Department of Planning and Environment

Narrabri Special Activation Precinct

Utilities Infrastructure Report

April 2023

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Narrabri Special Activation Precinct
Utilities Infrastructure Report

Department of Planning and Environment

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Rev	Date	Details
A	04/11/2022	Draft report
B	10/03/2023	Final report
C	28/04/2023	Web accessible Final

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Reviewed by:	Henry Swan	28/04/2023	
Approved by:	Graeme Steverson	28/04/2023	

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Acknowledgement of Country

We acknowledge country and pay respects to the Gomeroi/Gamilaroi/Gamilaraay/Kamilaroi people as the Traditional Owners and Custodians of the land and waters on which the Narrabri Special Activation Precinct is located on.

We recognise their continued connection to Country and that this connection can be seen through stories of place and cultural practices such as art, songs, dances, storytelling and caring for the natural and cultural landscape of the area.

We also recognise the continuing living culture of Aboriginal people, and the significance of Narrabri in that living culture. We recognise the contemporary stories of displacement and the cultural significance of Narrabri in the continued journey of self-determination in Australia.

Executive summary

The Narrabri Special Activation Precinct (SAP) is one of the six distinctive areas throughout regional NSW to bring together planning and investment to stimulate economic growth across a range of industries including freight and logistics, manufacturing, waste management and recycling, energy generation and agricultural and food processing activities. Narrabri SAP was declared the sixth and final SAP investigation area as its location has a strong reputation and proximity to one of Australia's highest productive grain regions and strong transport linkages to road and rail including the future Inland Rail.

The utilities infrastructure technical assessment is the focus for this report and provides a key technical input for the overall Narrabri SAP Structure Plan. This report assesses the essential utilities and services in terms of their capacities, condition and potential expansion to cater for the overall precinct master plan. This report analyses the existing services infrastructures and makes recommendations to upgrade or construct new services to meet the needs of the area through the SAP master planning process. In doing so, the proposed structure plans, population and visitor growth forecasts were analysed as well to assess the impact of the increasing demand on critical infrastructure including Sewer Treatment Plants (STPs), water intake location and electrical substations.

Findings

The outcomes of the assessment have identified the following:

1. The existing electrical network, water servicing capacity and telecommunications network can support the development of Stage 1 of the SAP without any major upgrades. Stage 1 electrical works include, installation of potentially two new 1.5 MVA and one 500 kVA padmount substations for the Inland Port and upgrading of necessary sections of the 22 kV feeder in front of the Inland Port site. And for the initial 600 residential lots in the Mount Kaputar precinct, installing two new 1.5 MVA, one 1 MVA padmount substations and upgrading of necessary sections of the incoming 22 kV feeder/s will be required.
2. The Transport and Logistics precinct can be supplied by one 22 kV feeder. The Narrabri Zone substation will require a new 30 MVA transformer to supply the Agricultural and Food Processing and Bioproducts precincts via three new 22 kV feeders and one new 22 kV feeder, respectively.
3. Future developments of Fertilizer and Chemicals, Waste Management and Recycling, Manufacturing, new Sewer treatment plant, and the remaining developments of Mount Kaputar precinct will require three new zone substations, with one 90 MVA Zone Substation for Fertilizer and Chemicals, one 60 MVA Zone Substation for Waste Management and Recycling, and one 80 MVA Zone Substation for the remaining Mount Kaputar precinct.
4. Stage 1 of the SAP is proposed to utilise the existing wastewater network and supported by necessary incremental upgrade of the existing Sewer Treatment Plant (STP), however some sections of the network may require upgrade which will be determined in future stages of design. However, a new STP has been identified as the preferred strategy to cater for ultimate growth. Feasibility and site investigations for the new STP in the vicinity of the SAP should commence immediately, to allow for implementation to support Stage 2, and to ensure any interim servicing arrangements/upgrades are as prudent and efficient as practical. Potential locations for the new STP are explored within this report.
5. New water bores will be required for Stage 2 of the SAP, and investigations are required to confirm the most feasible locations. New treatment, storage and pumping infrastructure will be required at the bore site(s) or a centralised site within the SAP. Subject to actual development demands, at least one new bore from the Pilliga Sandstone/Southern Recharge aquifer (separate from the Lower Namoi Alluvium, which is the current town water source) would be required during either Stage 2 or Stage 3, which could require an additional separate treatment process.

This report captures the outcomes of engagement with multiple stakeholders over the course of the delivery of this stage of planning including utility authorities, Narrabri Shire Council, Regional Growth NSW Development Corporation and NSW Department of Planning and Environment. Based on the information provided by these stakeholders, this report includes detailed analysis of data provided in the infrastructure planning assessment.

Indicative timing

The indicative timing of flooding and water quality infrastructure upgrades is shown in Figure ES.1. The timing is based on the nexus between the upgrade and land use generating the need for the upgrade. This timing is influenced by the rate of development and the staged release of land within the SAP and the Mt Kaputar residential area.

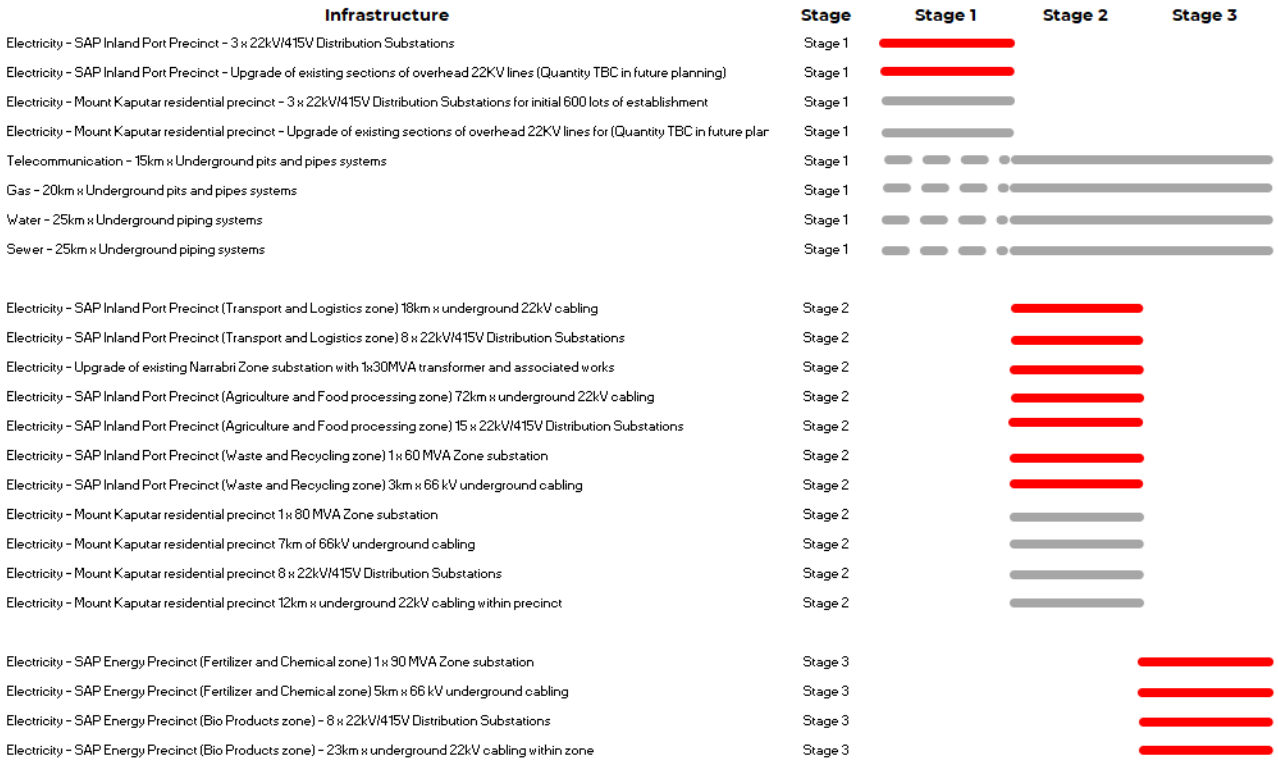


Figure ES.1 Overview staging of utilities infrastructure for Narrabri SAP across three stages

1 Introduction

1.1 Narrabri strategic significance/context

The New South Wales (NSW) Government, through its introduction of the Special Activation Precincts (SAPs) has identified six distinctive areas throughout regional NSW to bring together planning and investment to stimulate economic growth across a range of industries including freight and logistics, manufacturing, waste management and recycling, energy generation and agricultural and food processing activities. The planning and creation of these areas is partially facilitated and funded through the $4.2 billion Snowy Hydro Legacy Fund.

The establishment of SAPs is a joint NSW Government Agency initiative by the Department of Regional NSW, Department of Planning and Environment (DPE) and the Regional Growth NSW Development Corporation (RGDC) as part of the 20-Year Economic Vision for Regional NSW. DPE is responsible for preparing the planning framework whereas the Department of Regional NSW manages each precinct.

1.2 Scene setting

Narrabri is located in the heart of the Namoi Valley on the North West slopes and plains of New South Wales. The word Narrabri means ‘forked waters’, which describes the splintering waterways of the Namoi River, the Narrabri Creek and Horse Arm Creek. The township of Narrabri is the administrative centre of the Shire. Much of the Narrabri Shire population is centralised in the township of Narrabri, Wee Waa and Boggabri, and around the villages of Bellata, Edgeroi, Maules Creek, Baan Baa, Gwabegar and Pilliga. The Narrabri region is known for its fertile soils, abundant natural resources, strong industry and world-leading research.

In November 2020, Narrabri was declared the sixth and final SAP, enabled by its strong reputation and location within one of Australia’s highest productive grain region as well as its strong transportation linkages including existing road and rail connections and the future Inland Rail. To facilitate the planning within this precinct DPE has engaged WSP to prepare a series of technical studies regarding Utilities for Narrabri SAP. Overview of the Narrabri SAP area is shown in Figure 1.2.

Set against the backdrop of the Nandewar Ranges and on the banks of the Namoi River, the topography of the area varies from river plains through to mountain ranges. The Namoi River meanders through these plains and acts as the lifeblood of the area supporting agriculture, industry and people. The Namoi traverses the township of Narrabri from north west to south east. A number of smaller tributaries of the Namoi are also located within Narrabri including Mulgate Creek, Horsearm Creek and Long Gully. Narrabri has historically experienced flooding from each of these sources on a regular basis.

Narrabri township is located within the Narrabri Shire local government area (LGA), approximately 530 km northwest of Sydney. As of the 2021 census, the population of Narrabri township was 6,898 persons with 16% identifying as Aboriginal and/or Torres Strait Island Peoples.

The township lies at the junction of the Newell and Kamilaroi highways and has direct rail connection to the Port of Newcastle via the Walgett branch of the Main North line. Once completed, Narrabri will also have a direct connection to the new Inland Rail route which will connect Melbourne to Brisbane via new and upgraded track.

1.3 Masterplan process

The Narrabri Masterplan is the initial stage in determining the area and land uses for the Precinct and is guided and informed by DPE in partnership with the Department of Regional NSW and Narrabri Shire Council. Throughout master planning process, community, stakeholder and industry consultation will take place, as well as a range of technical studies to help inform the preparation of a draft master plan.

Creation of the Masterplan is developed across a series of key inputs and includes a range of technical disciplines including urban design, architecture, landscape design, engineering, and environmental disciplines. The Masterplan process and its stages are summarised in Figure 1.1.

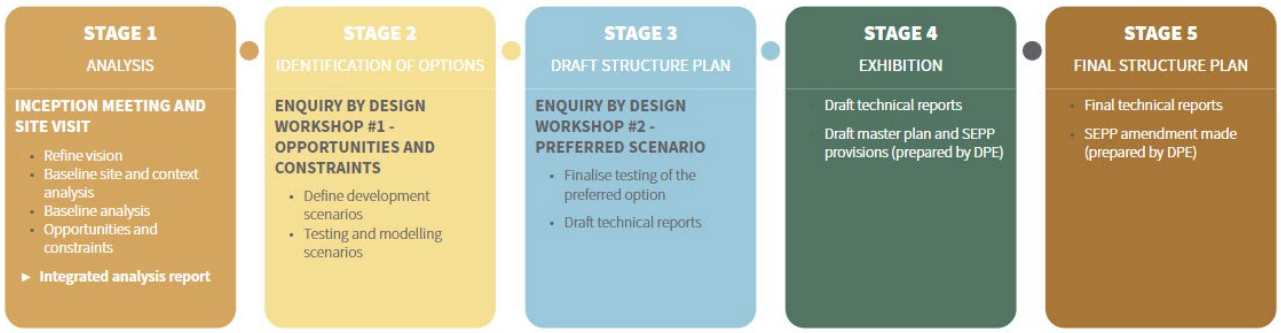


Figure 1.1 Narrabri SAP Masterplan process

The following is a summary of key inputs and activities completed to date that support the findings of this technical report:

- **Stage 1 Analysis:** This stage sets the scene for Narrabri SAP by refining the vision and providing a more detailed understanding the SAP. This stage is supported by overview findings from a site visit, baseline assessment across various technical topics, and identification of key opportunities and constraints.
- **Stage 2 Identification of Options:** Various scenarios of the Narrabri SAP were developed in conjunction with council and inputs from the technical findings from the baseline assessment. A preliminary Enquiry by Design (EbD) workshop was held on 29 and 30 March 2022 to develop a range of initial land use scenarios for further assessment.
- **Stage 3 Draft Structure Plan:** Develops more detailed structure requirements based on the preferred land use scenario based on the range of options assessed in Stage 2. The preferred land use scenario was assessed through a final EbD workshop held between 5 and 8 September 2022 to study the interdisciplinary constraints and key infrastructure requirements. This technical report assesses the land use Structure Plan from the final EbD workshop from a Utility's perspective. Figure 1.2 is an overview of the Narrabri SAP preferred land use scenario.

Following Stage 3 Draft Structure Plan, further community and stakeholder consultation will occur in the form of an exhibition period which includes display of technical reports from the Draft Structure Plan, Draft Master Plan, and SEPP.

1.4 Report structure

This Utilities Infrastructure report has been prepared to provide key inputs for the Narrabri SAP Structure Plan.

The remainder of this report is structured as follows:

- **Narrabri SAP overview – Structure Plan**

  Chapter 2 is an overview of the Narrabri SAP including key elements of the SAP as well as relationship with the Inland Port, Town Centre, and proposed residential areas. In addition, an indicative summary of land uses, employment, and population are summarised.

- **Local context**

  Chapter 3 provides an overview of local context from a Utility Infrastructure perspective summarising key strategic plans, policy, and planning documentation as well as existing conditions of the area.

- **Methodology**

  Chapter 4 includes a description of the process used of undertaking the study, and list of stakeholders involved and information relied upon as part of the study.

- **Assessment and findings**

  Chapter 5 provides technical inputs and findings for the Structure Plan against the visions and aspirations of the Narrabri SAP from the context of Utilities Infrastructure perspective.

- **Recommendations and conclusions**

  Chapter 6 summarises recommendations and conclusions based on findings and inputs for Utility Infrastructure within the Narrabri SAP.

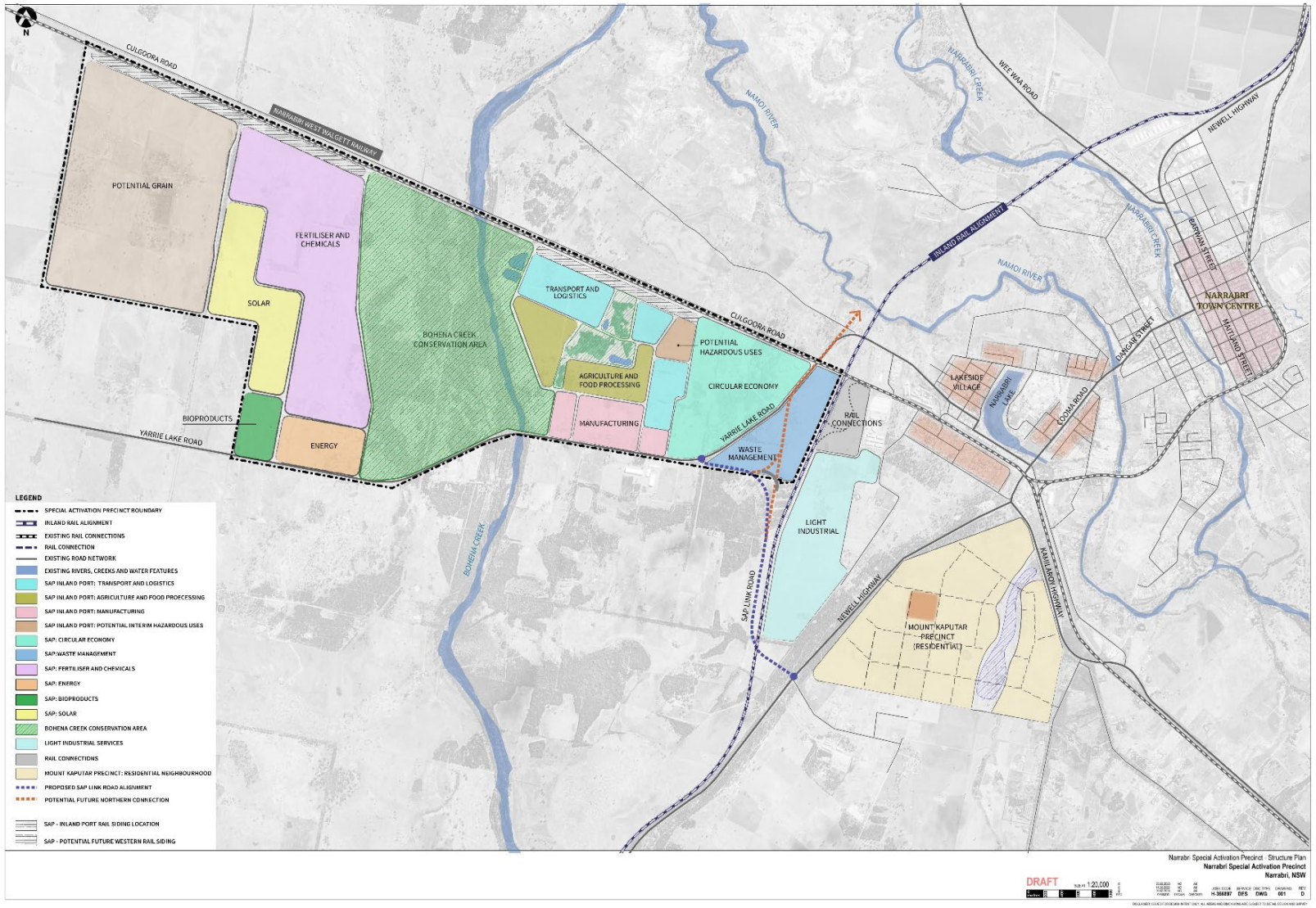


Figure 1.2 Overview of the Narrabri SAP (DPE, April 2023)

2 Narrabri SAP overview – structure plan

2.1 Overview

The Narrabri SAP boundary, was developed at the Final EbD workshop and covers an area of 2,629.45 ha. It is located to the west of the existing township and incorporates two areas separated by an environmental buffer zone. This boundary was utilised as a basis for all technical studies and was refined during the master planning and technical assessment process as summarised in Section 1.3. Figure 2.1 provides an overview of key elements of the Narrabri SAP.

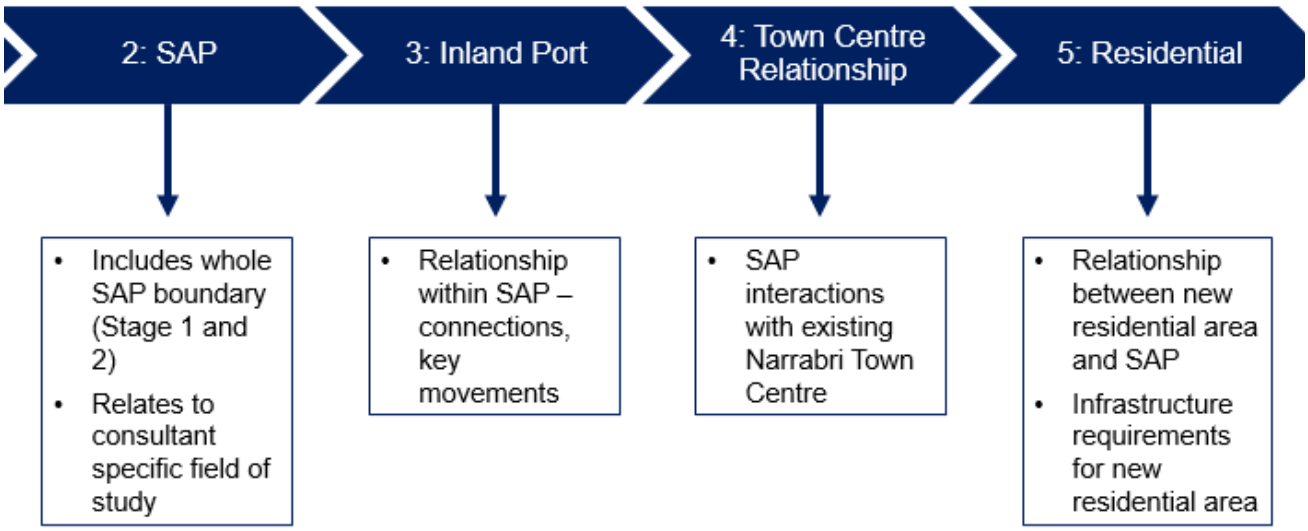


Figure 2.1 Overview of key elements of Narrabri SAP

2.1.1 Visions and aspirations

The vision and principles for the Narrabri SAP is grounded by the *7 Elements of Great Places* described which is based on the United Nation's *The New Urban Agenda framework.* The Narrabri SAP Vision and Principles were developed with this framework and summarised in Table 2.1. They were refined during the preliminary EbD to respond to feedback from stakeholders and consultants. This vision will guide the design and development of the precinct and the assessment of the merits of each of the scenarios.

Strengthening our relationship with Country and Water; the Narrabri SAP will retain the Town Centre as the heart of Narrabri, unlock greater economic growth for the region, leveraging from the Inland Rail, the Northern NSW Inland Port and the Narrabri Gas Project.

Table 2.1 SAP vision – 7 Elements of Great Places

Element	Vision
Equity	Strengthen the existing community and businesses; giving them the tools and the reason to stay whilst attracting economic and residential growth for Narrabri that will 'give back' to Narrabri. Respect the cultural and lifestyle diversity by providing access to housing, health, education, social and community infrastructure to enhance the liveability and lifestyle of Narrabri.
Identity	Establish a legacy at Narrabri for future generations to be proud of which reflects diversity, protects and respects the site's natural features, heritage and vegetation whilst integrating a cultural lens across the entire SAP in all actions.
Greenery	Use science and local knowledge to define constraints and opportunities enabling the protection of community and environment with a strong focus on safety, flood and bush fire risk, water security and bio values.
Urbanity	Reinforce the Town Centre as the heart of Narrabri; breaking down boundaries, addressing basic social deficits and embracing diversity to achieve a liveable and lovable place that is safe, connected and active.
Mobility	Plan for both regional and local equitable access for future residents, visitors and workers of all ages, abilities, and economic position; aiming to improve health, convenience and social connectedness.
Wellness	Prioritising the community's health, well-being and sense of belonging and setting a new environmental sustainability benchmark for energy intensive development.
Resilience	Grow and retain the local small industry community whilst up-skilling and attracting new industries and enterprises; setting a standard for innovation and circular economy across the board and including energy-intensive industries.

2.1.2 Staging

For the delivery of the Narrabri SAP, an indicative staging delivery plan is assumed to commence in 2024 and ongoing toward 2030 and beyond. Staging at this time is assumed across three stages and will be refined further as planning progresses:

- **Stage 1:** east of Bohena Creek with a focus on the transport and logistics land use (e.g. the Inland Port development), associated light industrial industry and assumed development of 600 new residential lots.
- **Stage 2:** remaining development east of Bohena Creek including associated industrial industry.
- **Stage 3:** west of Bohena Creek focussing on more hazardous heavy industry land development (such as energy, fertiliser and chemical production), bulk grain handling, and assumed development of a further 1,500 new residential lots.

Figure 2.2 provides an overview of the infrastructure delivery for the Narrabri SAP.

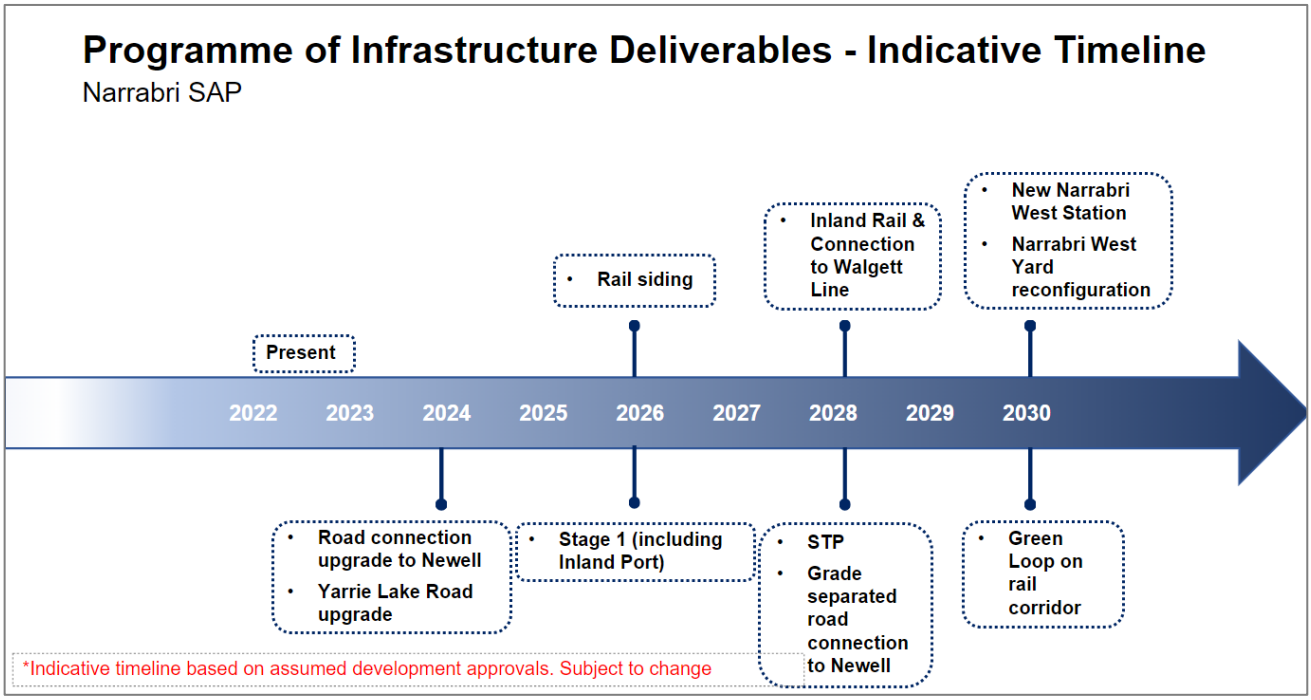


Figure 2.2 Indicative program and staging of infrastructure deliverables (subject to change)[1]

(1) Note: Reference of the 'Green loop' is considered a long-term strategic concept and is not assessed in this report.

2.1.3 Land uses

Land uses and size within the Narrabri SAP and external to the SAP are summarised in Table 2.2 and Figure 2.3 provides an overview of the land uses.

Table 2.2 Overview of land use and sizing within and outside the Narrabri SAP boundary

Land use within the Narrabri SAP boundary	Area (ha)	Land use outside of the Narrabri SAP boundary	Area (ha)
Fertiliser and Chemicals	366.62	Rail connection	44.92
Solar	144.14	Light Industrial (North)	106.75
Grain (Potential)	527.48	Light Industrial (South)	187.30
Western Rail Siding	37.75	Residential (2060 Target)	597.15[3]
Energy	63.31		
Bioproducts	40.79		
Inland Port (Rail siding and additional rail siding reserve)	36.07		
Transport and Logistics	108.20		
Interim Potential Hazardous Uses	19.19		
Waste Management and Recycling	94.32		
Agricultural and Food Processing	90.88		
Manufacturing	72.59		
Circular Economy[1]	181.75		
High Value Vegetation (To be retained)[2]	45.85		
Bohena Creek Conservation Area[2]	626.27		
Others (Rail, Roads, Decoupling Infrastructure)[2]	174.24		
Total	**2629.45**	**Total**	**936.12**

Source: DPE, 17 February 2023

(1) Circular Economy land use is identified land that align with circular economy goals by valuing resources, by getting as much use out of products and materials as possible, and reducing the amount of waste generated.

(2) Non-employment land uses

(3) The net residential area (excluding flooding area and main indicative connections) = 488.18 ha

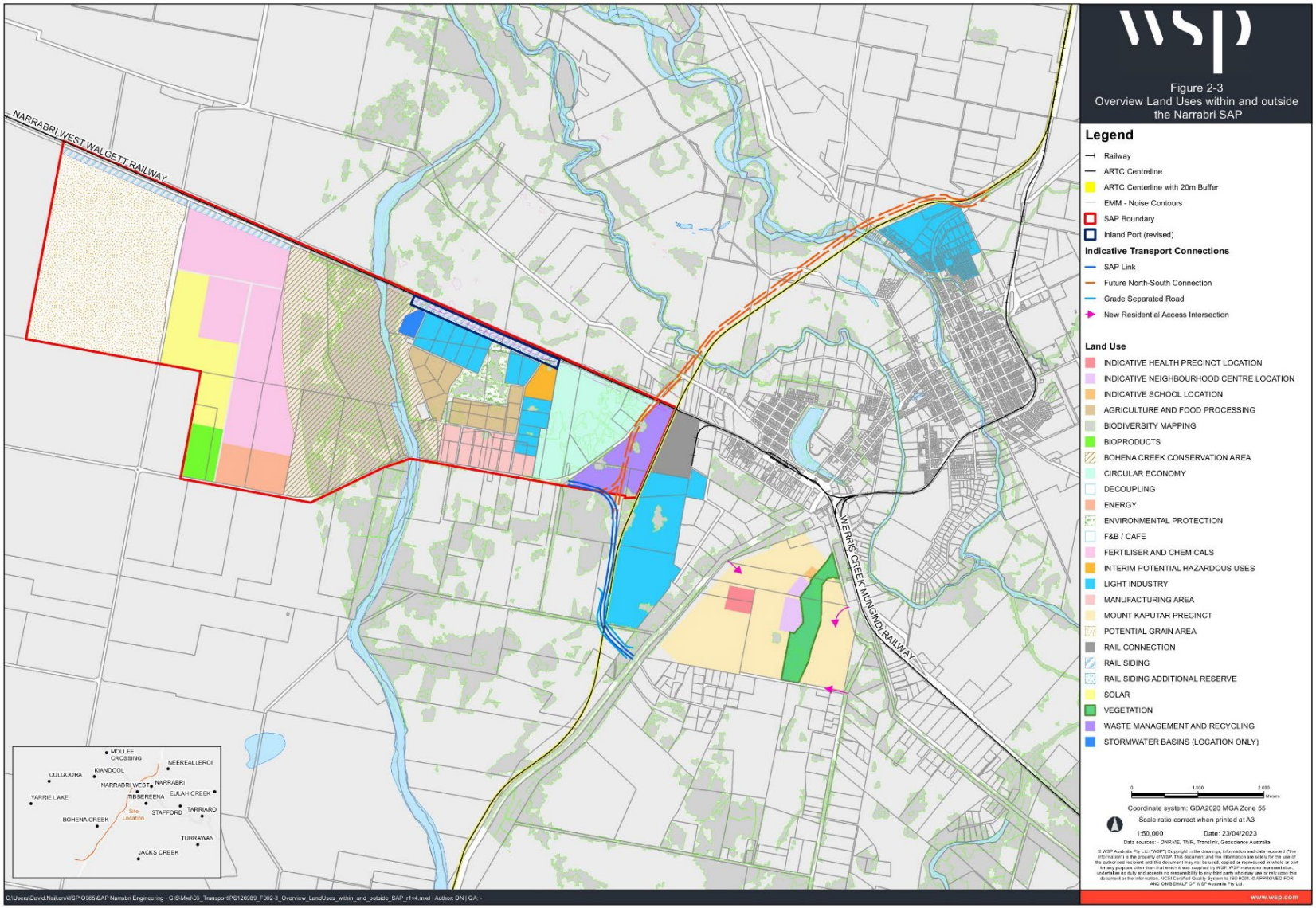


Figure 2.3 Overview land uses within and outside the Narrabri SAP (DPE, April 2023)

2.1.4 Employment

An estimate of the number of forecasted jobs created within the SAP is summarised in Table 2.3.

Table 2.3 Estimated employment requirements (FTEs) within the SAP based on high uptake sensitivity[1]

Industry	2027	2032	2042	2062
Fertiliser & Chemicals	260	260	260	260
Energy	10	10	10	10
Bioproducts	0	0	0	50
Transport & Logistics	70	80	90	120
Agricultural & Food Processing	40	220	220	220
Waste Management & Recycling	50	60	110	110
Total	**430**	**630**	**690**	**770**

Source: Narrabri SAP Economic Analysis Updated employment figures following September 2022 Enquiry by Design (EbD) Workshop (Aurecon, 2022-10-10)

(1) Employment numbers correspond to high uptake sensitivity with gas project

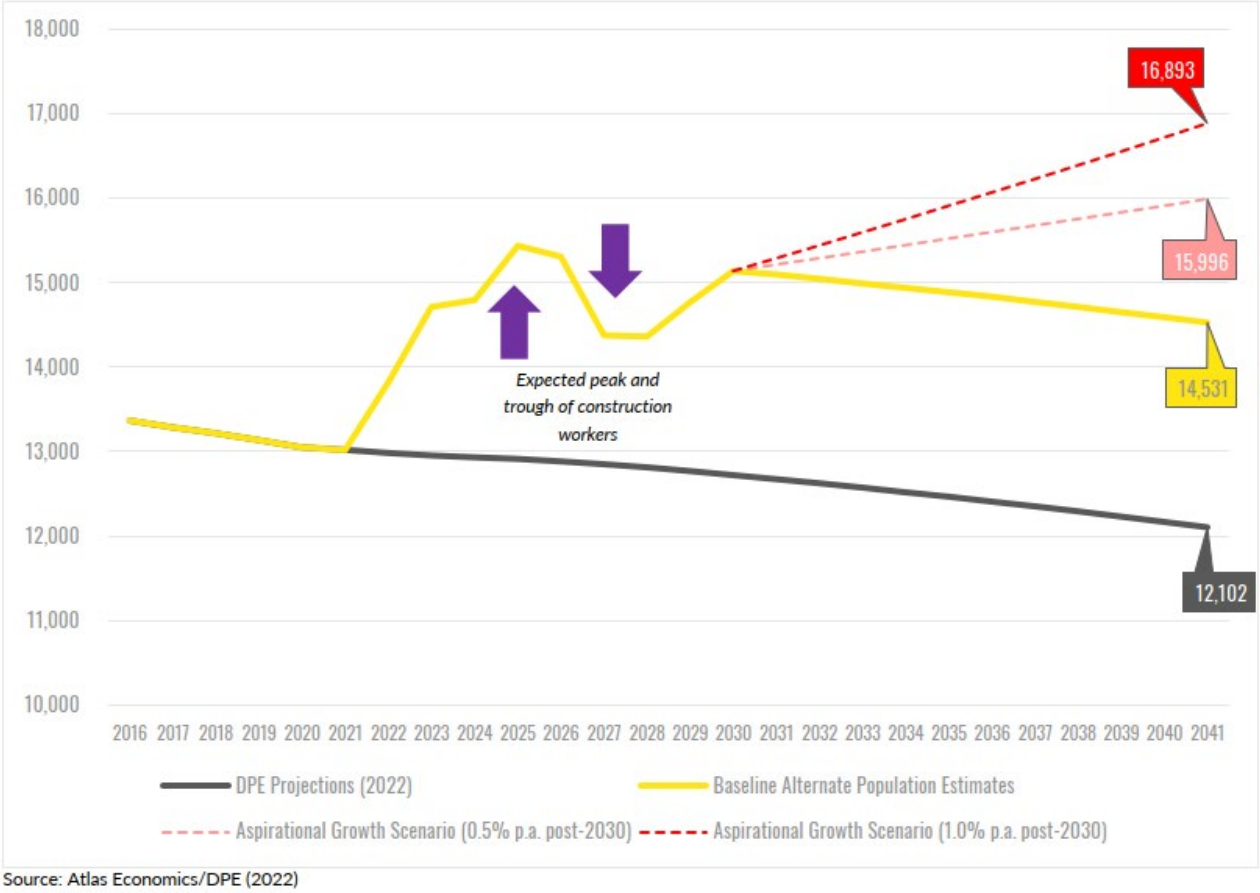
Assumptions related to these estimates include:

- It is assumed that the employment in the grain, rail siding, interim potential hazardous uses and circular economy areas would not increase substantially or is included in the estimates for other land uses.
- The employment numbers in Table 2.3 do not include a specific allowance for the land allocated for Manufacturing. DPE has advised that the total employment estimate should be considered the maximum number. For the purposes of this assessment, we have assumed that the manufacturing jobs are included within the Agricultural & Food Processing estimate (as they are adjacent to each other).
- It is assumed that the Transport & Logistics employment forecasts include those associated with the Inland Port and light industrial within the SAP.
- The numbers in Table 2.3 do not include an estimate of the number of jobs potentially created in the identified land external to the SAP (Light Industrial North and South). While the impact of this development is outside the scope of this assessment, we have included a nominal allowance for the purposes of estimating the road network performance for the SAP. Based on the relative proportions of their land areas (3.5 times), it is estimated that the number of jobs in the Light Industrial South area are 245 in 2027, 280 in 2032, 315 in 2042 and 420 in 2062.

2.1.5 Population

The Narrabri Shire region could reach a resident population between 14,500 and 16,900 residents by 2041 as shown in Figure 2.4. Based on these estimates the potential dwelling need for the Narrabri Shire region would be between 7,000 and 8,000 dwellings by 2041. Accordingly, the population estimate scenarios could require between 1,000 and 2,100 additional dwellings over the coming 20 years to 2041, equating to between about 50 to 110 additional dwellings per annum. These estimates identify a significant uptick in housing supply would be required to meet population growth.

Population estimates indicate that the SAP would increase the potential workforce as well as the population of Narrabri as a whole. The peak increase in workers is expected to occur in 2025/2026.



Source: Atlas Economics developed alternate population forecasts for DPE, November 2022

Figure 2.4 Narrabri Shire population projections (2016–2041)

For the purposes of this assessment, we have assumed that the maximum increase of new residents would be contained within the new residential area, and that it would be maintained, even if there is a decline in the population in current residential areas within Narrabri Town.

3 Utilities infrastructure context

3.1 Strategic plans, policy, and planning

Table 3.1 provides an overview of plans, policy, and planning for this report.

Table 3.1 Overview of plans and policy

Name	Description
State Infrastructure Strategy 2018	The NSW State Infrastructure Strategy includes a number of responses that directly align with the goals of the Engineering Package for the Narrabri Special Action Precinct. These include: — improve transport connections to key markets — improve access to international gateways and manage them for future growth — provide connections to and from proposed Inland Rail — facilitate private sector investment in secure, reliable, affordable energy — improve access to digital connectivity — ensure water supply and wastewater treatment to enable growth — support regional hubs to act as effective centres serving their surrounding regional populations.
Community Strategic Plan 2017–2027	The key strategic directions with direct relevance to the Engineering package are as follows: — investigate and implement alternative energy technologies to reduce Council's carbon footprint — implement a waste management strategy focusing on waste avoidance, reusing and recycling to minimise the proportion of waste sent to landfill and to maximise the use of our natural resources — conserve and manage our natural water resources for environmental and agricultural sustainability Minimise inappropriate disposal of waste through the expansion of recycling and collection programs. The objective for 'the impacts of extractive industries on the environment will be minimised' includes the strategy: — groundwater extractions are maintained in an environmentally sustainable manner to ensure long term viability and quality. The objective to 'become a manufacturing and logistics hub for the northern inland region' includes the strategies to: — promote Narrabri Shire as a national and state significant Manufacturing and Logistics Hub — develop at least one flood free manufacturing and intermodal logistics site that has access to quality infrastructure and the proposed inland rail network — explore opportunities for increasing efficiency of freight movements. The objective that 'value adding and industry innovation will drive employment' includes the strategy to: — promote opportunities created through abundant supply of energy and easy access to transport logistics.

Name	Description
NSW Streets Opening Coordination Council	SOCC provides guidance on space allocations for utility services within defined road reserves and sets relevant codes of practice in the interests of service providers, Road Authorities such as Local Councils, RMS, Forestry and Crown lands. For the purposes of this Guide to Codes and Practices, the NSW Streets Opening Coordination Council objectives can be summarised as: — enable coordination of underground utility works, prevent damage to other underground services, and minimise the impact on the local natural and built environment and the community that use the road reserve space — establish pathway allocations and practices for the provision of utility services to maximise public benefit and cost efficiency — minimise traffic and pedestrian interference caused due to road openings for the installation, operation and maintenance of utility services — promote implementation of agreed codes and practices for the excavation, back filling and reinstatement of roadways and pathways — encourage implementation of current and/or innovative technologies and methodologies that can minimise the damage to existing utility assets and road infrastructure — requiring the use of Traffic Management Plans for each road closure in part or full.

Table 3.2 provides an overview of reference material for this report.

Table 3.2 Reference material

Reference material	
	200810 NGP Economics Report_Acil Allen
	AEMC (Australian Energy Market Commission) Gas transmission pipelines map
	Narrabri CBD MasterPlan 2014 (Final Volume 1 and 2)
	Narrabri SAP Strategic Study_March 2021
	NSC Growth Management Strategy
	Waste Management Strategic Programming
	https://www.telstra.com.au/
	Essential Energy's Distribution and Planning annual report (DAPR) (Essential Energy, 2021)
	NSW Government published Local Water Utility (LWU)
	Daryl Stephens (2006), Growing Crops with Reclaimed Wastewater. Published by CSIRO

3.2 Existing conditions

3.2.1 Electricity

Narrabri's power distribution network (22 kV and LV) is owned and operated by Essential Energy that originates from the 66 kV Zone Substation consisting of two 30 MVA transformers, located at the intersection of Stoney Creek Road and Goldman Street (Figure 3.1).

The extent of the electrical networks of the different voltages are described below:

- The 22 kV network that is currently supplying Narrabri town and the extent into the proposed SAP area is shown in Figure 3.2 below. The low voltage network has not been shown for clarity, however is distributed further from the 22 kV network through a series of step down transforms/distribution substations and extends through the township and to regional properties.
- The network is generally an overhead electrical system and is typical of regional townships. Opportunities for undergrounding the electrical system are unlikely in Narrabri because it is not economical and does not offer any significant benefit to the network's capabilities.

Essential Energy's Transmission Network in Narrabri area consists of six 66 kV feeders; 879, 861/1, 882, 878/3, 833 and 834. Refer to Figure 3.3 below for geographical illustration.

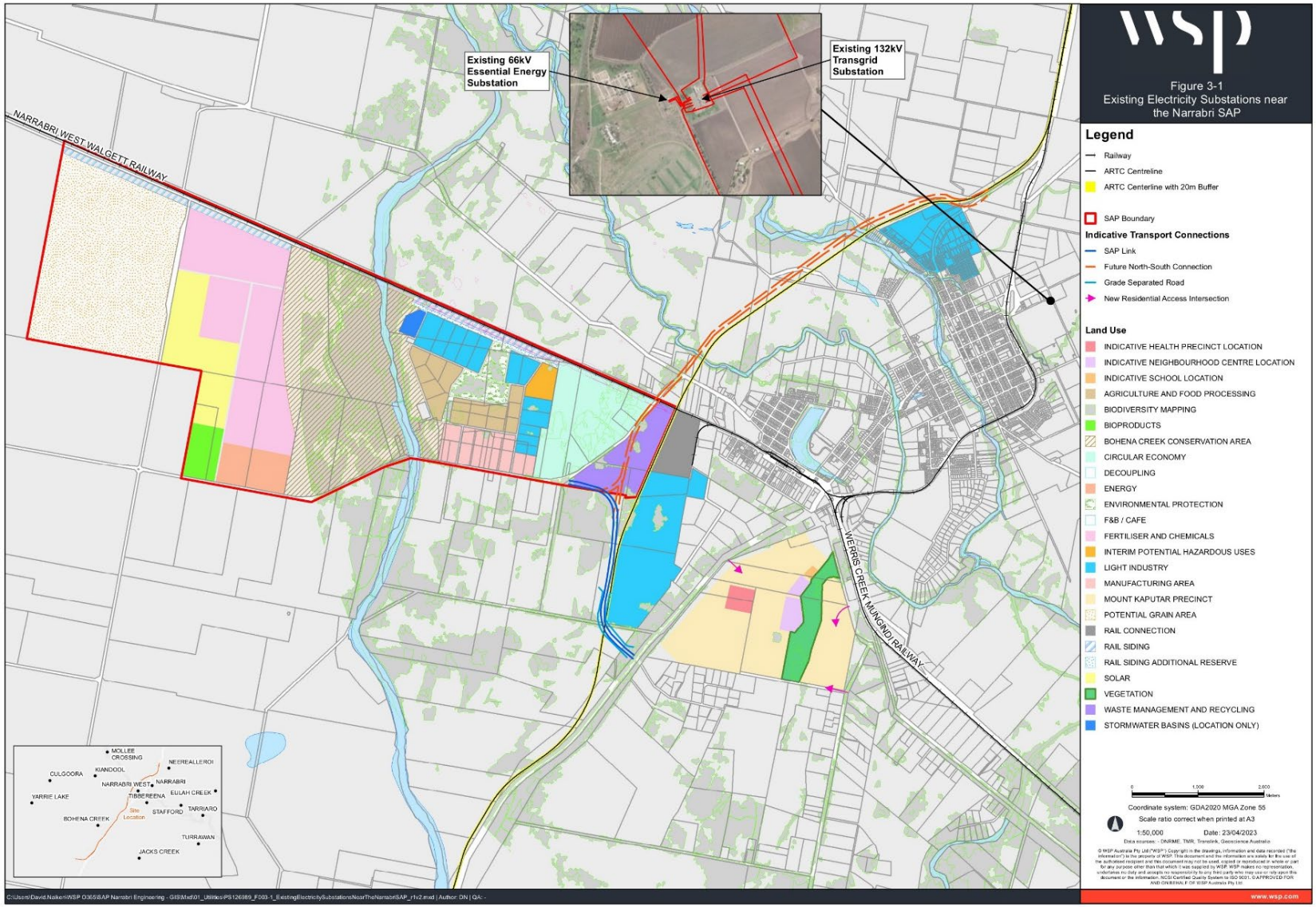


Figure 3.1 Existing electricity substations near the Narrabri SAP

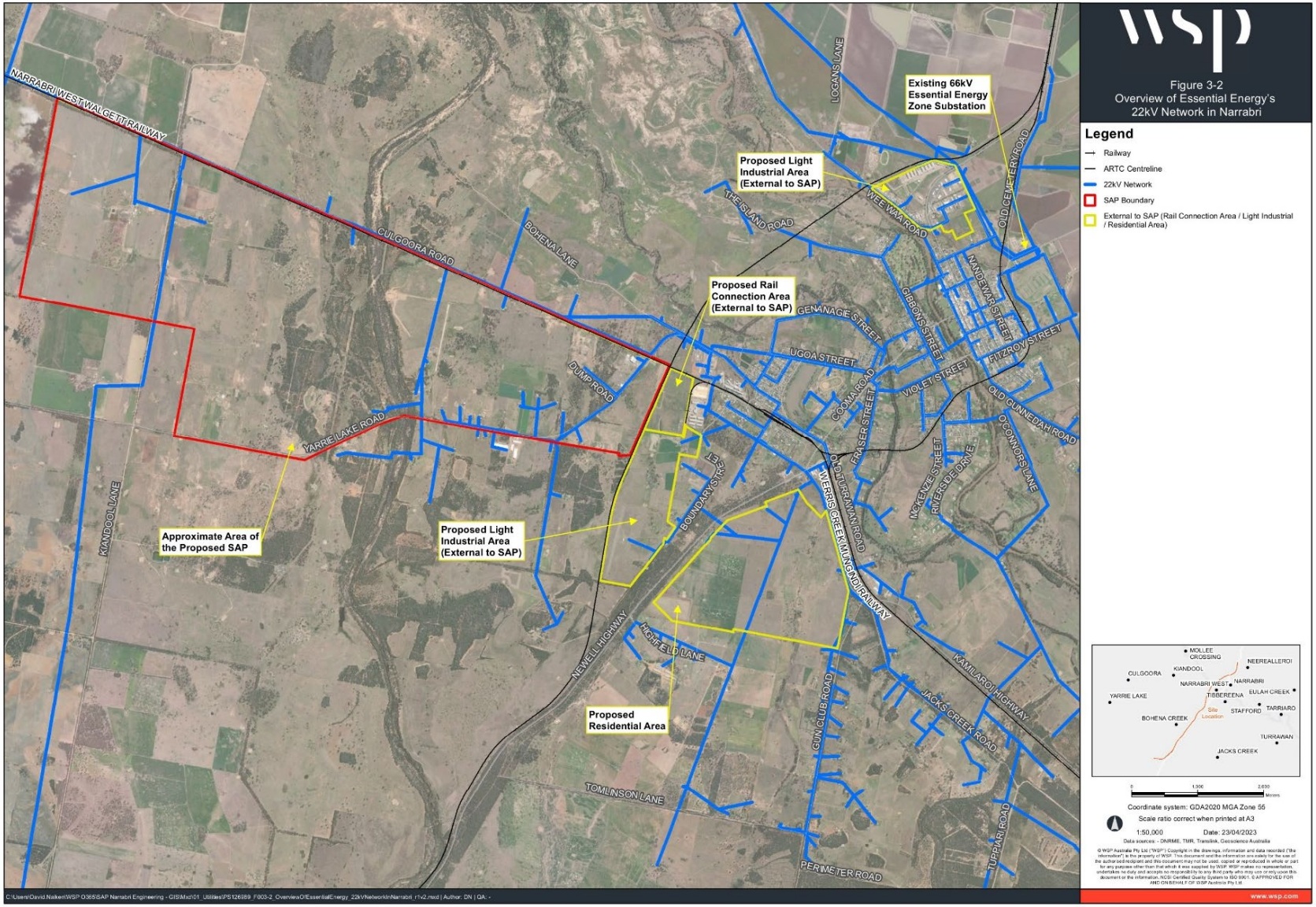


Figure 3.2 Overview of Essential Energy's 22 kV network in Narrabri

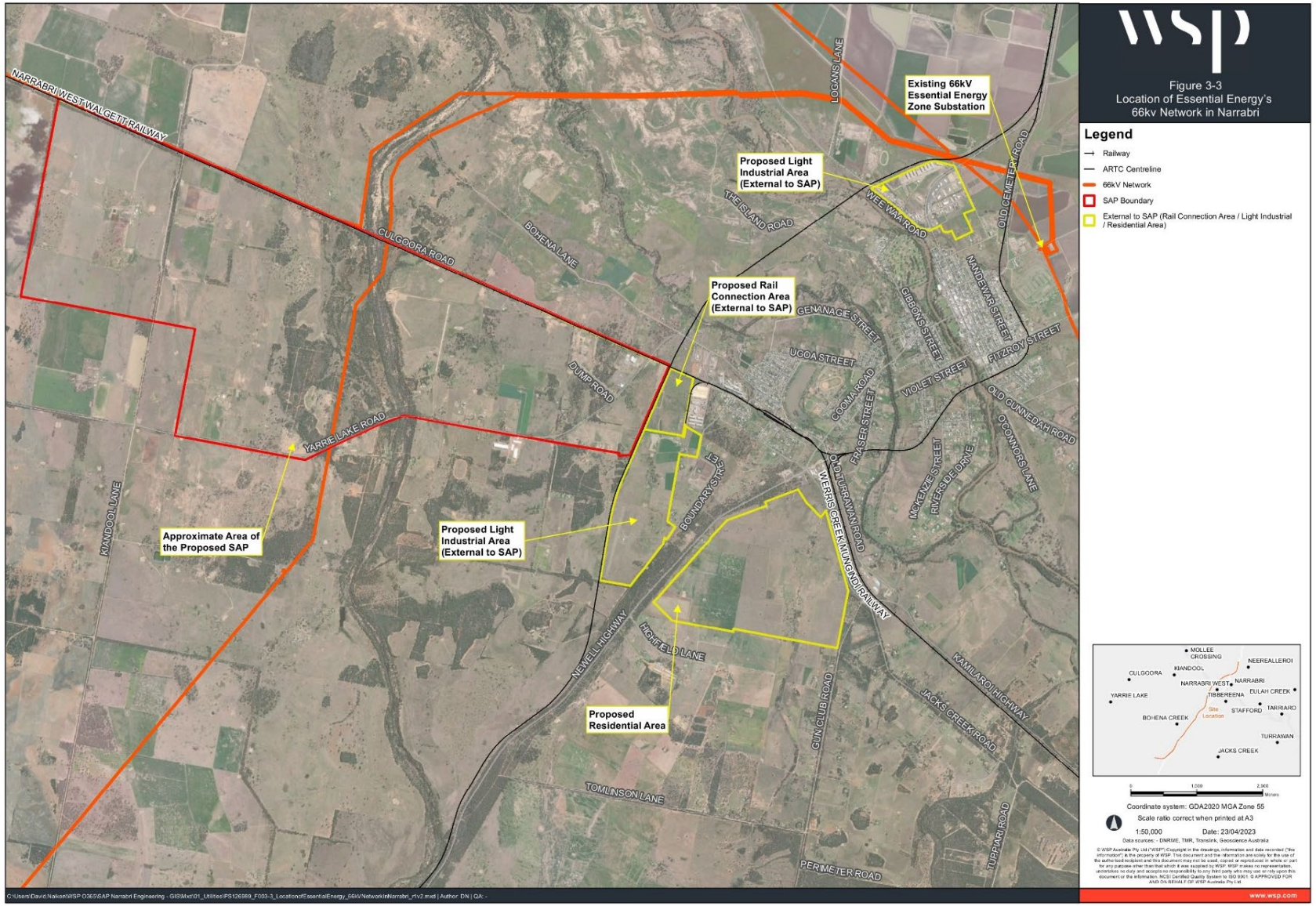


Figure 3.3 Location of Essential Energy's 66 kV network in Narrabri

Essential Energy's current network conditions and capacity have been studied based on the latest Distribution Annual Planning Report and their assessment and findings have been listed in Section 5.

As mentioned above, the existing Zone substation consists of 2 x 30 MVA transformers, each utilised up to 18 MVA, leaving a total spare capacity of approximately 24 MVA (Figure 3.4).

SUMMER	Narrabri Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			21/22	22/23	23/24	24/25	25/26		
Brewarrina	66/22	6.5/8			0	0.98	3.0	3.0	3.0	3.0	3.1	0.91	7
Burren Junction	66/22	5	5		5.5	1.00	2.5	2.5	2.5	2.5	2.5	0.57	2
Lightning Ridge	66/22	8	5		5.5	1.00	3.4	3.4	3.4	3.4	3.4	1.57	7
Merrywinebone	66/22	5			0	0.90	1.7	1.7	1.7	1.7	1.7	0.49	5
Narrabri	66/22/11	18/30	18/30		33	0.99	17.6	17.6	17.6	17.6	17.5	7.28	2
Walgett	66/22	10/16	10		11	0.99	5.2	5.3	5.4	5.6	5.7	2.07	9.5
Wee Waa	66/22	10	10		11	0.97	7.4	7.4	7.3	7.3	7.2	2.34	7

WINTER	Narrabri Supply Area POE50 Indicative Demand Forecast												
Substation	kV	Transformer Rating (MVA)			Firm Normal Cyclic Rating (MVA)	Forecast PF	Forecast (MVA)					Embedded Generation (MW)	95% Peak Load Exceeded (Hrs)
		Tx.1	Tx.2	Tx.3			2022	2023	2024	2025	2026		
Brewarrina	66/22	6.5/8			0	0.94	2.4	2.4	2.4	2.4	2.5	0.91	6
Burren Junction	66/22	5	5		6	0.97	1.7	1.7	1.7	1.7	1.7	0.57	3.5
Lightning Ridge	66/22	8	5		6	1.00	2.9	2.9	2.9	2.9	2.9	1.57	1.5
Merrywinebone	66/22	5			0	1.00	2.5	2.5	2.5	2.5	2.5	0.49	9
Narrabri	66/22/11	18/30	18/30		36	0.99	17.5	17.5	17.5	17.4	17.4	7.28	10.5
Walgett	66/22	10/16	10		12	0.94	4.3	4.4	4.5	4.5	4.6	2.07	6.5
Wee Waa	66/22	10	10		12	0.99	10.0	10.0	9.9	9.9	9.9	2.34	1.5

Figure 3.4 Narrabri's indicative demand forecast in summer from 2020/2021 to 2024/2025 (Essential Energy, Dec 2021 – Asset Management Distribution Annual Planning Report 2021)

Once this spare capacity has been utilised, necessary upgrades to the electricity network according to estimated timelines of each development will need to be forecasted in line with the development stages defined in the Master Plan and communicated to Essential Energy; it must be noted that early engagement is crucial to understand and clarify any contributory costs that the connection customer may incur to establish power supply.

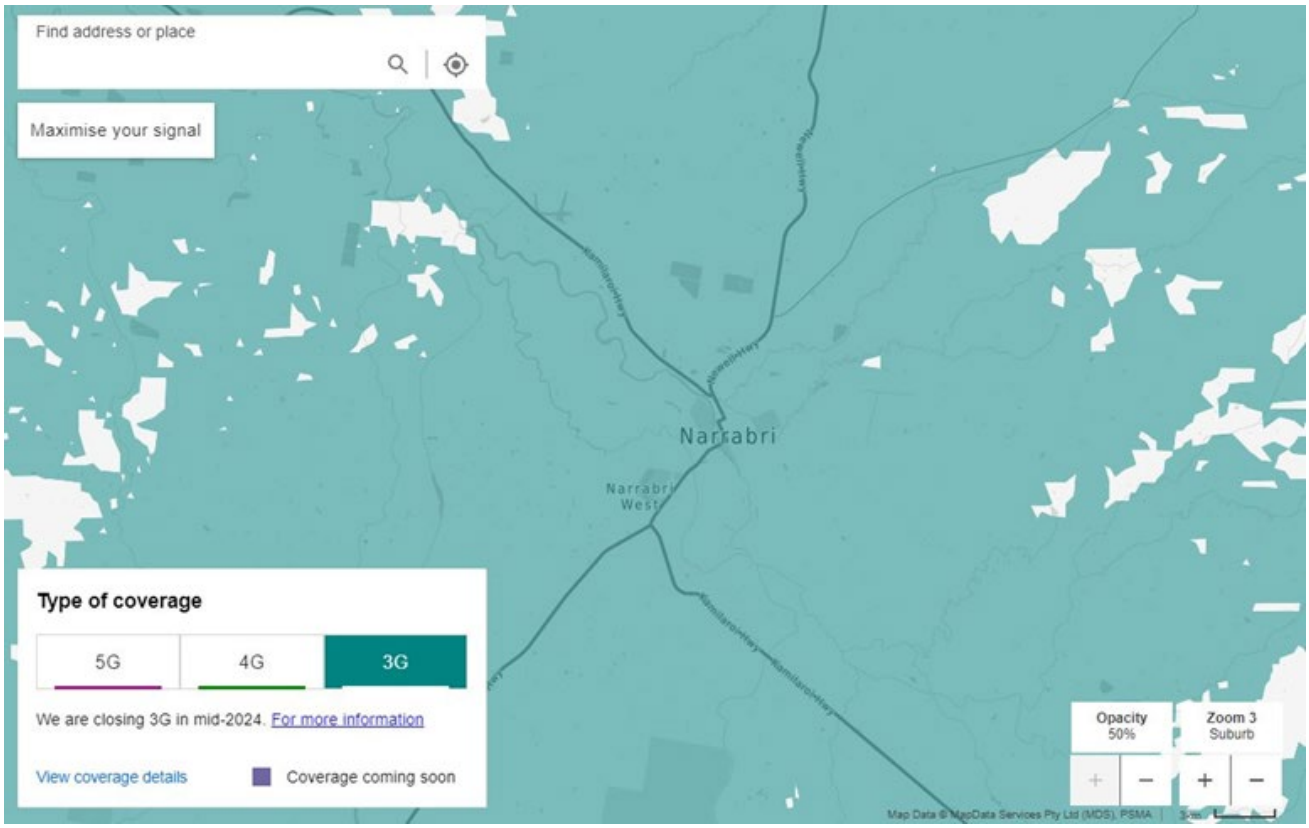
For each development, feasible routes and connection methodology would require further discussions with Essential Energy at detailed development planning stage. It must be noted that Essential Energy holds the right to select the appropriate voltage at which a facility should be supplied, in which case the connection methodology could be changed. It is likely that the Fertiliser & Chemicals facilities may be supplied from Essential's 66 kV transmission network and would require transmission Switching Stations to be established on their premises.

3.2.2 *Telecommunication systems*

The fixed line telecommunications network in Narrabri township is mainly operated by Telstra.

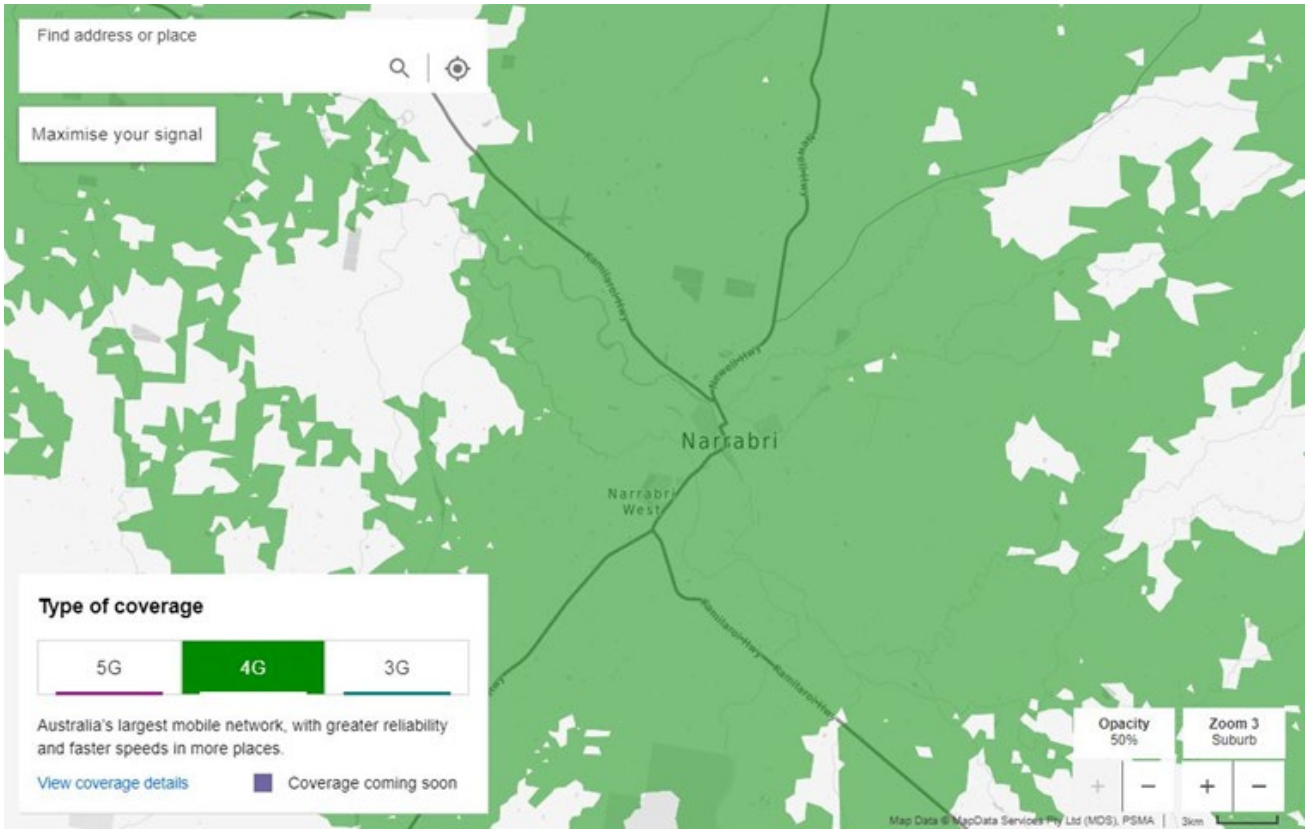
Based on desktop studies, it has been gathered that Telstra's 3G (Figure 3.5) and 4G (Figure 3.6) coverage extends through most of the SAP area. It was announced in October 2019 that Telstra's 3G Network (850 Mhz band) will close around June 2024 with the intention of expanding Telstra's 4G network capabilities.

At the moment, 5G coverage in this area is still non-existent and will require upgrade works for future industries and population growth. It should be noted that Telstra has planned to repurpose some of its 850 Mhz Spectrum for 5G with no material detriment to 3G voice calls for the existing customers. There may be some minor impacts to data speeds for 3G only capable devices in some areas, however the network will be closely monitored to manage capacity as required.



Sourced from https://www.telstrawholesale.com.au/products/mobiles/coverage.html

Figure 3.5 Overview of 3G network around Narrabri



Sourced from https://www.telstrawholesale.com.au/products/mobiles/coverage.html

Figure 3.6 Overview of 4G network around Narrabri

3.2.3 Gas

Currently there is no existing public gas infrastructure network within the Narrabri township or in the SAP area. Consumers in the region procure bottled gas for daily usage from suppliers such as Boral and Elgas.

There are currently three gas distributors in New South Wales; Central Ranges System, Jemena Gas Networks (NSW) and Wagga Wagga Gas Distribution Network none of whose service areas are in vicinity of Narrabri LGA. Santos is currently progressing with two major gas projects; the Narrabri Gas Project (NGP) and the Hunter Gas Project (HGP) which have been discussed in Section 5.4 in terms of their geographical locations and possible sourcing.

Due to the small population in the region, constructing a Jemena gas network in the past was not deemed a necessity. In addition, the periodic wet and dry periods in the region result in large ground movements. These movements increase the maintenance responsibility on the utility networks, adding additional costs to operating the network that had not seemed feasible with the small customer base in Narrabri.

The Narrabri region site is within Gunnedah Basin and holds a high concretion of natural gas. As such, the region is therefore considered as a potential mining area for gas companies to supply gas to the Australian market. Understanding the existing gas transmission network within the region and its connectivity to the Eastern Australian Gas Market is essential in understanding the potential of the planned gas infrastructure in the region.

The closest existing gas transmission pipelines are the Central Ranges Pipeline and Central West Pipeline that run from Tamworth and Dubbo into Moomba to Sydney pipeline. Refer to Figure 3.7.

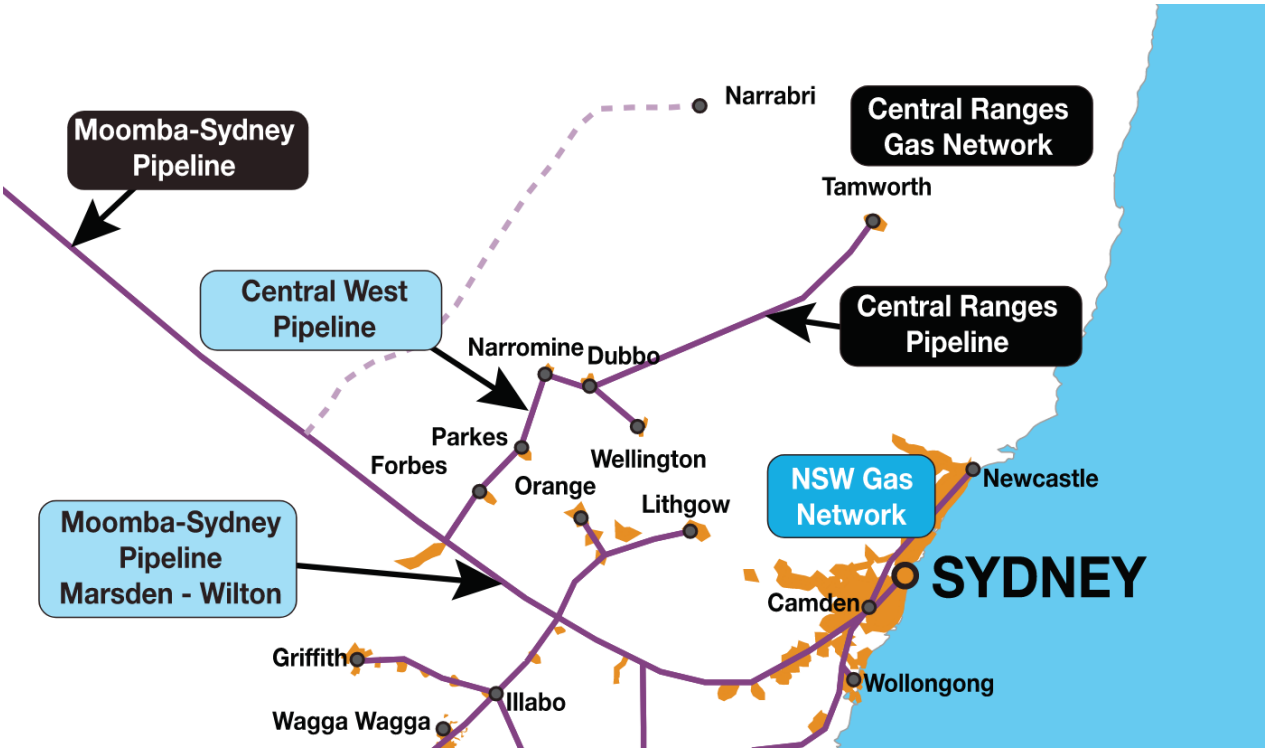


Figure 3.7 Overview of existing gas networks around Narrabri area (Essential Energy, 2020)

3.2.4 Potable water

The Narrabri town water (potable) supply is managed by Narrabri Shire Council, with Narrabri being the largest town within Council's service area. Refer to Figure 3.8 for an overview plan of this system. The extent of the water distribution network includes Narrabri and West Narrabri areas. The SAP study area is generally not serviced by existing water network, with only limited water mains extending into the north-east corner of this area.

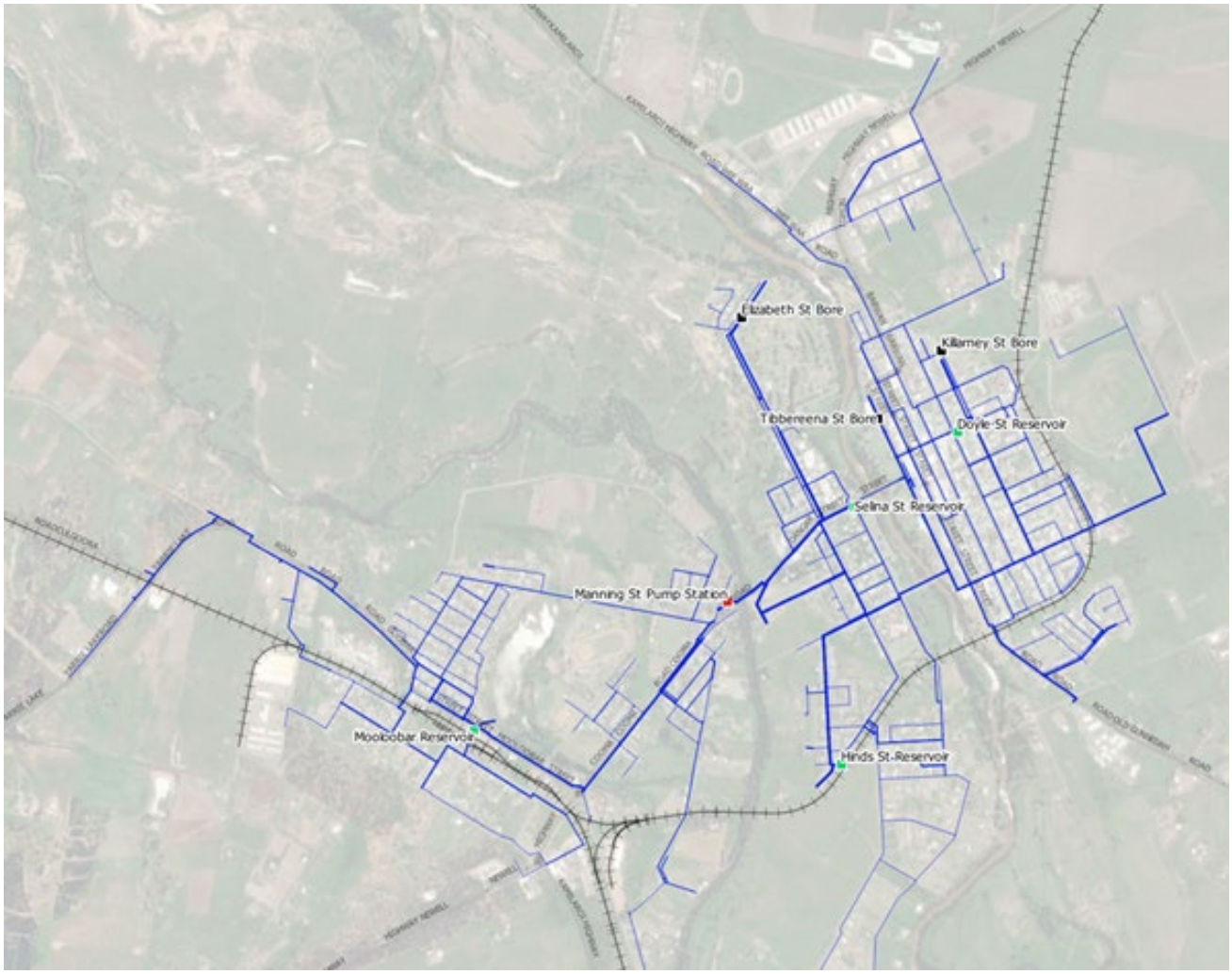


Figure 3.8 Existing water distribution network for Narrabri (WSP, 2023)

The town water supply, where the majority of customers are residential dwellings, is sourced entirely from the Lower Namoi groundwater source via three high yielding town water supply bores installed in the Lower Namoi alluvium, refer to Table 3.3 below.

Table 3.3 Narrabri Shire Council extraction bores

Number	NSC name/location	Nominal casing diameter	Extraction rate
GW030545	WNA-B1 (Killarney Street)	330 mm	75 L/s
GW060129	WNA-B2 (Tibbereena)	350 mm	80 L/s
GW970882	WNA-B2 (Elizabeth Street)	360 mm	60 L/s

There is no centralised water treatment facility in Narrabri and the water source quality and risk profile does not require advanced treatment from a water safety perspective. There are some aesthetic water quality issues from this water source which Council may in future consider additional treatment for, subject to community participation.

Disinfection is currently provided by gas chlorination at each bore site. As the source water contains natural fluoride, Council do not need to fluoridate the water.

Council have recently completed significant water network upgrades including storage reservoirs and bulk water mains, referred to as the Narrabri Water Augmentation Project.

For this assessment, the existing NSC town water supply and entitlement from the Pilliga Sandstone/Southern Recharge groundwater sources have been considered. NSC's local water utility access licence (subcategory – none) and associated water supply work approval currently utilises three groundwater bores for the township of Narrabri and are approved to extract up to 3,500 ML of groundwater from the Lower Namoi groundwater source.

Existing baseline demand is approximately 2,00 ML/yr. Refer to the Hydrogeology and Water Demand Study report for additional details regarding the overall water supply and demand considerations for the SAP.

The existing water reticulation network is supplied from four standpipe type reservoirs, which are between 3–5 ML capacity each, and have equal top water levels. This results in a consistent pressure level across the town, which suits the relatively flat topography. As the existing bores are located in the eastern part of Narrabri a booster pump station, located at Manning St, is used to transfer water into the western part of the network.

Available planning (Hunter H20, May 2015) indicates some existing network capacity limitations in the western part of the network, adjacent the SAP study area.

3.2.5 Wastewater (sewer)

NSC also manages the wastewater system including the Narrabri Sewage Treatment Plant (STP) located in the north-east of the town, as shown in Figure 3.9 below. The majority of the collected and treated sewage is currently used for irrigation for a variety of crops, including cotton, at NSC's Federation Farms scheme to the north of Narrabri.

The SAP study area is currently not serviced by the existing sewerage network, with the exception of a private pumped connection from Williams Dr near the grain handling facilities, in the far north-east of this area.

There are 11 individual gravity sewage catchments and Sewage Pump Stations (SPS) within the network, with two SPS being small lift-type stations.

There is also an existing pressure sewer network in the southern part of Narrabri (in the vicinity of McKenzie St), servicing a local rural residential area. This system uses a small grinder pump station within each lot, which is owned by the customer. These pump into the NSC owned pressure pipe network.

Available planning (Hunter H20, July 2016) indicates the network generally has adequate capacity for existing theoretical loading, with only some minor local issue identified.

Treatment is provided at a single centralized site, the Narrabri STP, located north of Newell Highway at the northern extent of the town. This STP uses a trickling filter process and is currently performing adequately, although has some asset age/condition issues. Most of the treated sewage from Narrabri STP is currently recycled and supplied to an agricultural re-use scheme to the north of the town. The recycled water is pumped approximately 14 km to Council's Federation Farm scheme. There are no other existing recycled water end-users. During high-inflow events, the Narrabri STP is also able to discharge treated effluent to Narrabri Creek under EPA license No. 200. The license has a volume limit of 20 ML/day, but also has pollutant load and concertation limits.

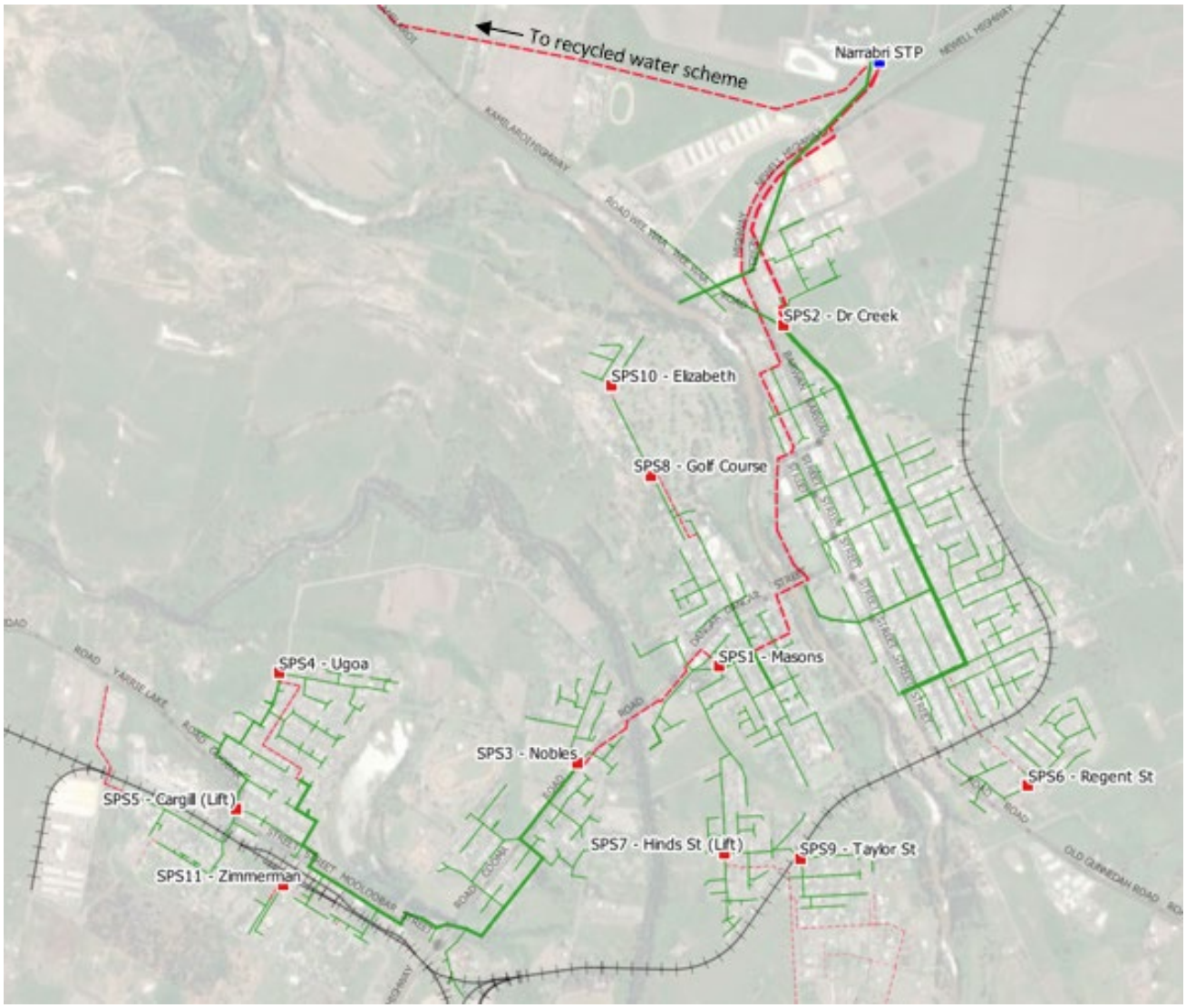


Figure 3.9 Existing sewer network for Narrabri (WSP, 2023)

4 Methodology

It is acknowledged that the developments associated with the Narrabri SAP project will have impacts on existing utilities as well as trigger substantial new infrastructure. The utility requirements have been assessed in accordance with current and future capacities in compliance with relevant authority processes, standards and regulations. WSP has engaged with all utility authorities and contemplated optimal strategies to enable infrastructure growth for the life of the master plan over the next 40 years until 2062. Based on this, the project team held a Final Enquiry by Design workshop and has contemplated the preferred scenario that is discussed in this report. This scenario considers a green loop from the centre of the town to the SAP area; as well as offering the opportunity for expanding a gas network from the proposed Santos Hunter Gas project into the town, reducing the need for use of bottled gas. The final preferred scenario, from a serviceability perspective, is based on three key elements:

- impact on the existing networks
- use of renewable energy and
- distance to the source of the service i.e. bore holes, substations, connection pits or pump stations.

The utilities assessment for the Narrabri SAP was carried out over three steps, with the work in each step developed from the previous phase of planning. A summary of the objectives of each step is described below.

- **Utilities baseline assessment:** This step provided a baseline context and information regarding serviceability constraints and opportunities to the SAP's technical study groups and stakeholders. The baseline assessment involved gathering existing utility information available from sources such as; Before You Dig Australia (formerly known as DBYD), ArcGIS, Distribution Annual Planning Report (from Essential Energy), Telstra website and Santos website.
- **Utilities Scenario Analysis:** This step involved quantitative evaluation for servicing the demands of the three scenarios developed for the Narrabri SAP Master Plan. Each of the scenarios comprised of different scales and types of development. The purpose of this stage was to test each scenario on their service abilities and opportunity constraints.
- **Utilities Final Report (this document):** Following step 2, the final EbD workshop was held with the respective technical study teams and key stakeholders. A final assessment based on the final SAP structure plan has been developed to address the current capacities of all essential services, their future plans of expansions and their alignment with Narrabri's SAP development. The specific details of the assessments, findings and recommendations are described in this report.

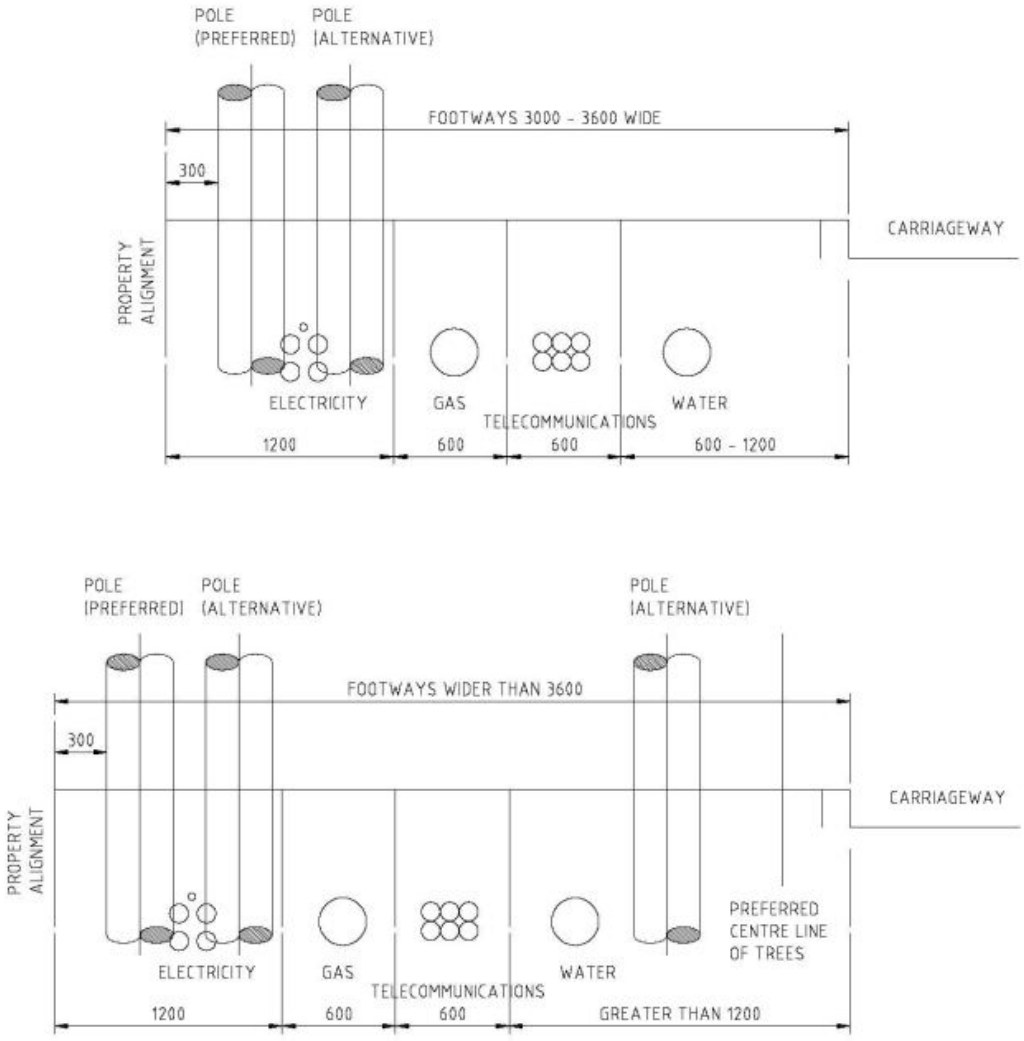
5 Assessment and findings

5.1 Overview

The proposed structure plan focuses on the majority of the industrial developments occurring west of the Narrabri Town centre and a new residential area south of the Narrabri town Centre.

To assess the proposed growth of the SAP, the stages depicted in Section 2.1.2 have been reflected on to understand the required extensions, upgrades and augmentations of all utility services. Growth areas proposed in the Structure Plan have resulted in the requirement to upgrade, expand and/or construct new assets for power, telecommunications, gas and water & wastewater infrastructure to service the areas; this section identifies and elaborates on these key findings. It must be noted that the advised quantities of new infrastructure, in this section, is subject to change based on final route selection, detailed geotechnical analysis and environmental impacts.

All new assets are expected to be installed in accordance with utility/asset owner requirements aligned within defined utility corridors dictated as per the NSW Street Opening Coordination Council. All necessary approvals to attain certified drawings that are approved for construction are to be the responsibility of the installer of the assets. Figure 5.1 below illustrates the general allocation of utility assets in the footway.



Sourced from NSW Street Opening Coordination Council Guide 2018 Rev 5.5

Figure 5.1 General utility allocations in footways

5.2 Electricity

The electrical demand estimation for Narrabri SAP is determined from the proposed land use budget developed by Hatch Roberts Day and the percentage net built area is derived from historical data of similar industries. Essential Energy's guidelines are then used to estimate the electrical demand rates for the proposed land use budget. However, several areas are excluded from the demand estimates, such as the Light Industrial areas in the North and South, the Rail Connection North West of the residential area, the solar power area, the Grain (Potential) area, the Interim Potential Hazardous use, and the Circular economy. These exclusions are due to their external location to the SAP area, farming land status, undefined consumer category, or minimal power demand requirements. Refer to Table 5.1 below for the areas considered in the power demand estimates.

The following points must be noted with regards to the assessment of the electrical network and the implications for future staging of SAP development:

- The proposed upgrades, in this section, are expected to be delivered in incremental stages driven by economic growth, load forecasting, alignment with Essential Energy's future upgrade plans.
- Essential Energy's network is a mesh network (interconnected) and further assessment of the loads at detail/delivery phase may reduce the number of feeders for each precinct. This will be defined in later design stages as Essential Energy will review the network for load sharing amongst feeders to optimise a more efficient and cost-effective network.
- Network capacity is not reserved unless a Connection of load application is formally submitted to Essential Energy. The determined works in this report are subject to confirmation by Essential Energy and that there may be a requirement for contributory investment from the customer to facilitate these works.

Table 5.1 Summary of average power demand estimates by land use type

Description	Proposed land use (ha)	Percentage of net built area (%)	Assumed net built area (m^2)	VA/sqm	Average demand estimates (MVA)
Agricultural and Food Processing	90.88	50	454,400	50	22.7
Bioproducts	40.79	50	203,950	50	10.2
Transport and Logistics	108.2	50	541,000	20	10.8
Inland Port	36.07	30	108,210	30	3.2
Fertiliser and Chemicals	366.62	50	1,833,100	50	91.7
Waste Management and Recycling	94.32	50	471,600	50	23.6
STP	70.35	50	351,750	50	17.6
Manufacturing	72.59	65	471,835	50	23.6
Residential (including school and Health precincts)	597.15	65	3,881,475	20	77.6
Total Estimated Power Demand for the SAP					**281.0**

5.2.1 Serviceability from existing Narrabri Zone Substation

The development of the Inland Port and the initial 600 dwellings in the Mount Kaputar precinct is expected as part of stage 1 according to the structure plan of the project. The Inland Port requires around 3.2 MVA and the 600 dwellings require around 4 MVA of load. It is possible that both sites could be supplied with power from the existing network by load shifting and making capacity available on the existing 22 kV feeders close to the sites. However, this is dependent on the existing capacity on these specific feeders and may require upgrade of sections of the feeders including overhead conductors and underground cabling. The development of the Inland Port and the initial 600 dwellings in the Mount Kaputar precinct would also require an upgrade of the existing STP due to additional sewerage generation. This upgrade is not substantial and is expected to be catered for from the existing 22 kV feeders in the vicinity of the STP. Nevertheless, this upgrade also depends on the existing capacity on this specific feeder and may require an upgrade of existing overhead conductors and replacement of a few poles.

Below is an overview of works required to establish power supply for stage 1 of the SAP (Figure 5.2):

- install potentially, 2 new 1.5 MVA padmount substations and 1 new 500 kVA padmount substation for the Inland Port
- upgrade necessary sections of the existing 22 kV feeder in front of the Inland Port site to cater for the new load
- install potentially, 2 new 1.5 MVA padmount substations and 1 new 1 MVA padmount substation for the initial 600 lots
- upgrade necessary sections of the existing 22 kV feeder within Mount Kaputar precinct to cater for the new load.

The determination of necessary interconnections for supply redundancy to the Inland Port and initial residential dwellings will depend on a better understanding of the establishments and will be decided during the detailed design process.

Upon completion of stage 1 servicing, the Narrabri Zone Substation will have approximately 16 MVA of available spare capacity.

- To provide power to the Transport and Logistics precinct, which requires around 10.8 MVA, a new dedicated 22 kV feeder can be established from the Narrabri Zone Substation. This feeder will connect to the existing 22 kV network to ensure supply redundancy. Since the Transport and Logistics precinct is expected to have multiple tenants occupying multiple lots, several padmount substations and associated low voltage networks will be required to supply the precinct. The type of connections for each tenant, such as low voltage or high voltage, will be determined after applications are submitted.
- After the Transport and Logistics precinct is developed as planned, the Narrabri Zone Substation will require an upgrade with a new 30 MVA transformer and associated HV switchgears to supply power to the Agricultural & Food Processing precinct and the Bioproducts precinct, requiring around 22.7 MVA and 10.2 MVA respectively. It is assumed that these precincts will also have multiple tenants, and as such, a distribution network will be established within the precincts, consisting of:
  - two to three 22 kV feeders for the Agricultural and Food Processing precinct, along with the appropriate number of substations and/or switching stations
  - one dedicated 22 kV feeder for the Bioproducts precinct, along with the appropriate number of substations and/or switching stations.

Refer to Figure 5.3 below, for the supply strategy for the Transport & Logistics precinct and the Agricultural & Food processing precinct.

Figure 5.2 Power supply strategy for Stage 1

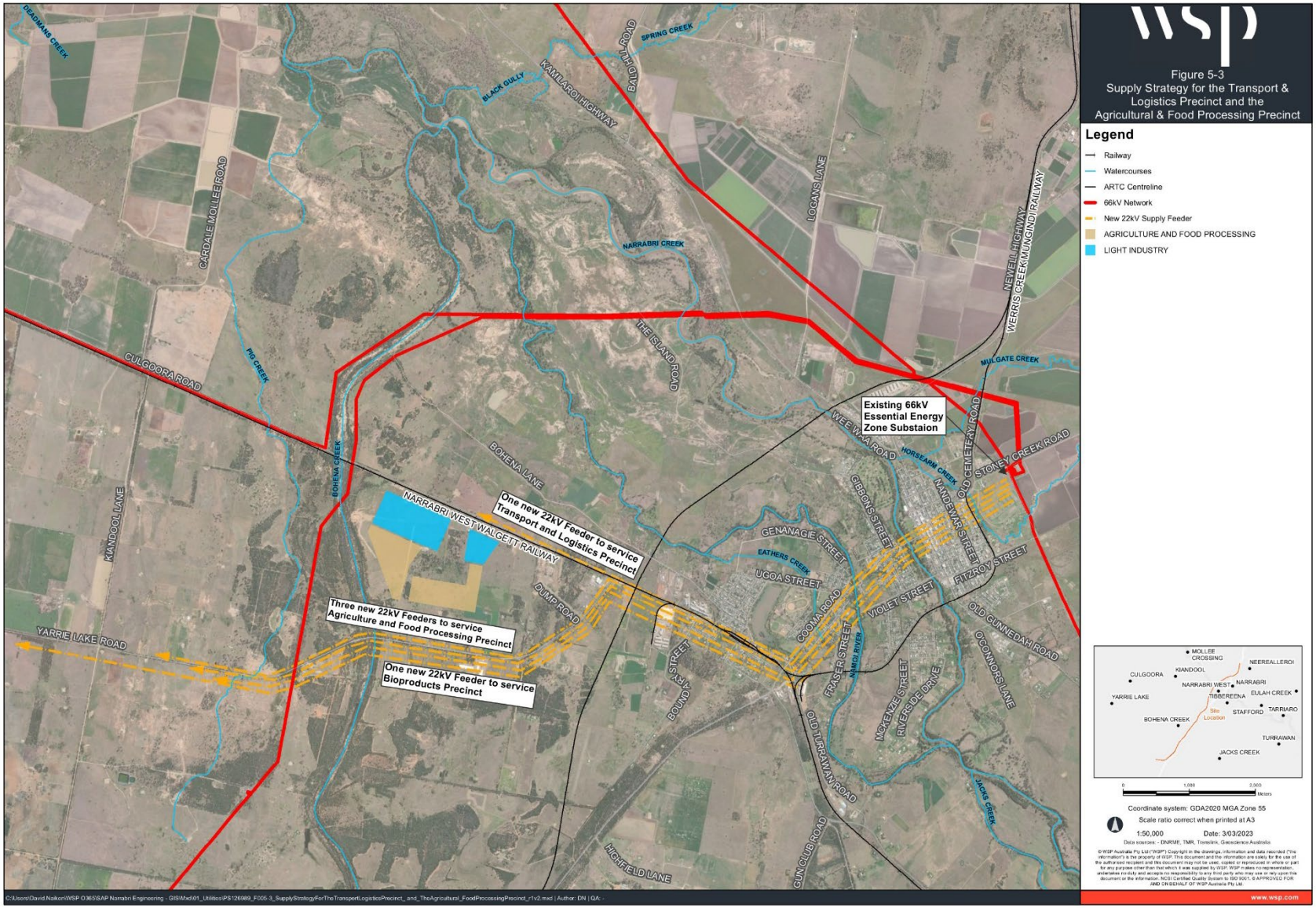


Figure 5.3 Supply strategy for the Transport & Logistics precinct and the Agricultural & Food processing precinct

5.2.2 *Future electrical infrastructure*

To meet the substantial power demands of the proposed land uses of the Fertilizer and Chemicals precinct, Waste Management and Recycling precinct, Manufacturing precinct, a new Sewer treatment plant, and the remaining developments in the Mount Kaputar precinct, it has been determined that three new zone substations will be required. These new zone substations are expected to be supplied at 66 kV from the nearest 66 kV feeder as shown in Figure 5.4. However, it is important to note that Essential Energy will need to assess the feeder capacity, voltage regulation, load growth, fault levels, distance, interference, and redundancy. The capacity of the feeder, voltage regulation, and fault levels need to be checked, future load growth needs to be estimated, distance and interference need to be evaluated, and backup power sources need to be assessed.

The Fertilizer and Chemicals precinct will require a 90 MVA zone substation consisting of 3 x 30 MVA transformers. This substation will be responsible for supplying power to at least ten 22 kV feeders that will be distributed through the precinct, providing power to several distribution substations located near each load centre.

The Waste Management and Recycling precinct will require a 60 MVA zone substation consisting of 2 x 30 MVA transformers. This substation will be responsible for supplying power to at least six to seven 22 kV feeders that will be distributed through the precinct, providing power to several distribution substations located near each load centre.

The remainder of the Mount Kaputar mixed residential precinct, consisting of 1500 residents, school and health precincts would require an 80 MVA zone substation consisting of 2 x 30 MVA plus 1 x 20 MVA transformers. This substation will be responsible for supplying power to at least eight to nine 22 kV feeders that will be distributed through the precinct, providing power to several distribution substations located near each load centre.

Suggested locations of these zone substations have been shown in Figure 5.4 below, however is dependant on a number of crucial factors:

1. Electrical Load Requirements: The zone substation should be located near the electrical loads it will serve to minimize transmission losses and ensure reliable and efficient electricity supply.
2. Proximity to Power Lines: The zone substation should be located close to existing high-voltage power lines to minimize the length of transmission lines required.
3. Accessibility: The site should be easily accessible for construction equipment, materials, and personnel.
4. Environmental Considerations: The site should be environmentally suitable, taking into account factors such as proximity to environmentally sensitive areas, noise, air pollution, and potential impacts on wildlife.
5. Land Availability: There should be sufficient land available to accommodate the substation, any necessary transmission lines, and any future expansions or upgrades.
6. Security: The site should be secure and protected against vandalism, theft, and other unauthorized access.
7. Safety: The site should be safe for both workers and the general public, with adequate safety measures in place.
8. Local Planning Regulations: The substation should comply with all relevant local planning regulations, including zoning laws, building codes, and environmental standards.
9. Community Engagement: Consultation with the local community is important to ensure that the proposed substation location is acceptable and that any concerns are addressed.

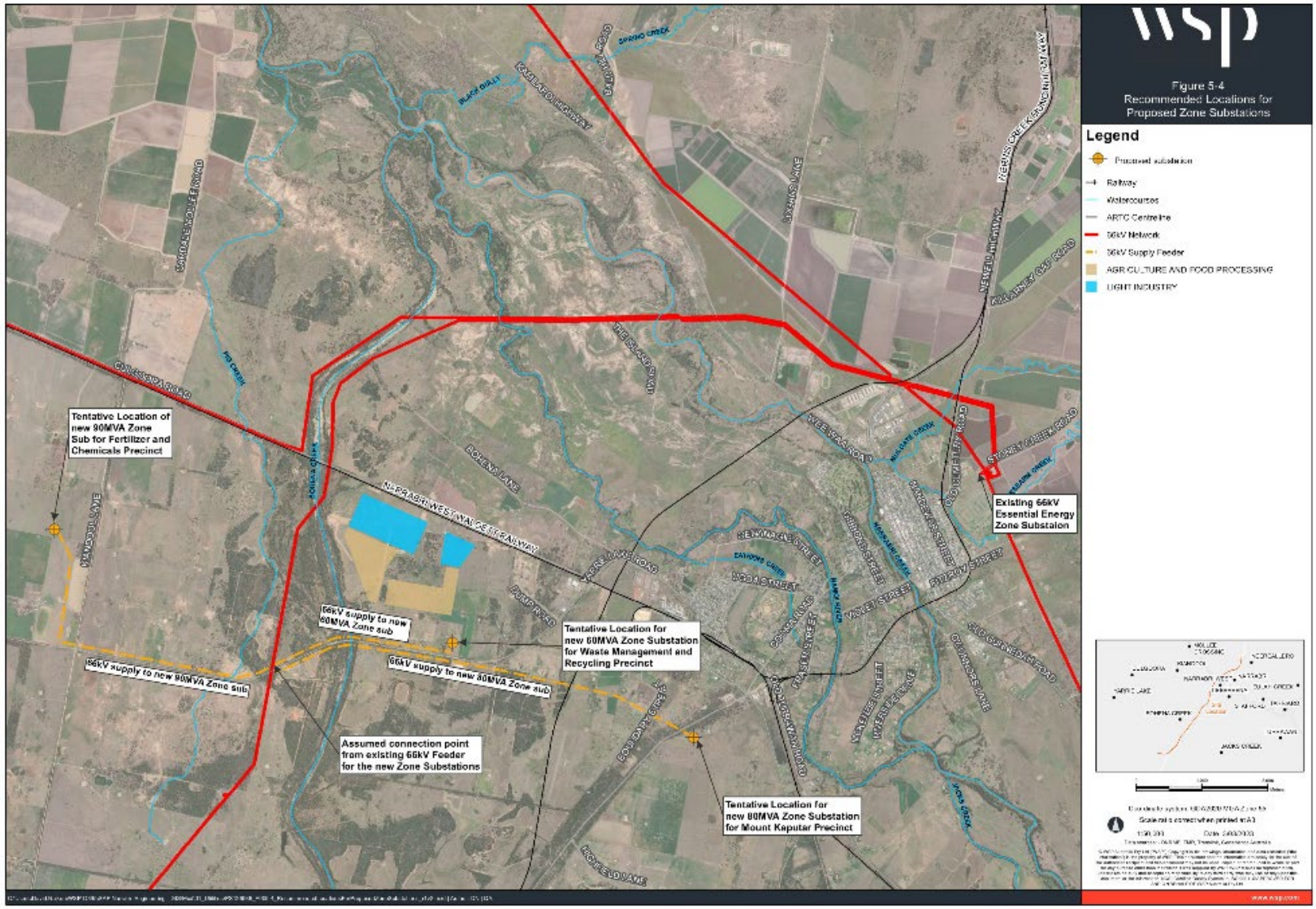


Figure 5.4 Recommended locations for proposed Zone Substations

5.3 Communication systems

The existing satellite telecommunications network in Narrabri is mainly serviced by Telstra providing 3G and 4G coverage. It is understood that in the initial stages of the SAP, 4G coverage would be satisfactory to establish and operate new industries and/or housing. To enable connectivity for the new establishments, service provider/s would require assessing the following main aspects:

- assess required subscriber access point capacities and capabilities for the potential new users. And to achieve this, the operator would ideally carry out:
  - potential upgrades of existing Base Transceiver Stations
  - establishment of new Base Transceiver Stations
- increase the network's backhaul capacity to be able to support the new users via expansion of pits and pipes systems.

Our investigation has shown that there are plans for improving the telecommunications network by installing a new backbone Base Transceiver Station on Williams Drive north East of the SAP area and will be capable of providing 5G connectivity. As mentioned earlier, it was announced in October 2019 that Telstra's 3G Network (850 Mhz band) will exit around June 2024 with the intention of expanding Telstra's 4G network capabilities as well as repurposing some of its 850 Mhz Spectrum for 5G.The existing fixed Telecommunication system in Narrabri is serviced by Telstra and AARNet. To service the Inland Port and the initial lot of 600 residential dwellings; it has been assessed that extension of new pits and pipes system and other associated communication infrastructure of approximately 10 km to 12 km will be required. However, it is understood that Stage 1 could possibly be supported wirelessly depending on bandwidth requirements and the network's available spare backbone capacity and the operator's future network expansion plans.

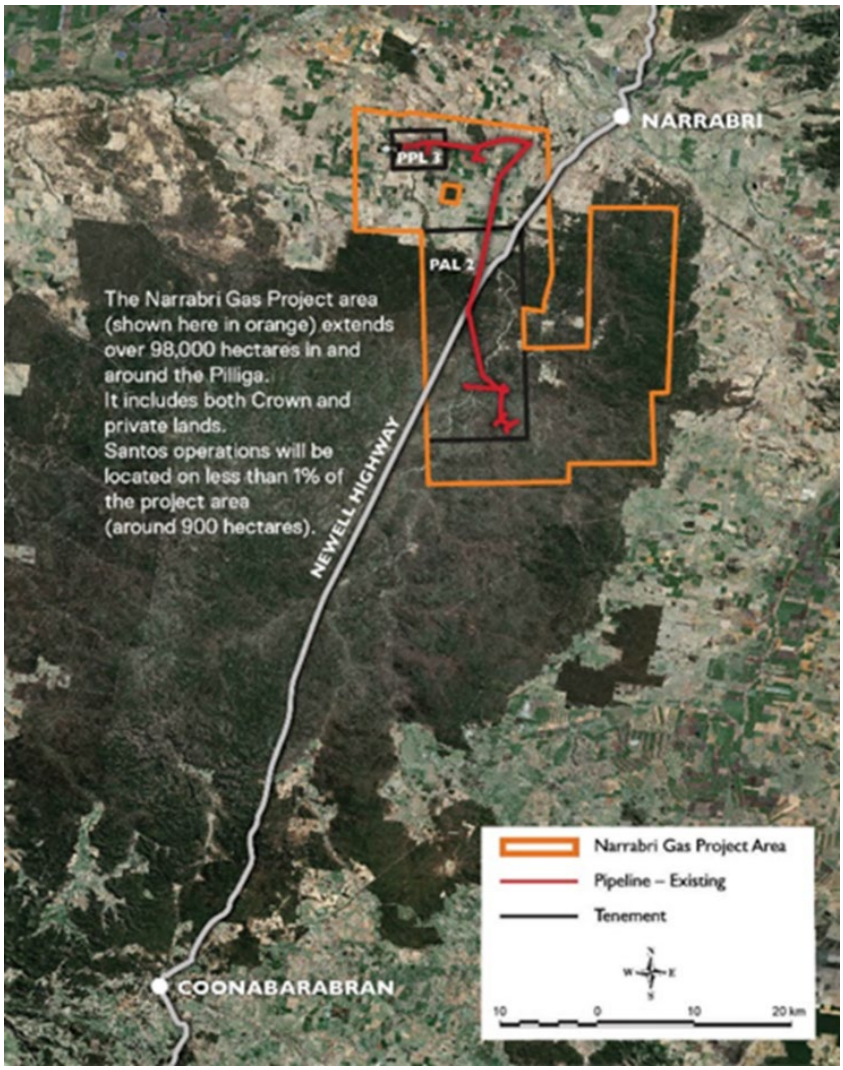
5.4 Gas

5.4.1 Narrabri Gas Project (NGP)

The Narrabri Gas Project (NGP) is a proposal by Santos with the potential to supply NSW homes, small businesses, major industries and potential electricity generators with up to half of the state's natural gas needs. During the second Enquiry by Design workshop the possibility of NGP to cater for Narrabri's local gas requirements was discussed, however no conclusion was reached.

The NGP proposes to establish a gas extraction plant south of Culgoora Road and may consider to accommodate Narrabri's local gas demands. Based on this assumption, a new gas distribution network system will be required to be established for the entirety of SAP area. Considering the proposed locations of the various types of establishments, it is deemed that around 18 km to 20 km of new underground gas reticulation network would be required to service the entire SAP, the new STP and the proposed residential precinct.

These assumptions are to be further discussed and confirmed in following stages of this SAP's progress; Figure 5.5 below indicates the location of the NGP.



Sourced from https://narrabrigasproject.com.au/about/narrabri-gas-project/ngp-map-area/

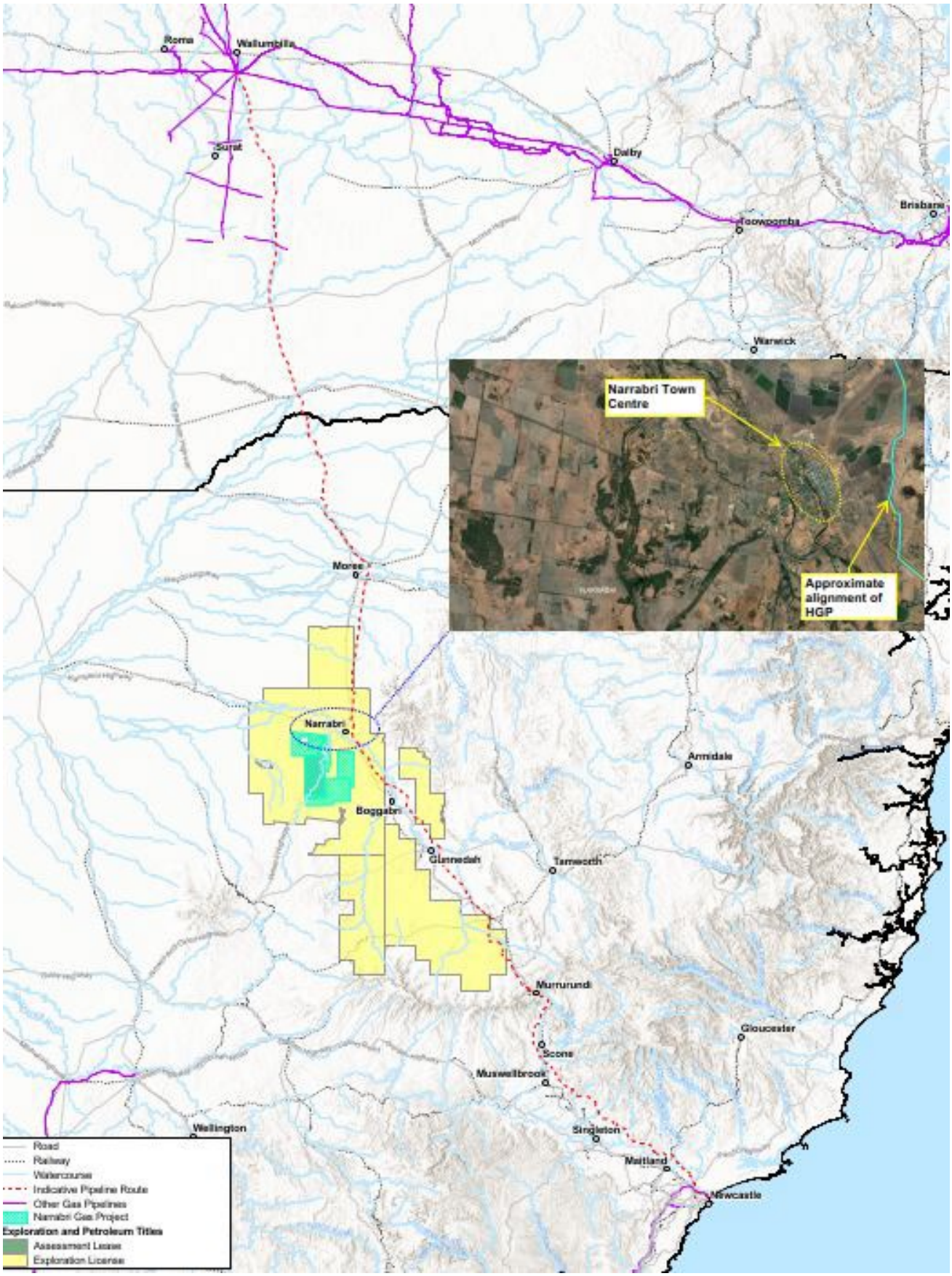
Figure 5.5 Indicative area/location of the Narrabri Gas Project

5.4.2 Hunter Gas Pipeline (HGP)

The Hunter Gas Pipeline project (recently acquired by Santos) has proposed to build and operate a high pressure, steel gas pipeline to transport gas from the Wallumbilla Gas Hub near Roma in Queensland to Newcastle in NSW via Moree, Narrabri, Gunnedah, Quirindi, Scone, Muswellbrook, Singleton and Maitland. The project is expected to bring a more direct connectivity to the Newcastle region and port via the Gunnedah basin and is planned to connect to the Santos Narrabri Gas Project sources. The entire pipeline is approximately 833-kilometre in length occupying a nominal easement width of 30 m and has already attained planning approvals from the NSW and Queensland governments. The pipeline design has also taken into consideration to transport hydrogen as user demand grows during the energy transition.

The HGP's proposed route tentatively runs along the eastern side of Narrabri's town centre and the project is also planned to include offtake points at various regional towns along the route and may offer an opportunity for NSC to acquire gas for the SAP. Considering the possibility of sourcing gas from the HGP, it is estimated that approximately 35 km to 40 km of new underground gas reticulation network would be required to service the entire SAP, the new STP and the proposed residential precinct. It must be noted that servicing of the existing residents and town centre of Narrabri has not been considered in this assessment.

Figure 5.6 below indicates the location of the HGP.



Sourced from https://huntergaspipeline.com.au/wp-content/uploads/12539250_Santos_001_PetroleumTitles_A0.pdf

Figure 5.6 Indicative area/location of the Hunter Gas Pipeline

5.5 Potable water and wastewater

5.5.1 Potable water

Based on the land-use areas defined in the structure plan, Stage 1 of the SAP development is expected to have a water demand of between 80–160 ML/yr. Outside of the SAP, the expected 600 lots of residential development is expected to have an additional demand of between 180–240 ML/yr. Stages 2 and 3 of the SAP will result in significantly higher demands. Refer to the Hydrogeology and Water Demand Study Report Section 5.4 for a detailed breakdown of the estimated demands.

Ultimate demand for the SAP is estimated to be between approximately 1,400–2,800 ML/yr, plus further approximately 700–1,000 ML/yr for the identified land uses outside of the SAP. It is noted there are significant assumptions and uncertainties with these demand estimates, and they are considered likely to be conservative (high). The Hydrogeology and Water Demand Study recommends a 'water demand trigger, action and response plan' is implemented to monitor actual demand and triggers for new infrastructure as development in the SAP occurs.

It is expected that the Stage 1 demands can be serviced from the existing NSC supply sources (bores) and water entitlement. However, extension of the network would be required and capacity constraints/infrastructure sizing reviewed during design and approval of specific developments. For the residential area outside of the SAP, which includes higher elevation land, it is unlikely that the existing network will be able to service development higher than the 215 m AHD contour. Hence a local booster pump station for this area should be considered during concept design.

Stage 2 will result in significant additional demands and will require new bores to be installed. Although the existing town water supply bores have existing approvals which would allow for increased extraction (up to the full annual volume entitlement), NSC have recently undertaken groundwater modelling to support the development of an Integrated Water Cycle Management (IWCM) strategy. These investigations indicate that additional bores are likely to be required to manage operational performance of the aquifer for any increases in total extraction.

Hydrogeology investigations are required to determine the most feasible location(s) and number of new bores in the vicinity of the SAP. New treatment, storage and pumping infrastructure is required either at each bore site or a centralized facility. Subject to actual development demands, at least one new bore from the Pilliga Sandstone/Southern Recharge aquifer (separate from the Lower Namoi Alluvium, which is the current town water source) would be required during either Stage 2 or Stage 3, which could require an additional separate treatment process.

Both Stages 2 and 3 include land above 215 m AHD elevation, which is unable to be serviced via the existing network. It is logical that the new network infrastructure, which will be required to support the new bores, is configured to allow servicing of the entire elevation range within the SAP. This will require a separate higher pressure zone compared to the existing town network. This pressure zone should extend outside of the SAP to also service the identified residential and light industry land use areas.

Based on the above assessments, the following key findings have been summarised (refer to Appendix A) for a conceptual sketch of the proposed servicing strategy):

- Stage 1 of the SAP to be serviced via extension of the existing network, noting that capacity issues will need to be reviewed and managed for specific development proposals. For Stage 1, it has been assessed that an extension of around 3 km of new water assets will be required, from the nearest connection point, to reach the frontage of the Inland Port site.
- Stage 1 development outside of the SAP (i.e. Mount Kaputar residential precinct) will require an extension of new water assets of around 2 km to 4 km from the nearest connection points plus a small booster pump station, if development above 215 m AHD elevation occurs.

- For Stages 2 and 3, additional water supply sources will be required over time as the SAP develops. It is important to note that the type, location and combination of new supply sources (i.e. new groundwater supply, potable vs. non-potable, alternative/recycled water) will need to be matched to appropriate demands/end-use types and this mix of sources will ultimately determine the configuration and extent of the reticulation assets.
- To service the ultimate SAP development, it is assumed that (at least) two new bores would need to be developed and either one or two new storage reservoir(s) in the order of 3–5 ML total capacity[1]. Depending on the location of the new bores, it may be more economical to have either a single reservoir and treatment facility or multiple facilities (i.e. at each bore site). If the identified development areas outside of the SAP are also to be serviced from these reservoirs, which is logical given the site elevation, the total reservoir capacity required is expected to be in the order of 4–7 ML.
- The topography of the SAP is such that there is no suitably elevated land in close proximity to enable gravity supply from a new storage reservoir. Hence, a ground level reservoir plus booster pump station arrangement has been assumed. In detailed planning and design, the feasibility of alternative arrangements can be explored (i.e. elevated or standpipe-type reservoirs or gravity supply from a reservoir located further to the south of the identified residential area).
- For servicing of Stages 2 and 3, approximately 15 km of trunk/connecting water mains are expected to be required. This is subject to further structure planning including stakeholder/community consultation, environmental assessments, final location and configuration of new bores, treatment equipment (chlorination), storage reservoirs and pump stations.

5.5.2 Wastewater

Based on the land-use areas defined in the structure plan, the expected wastewater generation from Stage 1 of the SAP is expected to be between approximately 2–4 L/s Average Dry Weather Flow (ADWF). Outside of the SAP, the expected 600 lots of residential development is expected to contribute an additional 4–6 L/s ADWF.

Stages 2 and 3 of the SAP will result in significantly higher wastewater generation in the order of 13–18 L/s ADWF ultimately, plus an additional 15–20 L/s ADWF for the identified land-use areas outside of the SAP. Refer to the Hydrogeology and Water Demand Study Report Section 5.3 for details of the assumed wastewater generation rates.

The sewage generated by Stage 1 will need to be managed by interim connection to the existing network. It is expected that some limited upgrades to existing network assets (i.e. potentially SPS03 gravity sewer, pumps and rising main) and/or the Narrabri STP will be required to support this. A new SPS located adjacent the Inland Port site will be required at Stage 1, assuming multiple properties are required to be serviced. The SPS would require an interim connection (via new rising main) to the existing network at Railway St North, with the initial pumps sized to discharge only a limited flowrate, to avoid capacity issues.

Outside of the SAP, the initial stage of the residential precinct will also require a new SPS in Stage 1, with rising main discharging to the existing network in Peele St. Subject to the existing receiving sewer capacity, additional upgrades to the existing network could be required, hence the initial pumping rate should be limited.

As development continues, a new STP will ultimately be required to service the SAP. The alternative strategy to significantly upgrade/replace the existing Narrabri STP and convey sewage from the SAP to this site (and return recycled water to the SAP) was identified as undesirable by the study team in the EbD process.

[1] Capacity based on 8 hours of estimated peak day demand. This has adopted consistent criteria to previous NSC network planning (Hunter H20, 2015) but has adopted 8 hours as the minimum of the 8-24 hour range, due to the likely conservatism of the SAP demand estimate.

The location of the new STP will require substantial feasibility and site selection investigations. This should explore the overall operational and financial requirements for wastewater collection, treatment and re-use in Narrabri. The key principles for selecting a new STP site are expected to be (but not necessarily limited to):

- proximity to the SAP. Ideally located to the northern side of the SAP as the site slopes to the north, promoting an efficient internal gravity
- proximity to the existing Narrabri STP site (if decommissioning of the existing STP or receiving treated effluent from the existing STP is proposed). Whilst still a considerable distance, the north-eastern side of the SAP is much closer to the existing Narrabri STP
- proximity to a suitable emergency discharge location (such as a waterway, subject to environmental investigations)
- planning zoning and buffer from sensitive odour receptors / land-uses (particularly residential)
- flood resilience
- heritage considerations
- environmental considerations including any regulatory approval conditions
- community engagement and input.

Figure 5.7 shows two identified possible STP locations based on the above considerations and input from NSC. However site selection investigations are required, addressing the above considerations, to identify actual feasible sites. Following this, engagement with regulators and stakeholders, plus financial analysis will be required to identify a preferred site.

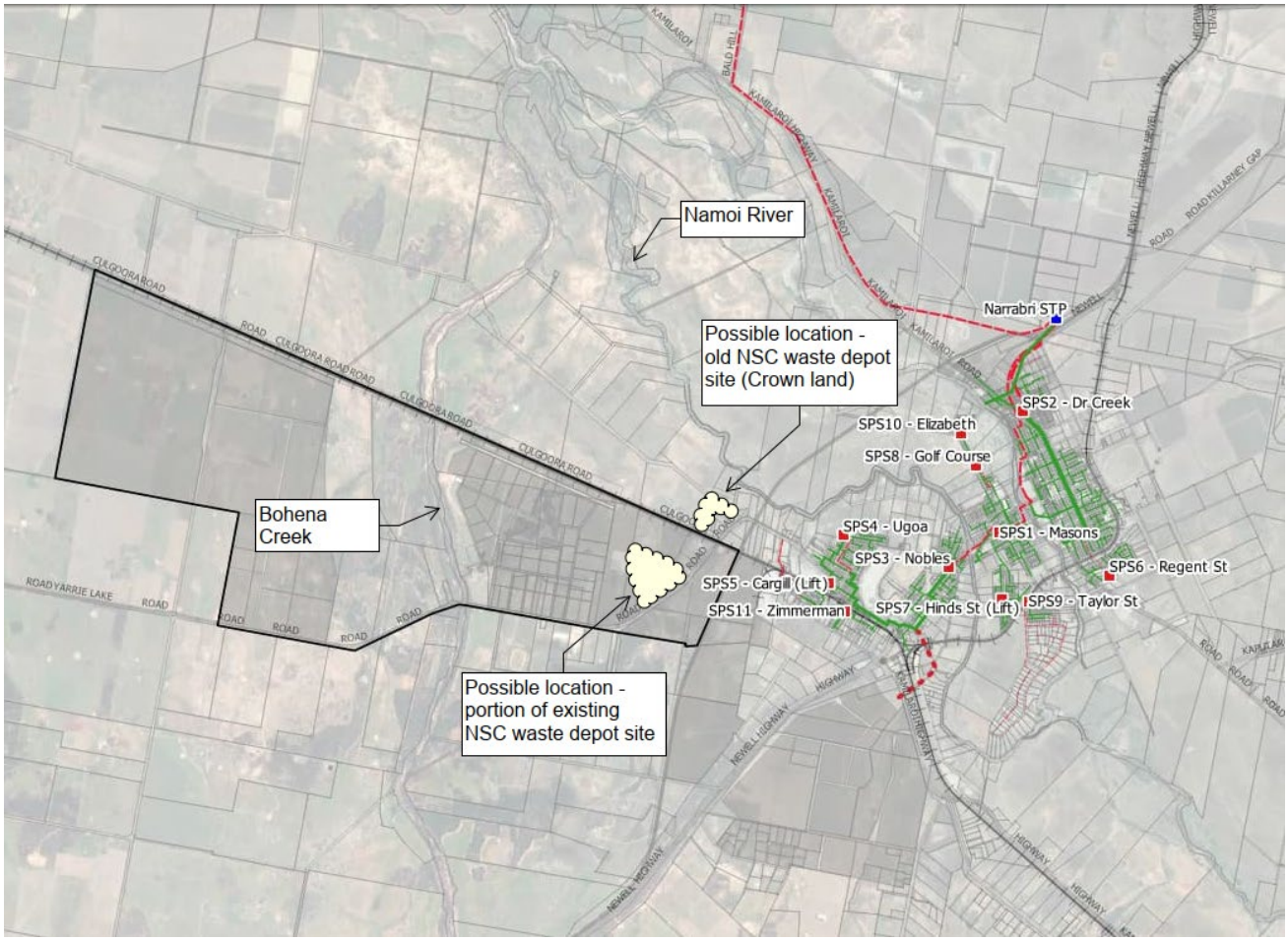


Figure 5.7 Possible locations for new Sewer Treatment Plant (indicative and for further discussion)

During Stage 2, expansion of the sewerage network within the SAP will be required, including new gravity trunk sewers and upgrade of the SPS. Although the land generally favours gravity servicing to the SPS at the northern extent, specific development requirements and staging may additional local SPS. Stage 3 is located on the far, western side of Bohena and will require a separate SPS catchment and rising main to convey wastewater to the central SPS.

The wastewater generation from the proposed SAP developments will provide additional opportunity for recycled water supply. This will be valuable in meeting the SAP water demands and achieving the sustainability aspects of the SAP vision, hence full re-use should be targeted. Refer to the Hydrogeology and Water Demand Study Report for further information about these overall supply and demand considerations. Recycled water uptake would require development of end-use demands within the SAP that suit this quality of water and/or additional levels of treatment to enable full utilisation.

There is also opportunity for the potential SAP developers/tenants to consider on-site wastewater and stormwater recycling facilities. For potential large customers this could offer a more optimised and cost-effective solution compared to authority operated systems. This should be encouraged where possible as a cost effective and sustainable approach for minimising water demands required from the town system.

Based on the above assessment, the following key findings have been summarised, however it must be noted that the below findings are subject to finalisation of the new STP feasibility and strategy (refer to Appendix B for a conceptual sketch of the proposed servicing strategy):

- For Stage 1, a new SPS in the vicinity of the Inland Port site is assumed, with approximately 4 km of new sewer rising main to the nearest connection point.
- Outside of the SAP, the Stage 1 residential precinct requires a new SPS and approximately 1.3 km of new rising main. Some limited network capacity upgrades (i.e. potentially SPS03 gravity sewer, pumps and rising main) plus limited upgrades to the existing STP should also be anticipated, subject to detailed assessment.
- For servicing the remainder of the SAP area following stage 1, approximately 15 km of sewer main works would be required, several additional SPS plus development of the proposed new STP facility and associated recycled water storage and reticulation system. Depending on the location of the new STP, and environmental requirements, an emergency outfall pipeline system (potentially to a waterway) may also be required.
- Ultimately, the sizing of the new STP is expected to be in the order of 2 ML/day ADWF if servicing only the SAP, and up to around 5 ML/day if servicing all of Narrabri. The new STP should be designed with suitable treatment processes to enable 100% effluent re-use, based on the water quality requirements for the specific SAP end-users. It is expected that a higher quality of tertiary treatment including filtration and disinfection will be required.

6 Recommendations and conclusions

6.1 Electricity

6.1.1 General

The following general recommendations are identified for electricity:

- Accumulate further details on the proposed Inland Port and expansion of the existing Sewer Treatment plant in terms of design, services, equipment types, demand loads and a feasible programme of commissioning to approach Essential Energy and initiate the contestability process for connection of load.
- As explained earlier in the report, after stage 1 of the SAP, the major electrical upgrades are expected. To align with the SAP's future stages, it is essential that early engagement with Essential Energy is initiated allowing at least two years for establishment of connection. Also, contemplate in greater detail the various stages of development of the remaining SAP with tentative timelines and inform Essential Energy to enable early start of electrical network planning to meet the required delivery milestones.
- Major electrical upgrades generally contain a client funded component; it is essential that the proponent commence preliminary conversations with Essential Energy in relation to this matter.
- As part of early engagement with Essential Energy, it is also important to carry out the following preliminary discussions:
  - analysis regarding site selection for the new predicted zone substations
  - carry out route options analysis for appropriate utilities corridors from potential power sources (Zone substations)
  - community consultations regarding any potential land acquisitions
  - carry out review of environmental factors, potential impacts on endangered species and areas of aboriginal and/or heritage significance.

6.1.2 Technical

Along with the general recommendations identified in Section 6.1.1, the following are key technical electricity aspects recommended for further analysis:

- Current status of Narrabri Zone Substation: At the moment, as per the latest Distribution Annual Planning Report, Narrabri Zone Substation has spare capacity of 24 MVA.
- Power supply requirements: In Stage 1, the development of the Inland Port and 600 dwellings at the Mount Kaputar precinct requires around 7.2 MVA of load, which can potentially be supplied from the existing network. However, it may require upgrading of the existing 22kV feeders, including overhead conductors and underground cabling, to cater to the new load. The extent of the upgrades will be known at the time of application submission in detail design stage.
- STP upgrade: The development of the Inland Port and the initial 600 dwellings would also require an upgrade of the existing STP due to additional sewerage generation. This upgrade is not substantial and is expected to be catered for from the existing 22 kV feeders in the vicinity of the STP.
- Power supply infrastructure: To establish power supply for stage 1 of the SAP, potentially, four new 1.5 MVA, one new 1MVA and one new 500 kVA padmount substations need to be installed. Additionally, upgrading necessary sections of the existing 22 kV feeders in front of the Inland Port site and within the Mount Kaputar precinct to cater to the new load is required.

- Supply redundancy: The determination of necessary interconnections for supply redundancy to the Inland Port and initial residential dwellings will depend on a better understanding of the establishments and will be decided during the detailed design process.
- Spare capacity: Upon completion of stage 1 servicing, the Narrabri Zone Substation will have approximately 16 MVA of available spare capacity.
- Transport and Logistics precinct: To provide power to the Transport and Logistics precinct, which requires around 10.8 MVA, a new dedicated 22 kV feeder can be established from the Narrabri Zone Substation. Several padmount substations and associated low voltage networks will be required to supply within the precinct. The type of connections for each tenant, such as low voltage or high voltage, will be determined after connection applications are submitted.
- Upgrade for Agricultural & Food Processing and Bioproducts precincts: After the Transport and Logistics precinct is developed, the Narrabri Zone Substation will require an upgrade with a new 30 MVA transformer and associated HV switchgears to supply power to the Agricultural & Food Processing precinct and the Bioproducts precinct, requiring around 22.7 MVA and 10.2 MVA respectively. A distribution network will be established within the precincts, consisting of two to three 22 kV feeders for the Agricultural and Food Processing precinct and one dedicated 22 kV feeder for the Bioproducts precinct, along with appropriate number of substations and/or switching stations.
- Incremental upgrades: These upgrades are expected to be delivered in incremental stages driven by economic growth, load forecasting, and alignment with Essential Energy's future upgrade plans.
- Fertilizer and Chemicals precinct would require a 90 MVA substation with 3 x 30 MVA transformers.
- Waste Management and Recycling precinct would require a 60 MVA substation with 2 x 30 MVA transformers.
- Mount Kaputar mixed residential precinct would require a 80 MVA substation with 2 x 30 MVA and 1 x 20 MVA transformers.
- Each of the above proposed zone substations is expected to have their own 22 kV network and associated substations based on number of eventual number of tenants and load.
- Suggested zone substation locations in Figure 5.4 depend on several critical factors, including electrical load requirements, proximity to power lines, accessibility, environmental considerations, land availability, security, safety, local planning regulations, and community engagement.

6.2 Telecommunication

6.2.1 General

The following general recommendations are identified for telecommunications:

- It is understood that the current telco network, being able to provide 3G and 4G coverage, would be able to meet the basic connectivity requirements of the first movers i.e. Inland Port and the initial 600 residential dwellings. It is expected that the connection procedure would follow the standard network extension policies of the service providers. However, it is recommended that early engagement would be beneficial provided that backhaul capacity and access points are made available.
- Accumulate further details on the proposed Inland Port and expansion of the existing Sewer Treatment plant in terms of design, services, communication equipment types, bandwidth requirements and a feasible programme of commissioning to approach Telstra and Optus to initiate the network expansion and connection process. It is recommended that engagement with the asset owners should not be any later than beginning of 2024 to be able to achieve the expected delivery by 2026.

- As Telstra's plan of upgrading the network progresses, it is expected that there will be no major interruption to the end user's connection status and no major upgrade of the end-user's equipment would be required.
- As part of early engagement with the telco operators, it is also important to carry out preliminary route options analysis for appropriate utilities corridors.

6.2.2 Technical

Along with the general recommendations identified in Section 6.2.1, the following are key technical telecommunication aspects recommended for further analysis:

- The existing telecommunications network in Narrabri is primarily serviced by Telstra offering 3G and 4G coverage .
- The fixed pit and pipe network is owned and managed by Telstra and AARNet. Extension of pits and pipes systems of approximately 10 km to 12 km will be required to service the Inland Port and initial 600 residential dwellings, with the possibility of wireless connectivity for Stage 1.
- To support new industries and housing, Telstra will need to assess the required subscriber access point capacities and capabilities and determine increase of the network's backhaul capacity. This will also inform if upgrade of existing BTSs and/or establishing new BTSs are required.
- Proposed installation of a new backbone Base Transceiver Station on Williams Drive offers the potential for 5G connectivity in the future.
- In preparation for the exit of Telstra's 3G Network (850 Mhz band) in June 2024, service providers is expected to prioritize expanding Telstra's 4G network capabilities and repurposing some of its 850 Mhz Spectrum for 5G.

6.3 Gas

The following recommendations are identified for gas:

- The Narrabri Gas Project or the Hunter Gas Pipeline has the potential to supply a significant portion of NSW's natural gas needs, including Narrabri's local gas requirements.
- The proposed locations of various types of establishments indicate that a substantial amount of new underground gas reticulation network will be required to service the entire SAP and the proposed residential precinct.
- It is strongly recommended that NSC, DPE, RGDC and all relevant decision-making stakeholders engage proactively with Santos to discuss and confirm the following matters, but not limited to:
  - Gain clarity on Santos' intentions and/or agreement to cater for Narrabri SAP's gas demands from either of the two projects.
  - Provided that Santos agrees to accommodate Narrabri SAP's local gas demands, it is essential for NSC to contemplate the following (but not limited to):
    - discuss with potential gas network operators regarding ownership and maintenance of the new gas distribution network once built
    - establish an appropriate trading mechanism as per the Gas Supply Hub Exchange Agreement V16 issued by the Australian Energy Market Operator (AEMO)
    - a retail mechanism by an appropriate entity establishing a Retail Gas Supply Agreement (RGSA) with the future end-users.
  - If Santos eventually disagrees with accommodating Narrabri's local gas demands, NSC and all relevant parties would need to discuss with Boral and Elgas in relation to their capability to support the SAP's gas demands through supplying additional on site storage through the provision of LPG cylinder supply.

It must be noted that considering the option of electrifying all new developments to service cooking and water heating to combat the impacts of climate change will have a significant impact on the electrical demand and hence capital expenditure on the electrical network upgrade as well as reducing the demand for bottled and mains gas over time.

6.4 Potable water and wastewater

6.4.1 Potable water

The following recommendations are identified for potable water:

- Additional bores within the Lower Namoi alluvium aquifer are required in the vicinity of the SAP, which can utilise NSC's existing remaining water entitlement (subject to investigations and relevant approvals). Since the future bore locations will significantly influence the water network configuration for the SAP, and will take some years to implement, early commencement is recommended for investigative groundwater investigations and obtaining approvals for new bores.
- The Pilliga Sandstone/Southern Recharge groundwater source has been identified in the Hydrogeology and Water Demand Study Report as likely to be a key additional water source for the ultimate development of the SAP. To ensure access, it is recommended that investigations into the feasibility of developing new bores from this source are also progressed.
- Subject to the proposed bore locations, a water network servicing strategy needs to be developed with NSC, including the location, configuration and sizing of storage reservoirs, pump stations, treatment equipment and key water mains. This strategy should also address the triggers for major infrastructure items based on analysis of the interim servicing of Stage 1 from the existing network.
- It is recommended NSC update their water network capacity assessment to reflect the current network configuration (which has changed significantly since the most recent planning study was undertaken) and to align with the SAP demands and servicing strategy.

6.4.2 Wastewater

The following recommendations are identified for waste water:

- Establishing a new STP in the vicinity of the SAP has been identified as the preferred ultimate strategy, however this requires significant investigations to confirm a feasible location and will take a number of years to implement. The location of the new STP, and timing of implementation, will significantly influence the water network configuration for the entire SAP, hence early commencement of STP feasibility and site selection investigations is recommended.
- In the interim (Stage 1), the SAP development will need to be serviced via connection to the existing network, which will require some new infrastructure including SPS, rising mains and potentially limited upgrades to existing network assets and/or the existing STP. The pumping rate of initial SPS may need to be limited to avoid exceeding the capacity of the existing receiving network. It would also be prudent for any interim upgrades to form part of the ultimate network configuration, to the extent possible.
- The new STP should be designed with suitable treatment processes to enable 100% effluent re-use, based on the water quality requirements for the specific SAP end-users. It is expected that a higher quality of tertiary treatment including filtration and disinfection will be required.
- Opportunities for the SAP developers/tenants to consider on-site wastewater and stormwater recycling facilities should be encouraged where possible as a cost effective and sustainable approach for minimising water demands required from the town system.
- As for the potable water system, it is recommended NSC update their wastewater network capacity assessment to reflect the current conditions and align with the SAP demands and servicing strategy.

Appendix A

Water servicing concept sketch

Narrabri SAP Water Servicing

Conceptual Sketch

LEGEND

- New water mains
- Existing water mains

Water Facilities

- Bore
- Pump Station
- Reservoir
- 215 m AHD Contour
- 240 m AHD Contour
- Major_Roads
- Existing_Railway

General Notes:
1) The location, number and configuration of future bores is subject to hydrogeology investigations and will be critical to determine/refine this service strategy
2) The 215 m AHD contour is shown. Areas above this elevation (i.e. south of this line) will receive low/inadequate pressure from the existing network pressure zone without booster pumping (interim) or establishment of a separate higher pressure zone (ultimately)
3) The 240 m AHD contour is shown. This is the minimum level suitable for a ground level reservoir to supply the SAP without booster pumping and/or elevated tanks
4) Connection points are shown based on previous planning (NSC, 2016) and are from larger existing mains. Ultimately, the new higher pressure zone will need to be isolated from the existing network

Proposed Stage 1 water main connection for Inland Port

Proposed Stage 1 connection points from existing DN200 main

Elizabeth St Bore

Killarney St Bore

Tibbereena St Bore

Selina St Reservoir

Manning St Pump Station

Mooloobar Reservoir

Hinds St Reservoir

Future bore + treatment (Location TBC)

Future bore + treatment (Location TBC)

Proposed booster pump station required for Stage 1 of residential areas > 215 m AHD elevation

Potential new reservoirs (tanks) for SAP and residential area (subject to location of future bores). Assumed ground level reservoirs with booster pump to achieve ~250 m AHD pressure level (alternatives including elevated tanks/standpipe tanks or ground level tank as shown south of residential area)

Opportunity for location of a ground level tank at >420 m AHD elevation in this area to supply SAP/residential area via gravity (subject to feasibility assessment and bore locations)

0 1 2 3 4 5 km

Scale correct when printed at A3
1:40000

Coordinate System: MGA Zone 55

Appendix B

Wastewater servicing conceptual sketch

Narrabri SAP Wastewater Servicing

Conceptual Sketch

General Notes:

1) The location and configuration of the future STP is subject to feasibility and site selection investigations and will be critical to determine/refine this service strategy. The alternative to a new STP would be major upgrade/replacement of the existing Narrabri STP plus extensive network upgrades within the existing network

2) SPS shown are conceptual based on topography and development footprint. Additional smaller SPS could be required for local/specific development needs. Assumed network layout is conceptual/diagrammatic only

LEGEND

- New Gravity Sewer Mains
- New Sewer RM
- Existing Gravity Sewer
- Existing Sewer Rising Main

SAP Study Area Boundary

Existing Sewer Facilities

- STP
- SPS
- Major_Roads
- Existing_Railway

Stage 3 SPS

New STP (Potential general location)

Recycled Water System

Future SAP Recycled Water Customers

Stage 1 Central SPS. Initially discharging to existing network via new rising main (not shown). Ultimately discharging to new SAP STP

Stage 2 / 3 additional SPS (if required)

Narrabri STP

SPS2 - Dr Creek

SPS10 - Elizabeth

SPS8 - Golf Course

SPS4 - Ugoa

SPS1 - Masons

SPS3 - Nobles

SPS6 - Regent St

SPS5 - Cargill (Lift)

SPS9 - Taylor St

SPS11 - Zimmerman

SPS7 - Hinds St (Lift)

Proposed residential area

New SPS (Stage 1) for residential area discharging to existing network. Limited allowable flowrate . Following construction of new STP, opportunity to divert this SPS to new STP catchment

Potential for additional upgrades to existing network (subject to new load, capacity investigations):
- Duplicate gravity main upstream of SPS3 (Nobles)
- Upsize SPS3 (Nobles)
- Upsize SPS3 (Nobles) RM

The above is based on NSC 2016 planning. These upgrades should be avoided until ultimate strategy incl. new STP is confirmed

Scale correct when printed at A3
1:40000

Coordinate System: MGA Zone 55

0 1 2 3 4 5 km

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