early Planning
Bradfield	Bringelly	Not yet known	Early Planning
CPA North	Bringelly	8,500	Early Planning
Bulky Goods Centre	Bringelly	27,000	Early Planning
Convenience Centre	Bringelly	3,500	Early Planning
Lowes Creek Maryland Precinct Local Centre	Bringelly	20,000	Early Planning
Mixed Use Precinct	Bringelly	4,000	Early Planning
CPA South	Cobbitty	6,000	Early Planning
Pondicherry Centre	Pondicherry	1,500	Early Planning
Source: NSW DPE, Deep End Services			

Firm Retail Supply Pipelin	Û			Table 2.3
NAME	SUBURB	RETAIL GLA (SQ.M)	STAGE	<b>COMPLETION YEAR</b>
Oran Park Podium – Stage 2	Oran Park	16,050	Development Approval	2024
Oxley Ridge	Cobbitty	3,000	Development Approval	2025
Ingleburn Road Commercial Development	Leppington	5,672	Development Approval	2025

Source: Cordell Connect, NSW DPE, Deep End Services

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## **3.0 RETAIL TRADE AREA**

## **RETAIL TRADE AREA DEFINITION**

#### Key Findings

- We defined a retail trade area to assess the market demand for retail uses at the subject site at build-out.
- The trade area refers to the area from which a centre or retailer is most likely to draw customers. The size and scale of trade areas in greenfield locations vary due to geographical and strategic planning context (refer Section 1 and 2).
- The adopted trade area has been based on the extent of Cobbitty Sub Precinct 5, Lowes Creek Maryland Precinct and Transport for NSW Travel Zone boundaries. It is defined as:
- Primary trade area comprises the BHL-owned portion of Cobbitty Sub Precinct 5 and extends south to Peter Brock Drive
- Secondary north trade area extends north from the primary trade area to Lowes Creek, partially overlapping with the Lowes Creek Maryland Precinct, and east to The Northern Road
- Secondary west trade area extends west from the primary trade area to Coates Park Road, north to Lowes Creek and south to Cobbitty Creek.
- Given the planned Local Centre to the north and Oran Park Podium to the east (refer Section 2), the trade area defined for the subject site reflects a relatively localised catchment.



Key Findings	Population and Retail Sper	nd Per Capita, Build-	Out (2056+)	Table 3.1
<ul> <li>For the purposes of our assessment, we have</li> </ul>	TRADE AREA SECTOR	POPULATION	TOTAL	RETAIL SPEND PER CAPITA*
forecast the population of the trade area at build- out (i.e. the ultimate population of the trade area	Primary	9,500**		
upon completion).	Secondary North	14,292		
<ul> <li>In preparing these projections, we have had regard to:</li> </ul>	Secondary West	16,389		
- Proposed dwelling yield for the subject site	Total Secondary	30,681		
(approximately 2,450 dwellings)	Total Trade Area	40,181		\$17,604
<ul> <li>Trojected resident population of the proposed Lowes Creek Maryland Precinct</li> <li>Travel Zone-level population projections published by Transport for NSW.</li> </ul>	* 2021 dollars ** Maximum potential population Source: ABS, MarketInfo, Urbis, Transport fo	or NSW, Deep End Services, AEC		
<ul> <li>The total trade area is projected to accommodate a resident population of ~40,180 persons at build-out. Up to approximately 9,500 of these</li> </ul>	Retail Spending Market* (\$	M), Build-Out (2056+		Table 3.2
the primary trade area alone (including ~7,500	PRODUCT GROUP	PRIMARY	OTAL SECONDARY	TOTAL TRADE AREA
<ul> <li>The secondary trade area is expected to reach a</li> </ul>	Food Retail	\$70.0	\$226.1	\$296.1
population of ~30,680 persons, largely driven by	Food Catering	\$24.1	\$77.8	\$101.9
the planned growth in the Lowes Creek Maryland Precinct.	Apparel	\$16.0	\$51.8	\$67.8
We project the total retail spending market at	Homewares	\$13.3	\$43.1	\$56.5
build out by multiplying an assumed spend per capita for each product group by the projected	Bulky Goods	\$18.7	\$60.4	\$79.1
population. For the purposes of our analysis, snend her canite date for the nearby Oran Park	Leisure/General	\$19.5	\$62.9	\$82.4
Precinct has been used as a proxy for trade area	Retail Services	\$5.6	\$18.0	\$23.6
residents.	Total Retail	\$167.2	\$540.1	\$707.3
projected to reach over \$700 million (\$2022) at build-out. The primary trade area is expected to account for almost a quarter of the total spending	*2022 dollars Source: MarketInfo, Transport for NSW, Dee	p End Services, AEC, Urbis		

**PROJECTED POPULATION AND RETAIL SPENDING MARKET** 

Cobbitty Retail Demand Analysis

market at \$167.2 million.

13/12/2022

# 4.0 DEMAND ANALYSIS AND RECOMMENDATIONS

Key Points  • For the purposes of this demand assessment	Methodology Overview		Figure 4.
we utilised a retail spending approach to project future retail floorspace needs in the trade area.	Trade Area Population	Spend per Capita	
<ul> <li>As illustrated in Figure 4.1, this approach comprises:         <ol> <li>Projecting the resident population of the trade area at huild-out</li> </ol> </li> </ul>			
<ol> <li>Multiplying an assumed spend per capita for each product group by the projected population to quantify the total trade area retail spending market</li> </ol>	Trade Area Retail Spending Market	Average Trading Levels per Sq.m	
<ol> <li>Dividing the total trade area retail spending market by average trading levels per sq.m for each product group (sourced from the Urbis Shopping Centre Benchmarks 2021) to estimate total trade area retail floorspace demand at build- out</li> </ol>	Trade Area Retail Floorspace Deman		Subject Site larket Shares
<ol> <li>Applying appropriate market shares for each trade area sector to the total trade area retail floorspace demand to estimate supportable retail floorspace at the subject site by product group.</li> </ol>	FIG	Supportable Retail porspace at Subject Site	

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## **RETAIL FLOORSPACE DEMAND ANALYSIS**

#### Key Findings

- Table 4.1, overleaf, outlines the key assumptions that have been used as part of the retail floorspace demand analysis for the subject site, and the results of our demand assessment.
- As noted previously, to estimate total trade area retail floorspace demand at build-out, we divided the total trade area retail spending market by average trading levels per sq.m for each product group.
- These average trading levels per sq.m have been sourced from the Urbis Shopping Centre Benchmarks 2021. These Benchmarks are based on an annual survey that Urbis conducts of all major retail centres across Australia. They therefore provide a robust and realistic estimate of actual turnover per sq.m for different product groups and centre types.
- As shown in the table, average trading levels vary significantly by product group, from ~\$2,300 per sq.m for bulky goods up to ~\$12,150 for food retail.
- Table 4.1 also outlines the market shares we have adopted for each trade area sector and product group. These rates effectively represent the share of floorspace demand that is likely to be captured by the subject site.
- Given the limited competing supply, the highest shares have been adopted for the primary trade

area (5-35%) followed by the secondary north and secondary west (1-15%). Relatively low market shares have been adopted for the secondary north and secondary west trade areas (1-15%) given the proximity of the planned Lowes Creek Maryland Precinct Local Centre and a planned centre in Pondicherry.

- Given the highly localised trade area, we have allowed for 10% demand from residents living beyond the trade area (i.e. can include those who work in the trade area but live elsewhere).
- On the basis of these assumptions, we estimate the subject site will be able to support up to ~6,040 sq.m of retail floorspace at build-out, including over 4,300 sq.m of food retail floorspace.
- A significant portion of this floorspace
   (~2,860 sq.m) will be required to meet the needs of primary trade area residents, while the remaining ~3,180 sq.m will be required to meet the demand of secondary trade area residents, and demand from beyond the trade area.

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Projected Supportable Reta	il Floorspace	- Total Trade	Area, Build-	Out (2056+)				Table 4.1
	F00D RETAIL	FOOD Catering	APPAREL	HOMEWARES	BULKY GOODS	LEISURE/ General	<b>RETAIL</b> Services	TOTAL RETAIL
Retail Spend – Trade Area (\$M)								
Primary	\$70.0	\$24.1	\$16.0	\$13.3	\$18.7	\$19.5	\$5.6	\$167.2
Secondary North	\$105.3	\$36.2	\$24.1	\$20.1	\$28.1	\$29.3	\$8.4	\$251.6
Secondary West	\$120.8	\$41.6	\$27.7	\$23.0	\$32.3	\$33.6	\$9.6\$	\$288.5
Total Trade Area	\$296.1	\$101.9	\$67.8	\$56.5	\$79.1	\$82.4	\$23.6	\$707.3
Average Trading Level per Sq.m								
Average Trading Level (\$/sq.m)	\$12,142	\$11,520	\$6,831	\$7,372	\$2,325	\$10,118	\$8,402	\$7,384
Total Floorspace Demand – Trade	Area (sq.m)							
Primary	5,766	2,091	2,348	1,810	8,045	1,924	665	22,649
Secondary North	8,674	3,146	3,532	2,724	12,103	2,895	1,000	34,074
Secondary West	9,947	3,607	4,050	3,123	13,879	3,320	1,147	39,073
Total Trade Area	24,388	8,844	9,929	7,657	34,027	8,139	2,812	95,796
Source: Urbis Shonning Centre Benchmarks 2	2021- Marketlufo Tran	snort for N.S.W. Deen	End Services AEC	1 Irbis				

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Projected Supportable Reta	il Floorspace	<ul> <li>Subject Site</li> </ul>	e, Build-Out	(2056+) cont.	:			Table 4.1
	F00D RETAIL	FOOD Catering	APPAREL	HOMEWARES	BULKY GOODS	LEISURE/ General	<b>RETAIL</b> Services	TOTAL RETAIL
Market Shares – Subject Site (%)								
Primary	35.0%	10.0%	5.0%	5.0%	%0.0	10.0%	35.0%	12.6%
Secondary North	5.0%	2.0%	1.0%	1.0%	0.0%	2.0%	5.0%	2.0%
Secondary West	15.0%	2.5%	1.0%	1.0%	0.0%	2.5%	15.0%	4.9%
Total Trade Area	16.2%	4.1%	1.9%	1.9%	0.0%	4.1%	16.2%	5.7%
Demand from Beyond the Trade Ar	еа			10	0%			
Supportable Floorspace – Subject {	Site (sq.m)							
Primary	2,018	209	117	91	0	192	233	2,860
Secondary North	434	63	35	27	0	58	50	667

Source: Urbis Shopping Centre Benchmarks 2021; MarketInfo, Transport for NSW, Deep End Services, AEC, Urbis

1,909

1,492 

Secondary West

Beyond

6,040 

4,382

Supportable Floorspace

Key Findings	Indicative Centre Compo	osition		Table 4.2
<ul> <li>Drawing on the subject site's supportable</li> </ul>		GLA (SQ.M)	% OF TOTAL GLA	INDICATIVE NO. OF TENANTS
quantum of retail floorspace estimated in Table 4.1 and Urbis' extensive database of	Supermarket	4,000	53%	-
successful shopping centres, we have outlined an indicative centre composition in Table 4.2.	Mini-Major	400	5%	1 (e.g. chemist, liquor)
As shown in the table, we recommend the	Retail Specialties	1,500	20%	See Table 4.3
subject site be anchored by a single tull line supermarket (~4,000 sq.m). This anchor could	Total Retail	5,900	78%	
be supported by 400 sq.m of mini-major floorspace (potentially a large chemist or liquor store) and 1,500 sq.m of retail specialty floorspace.	Non Retail	1,600	22%	7-8 (e.g. gyms, medical centre / suites, and local financial services)
We have also provided a recommended mix of	Total Centre	7,500	100%	
<ul> <li>The indicative mix of specialities includes</li> <li>600 sq.m of food tenancies (food retail and food catering), 200 sq.m of apparel, 150 sq.m</li> </ul>	Source: Urbis Shopping Centre Benchm	narks 2021		
of homewares, 200 sq.m of leisure/general, and 350 sq.m of retail services (e.g.	Indicative Retail Special	lty Mix		Table 4.3
hairdresser, dry cleaner, massage, key-cutter).		GLA (SQ.M)	% <b>DF GLA</b>	INDICATIVE NO. OF TENANTS
<ul> <li>In addition to the o, such square the floorspace, we recommend a further</li> </ul>	Food Retail	200	13%	1-2 (e.g. bakery, butcher, seafood)
1,600 sq.m of non-retail floorspace be provided in the centre (consistent with Lirbis'	Food Catering	400	27%	4-6 (e.g. take-away, casual dining)
benchmarks for supermarket based centres).	Apparel	200	13%	7
This non-retail floorspace could accommodate     rese such as nume medical surface and local	Homewares	150	10%	2
financial services (banks, accountants, etc).	Leisure/General	200	13%	2 (e.g. newsagents, florist, giftshop)
<ul> <li>Our recommended floorspace and centre composition is indicative for the purposes of</li> </ul>	Retail Services	350	23%	4-6 (e.g. dry cleaners, hairdresser, massage, key-cutter, optometrist)
informing the Planning Proposal. More detailed	<b>Total Retail Specialities</b>	1,500	100%	15-20

**RECOMMENDED CENTRE COMPOSITION** 

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Cobbitty Retail Demand Analysis

13/12/2022
# URBIS

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# URBAN HEAT REPORT SOUTH CREEK WEST

**COBBILITY-BRINGELLY** PRECINCT 5

Prepared for BHL

# EXECUTIVE SUMMARY

This report has been prepared on behalf of **BHL Group** (**BHL**, **the proponent**) to provide an assessment of the heat impacts associated with the rezoning of land within South Creek West. The site located on The Northern Road forms part of Precinct 5 in the South Creek West Land Release Area.

Precinct 5 comprises 303.15 ha of land and will accommodate up to approximately 12,000 people and builds on the NSW Government's vision and aspirations under the Western Sydney Growth Areas program. The Planning Proposal is seeking to rezone 172.68ha of land which forms 57% of the precinct. For simplicity, this report refers to the proposed rezoning land as **Cobbitty Precinct 5.** 

In line with the NSW Government's vision, a diverse range of housing typologies will be planned, targeted for and delivered to meet the residential market demands in south west Sydney. In addition, the precinct will integrate the delivery of a high amenity environment, focused around the principles of achieving a distribution of open space, community facilities, retail and other related nonresidential land uses that directly correlates with the needs for the incoming population, but also responsive to the constraints and opportunities of the site. It will promote pedestrian walkability and connectivity to public places and spaces across the precinct, and fundamentally build on the green and blue grid objectives.

AND AR DELANTS

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# Urbis staff responsible for this report were:

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Urbis acknowledges the important contribution that Aboriginal and Torres Strait Islander people make in creating a strong and vibrant Australian society.

We acknowledge, in each of our offices, the Traditional Owners on whose land we stand.

# 1. INTRODUCTION

Urban Heat is an increasingly problematic issue in the urban areas of Sydney and Australia. With the increasing temperatures from climate change, it will only continue to have a greater impact. Planning for urban heat is and will become an increasing priority for development in NSW.

Western Sydney is heating up twice over as fast as the eastern parts of the city and experience 6 times the number of days over 35 degrees (WSROC, 2021). Identifying measures and priorities to mitigate urban heat will be especially relevant to the Western Sydney growth areas as these parts of the city are greatly overrepresented when it comes to negative urban heat effects.

The Camden Local Government area is currently the fastest growing LGA in Australia, with more than 100 residents calling Camden home each week (Camden Council, 2021). With this growth, there are challenges to overcome and opportunities to be realized to ensure we create a liveable environment for residents and visitors for years to come.

This Urban Heat Report has been prepared by Urbis on behalf of BHL (**the Proponent**) to address the urban heat issues associated with the proposed amendments to the Precincts SEPP to facilitate the redevelopment of the site known as 'Cobbitty Precinct 5' (**the Precinct**) located on The Northern Road in the South Creek West Growth Area (**SWGA**).

# **VISION STATEMENT**

The vision for Cobbitty Precinct 5 is to deliver a high-quality, sustainable, vibrant master planned community which has been intricately designed to intertwine the new urban environment with the picturesque semi-rural character for which the Macarthur Region, and particularly the cowpastures, is renowned. The urban design for the site has been shaped by the unique existing natural characteristics and long history of the site, yet still achieves a coherent masterplan for the development enabling easy wayfinding and efficient land use integration.

# THE AIMS OF THE URBAN HEAT REPORT

As part of planning for new urban areas, Camden Council have identified the following specific aims of an Urban Heat Report:

- To understand the impact that new development will have on the physical environment and its communities in relation to Urban Heat Island.
- To ensure that precinct design further explores the distribution of ambient and surface temperatures whilst, seeking to minimise these to assist in improved thermal comfort.
- To assess the cooling potential of the nominated mitigation strategies and demonstrate how they can be implemented from a precinct level.
- To assist Council in providing qualitative and quantitative data that better supports and validates these strategies when addressing urban heat.
- Reporting the recommended measures to reduce the impacts of the Urban Heat, and providing further updates during development and a follow up report post development addressing whether these strategies were successful or could be enhanced.

This report seeks to specifically respond to these requirement, establishing a framework for future urban development.

# 2. SITE CONTEXT

# 2.1 PLANNING BACKGROUND

# **Current Planning Proposal**

A Planning Proposal was put on initial notification in July 2022 seeking to rezone South Creek West Growth Area Sub-Precinct 5, formally now referred to known as the **Cobbitty-Bringelly Precinct**.

The objectives and intended outcomes of the Planning Proposal will be facilitated through amendments to the *State Environmental Planning Policy (Precincts - Western Parkland City) 2021* (**Precincts SEPP**) and associated land use mapping provisions.

# **Urban Heat Report**

Council have requested the preparation of an Urban Heat Report which demonstrates how the Planning Proposal, ILP, DCP and Urban Design Report and Landscape Masterplan have considered measures to mitigate the effects of Urban Heat. Council requested that the report also address the relevant actions and priorities nominated by relevant strategic planning policies.

This report has been prepared by Urbis and peer-reviewed by Civille. The structure and recommendations have been prepared with consideration of the draft Urban Heat Report prepared by Camden Council and the WSROC Urban Heat Planning Toolkit.



Figure 1 South West Growth Centre and surrounding context

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# 2.2 PHYSICAL CONDITIONS

# The Site

The Precinct positioned along the western edge of South Creek West Land Release Area. The Cobbitty-Bringelly Precinct comprises an approximate area of 172 hectares.

The Precinct sits amongst land release areas identified for significant urban and industrial land use including Lowes Creek Maryland (LCM) to the north, Pondicherry, Catherine Fields and Austral and Leppington North to the east and Oran Park to the south.

# **Landform Characteristics**

The topography across most of the site is gently undulating.

Surface levels generally fall to the north, controlled by an irregular ridge line in the southern portion of the site.

A series of incised gullies have created an ephemeral dendritic drainage system which feeds a number of farm dams. Elevations range from a topographical high-point of 154m Australian Height Datum (AHD) on the south east ridgeline, to a topographical low-point of approximately 84m AHD in the north.

The ridgeline comprises steep upper slopes up to  $30^{\circ}$  with lower slopes of up to  $15^{\circ}$ . Most of the site's undulating terrain comprises slopes of  $0-10^{\circ}$ . It is noted that the construction of a Sydney Water reservoir which includes significant earthworks at the top of the south east ridge was ongoing at the time of reporting.

# **Road Infrastructure**

The main access to the Precinct is via The Northern Road, which lies on the eastern boundary of the Precinct. The Northern Road has recently been realigned and upgraded to support the growth areas, with the provision of key intersections into the site.

This will strengthen connection of the Precinct with key centres, i.e. Badgery's Creek Aerotropolis at the north, 20 minutes driving distance from Cobbitty Precinct. The Northern Road also provides access to Parramatta CBD and Sydney CBD.

# Climate

The Camden Airport Automatic Weather Station (AWS) is located approximately 5 kilometres south of the Precinct. Data has been collected by the Bureau of Meteorology since 1971 and is summarised below.

### Temperature averages and extremes

January is the warmest month on average at Camden Airport AWS (mean maximum temperature of 30.2°C), and July the coldest month (mean maximum temperature of 17.5°C).

The highest temperature ever recorded at the site was 46.4 °C on January 18 2013 and the lowest maximum temperature 8.4 °C on June 10 2021. Seasonally, mean maximum temperatures range from 28.9 °C in summer with a decile 9 of 35.7 °C, to 18.1 °C in winter with a decile 9 of 21.1 °C.

Annually, an average of 14.9 days are recorded where the temperature exceeded 35 °C.

# Wind Speeds

Mean wind speeds at Camden Airport AWS are relatively consistent throughout the year, ranging from approximately 7 to 10 km/hr. The strongest wind gust ever recorded at the site was 115 km/hr on 25 September 2020, from a north-northwest direction.

The predominant wind direction in all seasons is south-westerly.

# Humidity

Approximate average relative humidity (rh) is measured at both 9.00am and 3.00pm. It is defined as the amount of moisture in the air expressed as a percentage of the amount of moisture present if the air was saturated at that temperature.

Generally, humidity at Camden Airport AWS is higher at 9.00am than 3.00pm.

June is the most humid month on average with a mean 9.00am relative humidity of 84% which lowers to 56% by 3.00pm.

In summer, an average humidity of 74% is reached at 9.00am which reduces down to 51% at 3.00pm.



Figure 2 Key existing features of the precinct on aerial photo



# 3. STRATEGIC CONTEXT

# 3.1 STATE WIDE STRATEGIC DOCUMENTS

# **GREATER SYDNEY REGION PLAN: A METROPOLIS OF THREE CITIES**

The Greater Sydney Region Plan (**Region Plan**) is a strategy prepared by the Greater Sydney Commission (GSC) for managing growth and change to guide integrated land use planning and infrastructure delivery for Greater Sydney to 2056. The Region Plan is built on a vision of three cities where most residents live within 30 minutes of their jobs, education and health facilities, services and great places. The vision brings new thinking to land use and transport patterns to boost Greater Sydney's liveability, productivity and sustainability by spreading the benefits of growth.

The South West Growth Area is an identified area for anticipated growth and acceleration of housing growth. The Region Plan also identifies that development along the spine of South Creek and its tributaries will 're-imagine liveability and sustainability, providing new cool and green neighbourhoods and centres with generous open space in a parkland setting.'

The Urban Heat Report aims to support the achievement of **Strategy 38.1** of the Region Plan which is to mitigate the urban heat island effect and reduce vulnerability to extreme heat.

# **GREATER SYDNEY REGION PLAN: A METROPOLIS OF THREE CITIES**

Five District Plans were also prepared by the GSC as guides for implementing the Region Plan at a District level. Each plan is structured around priorities in relation to infrastructure and collaboration, liveability, productivity, sustainability and implementation. Precinct 5 is located within the Western City District.

The greatest increase in population in the Western District is expected in Camden Local Government Area (LGA), mostly in the South West Growth Area and strong growth across all age groups.

The proposed Urban Heat Report aims to respond to the following priorities of the Western City District Plan:

### Priority W15

Increasing urban tree canopy cover and delivering Green Grid connections

### • Priority W20

People and places adapt to climate change and future shocks and stresses Exposure to natural and urban hazards is reduced Heatwaves and extreme heat are managed

# **GREENER PLACES DESIGN GUIDE**

In November 2017, the GANSW released the Draft Greener Places Design Guide, the NSW Government's policy for green infrastructure in NSW. The guide presents a collection of priorities and four (4) principles and four (4) outcomes to guide design and planning in the delivery of green infrastructure in NSW, with a focus on open space for recreation, urban tree canopy and bushland and waterways. Fundamentally, the policies seek to respond to the following NSW challenges:

- Health
- Climate resilience
- · Rapidly growing population
- · Changing lifestyle and demographics
- · Infrastructure and urban renewal
- · Biodiversity loss

Built upon the principles of integration, connectivity, multifunctionality and participation the draft Guide seeks to achieve the following outcomes:

- 1. Conservation of the natural environment
- 2. Increased access to open space
- 3. Improved connectivity to promote active living
- 4. Increase urban greening to ameliorate climate extremes

The draft Guide provides recommendations for planning new development in greenfield sites to maximise opportunities for well-located and accessible parks and public open spaces that provide for a diverse range of recreational activities. The desired outcome for greenfield areas is to base public open space around natural systems, which support connectivity, active transport and a diversity of settings which enhance the local character. Additionally, such practice offers opportunities for improved water-sensitive urban design and habitat conservation, ultimately creating a stronger blue and green grid.

# **3.2 CAMDEN COUNCIL STRATEGIC DOCUMENTS**

# **CAMDEN LOCAL STRATEGIC PLANNING STATEMENT**

The Camden Local Strategic Planning Statement (**LSPS**) was endorsed by the Greater Sydney Commission in March 2021. The LSPS identifies the vision for land use planning over the next 20 years.

The overall vision for Camden is underpinned by four key themes: infrastructure and collaboration, liveability, productivity and sustainability. These mirror the priorities of the Region Plan and District Plan and are critical to how Camden will grow and evolve. The LSPS Structure Plan identifies a significant portion of the northern part of Camden (generally land identified in the South West Growth Centre) for future urban development. This area is expected to account for majority of residential growth with associated infrastructure required to be delivered in this area.

The proposed Urban Heat Report aims to respond to the following priorities of the LSPS:

- Local Priority S5
   Reducing emissions, managing waste and increasing energy efficiency
- Local Priority S6 Improving Camden's resilience to hazards and extreme weather events

# **CAMDEN LOCAL HOUSING STRATEGY**

The Camden Local Housing Strategy (**LHS**) was endorsed by Camden Council in December 2021 and was prepared in response to the region, district and local planning policy objectives to establish an evidence-based plan for housing in the Camden LGA over the next 10 and 20 years. Over the next 20 years, the LGA is forecasted to have the largest housing growth of any metropolitan Sydney council with a forecast demand for an additional 49,625 dwellings with most residential growth set to occur in the SWGA. Oran Park is identified as an establishing Town Centre that will continue to grow and evolve with a developing retail offering, civic precinct and emerging office floorspace.

The site is identified in the 'New Urban North' Precinct which includes growing and evolving land release precincts. Housing within this precinct comprises mainly of detached housing and dual occupancies.

The proposed Urban Heat Report aims to respond to the following priorities and actions of the LHS:

• **Priority 2** Delivering resilient, healthy and connected communities

### Action 12

Advocate for the development of guidelines that promote sustainability principles in the provision of infrastructure and utility services

Action 15

Establish urban tree canopy targets and advocate for opportunities to increase Camden's green cover and urban tree canopy

# **CAMDEN SUSTAINABILITY STRATEGY**

The Camden Council Sustainability Strategy is a four-year plan that brings together actions Council will implement to work towards creating a Sustainable Camden. The Sustainability Strategy is a whole-of-Council approach, linked to the key directions outlined in the Camden Community Strategic Plan and the local priorities of the Camden Local Strategic Planning Statement.

The proposed Urban Heat Report aims to respond to a range of actions and priorities aiming to embed sustainability into urban planning and design and create sustainable and resilient urban environments:

### • URB1 – Embed sustainability into urban planning and design

- Undertake a review of planning controls to ensure sustainability principles are embedded and local climate is considered.
- Develop a Sustainable Homes program, identifying energy and water efficiency retrofit opportunities as well as Camden specific sustainability information for new and existing homes.
- Ensure new release areas have adequate space for street trees.
- Increase the use of water sensitive urban design
- Create a water efficient landscape standard for use in public and private development.
- Work with water service providers to design and deliver infrastructure, water servicing and development approaches that best contribute to local and regional water supply and water cycle management.

### • URB2 – Deliver sustainable precincts

- Investigate planning and development controls and the use of incentives to encourage improvements in water and energy efficiency and the use of renewable energy in growth precincts.
- Advocate for the development of low carbon precincts within the South West Growth Area, with Leppington Town Centre as a pilot precinct.
- Ensure Green and Blue Grid principles are considered in the master planning and design of new precincts.

### URB3 – Maximise connectivity and Accessibility to the River

 Increase physical and visual connection to waterways and green spaces including linking cycling and walking network to the green corridor.

### URB4 - Increase urban tree canopy coverage

- Identify opportunities to implement improved canopy cover on public and private land.

### RES1 – Understand climate risks for Camden LGA

- Mitigate the urban heat island effect and reduce vulnerability to extreme heat.
- Work with Western Sydney District councils to develop standardized engineering specifications to address liveability and urban heat.

### RES2 - Minimise the impact of urban heat

- Review planning and development controls to assist with minimizing urban heat including the use of green roofs and walls, and water sensitive urban design.
- Encourage and promote green infrastructure such as green roofs and walls and water sensitive urban design.

### RES3 – Deliver climate mitigation and adaptation initiatives

- Develop and implement a climate mitigation and adaptation plan for Council and the community.
- Develop a risk and resilience action plan, addressing priority shocks and stresses identified in Resilient Sydney - A Strategy for City Resilience.

# 4. INDICATIVE LAYOUT PLAN

Design + Planning have prepared a draft ILP for Precinct 5, illustrated in **Figure 3**, which has informed the planning provisions proposed under this SEPP amendment.



# Land Use





Figure 3 Indicative Layout Plan

# 4.1 LAND USES AND DISTRIBUTION

The distribution of land uses across the site takes advantage of the large scale of the site whilst also ensuring an efficient and sensitive development of the landholding.

Use	Area (HA)/ Percentage of Precinct
Residential (Environment Living)	1.15 (0.7%)
Residential (LD1, LD2, MD1)	74.49 (43.1%)
Residential (Existing)	0.36 (0.2%)
Local Centre	1.81 (1%)
Educational Establishment	1.90 (1.1%)
Service Station	1.80 (1%)
Roads	42.5 (24.6%)
Riparian Corridor	17.19 (10%)
Playing Fields	9.21 (5.3%)
Open Space	11.70 (6.8%)
Waterbody	2.24 (1.3%)
Powerline Easement	5.80 (3.4%)
Detention Basins	0.77 (0.4%)
Water Tower	1.74 (1%)

# 4.2 LANDSCAPE MASTERPLAN

In association with the Draft ILP, Urbis has also prepared a draft Landscape Masterplan.

The defining element of the public realm is the Creek Parklands, the green spine that connect the whole precinct, and a combination of passive and active open spaces that are seamlessly integrated with an enhanced riparian corridor, providing a central green node which extends the open space outlook and provides for multi-functional open spaces.

The open space will support a broad spectrum of activities and interactions between people and nature and sustains environmental functions for the health of communities. Along with other community infrastructure and services, open spaces are significant public assets that contribute to the development of liveable and sustainable communities which can be easily activated by a wide range of uses across a broad range of experiences throughout all times of the day and year.

With consideration to the overall landscape character and open space demand identified in the Demographic, Social Infrastructure and Community Needs Assessment, an Open Space Strategy has been designed for the precinct and is underpinned by the following principles:

- Protect Environmental Quality
- Active Lifestyles
- · Connectivity within and Beyond
- A Connected Green Spine

The Landscape Masterplan proposes approximately 46 ha of open space across an extensive network of connected open space that conserves and reflects the landscape character and biodiversity of the precinct.

Overall, the landscape masterplan comprises of:

- 19.73 ha passive open space including the powerline easement
- 9.21 ha active open space (including provision for sports fields within this space).
- 17.19 ha riparian open space

A Street Tree Masterplan has also been developed for the precinct which provides an indicative layout of street trees and landscaping. The Street Tree Masterplan will help provide shade, comfort and amenity, particularly for pedestrians and to create visual order for the streetscapes.



Figure 4 Open Space Breakdown

# 4.3 ANTICIPATED TREE CANOPY

Based on the current distribution of uses identified in the ILP and the Landscape Masterplan, it is anticipated the Precinct is capable of achieving **36% tree canopy coverage** at tree maturity.

Use	Area (HA) Tree Canopy Assumption		Tree Canopy (HA)	
Residential (Environment Living)	1.15	30%	0.34	
Residential (LD1, LD2, MD1)	74.49	20%	14.9	
Residential (Existing)	0.36 20%		0.07	
Local Centre	1.81	20%	0.36	
Educational Establishment	1.90	30%	0.57	
Service Station	1.80	10%	0.18	
Roads	42.5	50%	21.24	
Riparian Corridor	17.19	80%	13.76	
Playing Fields	9.21	10%	0.92	
Open Space	11.70	80%	9.34	
Waterbody	2.24	0	0	
Powerline Easement	5.80	0	0	
Detention Basins	0.77	30%	0.23	
Water Tower	1.74	0	0	

While the precinct remains below the benchmark 40% tree canopy, it is noted that the proposed Landscape Masterplan maintains an extensive tree canopy within the public domain and open spaces where trees can be planted early in the development of the Precinct and are likely to be better maintained. This approach also ensures that the Precinct is not relying on private market housing within the Precinct to maintain the overall tree canopy long-term.

The table below identifies that the Landscape Masterplan exceeds the 40% tree canopy in both the street network and open space areas which is approximately 50% of the entire precinct.

It is also acknowledged that areas such as the powerline easement and water tower are restricted in terms of tree coverage by infrastructure requirements. If these areas were to provide a mature tree canopy of approximately 80% this would increase the overall site tree canopy to **39.44%**.

	Area (HA)	Tree Canopy (%)
Total Precinct Area	172.68	36%
Total Superlot Area	81.52	20.2%
Total Street Area	42.50	50%
Total Open Space Area	46.16	52.1%

# **ASSUMPTIONS**

### **Residential Land**

To anticipate the potential tree canopy and permeability of residential development within the precinct, an assessment has been undertaken of the relevant provisions of the Housing Code incorporated in *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008* for residential dwellings as this is the likely planning pathway for the redevelopment of the site.

Lot Size	Lot area	Maximum GFA	Minimum Open Space	
Attached Somi	200m2-250m2	78% of lot area	44sqm to 55sqm	
detached / Rear	>250m2-300m2	75% of lot area	62.5sqm to 75sqm	
(150 – 350sqm)	>300m2–350m2	235m2	65sqm to 115sqm	
Detached (350 – 450sqm)	>350m2-450m2	25% of lot area + 150m2	112.5sqm to 187.5sqm	
Detached Large >450m2–560m2		290m2	160sqm to 270sqm	
(450 – 600sqiii)	>560m2-600m2	25% of lot area + 150m2	270sqm to 300sqm	

Based on minimum open space and the inclusion of driveways/pathways etc, an assumption of 20% tree canopy has been used as a minimum for residential land (LD1, LD2 and MD1). This assumption ensures that the Precinct is not relying on private development to maintain tree canopy within the Precinct, with reliance focused on the public domain, streetscape and public parks.

### Local Centre

Based on the indicative layout and presumptive uses within the Local Centre, an assumption of 20% tree canopy has been used.

### **Educational Establishment**

Schools Infrastructure NSW have prepared *Guidelines for School Site Selection and Development* (October 2020) which identifies metrics which are used by the State government in identifying school sizes and capacity. The urban design guidelines for site selection require 10sqm of open space per student based on maximum school enrolments for new schools.

The current Demographic, Social Infrastructure and Community Needs Assessment prepared by WSP and ongoing discussions with Schools Infrastructure NSW anticipates the future educational establishment will have a demand of approximately 1,000 students. Based on the above metrics, approximately 1 hectare of the site will be used as open space. To allow for pathways and other outdoor facilities, an assumption of 30% tree canopy is assumed for the school site.

# **ASSUMPTIONS**

### **Service Station**

Based on existing DCP controls for light industrial development, an assumed tree canopy of 10% has been estimated for the service station and surrounding uses.

### Roads

An indicative road network and pedestrian and cycle network have been prepared by Design + Planning as part of the Draft Site Specific Development Control Plan for Precinct 5. Based on the current street sections and controls incorporated in to the DCP, street tree planting is required for all roads in the precinct. Based on a review of street sections, an estimate of 30% of road sections is dedicated to street trees and planting. This results in an assumed tree canopy of 50% for the road network.

### **Riparian Corridors and Local Parks**

Riparian corridors and local parks have been designed to maintain existing mature trees and ensure additional planting can be provided across the site. As such, an assumption of 80% for tree canopy coverage has been calculated for all riparian corridors and local parks.

### **Powerline Easement**

Given the powerline through the open space, tree canopy is not expected in this portion of the site. This area does provide additional opportunities for passive recreation within the Precinct and could contribute towards the Precinct's overall useable open space and is likely to incorporate a high level of low level plantings.

### **Playing Fields**

While trees will not be located within playing fields, it is anticipated some tree coverage will be provided surrounding playing fields to provide shelter for spectators and the like. As such, an assumption of 10% is anticipated for playing fields.

### **Drainage Basins**

The Draft ILP proposes a water management system that is integrated with the open space network. Given the integration between open space and the riparian network, a 30% rate of tree canopy has been associated with drainage basins for the Precinct.

### Water Tower

The water tower is currently under construction by Sydney Water, the proponent has no control over the tree canopy on this portion of the site. As such, it has not been incorporated in tree canopy assumptions/calculations.

# 5. POTENTIAL MEASURES TO ADDRESS URBAN HEAT

Local planning provisions are important mechanisms to influence built environment outcomes, and improved controls have the potential to reduce the impacts of urban heat. But this is also a new and complex space.

To inform the recommendations provided in this report, Urbis have reviewed the WSROC Urban Heat Planning Toolkit and Cool Suburbs tool to identify best-practice approaches which can be implemented into the overall design of the Precinct.

# **COOL SUBURBS TOOL**

The Cool Suburbs Tool (CST) is a voluntary, industry-based performance (ratings) tool prepared by WSROC in 2022 for place-based heat resilience. The CST has been designed for use by both developers and government, with the goal of supporting improved heat-mitigation outcomes.

The CST is intended to inform and guide planning and development decisions by providing a synthesis of urban heat science in an easy-to-use platform.

The CST's objectives include:

- Setting out a broad range of measures (represented by credits in the CST) that guide improved place- based urban heat resilience.
- Identifying specific measures that should be considered at different stages of the development process; supporting the Tool's use in early stages of planning and design.
- Scoring (via a rating system) the urban heat resilience of a range of developments from precinct to lot scale.
- Providing guidance for the assessment of urban heat resilience in existing, transforming, and new suburbs.

The following measures to address urban heat have been based on the design elements outlined in the Cool Suburbs Toolkit.

		Performanc	e Measure	Recommendation
Green Cover	Greater green cover such as tree canopy and vegetation has shown to have a major impact on urban heat by increasing evapotranspiration and shading adjacent surfaces.	<ul> <li>Incorpora cover from including spaces/p mature tr</li> <li>Retain ex where por Provide a canopy w public do</li> </ul>	ate green m day one green arks and ees kisting trees ossible a mature tree <i>v</i> ithin the main	The current ILP has incorporates a range of green open spaces Section 2.4 of the draft DCP provides details of open space network. Additional controls regarding tree retention are recommended
Permeable and cooling surfaces	Roads and non- permeable surfaces have been identified as major heat sources in urban areas.	<ul> <li>Incorpora permeab rather tha heat abso surfaces</li> </ul>	ite cool and le paving an impervious orbing	Additional controls are recommended to encourage permeable and cool paving
Water Sensitive Urban Design	Urban heat mitigation starts with retaining water in the landscape.	<ul> <li>Incorpora infrastruc passive in systems, wetlands gardens provide a water rete</li> </ul>	ate green sture such as rrigation stormwater and rain which high level of ention	WSUD measures are incorporated into the current draft DCP Additional controls should encourage water retention
Heat Resilient Social Infrastructure	Residents vulnerable to extreme heat include the elderly, people living with disability or chronic illnesses, and young children who do not have access to air conditioning.	<ul> <li>Provide a Council a community venues a associate support r during a heatwave as heat re covered l as well as bubblers play</li> </ul>	I network of Ind ity-run Ind ed services to esidents significant e event such efuges, bus shelters, s water and water	Consideration of heat resilient social infrastructure should form part of the Landscape Masterplan and relevant DCP controls

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		Performance Measure	Recommendation
Roof colour and surfaces	The concentration of many houses with dark roof colours not only contributes to increased urban heat but they can also increase the temperature inside the individual houses.	<ul> <li>Roof colour selected for new developments should avoid dark colours in order to not attract and store heat</li> </ul>	Introduce additional DCP controls relating to building design and materials and solar reflectivity levels.
Solar Control Systems (Shading)	Outdoor shading is useful in reducing both ambient air temperature and surface temperature.	<ul> <li>Outdoor shading structures at parks and outdoor recreational facilities should be used where tree canopy cannot provide cover.</li> </ul>	Review current DCP controls to ensure shading is encouraged
Orientation	Prevailing winds and sun direction/exposure should be considered when developing building designs and street orientation.	<ul> <li>Encourage building design which takes advantage of prevailing winds, natural ventilation, and solar access</li> </ul>	Introduce additional DCP controls relating to building design and materials. Current street layouts incorporate east-west streets which will benefit from summer afternoon easterly breezes.
Thermally Safe Housing	Achieving cool homes is an essential element in mitigating the impacts of urban heat. Houses are a refuge during extreme weather, therefore houses must be able to maintain safe temperatures without the need for air- conditioning or heating (passive thermal performance).	<ul> <li>Encourage building design which takes advantage of prevailing winds, natural ventilation, and solar access</li> </ul>	All new residential development is required to be compliant with BASIX. The WSROC toolkit recommends that for non-residential buildings, additional DCP controls aren't necessary. The recent 2019 NCC update included changes that indirectly improve urban heat outcomes for buildings.

		Performance Measure	Recommendation
Reducing energy use in building	Building more energy efficient housing and buildings is imperative for mitigating the effects of urban heat on the population. This also important for thermally safe housing	<ul> <li>Incorporate maximum efficiency appliances</li> </ul>	Introduce additional DCP controls relating to building design and materials for non- residential development.
Increasing renewable electricity generation	Reducing our reliance on fossils fuels is imperative if we want to reduce the effects of climate change.	<ul> <li>Encourage rooftop solar panels and residential battery storage</li> </ul>	Introduce additional DCP controls relating to building design and materials for non- residential development.
Reducing transport emissions	Transport contributes to a significant amount of carbon emissions in Australia. It also contributes to air pollution levels, especially in urban areas	<ul> <li>Encourage active and public transport use</li> <li>Encourage EV vehicles</li> </ul>	The ILP and Landscape Masterplan have been designed to provide a walkable community.

# 6. **RECOMMENDATIONS**

Council's Sustainability Strategy identify the need for planning controls for new development to mitigate urban heat and the urban heat island effect.

The Camden Local Strategic Planning Statement and Local Housing Strategy also includes priorities to ensure future development within Camden:

- Embeds sustainability into urban planning and design;
- Deliver low carbon precincts;
- · Maximises connectivity and accessibility to riparian corridors; and
- Increases urban tree canopy coverage.

To achieve better building and design responses to urban heat and the urban heat island effect, the following recommendations are:

- Introduce a new local provision the Precincts SEPP relating to Urban Heat
- Update the draft DCP to reflect measures identified to address Urban Heat.
- Introduce a specific section of the DCP providing additional development controls aimed at achieving sustainable and resilient buildings.

It is noted that the recommendations are based on information available at the time of preparation of this document. It is acknowledged that future updates to the current legislation including SEPP BASIX and the future Sustainable Buildings SEPP may introduce additional controls or considerations in relation to urban heat.

# 6.1 SEPP AMENDMENT

Cumberland Council and Penrith Council have recently introduced local provisions into their Local Environmental Plans (LEPs) to ensure that new development incorporates effective design and ongoing operation to reduce and remove urban heating from the environment and protect community health and wellbeing.

It is acknowledged that Camden Council is considering proposing a similar local provision with the *Camden Local Environmental Plan 2010* (Camden LEP). Given the site is located in the South-West Growth Centre, the intention of the current Planning Proposal is to rezone the site under the Precincts SEPP which would override any controls in the Camden LEP.

To ensure that urban heat is addressed by future controls, it is recommended that Appendix 5 Camden Growth Centres Precinct Plan of the Precincts SEPP incorporates a local provision relating to Urban Heat. Recommended wording is provided below (based on the gazetted provision from the Cumberland LEP, published in November 2021):

### Appendix 5 Camden Growth Centres Precinct Plan – Clause 6.9 Urban Heat

(1) The objective of this clause is to ensure new development incorporates effective design and ongoing operation to –

(a) reduce and remove urban heating from the environment, and

(b) protect community health and wellbeing.

(2) In deciding whether to grant development consent for the purposes of commercial premises, industries or residential accommodation, the consent authority must consider whether –

(a) the facade and roof of the proposed building and paved surfaces are designed to reduce adverse effects of solar heat on the surrounding land, including private open space and the public domain, and

(b) the awnings and eaves of the building are designed to provide shelter from the sun and improve public comfort at street level, and

(c) the heating, ventilation and air conditioning systems of the building are designed to minimise the release of heat in the direction of private open space and the public domain, and

(d) the development maximises the use of green infrastructure that is strategically designed and managed to support a good quality of life in an urban environment, and

(e) the development accommodates sufficient tree canopy, open space and deep soil zones to achieve urban cooling benefits, and

(f) the building is designed to achieve high passive thermal performance.

### In this clause –

### deep soil zone -

(a) means the soft landscaped part of a site area used for growing trees, plants and grasses that

(i) is unimpeded by buildings or structures above and below ground, and

(ii) provides opportunities for groundwater infiltration and canopy trees, and

(b) does not include basement car parks, services, swimming pools, tennis courts and impervious surfaces including car parks, driveways and roof areas.

**green infrastructure** means the network of green spaces, natural systems and semi-natural systems that support sustainable communities and includes waterways, bushland, tree canopy and green ground cover, parks and open spaces.

solar heat means radiant heat contained in the full spectrum of sunlight.

# 6.2 UPDATES TO CURRENT DCP CONTROLS

It is noted a Draft Development Control Plan has been prepared by Urbis as part of the original Planning Proposal Package currently being reviewed by Camden Council. Based on the initiatives and measures identified in **Section 5** of this report and updates to the ILP, the following updates are recommended to the draft Development Control Plan.

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**Recommended Updates** 

Section 2.3 Street Design and Road Network
Objectives

• To ensure that new streets provide street trees and canopy cover to reduce the urban heat island effect.

### Controls

- 1. Consistency with the following cross sections and Table 2 is expected for all sub arterial, collector and local roads to ensure consistency of road layout and cross-section across the precinct.
- 1. Consistency with the following cross sections identified in the Precincts SEPP DCP and Table 3 is generally expected for all sub arterial, collector and local roads to ensure consistency of road layout and cross-section across the precinct and with the Precincts SEPP DCP.
- 2. Where possible, the streetscape should incorporate materials with low heat conductivity and reflectivity, resulting in less solar absorption including but not limited to lighter coloured materials for road pavement and footpaths.
- 3. Mature trees should be retained and incorporated into the subdivision and public domain design where possible, to contribute to the mature tree canopy cover in the neighbourhood to provide visually interesting streetscapes, improve air quality, and enhance tree canopy cover.
- 2. Appropriate plant species are to be selected for the site conditions with consideration given to trees providing shade in summer and allowing sunlight in winter and to provide habitat.
- 3. Lighting for streets should use energy efficient LED lighting.
- 4. Sufficient facilities should be provided along key streets for foot travellers (i.e. seating, shading, water fountains etc.).

# 6.2 UPDATES TO CURRENT DCP CONTROLS

Current Draft Control	Recommended Updates
Section 2.4 Open Space and Recreation	on Network
Objectives	Objectives
	<ul> <li>To design open space with measures that contribute to a reduction in the number of very strong and extreme heat stress days.</li> </ul>
	<ul> <li>To harness the effects of blue and green infrastructure to enable urban cooling.</li> </ul>
Controls	
5. The detailed design of local sporting fields, neighbourhood parks, recreation activity nodes are to be generally in accordance with the following:	5. The detailed design of public domain including but not limited to local sporting fields, neighbourhood parks, recreation activity nodes should encourage the following design initiatives and features:
a) the need for a range of play spaces and opportunities to cater for all	<ul> <li>a range of play spaces with adequate shading and opportunities to cater for all ages</li> </ul>
b) the provision of adequate parking,	<ul> <li>b) provision of adequate parking, lighting and waste management facilities</li> </ul>
facilities	c) inclusion of interpretative signage detailing local history, Aboriginal cultural values, environmental education themes
<ul> <li>c) the inclusion of interpretative signage detailing local history, Aboriginal cultural values, environmental education themes and the like</li> </ul>	<ul> <li>and the like</li> <li>d) provision of amenities such as seating with adequate shading, drinking fountains, forms of evaporative cooling, street lighting, street information signs, planter boxes, feature fencing and the like</li> </ul>
d) the provision of amenities such as	
seating and shade structures, drinking fountains, street lighting, street information signs, planter boxes, feature fencing and the like.	8. Minimise paving in open spaces. Where needed, use pavements which are permeable and/or have low heat conductivity, resulting in less solar absorption. When using permeable pavers, it must be demonstrated there is no impact on the salinity or sodicity of underlying soils.
	9. Mature trees should be retained and incorporated into the public domain design and retained to contribute to the mature tree canopy cover in the neighbourhood, improve public amenity, improve air quality, and enhance tree canopy cover.
	10. Appropriate plant species (including deciduous and native species) are to be selected for the site conditions with consideration given to trees providing shade in summer and allowing sunlight in winter and to provide habitat.

11. Lighting for streets, parks and any other public domain spaces should use energy efficient LED lighting.

# 6.3 ADDITIONAL DCP CONTROLS

To ensure buildings and the public domain minimise cooling demand and to encourage sustainable design across the Precinct, the following updates are recommended to be incorporated in **Section 2 Development Planning** of the current draft Development Control Plan.

It is acknowledged that most residential development will require compliance with SEPP BASIX and the future Sustainable Buildings SEPP. Nevertheless, the following DCP controls have been prepared to ensure that all buildings can achieve a sustainable outcome to reflect the intentions and vision for Precinct 5.

### **Recommended Controls**

### Mitigating Urban Heat

### **Objectives**

- Design built form and open space with measures that contribute to a reduction in the number of very strong and extreme heat stress days.
- Manage urban heat island effects to ensure a high level of comfort for workers and residents throughout the year, with a focus on hot days and the summer period.
- Minimise cooling demand indoors and heat absorbance through orientation, the design of roofs and facades and materials

### Controls

### **Building Orientation and Design**

- 1. Orientate buildings to take advantage of prevailing winds, natural ventilation, and solar access to maximise passive cooling and where practical, minimise the need for air conditioning. Where possible, buildings should be orientated to include a north facing roof where a solar hot water system or collector can be installed.
- 2. Western and northern building facades should be designed to incorporate eaves, awnings or external shading devices to shield the building from hot summer sun, while allowing direct sunlight in winter.
- 3. Where possible, tree planting should be encouraged on western and northern building facades to shade external walls.
- 4. To minimise energy use, buildings should incorporate the following thermal design principles:
  - a) Seek to incorporate on-site renewable energy sources to supplement energy needs;
  - b) Use high levels of insulation as a simple means of reducing energy consumption; and
  - c) Provide effective metering systems to monitor the energy performance of buildings.
- 5. Where possible, non-residential development should include maximum efficiency appliances such as 100% energy efficient lighting and 5-star efficient cooling and heating systems.

# 6.3 ADDITIONAL DCP CONTROLS

### **Recommended Controls**

### Mitigating Urban Heat

### Controls

### **Building Materials**

- 1. Building design is to use, where possible recycled and renewable materials; non-reflective and/or lighter coloured materials and finishes on main external parts of the building including roofs.
- 2. Achieve the nominated Solar Reflectance Index (SRI) minimums for all roofs:
  - a) for roof pitches less than 15, a SRI minimum of 64, with a minimum 3 year manufacturer guarantee.
  - b) for roof pitches greater than 15, a SRI minimum of 34, with a minimum 3-year manufacturer guarantee.
  - c) for rooftop terraces a SRI minimum of 28, with a minimum 3-year manufacturer guarantee.

At least 75% of the roof area is to meet nominated SRI values and/or be designed as a green roof. Areas where solar panels (PV) are mounted on a roof are count toward the 75% SRI area calculation.

3. Encourage water retention in irrigation systems used.

# 7. CONCLUSION

This Urban Heat Report has been prepared to support the rezoning of Precinct 5 within the South West Growth Area. The site is identified as a strategic local centre for urban development.

This report has assessed the current Planning Proposal package to identify how the current design has addressed the effects of urban heat and to recommend any further measures which should be considered by Council.

Having considered all relevant matters, the proposal represents a sound development outcome that fulfils the vision to develop the Cobbitty-Bringelly Precinct into a highquality master planned community in Western Sydney.





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<b>ONTENTS</b> CUTIVE SUMMARY	INTRODUCTION VIA METHODOLOGY	<b>EXISTING SITE AND VISUAL CONTEXT</b>	PROPOSED DEVELOPMENT	VIEW SELECTION	VIEW EFFECTS ANALYSIS	VISUAL IMPACT ASSESSMENT	CONCLUSION	VDIX 1 - DESCRIPTION OF VISUAL EFFECTS
C H	1.0 2.0	3.0	4.0	5.0	6.0	7.0	8.0	APPEI

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URBIS STAFF RESPONSIBLE FOR THIS REPORT:

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Project Code: P0018796

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**APPENDIX 2 - VISUAL ASSESSMENT PHOTOMONTAGE METHOD** 

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# **EXECUTIVE SUMMARY**

This VIA report has been prepared by Urbis Pty Ltd to accompany a Planning Proposal on behalf of BHL Group who seeks to amend the State Environmental Planning Policy (Precincts – Western Parkland City) 2021 (Parkland City SEPP) for the site Cobbitty Sub Precinct 5 (Precinct 5) located on The Northern Road, in the South Creek West Land Release Area. Indicative massing models prepared by Urbis are intended to inform the planning proposal for the site and as such have been used for analysis to inform the determination and rating of potential visual impacts. Our analysis is based on accurate and certifiable photomontages, from a representative sample of views from within the site's visual catchment.

Minor updates have occurred to the ILP since the preparation of the current photomontages. Given the minor nature of these changes and limited visibility of much of the site from the public domain, updates to the ILP do not impact on the recommendations and findings of this report. The extent and significance of the potential visual change has been assessed using a well-established and accepted VIA methodology which is outlined on page 8. We determined the visual catchment using GIS mapping software (LiDAR data) to determine access to views of the tallest built form proposed from the surrounding area, and ground-truthed topographical high points and sensitive view places during fieldwork.

Photomontages are useful objective visual aids and were prepared in a manner that satisfies the guidance included in the practice direction established by the Land and Environment Court of NSW.

4 views were selected for modelling in photomontages and were used for further analysis to consider the extent of visual change, the effects of those changes on the existing visual environment and the importance of those changes, being the final rating of visual impacts.

Of the 4 views analysed, 3 were rated as a low-medium, and 1 as medium.

The proposal predominantly blocks views of open sky from both near and distant locations and does not block any scenic or highly valued landscape elements.

In our opinion, this planning proposal can be supported on visual impacts grounds.
# **1.0 INTRODUCTION**

## I.I PURPOSE OF THE REPORT

This Visual Impact Assessment (VIA) report supports a planning proposal that seeks to amend the State Environmental Planning Policy (Precincts – Western Parkland City) 2021 (Parkland City SEPP) for the site located on The Northern Road. This planning proposal is seeking to rezone 172.74ha of land that forms 57% of Precinct 5.

## **1.2 PLANNING OBJECTIVES**

The proposed amendments seek to transition the existing rural landscape into a new residential community, which importantly builds on the NSW Government's vision and aspirations under the Western Sydney Growth Areas program.

The proposal includes a master plan for the precinct via a draft ILP for Precinct 5 that aims to achieve the following objectives:

- To facilitate high quality urban development that meets environmental sustainability objectives.
- To protect and enhance riparian corridors, significant vegetation and natural features by thoughtfully incorporating them into the masterplan and creating a unique semi-rural character within the development.
- To preserve the potential Aboriginal heritage sites located within the creek lines.
- To ensure the new urban form promotes resilience to climate change and incorporates design measures to address the impacts of the urban heat island effect.
- To create a community that is connected to nature by maximising opportunities for residents to access and enjoy the outdoors.
- To ensure all development achieves a high standard of urban and architectural design quality which complements the unique setting of the development.
- To promote housing that provides a high standard of residential amenity.
- To create walkable neighbourhoods with good access to public transport.
- To maximise access to local employment and business within the adjoining Major Centres.
- To create a vibrant Neighbourhood Centre which serves as the heart of the community and fosters interactions.

#### L3 THE SITE

The site broadly sits across parts of two suburbs, Cobbitty and Bringelly within the Camden LGA and Southwest Growth Area (SWGA). It is located approximately 45km southwest of Parramatta CBD and 65km southwest of Sydney CBD. The site is in proximity to the Western Sydney Aerotropolis (Aerotropolis) approximately 5.5km north of the site and city shaping infrastructure, such as the Western Sydney Airport.

The site is an amalgamation of four lots owned by BHL land holding and is known as Cobbitty Sub Precinct 5 (Precinct 5). It is located on The Northern Road in Bringelly, forming part of Precinct 5 in the South Creek West Land Release Area. Cobbitty is predominately rural in character, with the surrounding visual landscape characterised by a mixture of rural and pastoral uses, established settlements and new, developing and approved but not yet constructed urban areas. The rural areas are characterised by pastoral landscapes, farming practices, remnant vegetation and woodland with limited building development that is generally spatially separated from one another. The site is an irregular shape and bound by sites that are occupied by commercial uses to the north near the western edge of The Northern Road, vacant rural land to the west and south with the south being characterised by dense vegetation. The Northern Road to the east of the site gently undulates and curves around local landforms of dams and highpoints. At present the lots on site are vacant greenfield lots that sit just out of the Oran Park town centre.

The topography across most of the site is gently undulating. Surface levels generally fall to the north, dictated by the irregular shaped ridge line which bounds the southern part of the site.



 HIGURE 1
 SITE LOCATION

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 South Creek, Cobbitty Visual Impact Assessment

# 2.0 METHODOLOGY

## 2.1 URBIS METHODOLOGY

#### OVERVIEW

There is no determinative or required VIA methodology adopted in NSW to assess the visual impacts of new built forms in urban settings. The methodology followed for this VIA is based on our analysis of a number of published methods including the Guidelines for Landscape and Visual Impacts Assessment 3rd edition, published by the Landscape Institute and Institute of Environmental Management and Assessment (GLVIA) and on the experience gained by Urbis staff, specialising in VIA.

Review relevant information, policies, documents

This report also draws on concepts of impact assessment including quantum of change (extent of visual effects) and importance of that change (impacts), and the Guideline for landscape character and visual impact assessment, Environmental Impact Assessment practice note EIA - NO4 prepared by the Roads and Maritime Services December 2018 (RMS LCIA).

Although the content and purpose of the RMS LCIA is to assess the impact on the aggregate of an area's built, natural and cultural character or sense of place rather than solely on views, it provides useful guidance as to the logic and process of Visual Impact Assessment (VIA).

### 2.2 KEY STEPS OF URBIS VIA METHODOLOGY Stage1: Preliminary Research and Analysis

- Establish baseline factors; identify and describe the existing visual landscape in terms of visual character, scenic quality, viewer
- sensitivity and view place sensitivity
  Identify and describe the visual effects of the proposed development on those baseline factors

## **STAGE 2: ANALYSE THE VISUAL EFFECTS**

On baseline factors and specifically in relation to all views that have been modelled.

## STAGE 3: ASSESS THE VISUAL IMPACTS

In the context of relevant subjective 'weighting' factors:

- Consider additional factors that influence the level of visual effects by adding 'weight' to each to arrive at a level of visual impacts for example; consider visual effects in the context of Physical Absorption Capacity (PAC), compatibility with particular features for example with heritage items, desired future character, an existing concept approval or with maritime features.
  - Consider the proposed development in the context of the relevant regulatory framework for example SEARs, SEPPs, LEPs and DCPs etc.
- Consider mitigation strategies if appropriate for example ameliorative planting, earthworks or alternate massing of a proposed development.
- Identify residual visual impacts.



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## **3.0 EXISTING SITE AND VISUAL CONTEXT**

# 3.1 VISUAL CHARACTER OF THE SUBJECT SITE

The subject site features four lots which are characterised by open pastoral lands and limited development. An internal site road runs east to west connecting to The Northern Rd. The site contains a single lowrise residential building, associated farm buildings adjacent the access road boundary. Dense mature vegetation also lines the east to west existing residential road accessway to the east of the site. The site is characterised by a gently undulating landscape with dense vegetation surrounding highpoints. The site is lowest at the northeast, gently sloping upwards towards the south of the site. The site's highest point is located at the southeast approximately 40m higher above the rest of the site, with a secondary highpoint located at the west boundary of the site.

#### Heritage

The site is located nearby to two State Listed Heritage Items including Denbigh Curtilage Area to the south of the site, and Maryland to the north. Consideration of visual impacts on access to views of and between heritage items will be considered in the VIA.

# Denbigh Curtilage Area - 421 The Northern Rd, Cobbitty

To the south of the site, the State Heritage Listed item, Denbigh Curtilage is a colonial farm complex and homestead that has operated as a farm since 1817. Its rarity is due to its Loudon model of homestead siting within an intact rural landscape fundamental to its interpretation. The original land grant has preserved substantial 19th century buildings on site including the homestead complex, and two cottages; Cluny and Roberts Cottage. A former quarry, accessway, and cottage gardens remain within the curtilage. The homestead is sited contrasting the surrounding open agricuttural landscape. The house looks across fields to the north to a line of hills - the location of a small vineyard known as Plantation Hill. The house is built of weatherboard materiality, with a hipped roof that extends over the house and a brick paved veranda on timber square pots. A large forest red gum is the central landscape piece to the farm buildings, coach house, and stables.

## Maryland - 773 The Northern Rd, Bringelly

Built in 1816, State Heritage Listed item Maryland retains significance due to its highly intact major mid-19th century rural estate which continues as a working estate today. Occupying a prominent hilltop location in the area to the north of the subject site, the homestead and its layout follows the characteristics of the Summit model of homestead. Marylands is located immediate north of the site located on an elevated knoll where its associated landscape is visually prominent in views from

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The Northern Road and subject site. The listing includes; the homestead group, garden and grounds including the hill slopes of former vineyards, winery and farm store buildings complex outbuildings, gatehouses, two early estate drives, home farm paddocks and one paddock dam complex, and a dairy complex including coach house, stables, sheds and home farm cottage accommodation. Other historically related rural elements include driveways, home farm, creek lines, fence lines, in a considered arrangement. It retains important traditional historic views to and from The Northern Road.

## **3.2 SURROUNDING VISUAL CONTEXT**

#### North

North of the site, vacant rural land inclines downward towards the northeast. At the west, south, and east, land slopes up and away from the site. Mature trees are interspersed across the site, particularly located in a north-south stand. Built form to the immediate north of the site is located at the western edge of The Northern Rd, with land uses including residential and heavy industrial with low-rise built form. These can be seen at the Hi-Quality Group Recycling Centre, and 749 The Northern Rd.

#### South

The south of the site is bound by heavily vegetated rural lots and encompasses the south facing slope of the highpoint located within the subject site.

#### East

The site is bound to the east by The Northern Rd, and Marylands Link Rd 2 to the North. Across The Northern Rd, the adjoining site is pastoral land largely devoid of built form where land is characterised by a gradual fall to the east with mature vegetation interspersed across. A continual line of trees is located west to southeast adjacent to the southern highpoint on site. Dams are also present throughout. Some lots are dedicated to low rise residence, and farming. This can be seen for example at Noo-Noora located at 772 The Northern Rd. Low-rise residential land is zoned across from the southern portion of the site. While presently vacant, it is expected to grow in future along with its adjacent vacant neighbouring sites.

#### West

Immediately west of the site is the vacant land characterised by dense, irregularly interspersed mature trees, dams, and a well vegetated highpoint.

#### WIDER VISUAL CONTEXT North

The wider visual context to the north of the site (Bringelly) includes a mixture of relatively vacant and undeveloped rural lands, spatially separated and isolated residential flat buildings, farm associated built form, and industrial earth works set amongst the heavy riparian vegetation. Buildings are located extending off The Northern Road, and Bringelly Rd in an irregular and spatially separated manner.

Bringelly is characterised by a variety of open space and low-rise built form including recreational open space at Bringelly Park, commercial uses such as the Bringelly childcare centre, Bringelly Family Medical Practice and Board my paws dog boarding, as well as industrial in PGH Bricks and Pavers Factory. Community facilities include Bringelly Public School and St Joseph Conference Centre. Residential Land uses within the area are low and medium height detached buildings that are spatially separated due to the nature of large rural lots and situated amongst heavily vegetated pastoral land. Notable locations nearby include the University of Sydney Camden Farms.

#### East

The wider visual context to the east side of the Northern Road (Catherine Field and Leppington) is characterised by a variety of uses including rural land largely devoid of built form, and Primary Production small lots. The land features a broad crossfall eastwards towards Catherine Field which is met by a north-south riparian corridor of South Creek. Catherine Field which is met by a north-south riparian corridor of South Creek. Catherine Field which is met by a north-south riparian corridor of South Creek. Catherine Field is characterised by primary production small lots amongst heavily vegetated corridors. The north-southeast running of Rileys Creek and its associated riparian corridor denotes a suburb boundary between Oran Park and Leppington. Looking further east, Leppington is characterised by an irregular grid settlement pattern of primary production small lots. Buildings are spatially detached from one another as a result of being on large residential parcels of land and feature a large setback from the road.

#### Southeast

The wider visual context to the southeast (Oran Park, Harrington Park) includes a variety of Land uses including low and medium residential buildings, environmental conservation land, and open space recreational land. Examples of this include residential development to Oran Park, Harrington Park, Open spaces to Grandstand Park and Harrington Park football fields.

The settlement patterns of Oran Park and Harrington Park are irregular shaped which can be attributed to the location of riparian corridors of Campbell River and Narellan Creek east of The Northern Rd. Building heights are low and medium rise with densely packed built form. This

is observed in more recent residential development at Oran Park for example; to both sides of Peter Brock Dr. Oran Park and Harrington Park are separated by Harrington Forest vegetation corridor running east to west between The Northern Rd and Oran Park Rd. In this corridor Harrington Forest Hiking Area and Crear Hill Lookout are located.

#### Southwest

The southwest (Cobbitty) features predominantly environmental conservation and residential land uses divided into large lot residential and low-rise residential buildings. The southwest captures the curve of the Nepean River at which adjacent landforms include agricultural land, and heavy areas of riparian vegetation. This occurs around Cobbitty Creek and along a southern portion of Cobbitty Rd, connecting to the riparian area of the Nepean River bend. Roads and low-rise built form are located off Cobbitty Rd with low rise residential and commercial uses concentrated along its central corridor. Notable areas in the southwest include educational institutions such as University of Sydney Camden Campus, Mater Dei School, Macarthur Anglican School, and commercial uses such as Cobbitty Village Markets, and Michelia Club Harrington Growe. Further south, Camden airport is located approximately seven kilometres from the subject site.

#### West

The wider west (Theresa Park and Werombi) context has a pastoral character which is characterised by heavy vegetation and zoned as primary production land. Heavy vegetation is particularly concentrated around Gulger Nature Reserve on the Napean River, and Its adjoining creeks such as Forest Hill Creek, Eagle Creek, and Bushrangers Creek. The Nepean River curves in a north-south direction dividing Theresa Park and Coblitty. Lots are large and sit predominantly to the east or west of Coates Park Rd. Built form features residential and industrial buildings which are low-rise and of a spread-out nature and are nestled off roads amongst areas of heavy vegetation. Areas of interest here include livestock including livestock breeding, stables, and a racecourse.



 FIGURE 2
 VISUAL CATCHMENT OF SITE BASED ON VISIBILITY FROM ALL HEIGHT RANGES WITHIN THE SITE (PRODUCED BY URBIS SEPTEMBER 2022)

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Photo 6. View west from western edge of the Marylands Link Road 1.



Photo 5. View north from western edge of the Marylands Link Road 1.







Photo 4. Detail view of local vernacular residential built form at 875. The Northern Road.



**REPRESENTATIVE VIEWS FROM THE VISUAL CONTEXT** 

View west from within the south east part of the site. Photo 2.

Photo 1. View north from local highpoint adjacent to Gracilis Avenue.



Photo 3. View north from east side of the Maryslands Link Road 1.

### **3.3 VISUAL CATCHMENT**

#### What is a visual catchment?

The potential visual catchment is the theoretical area within which parts of the proposed development may be visible. The visibility of any proposed development varies depending on constraints such as the blocking effects of intervening built form, vegetation, infrastructure and topography.

Visibility refers to the extent to which the proposal would be physically visible, identifiable for example as a new, novel, contrasting feature or alternatively as a recognisable but compatible feature.

## 3.3.1 EXTENT OF VISUAL CATCHMENT

Fieldwork observations and LiDAR data across the potential visual catchment based on selected elevated high points have been used to determine the extent of external visibility of the existing and proposed built forms (indicative massing envelopes) proposed on the site. Fieldwork observations were tested using LiDAR mapping where visibility or view sheds, were tested using the highest RL proposed in relation to all height limits of the built form including low-rise residential at 9m, mid-rise residential at 12m, and the Town Centre at 21m. Indicative visibility shown in the Figure 3 map suggests limited visual catchment within the surrounding suburbs, with increased visibility from topographical high points near the site. Specifically, potential visibility is highest from local topographical highpoints to the north, northeast, and northwest around Lowes Creek. At the wider northeast, relatively vacant primary production lots such as from those to Carrington Rd, will keely have clear view access to site. This is privately owned land which will have limited to no public access. This is also true for vacant primary production lots such as of those north and west of Maryland Link Rd 2. It should be noted that visibility to the proposal is dependent upon intervening built form and vegetation, as well the nature of public access to the site, further limiting view access.

Overall, the potential visual catchment of the site is expected to be minimal due to the nature of access to locations where highpoints are available, in combination with extensive vegetation.

## 3.4 VIEW PLACE SENSITIVITY

View place sensitivity refers to the importance of a view or view place in the public domain. View place sensitivity means a measure of the public interest in the view. Public interest is reflected in the relative number of viewers likely to experience the view from a publicly available location. Places from which there would be close or middle-distance views available to large numbers of viewers from public places such as roads, or to either large or smaller numbers of viewers over a sustained period of viewing time in places such as reserves, beaches and walking tracks, are considered sensitive viewing places. The widest number of closest and potentially most affected views are from immediately surrounding vacant rural lots and The Northern Rd to the east resulting in limited to nil view place sensitivity impacts. Medium and distant views looking west to site may be available from the adjacent The Northern Rd. The location of The Northern Road's northsouth direction suggests temporary high visibility from a moving location when travelling between Oran Park and Bringelly.

## **3.5 VIEWER SENSITIVITY**

Viewer sensitivity is a judgement as to the likely level of private interest in the views that include the proposed development and the potential for private domain viewers to perceive the visual effects of the proposal. The spatial relationship (distance), the length of exposure and the viewing place within a dwelling are factors which affect the overall rating of the sensitivity to visual effects.

Private domain views to the subject site and the built form proposed are largely limited but may be available from a distance to limited isolated and intermittent locations of existing residential buildings. These can be observed from the south of the site from residential buildings located around Olive Hill Dr; however, views are likely to be obscured by heavily vegetated highpoints to the south of the site. It is also noted that land voce than adjacent knolls to the west and north resulting in limited if any visibility.



HIGURE 3 VISUAL CATCHMENT OF SITE BASED ON VISIBILITY FROM ALL HEIGHT RANGES WITHIN THE SITE (PRODUCED BY URBIS SEPTEMBER 2022)

High

Nov

## 4.0 PROPOSED DEVELOPMENT



Land Use

The vision for Cobbitty Sub-Precinct 5 is to deliver a high-quality, sustainable, vibrant master planned community which has been intricately designed to intertwine the new urban environment with the picturesque semi-rural character for the Region. The intended outcome of this Planning Proposal is to amend the Parkland City SEPP as follows:

- Incorporate the site on the 'Land Application Map' for the Parkland City SEPP
- Rezone the land to part:
- B1 Neighbourhood Centre
- B4 Mixed Use
- C2 Environmental Conservation
- C4 Environmental Living
- R2 Low Density Residential
- R3 Medium Density Residential
- SP2 Infrastructure
- Introduce building heights as follows:
- 9 metres for low-density residential uses, allowing for developments of up to two storeys in height.
- 12 metres for medium-density residential uses, allowing for
- development of up to three storeys in height.21 metres for the village centre where mixed-use developments
- 21 metres of the vittage centre writere mixed use developments are proposed and will allow for development of up to 6-9 storeys in height.
- The site could consist of approximately 3,800 dwellings and cater to a population of 12,000 people supported by:
- Easy access to jobs in the Western Sydney Aerotropolis
- Local shops, community uses and services, and proximity to the Oran Park Town Centre
- Over 78ha of open space, including 32 ha of sporting fields and local parks
- Open space typologies also include creeks, grasslands, playgrounds, and other nature-based recreation areas
- Pedestrian and cycling connections including a central green corridor
- Prominent creeks and riparian areas that retain water in the local environment
- A future local school
- Integrated stormwater and services infrastructure that improve local amenity



FIGURE 4 DRAFT ILP MAP (SOURCE: DESIGN + PLANNING)

# **5.0 VIEW SELECTION**

## 5.1 VIEWPLACE SELECTION

In simple terms, the key purpose of a VIA for a planning proposal where simple massing envelopes will be assessed, is to determine the quantum of visual change (ie level of visual effects), external visibility, that is the extent of change that will be visible from external public domain locations, and to consider the importance or sensitivity of the view place (including its accessibility). The range of views assessed should include close, medium and distant views so that a representative sample of the types of views that are likely to be experienced by the public are considered. In this way conclusions about visual impacts across the wider, 'theoretical' potential visual catchment can be considered. Visibility is also considered in terms of its likely exposure period for example: the kind of viewing locations, private domain, public domain, parks and reserves and whether potential views will be available for a sustained period, for example from moving viewing situations e.g. from transport/rail/road corridors. Urbis have considered these factors as part of our desktop review and prior to undertaking or fieldwork. Prior to undertaking fieldwork, Urbis staff undertook a desktop review of all relevant statutory and non-statutory documents, an analysis of aerial imagery and topography and LiDAR data to establish the potential visual catchment and to inform fieldwork inspections. Following fieldwork undertaken by Urbis on the 11th of August 2022 to familiarise ourselves with the site and surrounding visual setting, and the documentation of a range of representative views from close, medium and distant locations surrounding the site, Urbis selected and recommended 4 view places for further analysis via the use of objective visual aids.

## 5.2 USE OF PHOTOMONTAGES

The following pages undertake a detailed analysis of 4 views. These 4 modelled views represent a range of viewpoints the proposed development.

Photomontages were prepared by Urbis (see Appendix 2) and are analysed against criteria which have been used to make judgements in relation to the effects and impacts of the proposed development on each of the modelled views. Please refer to Appendix 1 for details on the descriptions and their ratings. The photomontages of the built forms proposed include only a simple massing model in the existing visual environment. The photomontages do not include any ameliorative planting, architectural detailing, materiality or colours all of which will serve to soften the appearance of the built form.

## **6.0 VIEW EFFECTS ANALYSIS**

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/iew No.	

View 01	VIEW SOUTH TO SITE FROM EAST END OF MARYLAND LINK RD 2
View 02	VIEW WEST TO SITE FROM THE NORTHERN ROAD INTERSECTION ADJACENT 680 THE NORTHERN RD
View 03	VIEW NORTHWEST TO SITE FROM SOUTHWEST EDGE OF SITE HIGHPOINT
View 04	VIEW NORTHEAST TO SITE FROM EAST EDGE OF DENIBIGH CURTILAGE

	ice boundary location
land fixik ki 2	
	3

Figure 5 PHOTOMONTAGE LOCATION MAP

#### **VIEW 01**

# VIEW SOUTH TO SITE FROM EAST END OF MARYLAND LINK RD 2

DISTANCE CLASS

 Medium • 550m

### **EXISTING COMPOSITION OF THE VIEW**

local vegetated highpoints, as well as views of distant livestock and further pastoral land elements. Such pastoral land could be described as typical or vernaoular in relation to the local visual context. Powerlines and their associated structures are visible in the distance. The background is comprised of open sky. This is a south facing view toward the site and is predominantly characterised by open gently undulating pastoral land. Scattered areas of mature vegetation are visible in the mid-ground, with a wire fence in the foreground denoting the site boundary. The distant composition comprises dense mature vegetation and the grassed foothills of slopes to

# VISUAL EFFECTS OF THE PROPOSED DEVELOPMENT ON THE COMPOSITION AS MODELLED

Landscape are obscured by the built form proposed, with some remaining partially visible behind the massing. The background remains Largely undisturbed. The proposed built forms do not block iconic or heritage views, views to individual icons or scenic or highly valued vegetation remain visible in the mid-ground. Views of the background vegetation and distant The fore and mid-ground remain largely as unchanged pastoral views. The built form in view appears as low and mid-rise blocks of long linear form. Scattered areas of mature The proposal introduces new built form into the mid and back-ground composition. compositions.

Visual effects of proposed development	
Visual Character	Low
Scenic Quality of View	Low-Medium
View Composition	Low
Viewing Level	Low
Viewing Period	Low
Viewing Distance	Low
View Loss & View Blocking Effects	Low
Rating of visual effects on variable weighting factors	
Public Domain View Place Sensitivity	Low
Physical Absorption Capacity	Low-Medium
Compatibility with Urban Context and Visual Character	Medium
Compatibility with desired future character	High
Overall rating of significance of visual impact	LOW-MEDIUM



FIGURE 3 EXISTING VIEW



VIEWPOINT LOCATION FIGURE 4

Figure 6 VIEWPOINT 01 PHOTOMONTAGE



#### VIEW 02

# VIEW WEST TO SITE FROM 680 THE NORTHERN ROAD

DISTANCE CLASS

 Medium <500m</p>

### **EXISTING COMPOSITION OF THE VIEW**

northern site boundary. In the distance, mature vegetation is located on gently sloped adjacent rural lands. Powerlines and their associated structures are also located in the distance. The background consists of open sky. foreground contains a fenced off section of road under construction. The mid-centre of the composition presents a mature row of vegetation flanking an existing site access This is a west facing view towards the site from across The Northern Rd. The view is characterised by the road carriageway and streetscape seen in the foreground, with open pastoral land gently sloping upwards towards the west in the mid-ground. The site is vacant grassed land with intermittent mature vegetation located towards the road to a single storey residence surrounded by mature palm trees. The remaining

# VISUAL EFFECTS OF THE PROPOSED DEVELOPMENT ON THE COMPOSITION AS MODELLED

mid-ground, built form appears as low-rise masses of rectilinear form replacing previously vacant grassed land. A stand of palm trees to the composition centre remains largely intract. The proposed form obstructs views to the existing single storey residence in view and its associated vegetation. Some vegetation tops within the site remain partially visible behind massing only obscuring minor lower sections. The proposed built forms do not block iconic the proposed massing. The background of open sky remains largely undisturbed with the The proposal introduces new built form into the mid-ground of the composition. In the or heritage views, views to individual icons or scenic or highly valued compositions.

Visual effects of proposed development	
Visual Character	Low
Scenic Quality of View	Low- Medium
View Composition	Low
Viewing Level	Low
Viewing Period	Low
Viewing Distance	Low
View Loss & View Blocking Effects	Low-Medium
Rating of visual effects on variable weighting factors	
Public Domain View Place Sensitivity	Low
Physical Absorption Capacity	Medium
Compatibility with Urban Context and Visual Character	Medium
Compatibility with desired future character	High
Overall rating of significance of visual impact	I DW -MEDILIM



FIGURE 3 EXISTING VIEW



VIEWPOINT LOCATION FIGURE 4



Figure 7 VIEWPOINT 02 PHOTOMONTAGE



#### VIEW 03

VIEW NORTHWEST TO SITE FROM SOUTHWEST EDGE OF SITE HIGHPOINT

DISTANCE CLASS

Close

<100m</li>

### **EXISTING COMPOSITION OF THE VIEW**

land which could be described as typical or vernacular in relation to the local visual context. Powerlines and their associated structures are visible in the distance against a This is an expansive view facing northwest towards the site. It is predominantly characterised by open, undulating hills of pastoral grazing land, with lines of scattered mature vegetation on vacant land. The distant composition includes similar characteristics of further pastoral land elements devoid of built form. Such pastoral background of open sky.

## VISUAL EFFECTS OF THE PROPOSED DEVELOPMENT ON THE COMPOSITION AS MODELLED

built form in view appears as low-rise blocks of rectilinear form that slope down with the topography. The proposed massing obstructs views to scattered groups of mid-ground and distant vegetation, as well as views to background undulating hills. The foreground remains largely as an unorhanged open grassed hillside. The background of open sky remains largely undisturbed with the massing only obscuring very minor sections of sky. The proposed built forms do not block iconic or heritage views, views to individual icons or scenic or highly The proposal introduces new built form into the mid-ground of the composition. The valued compositions.

Visual effects of proposed development	
Visual Character	Low
Scenic Quality of View	Low-Medium
View Composition	Low-Medium
Viewing Level	Low
Viewing Period	Low
Viewing Distance	Low-Medium
View Loss & View Blocking Effects	Low-Medium
Rating of visual effects on variable weighting factors	
Public Domain View Place Sensitivity	Low
Physical Absorption Capacity	Medium
Compatibility with Urban Context and Visual Character	Medium
Compatibility with desired future character	High
Overall rating of significance of visual impact	LOW-MEDIUM





FIGURE 3 EXISTING VIEW





Figure 8 VIEWPOINT 03 PHOTOMONTAGE



#### VIEW 04

VIEW NORTHEAST TO SITE FROM EAST EDGE OF DENIBIGH CURTILAGE

DISTANCE CLASS

• Close • <100m

### **EXISTING COMPOSITION OF THE VIEW**

This is an expansive view facing northeast towards the site. It is taken from the eastern edge of heritage listed Denbigh Curritage situated on a local hippoint. The view is predominantly characterised by open, lower hills of pastoral grazing land with etumps of scattered mature vegetation on vacant land. The mid-ground composition includes dams and similar characteristics of further pastoral land elements largely devoid of built form. There are distant partial views of agricultural buildings, as well as powerlines and their associated towers which run from west to east across the composition. Dense areas of mature vegetation line the background against a backdrop of open sky.

## VISUAL EFFECTS OF THE PROPOSED DEVELOPMENT ON THE COMPOSITION AS MODELLED

In this view, new built form is introduced into the mid-ground of the composition. The foreground remains largely as an unchanged open grassed miliside. The built form appears as low and mid-rise blocks of rectilinear form that slope to follow gentle hill slopes previously vasant. The built form obstructs views to scattered groups of mid-ground vegetation however, the upper parts of some vegetation remain visible. Distant views of sky remains largely undisturbed with the massing only obscuring very minor sections of sky remains largely undisturbed with the massing only obscuring very minor sections of sky remains largely undisturbed with the massing only obscuring very minor sections of sky remains chighly valued compositions.

Visual effects of proposed development	
Visual Character	Medium
Scenic Quality of View	Medium
View Composition	Medium
Viewing Level	Low-Medium
Viewing Period	Low
Viewing Distance	Medium
View Loss & View Blocking Effects	Low
Rating of visual effects on variable weighting factors	
Public Domain View Place Sensitivity	Low
Physical Absorption Capacity	Medium
Compatibility with Urban Context and Visual Character	Medium
Compatibility with desired future character	High
Overall rating of significance of visual impact	MEDIUM



FIGURE 3 EXISTING VIEW



FIGURE 4 VIEWPOINT LOCATION

Figure 9 VIEWPOINT 04 PHOTOMONTAGE



## 7.0 VISUAL IMPACT Assessment

erate prominence means: posal has either no visual effect on the landscape or the vident but is subordinate to other elements in the scene bv	as well as single or double storey residential dwellings. Residential built form is similar in scale, height and character and are located within surrounding areas including Oran Park and Harrington Park. Similarly,
small scale, screening by intervening elements, difficulty of ied or compatibility with existing elements. he proposal is either evident or identifiable in the scene, but is	lots to the immediate site south are zoned as residential land which will extend upon the existing low-rise residential built form east of Olive Hill Dr, ultimately connecting development at the site to those already existing nearby.
ent, makes a smaller contribution to the overall scene, or does substantially with other elements or is a substantial element, lent in prominence to other elements and landscape 1 the scene.	All views were rated as having a medium-high compatibility; however, it is noted that future expected development in the area of similar land use, scale, style, and height will ultimately provide a 'down-weight' to the level of visual effects reducing their imnortance over time.
nvironment has a generally low-medium capacity to absorb anges proposed. This is due to the vacant rural landscape minantly devoid of built form within the immediate and 2. It is noted that the location of the surrounding south	7.4 COMPATIBILITY WITH REGULATORY FRAMEWORK
ant lands for future residential development means that 3 south surrounding lots are expected to mirror the built ale of the growth within the proposed site. It is also noted further south to fran Dark the existing huilt form of how-	The Planning Proposal is consistent with and supports a range of strategic planning outcomes established by Camden Council and the NSW Government.
ial development is not dissimilar to what is being proposed. ial development is not dissimilar to what is being proposed. ated as low-medium and 3 as medium-high PAC, this at the site has a relatively moderate capacity for PAC. at for all views PAC will increase over time as further	Compatibility with desired future character and objectives of the area in all views were found to be high. A high compatibility rating is a 'down- weight' in relation to the overall rating of visual impacts.
t occurs within surrounding adjacent lots.	Residual effects are defined by leaders in visual perception, as follows;
(UAL COMPATIBILITY actibility is not a measure of whether the proposal can be nauished from its surroundinas. The relevant parameters	The final question to be answered after the mitigation factors are assessed, is whether there are any residual visual impacts and whether they are acceptable in the circumstances. These residual impacts are
mpatibility are whether the proposal can be constructed without the intrinsic scenic character of the locality being	predominantly related to the extent of permanent visual change to the immediate setting.
y changed. It assumes that there is a moderate to high ne project to some viewing places. It further assumes that nts which presently do not exist in the immediate context eived as visually compatible with that context provided that esult in the loss of or excessive modification of the visual the locality.	In terms of the urban component of the development, residual impacts relate to individuals' preferences for the nature and extent of change which cannot be mitigated by means such as colours, materials and the articulation of building surfaces. These personal preferences are to or resilience towards change to the existing arrangement of views. Individuals or groups may express strong preferences for either the
ve analysis of the compatibility of similar items to the h other locations in the area which have similar visual ad scenic quality or likely changed future character can give a likely future compatibility of the proposal in its setting.	existing, approved or proposed form of urban development. In our opinion visual impacts on the views modelled are anticipated by the planning controls and the effects are similar to the existing scale of residential development located nearby, height, form.
ed development has a moderate compatibility with the al character of the site and the immediate visual context. surrounding built form is characterised by largely vacant rimary production lots and associated industrial buildings,	The retention of some vegetation throughout the site, such as dense vegetation to the site south and southwest around local highpoints will help to create filtering effects to the built form proposed and will serve

Low to mode

Having determined the level of extent of the visual change based on the

4 representative modelled views (photomontages) Urbis has applied

impacts or importance of the visual effects. Descriptions of relevant

relevant weighting factors to determine the overall level of visual factors to be considered are outlined below, reproduced with the

proposal is e Low: The pro virtue of its s being identif.

alterations in less promine but is equiva Moderate: T not contrast

The visual er rise resident the visual ch that is predo adjacent site adjacent vac neighbourinç orm and sca that looking

suggests that It is noted tha L view was r developmen

#### VISI 7.3

unacceptabl can be perce seen or distii for visual cor visibility of th novel elemei they do not r **/isual Comp** and utilised character of

proposal wit A comparati character ar guide to the

ural land, pi The propose existing visu Much of the

Prepared by Urbis for BHL Group

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over the last 20 years as part of his research in visual perception and the permission of Dr Richard Lamb, who has developed these descriptions The overall rating for view place sensitivity was weighted according to The weighting factors most relevant for consideration are sensitivity, assessment of visual impacts. SENSITIVITY

visual absorption capacity and compatibility with urban features.

the influence of variable factors such distance, the location of items of heritage significance or public spaces of high amenity and high user numbers.

ocal knoll or visually prominent location or a place of high cultural value sensitivity for example its use as an important public reserve, elevated Notwithstanding these ratings in our opinion there are no other factors views given the limited extent of the potential visual catchment of the This report addresses potential visual impacts on close and medium existing site and proposed development. Views from four locations that would render these view places as being of moderate or high were assessed, with the sensitivity of the locations rated as low. both Indigenous and non-Indigenous).

#### PHYSICAL ABSORPTION CAPACITY 7.2

existing visual environment can reduce or eliminate the perception of the Physical Absorption Capacity (PAC) means the extent to which the visibility of the proposed redevelopment.

physically hide, screen or disguise the proposal. It also includes the extent of boats and buildings, the scale and character of these allows them to blend with or reduce contrast with others of the same or closely similar to which the colours, material and finishes of buildings and in the case kinds to the extent that they cannot easily be distinguished as new PAC includes the ability of existing elements of the landscape to features of the environment.

Prominence is also an attribute with relevance to PAC. It is assumed in this assessment that higher PAC can only occur where there is low to moderate prominence of the proposal in the scene. Prominence is also an attribute with relevance to PAC. It is assumed in this assessment that higher PAC can only occur where there is low to moderate prominence of the proposal in the scene.

FECTS	
= VISUAL EF	
Y TABLE OF	
SUMMAR	
Table 2	

VIEW REFERENCE	LOCATION	NB: high ratings mean low	r impacts e.g. where there is high weigh	n compatibility or absorption, this reduces the significance of the ntime factor"	OVERALL RATING OF SIGNIFICANCE OF VISUAL IMPACT
		Public Domain View Place Sensitivity	VISUAL ABSORPTION CAPACITY	COMPATIBILITY WITH URBAN CONTEXT AND VISUAL CHARACTER	
View 01	VIEW SOUTH TO SITE FROM EAST END OF MARYLAND LINK RD 2	row	LOW-MEDIUM	MEDIUM-HIGH	LOW-MEDIUM
View 02	VIEW WEST TO SITE FROM THE NORTHERN ROAD INTERSECTION ADJACENT 680 THE NORTHERN RD	ΓOW	MEDIUM	MEDIUM-HIGH	LOW-MEDIUM
View 03	VIEW NORTHWEST TO SITE FROM SOUTHWEST EDGE OF SITE HIGHPOINT	ΓOW	MEDIUM	MEDIUM-HIGH	LOW-MEDIUM
View 04	VIEW NORTHEAST TO SITE FROM EAST EDGE OF DENIBIGH CURTILAGE	ΓOW	MEDIUM	MEDIUM-HIGH	MEDIUM

RATING OF VISUAL EFFECTS ON VARIABLE WEIGHTING FACTORS AS LOW, MEDIUM OR HIGH

"(Refer to Table 4 in Appendix 1 for descriptions of ratings

factors are applied to the overall level of visual effects.

To arrive at a final level of significance of visual impact, the weighting

7.5.1 APPLYING THE 'WEIGHTING' FACTORS

to reduce the initial level of visual impacts. In our opinion, this provides a down-weight to the overall level of visual impacts.

### 7.5.2 OVERALL VISUAL IMPACTS

objectives that are included in the South Creek West Growth Area (SWGA) including the Metropolis of Three Cities: Greater Sydney Region Plan (2018), the Western City District plan (2018) and Western Sydney The proposed development was found to be consistent with planning Aerotropolis Plan.

compatible with the planning objectives and provide a 'down-weight' to In this regard the level of visual effects generated were found to be the level of visual impacts.

# **8.0 CONCLUSION**

- The proposal creates a generally low-medium visual effect on the base line factors such as visual character, scenic quality, and view place sensitivity from public domain views.
- Of the four views analysed, the overall visual impacts resulted in a low-medium to medium range on the rating scale.

•

- Visual catchment to the site was deemed limited to surrounding topographical elevated areas characterised by dense vegetation with limited public access.
- For all views, proposed built forms do not block iconic or heritage views, views to individual icons or scenic or highly valued compositions.
- The scale, height and character of the proposed residential built form is similar to existing examples in the surrounding landscape including Oran Park, Harrington Park, and lots surrounding the site at Olive Hill Dr.
- It is noted that the overall view ratings will further lessen with expected development to the surrounding areas zoned as residential land, and development to the site will ultimately be seen as extension of existing residential developments to Oran Park and Harrington Park.
- Considering the likely view impacts to the immediate and wider area based on the representative modelled views and the overall low-medium to medium view impact ratings, in our opinion the view impacts are considered acceptable.

## **APPENDIX**

Factors	Low Effect	Medium Effect	High Effect
Scenic quality	The proposal does not have negative effects on features which are associated with high scenic quality, such as the quality of panoramic views, proportion of or dominance of structures, and the appearance of interfaces.	The proposal has the effect of reducing some or all of the extent of panoramic views, without significantly decreasing their presence in the view or the contribution that the combination of these features make to overall scenic quality	The proposal significantly decreases or eliminates the perception of the integrity of any of panoramic views or important focal views. The result is a significant decrease in perception of the contribution that the combinations of these features make to scenic quality
Visual character	The proposal does not decrease the presence of or conflict with the existing visual character elements such as the built form, building scale and urban fabric	The proposal contrasts with or changes the relationship between existing visual character elements in some individual views by adding new or distinctive features but does not affect the overall visual character of the precinct's setting.	The proposal introduces new or contrasting features which conflict with, reduce or eliminate existing visual character features. The proposal causes a loss of or unacceptable change to the overall visual character of individual items or the locality.
View place sensitivity	Public domain viewing places providing distant views, and/or with small number of users for small periods of viewing time (Glimpses-as explained in viewing period).	Medium distance range views from roads and public domain areas with medium number of viewers for a medium time (a few minutes or up to half day-as explained in viewing period).	Close distance range views from nearby roads and public domain areas with medium to high numbers of users for most the day (as explained in viewing period).
Viewer sensitivity	Residences providing distant views (>1000m).	Residences located at medium range from site (100-1000m) with views of the development available from bedrooms and utility areas.	Residences located at close or middle distance (<100m as explained in viewing distance) with views of the development available from living spaces and private open spaces.
View composition	Panoramic views unaffected, overall view composition retained, or existing views restricted in visibility of the proposal by the screening or blocking effect of structures or buildings.	Expansive or restricted views where the restrictions created by new work do not significantly reduce the visibility of the proposal or important features of the existing visual environment.	Feature or focal views significantly and detrimentally changed.
Relative viewing level	Elevated position such as ridge top, building or structure with views over and beyond the site.	Slightly elevated with partial or extensive views over the site.	Adjoining development, public domain area or road with view blocked by proposal.
Viewing period	Glimpse (e.g. moving vehicles).	Few minutes to up to half day (e.g. walking along the road, recreation in adjoining open space).	Majority of the day (e.g. adjoining residence or workplace).
Viewing distance	Distant Views (>1000m).	Medium Range Views (100- 1000m).	Close Views (<100m).
View loss or blocking effect	No view loss or blocking.	Partial or marginal view loss compared to the expanse/extent of views retained. No loss of views of scenic icons.	Loss of majority of available views including loss of views of scenic icons.
<b>Table 3</b> Descriptio	n of Visual Effects.		
Factors	Low Impact	Medium Impact	High Impact
Physical absorption capacity	Existing elements of the landscape physically hide, screen or disguise the proposal. The presence of buildings and associated structures in the existing landscape context reduce visibility. Low contrast and high blending within the existing elements of the surrounding setting and built form.	The proposal is of moderate visibility but is not prominent because its components, texture, scale and building form partially blend into the existing scene.	The proposal is of high visibility and it is prominent in some views. The project location is high contrast and low blending within the existing elements of the surrounding setting and built form.
Compatibility with urban/natural features	High compatibility with the character, scale, form, colours, materials and spatial arrangement of the existing urban and natural features in the immediate context. Low contrast with existing elements of the built environment.	Moderate compatibility with the character, scale, form and spatial arrangement of the existing urban and natural features in the immediate context. The proposal introduces new urban features, but these features are compatible with the scenic character and qualities of facilities in similar settings.	The character, scale, form and spatial arrangement of the proposal has low compatibility with the existing urban features in the immediate context which could reasonably be expected to be new additions to it when compared to other examples in similar settings.

 Table 4
 Indicative Ratings Table of Visual Impact Factors.

#### APPENDIX 1 Description of visual

Published on the NSW Department of Planning, Industry and Environment website via major projects tab (NSW DPIE). This information has been developed by RLA and is acknowledged as being a comprehensive summary of typical descriptions regarding visual effects. The descriptions below have been used as a guide to make subjective

**EFFECTS** 

### APPENDIX 2 VISUAL ASSESSMENT PHOTOMONTAGE Method



## PHOTOMONTAGES PREPARED BY:

Urbis. Level 10. 477 Collins Street. MELBOURNE 3000.

#### DATE PREPARED:

21 September 2022

### VISUALISATION ARTIST :

Ashley Poon, Urbis- Lead Visual Technologies Consultant Bachelor of Planning and Design (Architecture) with over 20 years' experience in 30 visualisation

## LOCATION PHOTOGRA PHER:

Nick Sisam, Urbis - Senior Consultant, National Design under direction from Jane Maze-Riley, Urbis - Director, National Design

#### CAMERA:

Canon EOS 6D Mark II - 26 Megapixel dgital SLR camera (Full-frame sensor)

## CAMERA LENS AND TYPE :

Canon EF 24-105mm #4L IS USM

#### SOFTWARE USED:

- 3DSMax 2023 with Arnold 5.0 (3D Modelling and Render Engine)
- AutoCAD 2022 (2D CAD Editing)
- Globalmapper 23 (GIS Data Mapping / Processing)
  - Photoshop CC 2022 (Photo Editing)

#### DATA SOURCES :

- Point cloud and Digital Elevation Models from NSW Government Spatial Services datasets Penrith 2019-07
  - and Wollongong 2019-06
- Aerial photography from Nearmap 2022-06-15
- Proposed masterplan CAD drawings received from Design+Planning 2022-08-24
- Proposed 3D massing model prepared by Urbis based on supplied masterplan drawing

#### METHODOLOGY :

Photomortages provided on the following pages have been produced with a high degree of accuracy to comply with the requirements as set out in the practice direction for the use of visual aids in the Land and Environment Court of New South Wales.

The process for producing these photomontages are outlined below:

- Photographs have been taken on site using a full-frame digital camera coupled with a quality lens in order to obtain high resolution photos whilst minimising image distortion. Photos are taken handheld at a standing height of 1.6km above natural ground level. Photos have generally been taken handheld at a standing of a 35mm or 35mm with A photo taken using the 50mm focal length on a full-frame camera (equivalent to 40° horizontal field-of-view / 46.8° diagonal field-of-view / 16.8° diagona
- Using available geo-spatial data for the site, including independent site surveys, aerial photography, digital elevation models and LIDAR point clouds, the relevant datasets are validated and combined to form a georeferenced base 3D model from which additional information, such as proposed architecture, landscape and photographicviewpoints can be inserted.
- Layers of the proposed development are obtained from the designers as digital 3D models and 2D plans. All
  drawings/models areverified and registered to their correct geo-location before being inserted into the base 3D
  model.
- For each photo being used for the photomontage, the photo's location, camera, lens, focal length, time/date and
  exposure information is extracted, checked and replicated within the 3D base model as a 3D camera. A camera
  match is created by aligning the 3D camera with the 3D base model against the original photo. matching the
  original photographic location and neglitization and large and large and
  original photographic location and neglitization.
- From each viewpoint, a reference 3D model camera match is generated to verify an accurate match between the base 3D model (existing ground survey/vegetation etc.) and original photo. A 3D wireframe image of the 3D base model is rendered in the 3D modelling software and composited over the original photo using the photoediting software.
- From each viewpoint, the final photomontage is then produced by compositing 3D rendered images of the proposed development into the original photo with editing performed to sit the render at the correct/lew depth. Photographic elements are cross-checked against the 3D model to ensure dements such as foreground trees and buildings that may occlude views to the proposed development are retained. Conversely, where trees/ buildings may be removed as part of the proposal, these are also removed in the photomontage.



URBIS

EC:














URBIS

REV:-









