Infrastructure Services Report

South Dural

80216070

Prepared for
APP

August 2016

Cardno
Shaping the Future

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1 Executive Summary

The South Dural Precinct in Hornsby Local Government Area (LGA) is proposed for rezoning. The site of approximately 240 Hectares located in Dural, is currently rural residential and the proposal is to rezone the subject site as mixed use residential development. This report is prepared to investigate existing services available in the area and propose any lead-in works required to enable development of the proposed land.

Existing potable watermains are present in all perimeter roads. The site is currently supplied by Sydney Water's Prospect North trunk water delivery system. Sydney Water has indicated amplifications to the existing potable water supply system are required for the future growth. The site is part of West Hornsby Waste Water system catchment, which has sufficient capacity for the development. There will be potential requirement to build wet weather storage on the development site. The waste water carrier service is available at the intersection of the New Line Road- Hastings Road and will need to be extended as required to service the development. Further discussions with Sydney Water including a strategy planning report will be required at the detail design stage.

Electricity is currently supplied by Endeavour Energy and Ausgrid. Preliminary investigation shows nearest electrical zone substations have enough capacity for the development and lead-in work will be required for the electrical supply. Consultation with both service providers, Endeavour Energy and Ausgrid will be required to optimise lead-in route and discuss current supply availability from existing network.

NBN Co has provided a high level feasibility for the site. Lead-in work from Dural will be required for the telecommunications. The natural gas services are present with sufficient capacity near the site and will be connected as required. Discussions with NBN Co and Jemena will be required at individual precinct planning.

The report discusses various options and suggests a possible lead-in route. In summary, the majority of the services are available and some lead-in works will be required to service the proposed residential development.

The perimeter roads, Old Northern Road and New Line Road will need to be upgraded to allow for the proposed development. Road upgrades and intersection modifications are covered in the "South Dural – Perimeter Road and Intersection Analysis" prepared by Parsons Brinckerhoff. Stormwater management of the site is discussed in a separate report prepared by Cardno.

The development can be serviced with some services available for connection and some lead-in works will be required. The development will be staged and further investigation to be carried out for a timely availability of the services for the development.

2 Introduction

Cardno (NSW/ACT) has been commissioned by APP to carry out the initial investigation on the services infrastructure to facilitate development planning of a residential subdivision at South Dural.

This report investigates the availability of services infrastructure near the site and documents the services required for the development of South Dural Precinct. The report covers major infrastructure supply requirements for the site development with respect to wastewater, potable water, electricity, gas and telecommunications. Stormwater management of the proposed site is documented in "South Dural Water Cycle Management Plan" prepared by Cardno June 2016.

The current site is predominantly low density rural residential lots. We understand this report will be referenced in support of the rezoning of the area from its current land-use. The report highlights any potential areas of concern for infrastructure servicing.

2.1 The Development Site

The proposed site is situated in Dural within the Hornsby LGA. The site is surrounded by major arterial roads – Old Northern road to the North-West, New Line Road and Hastings Road to the South-East. Existing lots get access through the arterial roads, an internal cul-de-sac Franlee Road and Wayfield road. Existing SydneyHills Lifecycle Estate and Glenhaven Green retirement village are expected to remain undeveloped and are excluded from this investigation.

The site has approximately 124, predominantly rural lots and steep topography with slopes ranging from 5-12%. The site has a major ecological footprint of native trees and habitats covering approximate 30% of site area. The entire site catchment discharges to the Georges creek and its tributaries which traverse through generally in the North-East. The South Dural development location and layout is shown in Figure 2-1.

Trunk and reticulation gravity services such as stormwater and sewer generally follow the existing topography and road layout. The proposed development has an approximate area of 240 hectares and will consist of approximately 2,900 new residential dwellings and apartments along with neighbourhood parks, riparian corridors, a sporting field, drainage reserves, pedestrian and cycle network. In general, low-rise apartments are proposed near the riparian corridors and major collector roads.

It is anticipated the construction of the first stage will commence in 2019 and will take up to 10 years for the entire development to complete. The site can be developed by different developers simultaneously or can be staged.

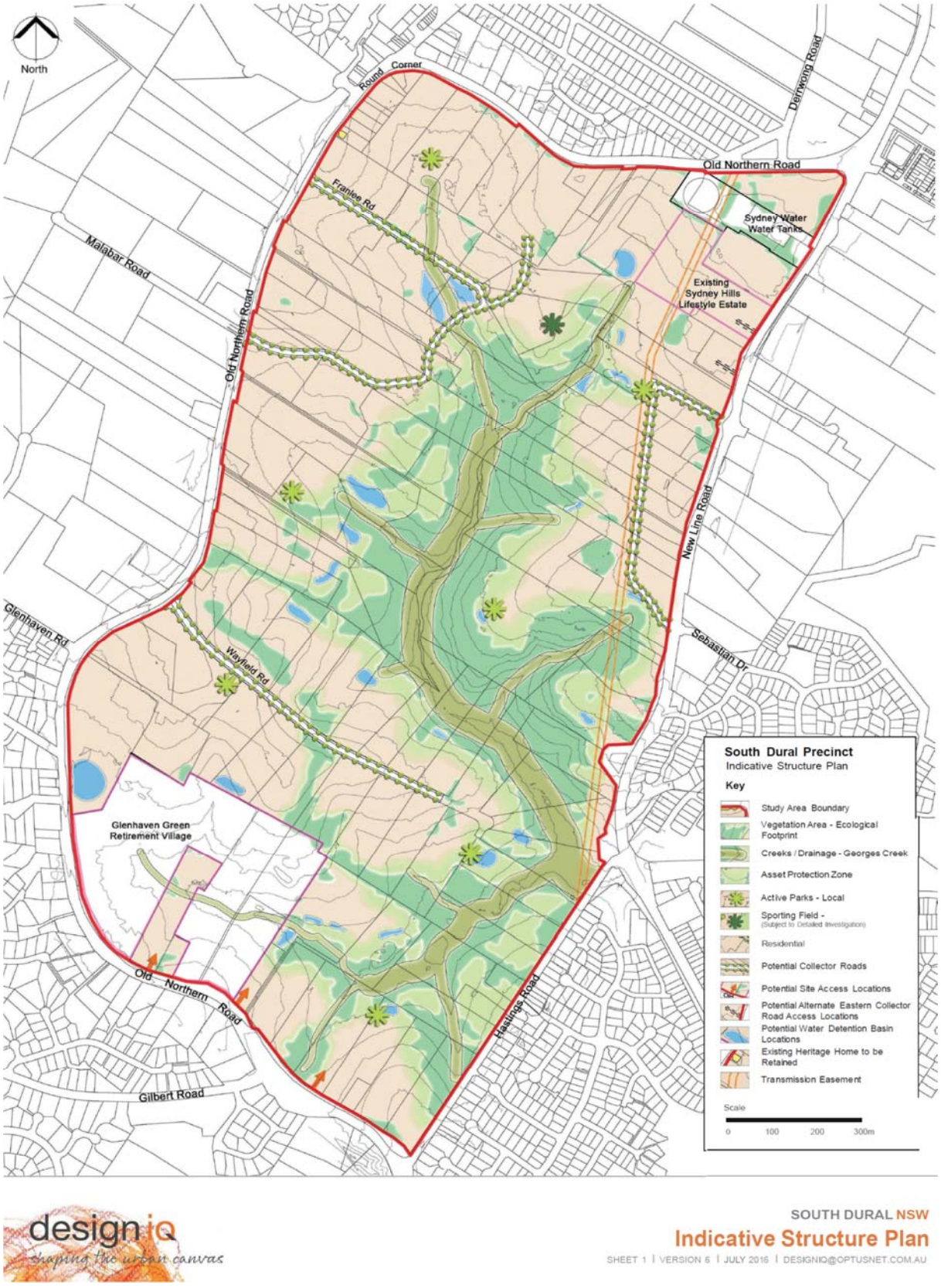


Figure 2-1 Indicative Layout Plan

3 Methodology

The utility services strategy commenced with a desktop study of existing utility services. The dial before you dig services search was carried out and underground services information collected. The current developed land use is predominately rural residential and the existing utility infrastructure is commensurate with this land use.

The requirements for utilities infrastructure for potable water, waste water, electricity, telecommunications and natural gas were considered. Utility agencies were consulted for initial input regarding the supply of service infrastructure. Following initial review, a coordination meeting was held with Sydney Water to better understand requirements, catchment allowance and timings for key infrastructure elements.

Connection points for lead-in infrastructures were established based on likely staging, proximity to existing mains and in consideration of utility authority requirements. Final connection and staging details should be established during the detailed design and assessment phase.

The internal servicing strategy will be developed further to provide a framework for the delivery of the stages. A final utility servicing and trunk infrastructure scheme should be formulated in consultation with the relevant utility agencies during the council approvals phase.

4 Infrastructure Services

The majority of the utility services are present in Old Northern Road, Hastings Road and New Line Road. This section discusses existing and proposed services, lead-ins and estimate of probable costs.

4.1 Waste Water

Sydney Water is the certifying authority for all potable and wastewater mains proposed within the Sydney metropolitan area. The mains are developer funded and pending the approval of a Section 73 application, the assets are transferred to Sydney Water for ongoing ownership and maintenance. In 2014 Sydney Water has carried out a high level assessment to understand the capability of water and wastewater systems to service future growth including South Dural area.

The site is not currently sewered by Sydney Water's network however there are potential connection options into the West Hornsby Wastewater System. There is currently a DN450 carrier main which terminates within the proposed development site at the intersection of New Line Road and Hastings Road (Refer Figure 4-1). This will serve as a potential connection point.

Sydney Water's growth servicing strategy has included the proposed development and confirmed that the West Hornsby catchment has sufficient capacity to service the subject site. There will be a potential requirement to build wet weather storage on the development site to reduce the risk of breaching the West Hornsby Wastewater System licence limit. Further development planning will require preparation of a strategic planning report and a detail planning report in consultation with Sydney Water.

For the development of the site the existing DN450 carrier main would have to be extended within the development. The work consists of constructing a DN450 carrier main with branch mains servicing each village within each precinct. The sewer carrier will service all the stages via gravity sewer. Each precinct / village would drain via internal reticulation into the branch mains and eventually into the main carrier. The concept design and servicing option has been based on the existing surface level and connection point as per above. The preliminary costs for waste water services are tabled below.

Item	Work Description	Estimate
1	Sewer Reticulation	$4,320,000
2	Sewer Lead-In	$3,060,000

4.2 Potable Water

The site is currently being serviced by Sydney Water's Prospect North trunk water delivery system, via the Dural South and Dural Elevated water supply reservoir zones. As per Sydney Water's growth servicing strategy both systems require amplifications as early as 2020 to accommodate the proposed growth. Each development precinct will required to carry out further strategic and detailed planning in consultation with Sydney Water.

There are currently two DN100 and DN200 services available for connection for the proposed development (Refer Figure 4-1).

It has been identified a minimum DN200 main will be required to comply with the supply of water for firefighting. The required sizing can be determined via detailed modelling and the nearest main for connection can be determined. The preliminary costs for water services are tabled below.

Item	Work Description	Estimate
1	Water Reticulation	$1,800,000
2	Water Lead-In	$20,000

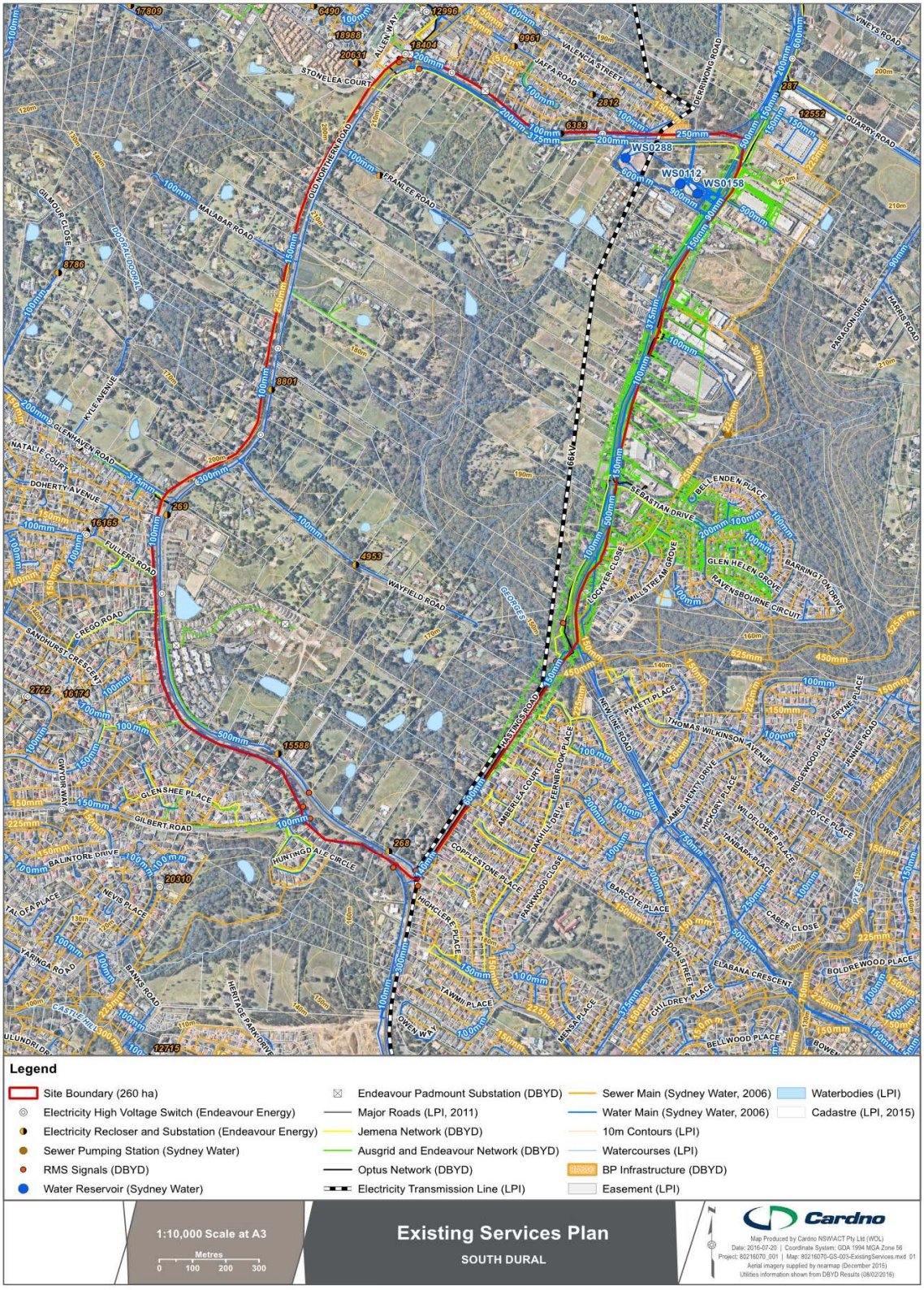


Figure 4-1 Existing Services Plan

4.3 Electricity

The site is located at the supply boundary between Ausgrid (formerly Energy Australia) and Endeavour Energy (formerly Integral Energy). The existing properties off Old Northern Road, Wayfield Road and Franlee Road are currently supplied by Endeavour Energy. The existing properties off New Line Road are currently supplied by Ausgrid.

There is an existing 66kV overhead (OH) transmission line running through the site, from Hasting Road to Dural Hotel / Motel and the Old Northern Road. The current 66kV OH line is supported on a single pole arrangement with 3 x 66kV conductors but without an overhead earth wire (OHEW).

4.3.1 Additional Information

- Old Northern Road and New Line Road will require road upgrade for the proposed development. As such, there may be an opportunity to underground 11kV and low voltage (LV) overhead (OH) lines along Old Northern Road and re-route the 66kV line as underground cable within Old Northern Road;
- Some high value properties may not be subdivided and power supply to these remaining properties will need to be maintained;
- There will be pedestrian pathways surrounding each isolated development area but at this stage there is no proposed route from the southern end to northern end across the entire site. These may be used to underground the 66kV OH lines;
- It is assumed that the existing Glenhaven Green Retirement Village and Sydney Hill Lifestyle Estate within the club are to remain; and
  Since both Endeavour Energy and Ausgrid service the proposed site area, they will serve as the certifying authority for any electrical reticulation design to be prepared for the precinct.
- Existing 66kV OH lines can be relocated underground with proper easement. The treatment of the electrical line will need to be further investigated at time of the particular precinct development.

4.3.2 11kV Network Distributor Supply Region

Ausgrid verbally advised the supply boundary between utilities is determined by asset ownership rather than Council administrative boundary. The development site has both electrical suppliers available and the supply of can be either from Ausgrid or Endeavour.

Figure 4-2 Electrical Supply– Sydney region

4.3.3 Proposed Development Maximum Demand

Based on the conceptual design, there are 1067 apartments and 1794 lots allowed for the assessment. Apartment design has not been disclosed with design type, therefore all apartments are assumed as medium density development with 5kVA After Diversity Minimax Demand (ADMD). Lots of approximately 350 m^2 and building size of 230 m^2 with 6kVA ADMD demand were assumed.

All calculations are based on Endeavour Energy requirements. Ausgrid may slightly have different ADMD requirement but it would be very similar to Endeavour.

To sum up, the total ADMD is 5 x 1067 + 6 x 1794 = 16099kVA (16.1MVA). With allowance for some minor commercial development (road front shops), it is recommended to allow 20MVA ADMD. Current Endeavour Energy method is used in above and each utility authority has different method to consider.

4.3.4 Summary of Existing Zone Substations

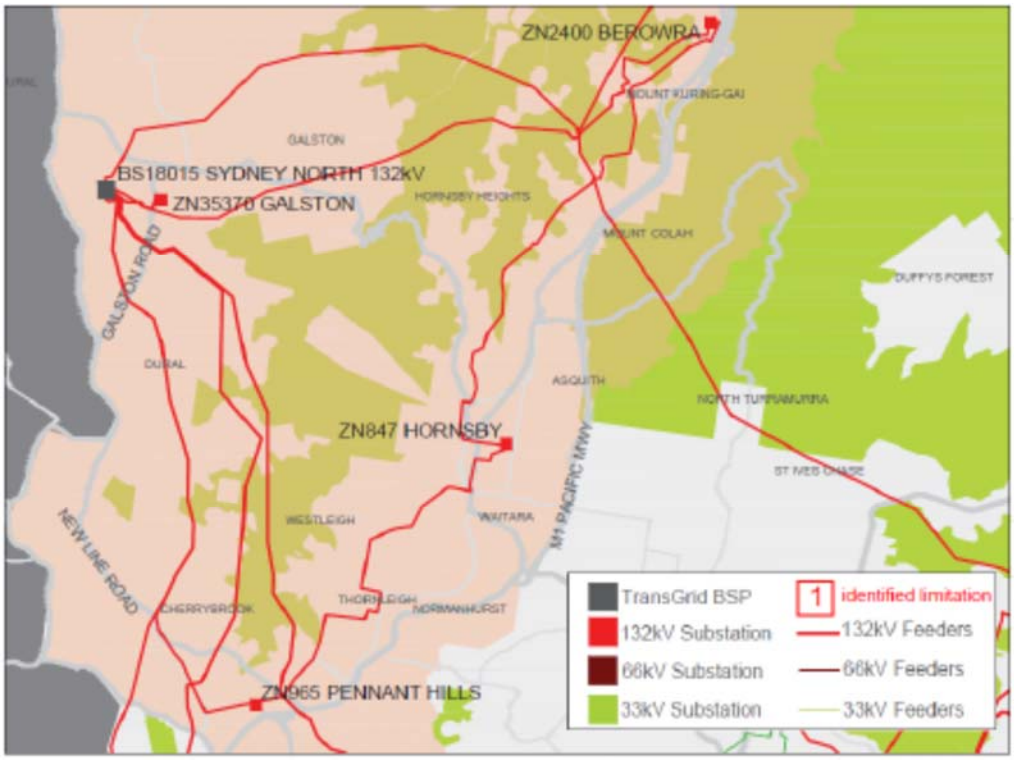
Based on desktop assessment, the spare capacities off each zone substation nearby are documented below:

a) 28 MVA Galston
b) 40MVA Pennant Hills
c) 6MVA Kenthurst
d) 26MVA Castle Hill
e) 9MVA Cheriton Zone (there are limitations on the transmission network in the area)

4.3.5 Existing Ausgrid 11kV Distribution Network Study

Ausgrid Load Area
The Ausgrid network shown has two Zone substations located near the site. Galston Zone to the North East and Pennant Hills Zone to the South East.

In the 2015 Distribution Planning Report both zones are shown to have available capacity based on their forecasts and there are no limitations identified in the area. Note this only includes confirmed projects and does not include proposed loads or projects in development.



North West Area - STS and ZS details										
	Total Capacity (MVA)		Firm Capacity (MVA)		Load Transfer Capacity (MVA)		95% Peak Load Exceeded (hrs/yr)		Embedded Generation (MVA)	
Substation	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Solar PV	Other
Berowra 132/11kV ZS	82.9	85.5	42.3	44.6	17.6	20.4	-	3.0	2.0	
Galston 132/11kV ZS	76.2	76.2	38.1	38.1	9.3	8.1	2.8	-	0.9	
Hornsby 132/11kV ZS	171.5	171.5	114.3	114.3	46.3	51.8	4.3	4.3	3.1	0.110
Pennant Hills 132/11kV ZS	164.1	171.5	106.9	114.3	24.1	29.9	4.5	-	5.5	

SUMMER - North West Area STS and ZS Load Forecast									
		Actual Load			Forecast Load				
Substation		2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Berowra 132/11kV ZS	MVA	24.3	19.1	18.3	21.3	20.6	20.2	20.1	20.4
	PF	0.93	0.94	0.93	0.93	0.93	0.93	0.93	0.93
Galston 132/11kV ZS	MVA	9.5	9.4	9.3	10.4	10.1	9.9	9.8	9.9
	PF	0.92	0.93	0.93	0.93	0.93	0.93	0.93	0.9
Hornsby 132/11kV ZS	MVA	70.3	60.6	60.7	65.7	63.6	62.4	62.2	57.2
	PF	0.97	0.97	0.97	0.99	0.99	0.99	0.99	0.99
Pennant Hills 132/11kV ZS	MVA	80.4	68.2	65.3	90.6	88.0	86.5	86.1	68.4
	PF	0.95	0.96	0.96	0.96	0.96	0.96	0.96	0.96

WINTER - North West Area STS and ZS Load Forecast									
			Actual Load		Forecast Load				
Substation		2012	2013	2014	2015	2016	2017	2018	2019
Berowra 132/11kV ZS	MVA	21.2	20.6	20.6	19.7	19.7	19.1	19.0	19.3
	PF	0.97	0.90	0.97	0.97	0.97	0.97	0.97	0.97
Galston 132/11kV ZS	MVA	8.7	8.6	8.1	8.5	8.1	7.8	7.8	7.9
	PF	0.96	0.97	0.97	0.97	0.97	1.0	1.0	1.0
Hornsby 132/11kV ZS	MVA	62.7	59.1	59.6	64.1	61.1	59.7	59.3	54.3
	PF	0.90	0.99	0.99	1.00	1.00	1.00	1.00	1.00
Pennant Hills 132/11kV ZS	MVA	69.3	59.0	59.7	75.6	71.7	69.8	69.1	51.5
	PF	0.90	0.99	0.99	0.99	0.99	0.99	0.99	0.99

Figure 4-3 11kV Ausgrid Network

4.3.6 Existing Endeavour Energy 11kV Distribution Network Study

Endeavour Load Area

The Endeavour network shown has three Zone substations located near the site - Kenthurst Zone to the North West and Castle Hill and Cheriton Ave Zones to the South.

In the 2015 Distribution Planning Report all zones are shown to have available capacity based on their forecasts and there are no limitations identified in the area. Note this only includes confirmed projects and does not include proposed loads or project in development.

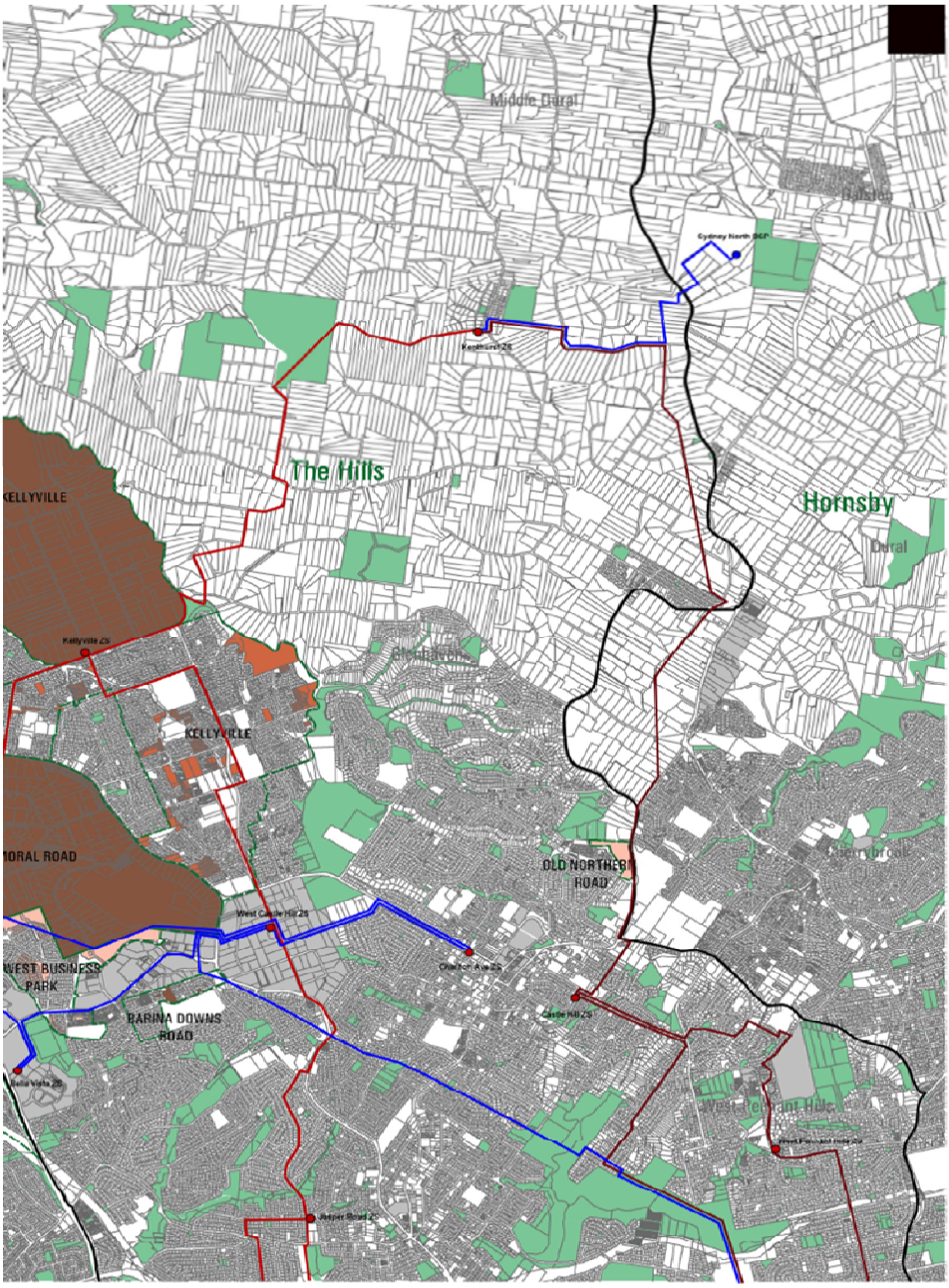


Figure 4-4 11kV Endeavour Energy

TABLE 51: CARLINGFORD TS – TRANSFORMER RATING AND SUBSTATION DETAILS

Substation	Voltage Levels	Transformer Description (MVA)	Installed Capacity Total 'N' (MVA)	Firm Rating Secure 'N-1' (MVA)	95% Peak Load Exceeded (hours)	Embedded Generation (MW)
Castle Hill ZS	66/11kV	3 x 25	75	50	8.00	0.60
Dundas ZS	66/11kV	3 x 35	105	52.5	1.75	3.02
Rydalmere ZS	66/11kV	2 x 35	105	70	4.00	1.01
West Pennant Hills ZS	66/11kV	2 x 35	70	35	2.75	1.86
Carlingford TS	132/66kV	4 x 120	480	360	3.25	-

TABLE 52: CARLINGFORD TS – SUMMER DEMAND FORECAST

Substation Name	Forecast PF	Actual (MVA)		Forecast (MVA)				
		2014	2015	2016	2017	2018	2019	2020
Carlingford (Ausgrid)	0.900	99.1	94.2	96.1	92.3	90.7	90.6	90.8
Castle Hill ZS	0.959	20.1	21.8	23.8	23.7	23.6	23.4	23.3
Dundas ZS	0.979	36.6	37.2	36.4	38.7	39.3	39.5	39.5
Rydalmere ZS	0.983	34.2	32.6	34.6	36.2	36.1	36.0	35.9
West Pennant Hills ZS	0.979	22.9	21.9	22.3	25.4	20.5	20.3	17.0
Carlingford TS	0.997	195.8	187.4	195.5	198.8	193.0	192.8	189.5

TABLE 53: CARLINGFORD TS – WINTER DEMAND FORECAST

Substation Name	Forecast PF	Actual (MVA)		Forecast (MVA)				
		2013	2014	2015	2016	2017	2018	2019
Carlingford (Ausgrid)	0.886	103.9	88.2	89.2	86.2	85.4	85.9	86.3
Castle Hill ZS	0.985	13.8	13.3	13.5	13.5	13.5	13.5	13.5
Dundas ZS	0.983	32.9	34.2	34.3	35.7	36.6	37.3	37.6
Rydalmere ZS	0.983	29.6	27.9	27.6	27.6	27.6	27.6	27.6
West Pennant Hills ZS	0.975	17.3	17.8	26.6	29.8	18.6	18.6	18.6
Carlingford TS	0.973	187.4	169.8	170.6	172.4	162.1	163.1	163.8

TABLE 161: SYDNEY NORTH BSP – TRANSFORMER RATING AND SUBSTATION DETAILS

Substation	Voltage Levels	Transformer Description (MVA)	Installed Capacity Total 'N' (MVA)	Firm Rating Secure 'N-1' (MVA)	95% Peak Load Exceeded (hours)	Embedded Generation (MW)
Kellyville ZS	33/11kV	2 x 25	50	25	2.00	1.51
Kenthurst ZS	66/11kV & 33/11kV	1 x 25(33kV) + 1 x 25(66kV)	50	25	2.00	0.90

TABLE 162: SYDNEY NORTH BSP – SUMMER DEMAND FORECAST

Substation Name	Forecast PF	Actual (MVA)		Forecast (MVA)				
		2014	2015	2016	2017	2018	2019	2020
Kellyville ZS	0.982	19.1	20.4	20.8	20.7	20.6	20.4	20.3
Kenthurst ZS	0.979	21.4	17.9	18.2	18.1	18.0	17.9	17.8
Sydney North BSP	0.995	41.3	35.7	32.2	32.0	31.8	31.6	31.4

TABLE 163: SYDNEY NORTH BSP – WINTER DEMAND FORECAST

Substation Name	Forecast PF	Actual (MVA)		Forecast (MVA)				
		2013	2014	2015	2016	2017	2018	2019
Kellyville ZS	0.993	13.1	12.6	11.6	11.9	11.9	11.9	11.9
Kenthurst ZS	0.994	17.7	19.1	18.1	18.4	18.4	18.4	18.4
Sydney North BSP	0.995	30.5	32.4	29.7	30.3	30.3	30.3	30.3

TABLE 171: VINEYARD BSP – TRANSFORMER RATING AND SUBSTATION DETAILS

Substation	Voltage Levels	Transformer Description (MVA)	Installed Capacity Total 'N' (MVA)	Firm Rating Secure 'N-1' (MVA)	95% Peak Load Exceeded (hours)	Embedded Generation (MW)
Bella Vista ZS	132/11kV	3 x 45	135	90	2.75	2.93
Cheriton Avenue ZS	132/11kV	2 x 45	90	45	4.50	1.63
Marsden Park ZS	132/11kV	1 x 45	45	NA	-	-
Mungerie Park ZS	132/11kV	3 x 45	135	90	3.25	2.98
Parklea ZS	132/11kV	3 x 45	135	90	5.25	8.60
Schofields ZS	132/11kV	2 x 45	90	45	7.00	1.28
South Marsden Park ZS	132/11kV	1 x 15	15	NA	-	-
West Castle Hill ZS	132/11kV	2 x 65	130	65	5.50	9.30
Hawkesbury TS	132/33kV	3 x 120	360	240	8.50	-

TABLE 172: VINEYARD BSP – SUMMER DEMAND FORECAST

Substation Name	Forecast PF	Actual (MVA)		Forecast (MVA)				
		2014	2015	2016	2017	2018	2019	2020
Bella Vista ZS	0.972	37.5	40.5	41.3	41.4	41.2	41.0	37.6
Cheriton Avenue ZS	0.982	24.4	26.8	35.9	27.8	31.3	31.1	24.5
Marsden Park ZS	0.900	-	-	1.6	5.9	7.5	9.3	14.4
Mungerie Park ZS	0.950	38.4	41.6	45.3	47.9	50.6	53.4	55.0
Parklea ZS	0.973	70.7	76.1	83.6	84.2	84.7	85.1	85.5
Schofields ZS	0.900	15.4	15.3	20.3	23.8	25.2	26.4	30.0
South Marsden Park ZS	0.900	-	-	3.2	9.0	14.9	19.0	22.5
West Castle Hill ZS	0.929	36.6	34.5	42.0	41.9	41.8	41.6	41.5
Hawkesbury TS	0.993	135.8	148.0	155.3	156.1	161.0	161.7	163.0
Vineyard BSP	0.969	373.6	388.9	422.9	432.4	453.7	489.1	495.6

TABLE 173: VINEYARD BSP – WINTER DEMAND FORECAST

Substation Name	Forecast PF	Actual (MVA)		Forecast (MVA)				
		2013	2014	2015	2016	2017	2018	2019
Bella Vista ZS	1.000	35.0	27.4	29.9	29.9	29.9	29.9	29.9
Cheriton Avenue ZS	0.997	21.3	22.0	32.9	27.7	27.7	30.6	30.6
Marsden Park ZS	0.900	-	-	1.0	4.7	5.8	6.9	10.2
Mungerie Park ZS	0.995	21.5	25.9	27.5	28.5	30.1	31.6	32.6
Parklea ZS	1.000	45.4	46.5	46.5	47.0	47.6	48.1	48.7
Schofields ZS	0.900	12.0	11.9	18.0	18.4	18.9	19.7	22.0
South Marsden Park ZS	0.900	-	-	2.0	6.7	10.7	13.6	16.1
West Castle Hill ZS	0.968	23.1	24.0	23.0	23.0	23.0	23.0	23.0
Hawkesbury TS	0.991	102.4	104.9	109.9	109.8	110.9	112.4	113.6
Vineyard BSP	0.978	261.8	267.6	278.6	283.5	292.0	325.3	336.7

Figure 4-5 Electrical Zone Substations

4.3.7 11kV Feeder and Low Voltage Distributor Service Strategy

11kV Distribution Network

In general, each 11kV feeder (OH or UG) can take up to 8 to 9 MVA, however due to redundancy supply requirements, the maximum allowable 11kV feeder service capacity is generally limited to 4-5MVA.

Based on the calculated maximum demand of 20MVA (16MVA plus additional), there will be 4 to 5 (assume 4 as existing 11kV feeders in this area from Ausgrid and Endeavour may supply up to 4MV in total) 11kV feeders required. If all feeders are from same zone substation, the following should be noted:

- In general, Endeavour Energy only allow 2 x 11kV feeders in the same trench. This will double the 11kV lead-in cost if 4 feeders are required; and
- Ausgrid may allow up to 4 x 11kV feeders in the same trench. If the feeder numbers are no more than 4, it is economic to run feeders from Ausgrid.

There are 3 options in line with existing zone substation locations:

a) Run 4 x 11kV feeders in 2 trenches from Castle Hill Zone Substation (Endeavour);

b) Run 4 x 11kV feeders in 1 trench from Galston Zone Substation (Ausgrid); or

c) Service partial development off existing 11kV feeders from both Ausgrid and Endeavour Energy and request Ausgrid or Endeavour to establish a new zone substation to eliminate lead-in cost. Note Endeavour Energy or Ausgrid will have to run a community cost test to confirm if a new zone is acceptable. This option is not very like to be accepted by EE or Ausgrid but should be investigated.

It is recommended option b) be considered at this stage.

LV Reticulation Network

Should most of the site be serviced by the Endeavour Energy Distribution Network, the default pad mount substation size in Urban Residential Development (URD) is 500kVA or 315kVA (only for limited amount of customers, e.g. residual of an existing development). Each 500kVA substation, based on the calculation of maximum capacity and fuse capacity after derating can generally service approximately 70 residential customers. Depending the substation location and road layout, the maximum number of customers per substation may decrease due to voltage drop calculations. It is noted that Endeavour Energy may allow 1 pillar box servicing 4 lots.

Ausgrid default substation in URD is 400kVA but Ausgrid uses larger fuses and does not derate fuses. As such, each Ausgrid 400kVA substation can service approximately 67 customers but also may decrease due to voltage drop. It is noted that Ausgrid generally allow 1 pillar box servicing 2 lots.

Since each substation construction cost is around $90,000, it is strongly recommended to carry out an overall master plan to locate each substation sitting at the most desirable location. The master plan should have all substations located with the typical LV distributor voltage drop performed.

a) Choose Endeavour as Network Distributor; or

b) Choose Ausgrid as Network Distributor

Cost Option A) Endeavour Energy				
Substation	41	per	$95,000	$3,895,000
Average per lot cost (LV)	2861	m	$7,500	$21,457,500
Other Cost	1	%	10	$2,145,750
ELECTRICAL TOTAL				**$27,498,250**

Cost Option B) Ausgrid				
Substation	43	per	$90,000	$3,870,000
Average per lot cost (LV)	2861	m	$8,000	$22,888,000
Other Cost	1	%	10	$2,288,800
ELECTRICAL TOTAL				**$29,046,800**

In line with the 11kV lead-in recommendation, it is recommended to use Ausgrid as the supply authority.

The following should be noted:

a) Depending on the preferred staging, that Old Northern Road is assumed as a possible trunk supply route; and

b) Padmount substations will generally be established on easements with a restriction placed on the title of the burdened lot to benefit Endeavour Energy or Ausgrid.

All high and low voltage conductors for the site will be located underground to improve urban amenity and provide extreme weather protection in accordance with Endeavour Energy / Ausgrid guidelines. Further investigation and design will be undertaken by accredited designers in consultation with Endeavour Energy / Ausgrid as part of ongoing design development.

4.3.8 Public Roadway Lighting Strategy

It should be noted that Hornsby Shire Council should nominate the public lighting design requirement where it may not necessarily have to follow AS1158. However in most cases, Council will choose AS1158 as the design guideline.

All internal roads seem to be category P4 therefore Sylvania Street LED 18W light should be used. Endeavour Energy unfortunately will not take ownership of any decorative light fittings therefore all new street light fittings must be Sylvania Urban shape or similar. However EE has decorative columns available for use. Ausgrid permits some decorative light fittings and columns but this will require more lights to be installed. Please refer Ausgrid NS119 for more information.

Old Northern Road is managed by RMS and preliminary discussion with RMS indicates that this road, it is to be widened, will be designed to Category V3. New Line Road will be designed to V5. Please note Sylvania has released a new LED major road light which is under trail by Endeavour and Ausgrid. By the time Old Northern Road requires lighting design, this product may be available for use.

4.3.9 Summary of Budget Estimate for Electrical Works

This budget estimate is based on experience and is for information only.

11kV Lead-in

Cost Option B					
Electrical Lead-in (4 feeder per trench)	4850	m	$1,200	$5,820,000	
Electrical Lead-in (2 feeders per trench)	0	m	4800	$0	
Other Cost		%	15	$873,000	Traffic Control etc
ELECTRICAL TOTAL				**$6,693,000**	
ELECTRICAL PER LOT				**$2,339.39**	

Subdivision

Cost Option B					
Substation	43	per	$90,000	$3,870,000	
Average per lot cost (LV)	2861	m	$8,000	$22,888,000	
Other Cost	1	%	10	$2,288,800	
ELECTRICAL TOTAL				**$29,046,800**	
ELECTRICAL PER LOT				**$10,152.67**	

In Total

	66kV	11kV	Subdivision	
ELECTRICAL TOTAL	$5,106,200	$6,693,000	$29,046,800	$40,846,000

4.4 Telecommunications

NBN Co remains the infrastructure provider of last resort (IPOLR) in developments with 100 lots or more within its fixed line footprint. Telstra remains the IPOLR in developments with fewer than 100 lots and in developments outside the NBN fixed line footprint. Under the new guidelines effective March 2015, the NBN Co is under strict instructions to maximise efficiency in servicing new developments and needs to actively pursue alternative delivery models where possible.

The funding and installation of optical fibre for all large greenfield developments is now undertaken by NBN Co as part of the National Broadband Network rollout. The NBN Co has provided a preliminary feasibility statement for the South Dural development. The developer is responsible for the cost and implementation of a pit and pipe network.

It will be up to NBN Co to enter into agreements with developers, contractors and alternative network providers for networks to be built and operated using a wide range of models – including co-investment and build-own-operate models.

As part of the feasibility NBN Co has indicated a backhaul cost of $91,450. NBN Co may charge developers a contribution of up to 50 per cent of the first $1000 per lot of capital costs it incurs in providing backhaul. Developers will be liable for up to 100 per cent of backhaul costs in excess of $1000 per lot.

4.5 Natural Gas

Existing Jamena natural gas services are present in Old Northern Road, New Line Road and Hickson Road. Natural gas supply is currently not available within the Precinct.

The services connections, sizing and staging will be undertaken by Jemena at detailed design stage.

Jemena has confirmed upon the provision of the fixed approved layout and load configuration for the development further full economic evaluation can be undertaken. Natural gas infrastructure will be reticulated along with electricity and telecommunications services in common trenches.

4.6 Recycled water

There is no recycled present at site. Recycled water will not be provided.

5 Staging

The development of the site will be staged. The staging will be based on the development ownership, site constraints, access and services availability.

As part of this investigation the site has been staged as

- Stage 1 – North West precinct;
- Stage 2 – South precinct; and
- Stage 3 – North East precinct.

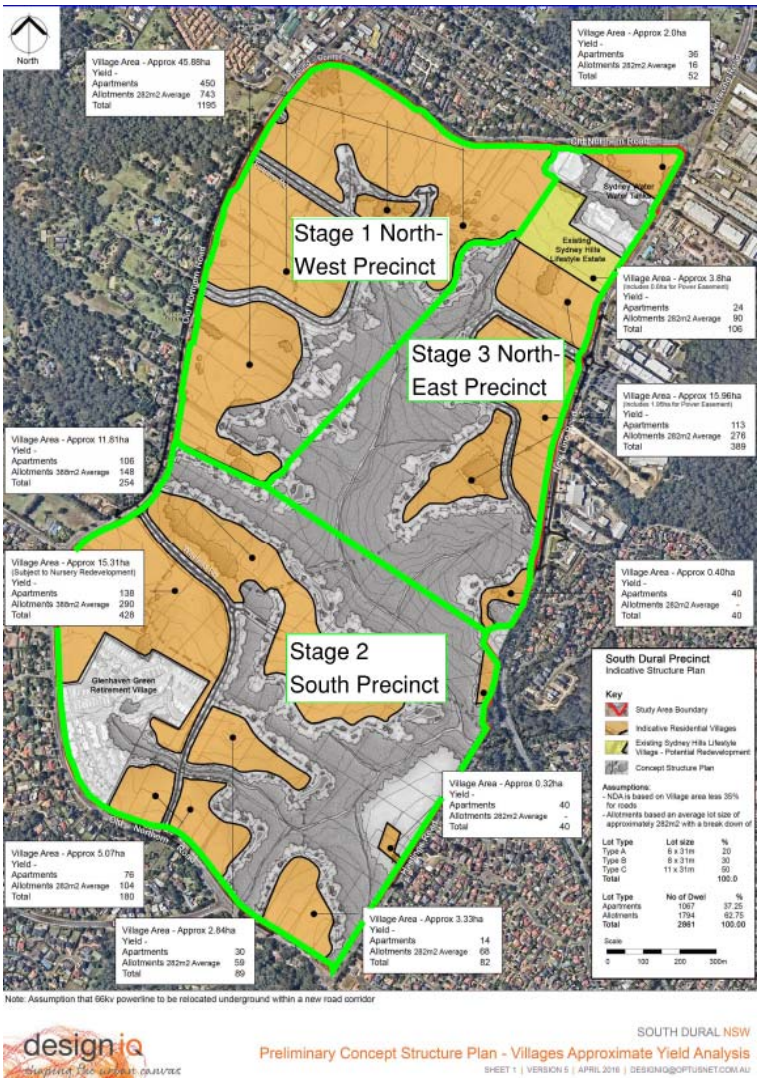


Figure 5-1 Indicative Staging Plan

All necessary lead-in services will need to be constructed to service proposed stages. An interim staging option for waste water has been investigated. This involves constructing a wastewater storage system in

Stage 1 in case of approval delays. It is proposed that the precinct drains via internal gravity reticulation. However rather than draining to the branch mains, it is stored in sewer tanks until it can be discharged off site via vacuum trucks. The total storage required will be based on the proposed number of lots and apartments in each stage. Stage 1 will require a storage tank of 559KL capacity with Sydney Water's requirement to be able to store wastewater for a 24 hour. This option will need to be further investigated at detail design and discussed with Sydney Water.

The actual staging of the South Dural development will consider additional constraints such as stormwater management, together with market forces in the release of land. It is anticipated that the staging boundaries nominated by this report will form the broad framework under which a more detailed development staging can be developed by the proponent. There may be some opportunity for changes to the existing network to redistribute loads and make more supply available to the required development. Table below contains a summary of the utility services timing and constraints.

STAGE	INFRASTRUCTURE	TIMING & CONSTRAINTS
1, 2 and 3	Wastewater	A sewer carrier will need to be extended to service Stage 1, Stage 2 and 3 branch main will be connected to the carrier.
	Potable	Existing watermain present in the Old Northern Road and minimal constraint expected for Stage 1, 2 or 3 development
	Recycled	Reticulated service is not available and not investigated.
	Electrical	Lead-in will be required for the subdivision and will need to be reticulated to different stages.
	NBN	Lead-in will be required for the subdivision. NBN Co will ensure properties are optic fibre ready upon establishment and signing of the Developer Agreement
	Gas	Existing gas available in the Old Northern Road and little constraint expected for Stage 1, 2 or 3 development

6 Limitations

The concept servicing strategy for the South Dural Precinct has been developed on the basis of available trunk infrastructure brought to the boundary of South Dural with sufficient capacity to service the proposed residential development. While discussions with utility authorities generally indicates this to be the case Cardno does not offer any warranty over this third party advice. In the case of Endeavour Energy, Jemena and to a lesser degree Sydney Water, the only guarantee to supply is on lodgement and approval of a Development Application with the relevant Local Government Authority.

It should be noted that the lead-in service strategies are concept only and are subject to further investigation and discussion with all services authorities at the detailed design stage. Lead-in routes may be optimised during this phase to improve serviceability and reduce material costs.

7 Conclusion

This report concludes that electrical and communication services are required to be extended from relevant zone substations for the proposed development. The sewer carrier at the corner of Hastings Road and New Line Road need to be extended to service the proposed development. Sydney Water has indicated West Hornsby Sewage Treatment Plant has enough capacity to serve this site. Existing Sydney Water potable water supply system will require amplifications to accommodate the proposed growth. Natural gas will be extended from existing services on old Northern Road, Hastings Road and New Line Road. The concept design and staging should be further investigated at detailed design.

Cardno recommends ongoing dialogue is maintained between the Department of Planning and Infrastructure, utility authorities and Lyon Group in order to ensure development proceeds in a logical and timely manner.