Appendix O

Land Capability and Soil Salinity Working Paper

New Grafton Correctional Centre SSDA 7413

INFRASTRUCTURE NSW

New Grafton Correctional Centre

Infrastructure New South Wales

Land Capability and Soil Salinity Working Paper

Final | V05V02

1 August 2016

New Grafton Correctional Centre

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Document history and status

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Contents

Terms and acronyms used in this document

Acronym	Definition
ASRIS	Australian Soil Resource Information System
CEC	Cation Exchange Capacity
CSNSW	Corrective Services New South Wales
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DLWC	Department of Land and Water Conservation
DPE	Department of Planning and the Environment
DPI	Department of Primary Industries
EC	Electrical Conductivity (Salinity levels)
EIS	Environmental Impact Statement
EP&A Act	*Environment Planning and Assessment Act 1979*
ESD	Ecological Sustainable Development
ESP	Exchangeable Sodium Percentage
GPS	Global Position System
GSG	Great Soil Groups
INSW	Infrastructure New South Wales
LGA	Local government area
NATA	National Association of Testing Authorities
NCST	National Committee on Soil and Terrain
NGCC	New Grafton Correctional Centre
NOW	NSW Office of Water
NSW	New South Wales
OEH	Office of Environment and Heritage
Project	Comprises the New Grafton Correctional Centre which will provide up to 1,700 new prison beds, within a maximum and minimum security correctional centre with relevant support services and facilities.
Project Site	Comprised of two properties Lot 26 DP 751376 and Lot 1 DP 1190399 and is located at 313 Avenue Road, Lavadia.
Proposal	Comprises the concept proposal and the Stage 1 works development application.
SEARs	Secretary Environment Assessment Requirements
SRD SEPP	*State Environmental Planning Policy [State and Regional Development] 2011*
SMU	Soil Mapping Unit
SSD	State Significant Development

Executive Summary

Infrastructure NSW (INSW) on behalf of Corrective Services NSW (CSNSW), a division of the Department of Justice, is seeking approval under Division 4.1, Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the concept proposal and Stage 1 Development Application (DA) for the New Grafton Correctional Centre (the Project). The Project will be located on a 195-hectare site (the Project Site), approximately 12.5 kilometres south-east of Grafton in the Clarence Valley local government area (LGA). The concept proposal and the Stage 1 works application comprise the Proposal.

This working paper presents a Land Capability Assessment for the Project Site which includes consideration of salinity, and discusses impacts on the land resource associated with construction and operation of the Project. The land capability assessment was prepared according to the *Soil and land constraint assessment for urban and regional planning* (Department of Environment, Climate Change and Water 2010). The soil salinity was assessed in accordance with *Site Investigations for Urban Salinity* (Department of Land and Water Conservation 2002).

An integrated soil survey was conducted by Jacobs in February 2016 and 15 locations were investigated across the Project Site. A total of 34 samples were collected and analysed by a National Association of Testing Authority (NATA) accredited laboratory in Sydney.

Based on the outcomes of the land capability assessment, the main constraints to the proposed land use are seasonal waterlogging of the soils and a general foundation hazard due to the dispersive nature of the clay subsoils. Similar land capability scores were found for the two disturbance types: standard and medium density development, indicating that the land is potentially suitable for both types of development. Soil mapping units were developed based on similar properties repeated across the landscape and thus the changes in soil units are reflected in the land capability scores. Overall, the Project Site can be considered as suitable for the proposed land use, if the key soil constraints associated with each soil mapping unit are mitigated.

The salinity assessment indicated that soils are not saline and are unlikely to be corrosive to concrete or steel infrastructure. Changes to the site hydrology (e.g. removal of vegetation) may result in the capillary rise of salts from the clay subsoils; however, it is unlikely that salt levels would rise to the required concentration to cause damage to infrastructure. The proportion of clay materials within the soils would reduce the risk of salt rising as solutes move slower in clay in comparison to sandy materials.

Overall, the site salinity would not present a problem to the Project, including the construction of structures, providing the materials are managed according to their chemical properties. The development of the Project Site is unlikely to cause an increase in salinity across the landscape providing the water table levels are managed.

1. Introduction

1.1 Background

Infrastructure NSW (INSW) on behalf of Corrective Services NSW, a division of the Department of Justice, is seeking approval under Division 4.1, Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the concept proposal and Stage 1 Development Application (DA) for the New Grafton Correctional Centre (the Project). The concept proposal and the Stage 1 works development application comprise the Proposal.

The Project satisfies the criteria of Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011* as the capital investment value of the correctional centre exceeds $30 million. As such, the Project is declared to be a State Significant Development (SSD) under Division 4.1, Part 4 of the EP&A Act and the Minister for Planning is the consent authority for the application. The Secretary's Environmental Assessment Requirements (SEARs) for the Proposal were issued by the Department of Planning and Environment (DPE) on 21 December 2015.

1.2 Locality

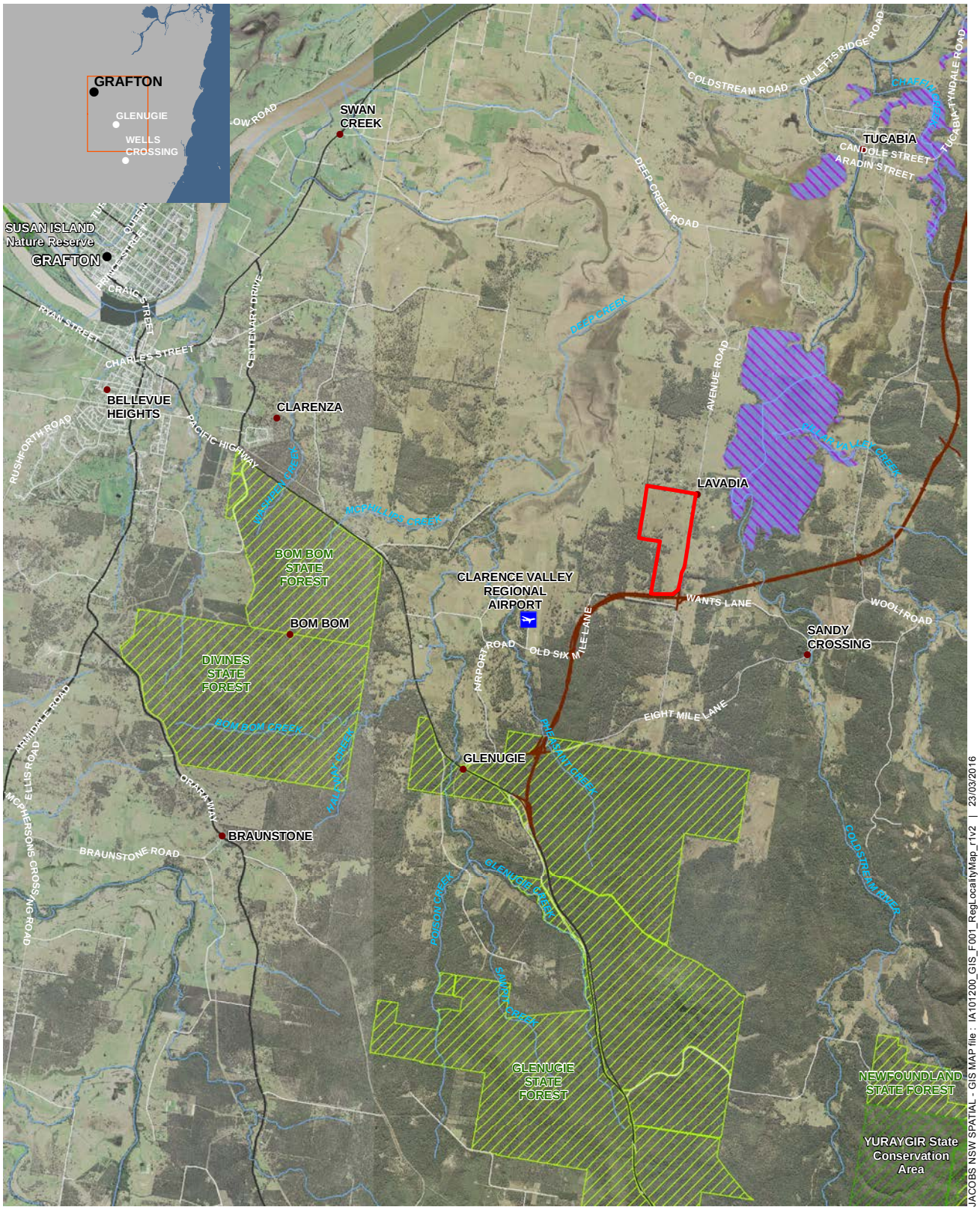
The Project is located at 313 Avenue Road, Lavadia (the Project Site), approximately 12.5 kilometres southeast of Grafton (refer to **Figure 1-1)** and within the Clarence Valley Local Government Area (LGA). The Project Site is zoned RU2 - Rural Landscape under the *Clarence Valley Local Environmental Plan 2011.* Development of a correctional centre within the RU2 zone is permissible with consent.

The Project Site includes two cattle grazing properties comprised of Lot 26 DP 751376 and Lot 1 DP 1190399 and is 195 hectares in size (refer to **Figure 1-2**). In July 2015, development consent for a dwelling house in the southeast corner of Lot 1 DP 1190399 was granted by Council and construction of the house and adjacent shed is complete. The site is bounded by Avenue Road (also recognised as Golden Mile Road) to the east, and Old Six Mile Lane to the south. Avenue Road connects to the Pacific Highway via Eight Mile Lane to the south and Old Six Mile Lane connects to the Pacific Highway to the west.

It is noted that the Grafton bypass portion of the upgraded Pacific Highway project (by Roads and Maritime Services) will, in addition to the reconfigured Old Six Mile Lane, form the southern boundary of the site once completed in approximately 2019. As part of that project, Avenue Road will pass over the Pacific Highway and the intersection of Avenue Road and Old Six Mile Road will be upgraded to improve local access, without direct connection to the highway.

1.3 Project description

The New Grafton Correctional Centre (NGCC) requires a staged development application that sets out a concept proposal for a new correctional centre at Grafton that provides maximum and minimum security facilities and includes a total of 1,700 beds. The concept proposal includes a maximum built form height of 12 metres (approximately three storeys) with a gross floor area of approximately 100,000 square metres. The staged development application also seeks concurrent Stage 1 approval for site clearance and preparatory works. **Table 1-1** provides a summary of the Proposal's key components and features.



Legend

- The Project
- Grafton Bypass (proposed)
- SEPP 14 Wetlands
- National Park Reserves
- State Forests

0 2 4 Km

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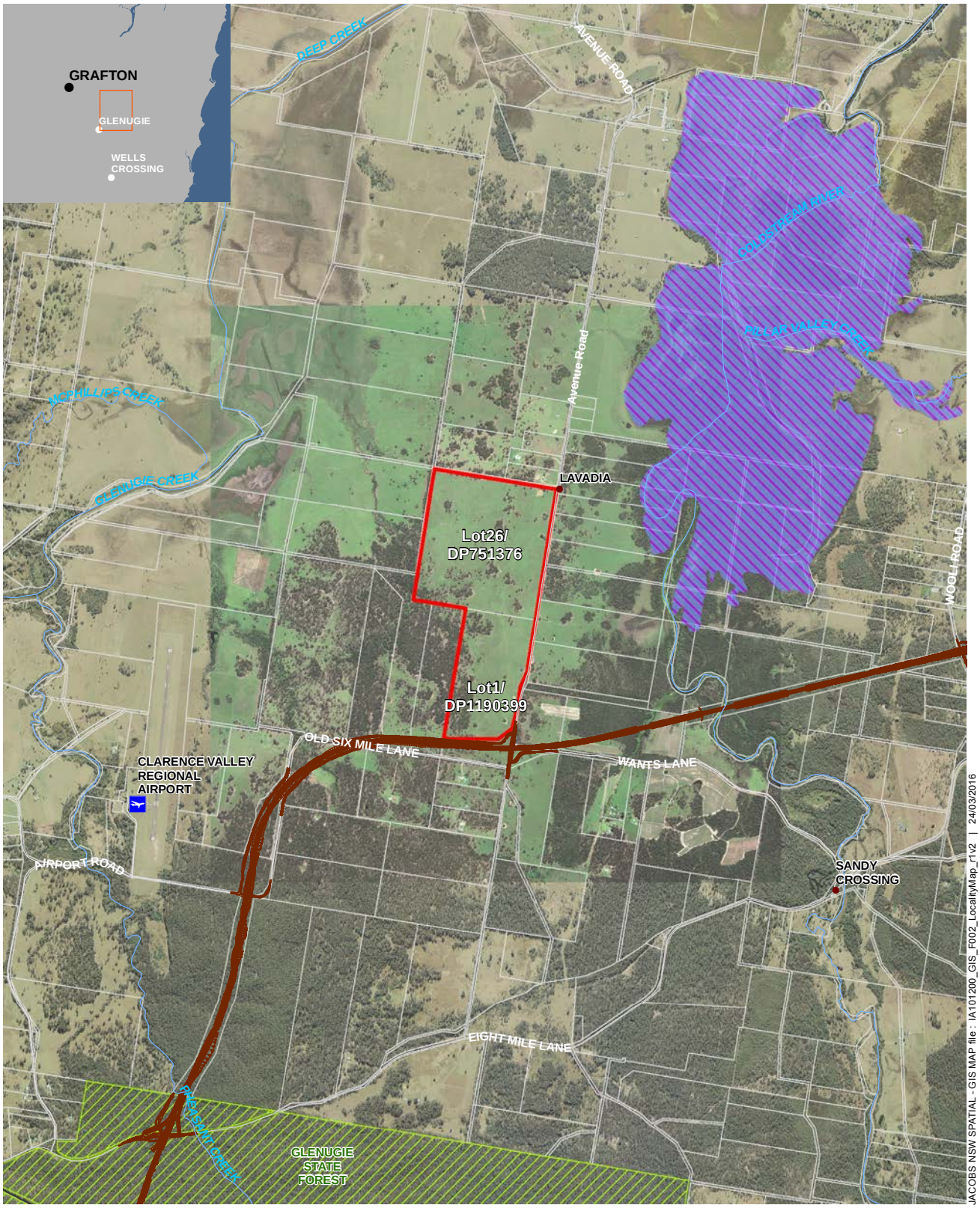
Data sources

Jacobs 2015
LPI 2015
NSW DPE 2015
RMS 2013 (W2B Alliance)

Figure 1-1 | Regional Locality



Legend

- The Project
- Grafton Bypass (proposed)
- SEPP 14 Wetlands
- State Forests

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Data sources
Jacobs 2015
LPI 2015
NSW DPE 2015
RMS 2013 (W2B Alliance)

Figure 1-2 | The Project

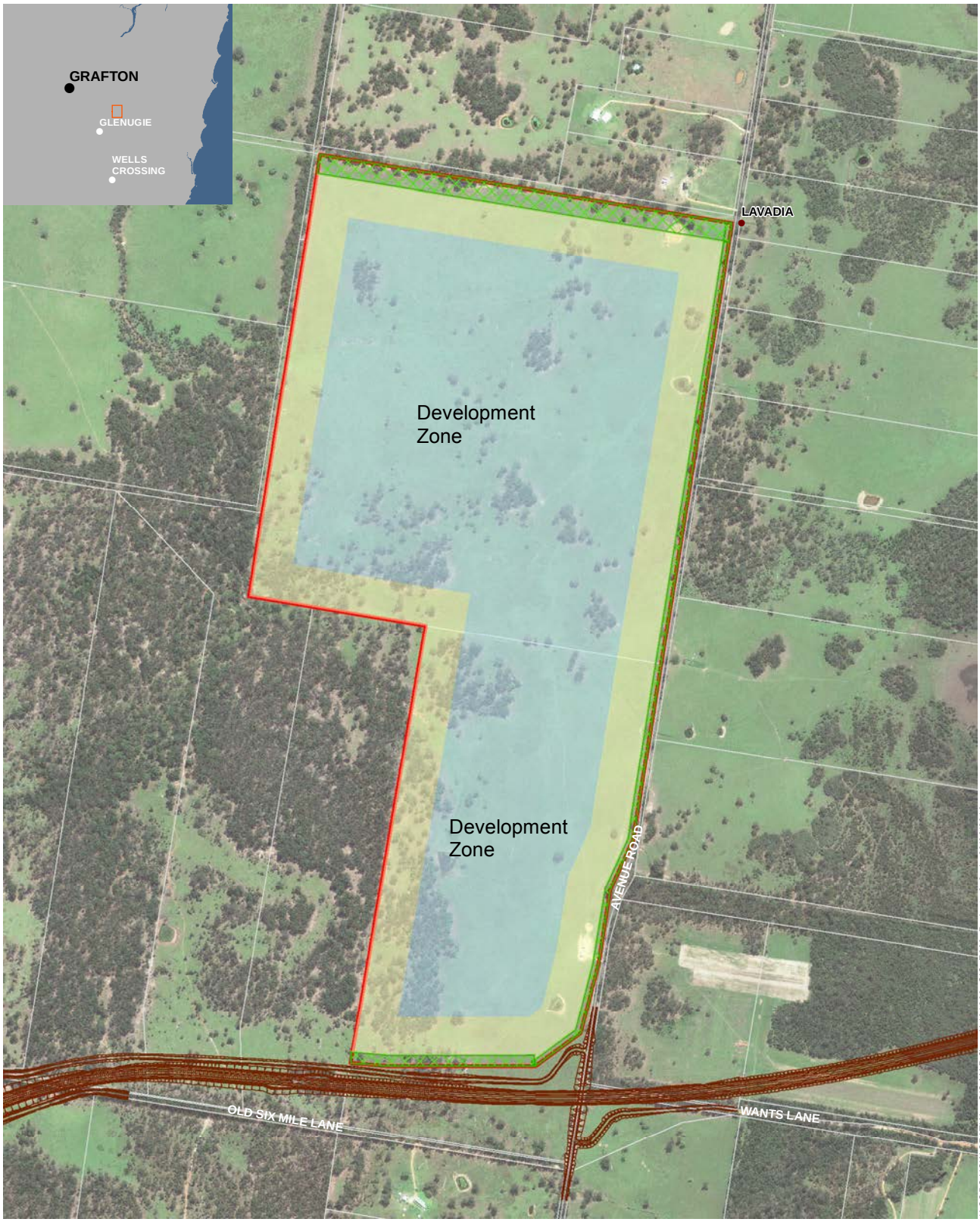
Table 1-1 Key Project Components

Stage	Description
Development summary	The staged SSD application seeks approval for: · A concept proposal for the New Grafton Correctional Centre. · First stage site clearance and preparatory works for the Project. · Together referred to as the Proposal.
Project Concept Proposal	The NGCC includes a maximum and minimum security correctional centre of 1,700 beds comprised of: · A maximum security section of 1,300 beds that will include: 1000 beds for male inmates. 300 beds for female inmates. · A minimum security section that will include: 400 bed residential accommodation for male inmates. The building envelope including the configuration, location and number of building structures required for the project would not be determined until the detailed design is completed as part of the Stage 2 works. Consequently, the Stage 2 construction works for the Project could occur anywhere within the development zone shown in **Figure 1-3**. The total footprint around both the maximum and minimum correctional centres, including the carpark, is around 45 hectares. Features of the Project include the following: · The concept proposal includes a maximum built form height of 12 metres (approximately three storeys). · The gross floor area will be approximately 100,000 square metres. · A six-metre-high fence or wall will be constructed around the perimeter of the facility, with light and security camera poles up to 10 metres in height. · Store buildings, small ancillary facilities and a central energy plant will be located outside the perimeter walls / fences. · Internal access into and out of the correctional centre from Avenue Road will be provided. · Car parking for approximately 500 car spaces. · Other associated facilities include recreational oval, special accommodation units, health facilities, education and programs areas, administration, workshops, staff amenities, visitor facilities and utilities. · A 100-metre wide Asset Protection Zone (APZ) would be cleared around the correctional centre and associated facilities and car parking area in accordance with the Rural Fires Act 1997 and requirements of the Planning for Bush Fire Protection (PBP; NSW Rural Fire Service [RFS], 2006). · A vegetation buffer outside the APZ would be provided along the northern, eastern and southern boundaries of the Project Site. The buffer would be 50 metres wide along the northern property boundary, 15 metres wide to the east along Avenue Road and 30 metres wide along the southern property boundary. · Fire access roads on the inside and the outside of the perimeter fence of the facility will be constructed to ensure safe operational access for emergency services personnel responding to a bushfire event. · Water, wastewater, power and communication utilities within the Project Site. · Landscaping of ground cover and /or shrubbery in areas to be defined.

Stage	Description
Stage 1 Site Clearance and Preparatory Works	Stage 1 (early works) DA, includes preparatory work within the cadastral boundaries of Lot 26 DP 751376 and Lot 1 DP 1190399. This would involve: • Vegetation clearance and biodiversity management activities. • Construction of access roads including fire access roads to the extent required to conduct Stage 1 works. • Construction of auxiliary facilities such as construction compound, construction staff parking facilities and stockpiles sites. • Temporary provision of water, power and communication services within the site to the extent required to conduct Stage 1 works. • Demolition of the existing house and sheds. • Bulk excavation and site stabilisation works as required. • Landscaping.
Value	The capital investment value for the Project is in excess of $30 million.
Project Site	• Located at 313 Avenue Road, Lavadia. • Lot 26 DP 751376. • Lot 1 DP 1190399. • Project Site is195 hectares (ha) in size.

Future works regarding the design, construction and servicing of the Project will be based on the final design and layout of the facilities and will be the subject of future staged development application(s).

The construction activities associated with the Stage 1 site clearance and preparatory works is estimated to take six to 12 months and provide around 50 full time equivalent positions.



Legend

- The Project
- Landscaping zone
- Asset Protection Zone
- Development Zone
- Grafton Bypass (proposed)

0 250 500 Metres

1:15,000 @ A4

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Data sources

Jacobs 2015
LPI 2015
NSW DPE 2015
RMS 2013 (W2B Alliance)

Figure 1-3 | The Project

1.4 Project objectives

The objectives of the Project are to:

1) Be a safe and secure correctional centre.
2) Be a humane and ethically managed centre.
3) Help reduce the risk of re-offending through (among other things) preparing inmates for reintegration into the community on release from the CSNSW network.
4) Manage resources effectively and efficiently, enhancing value for money.
5) Utilise effective governance arrangements.
6) Produce strong economic and social benefits to the local Grafton region, the northern NSW region and the broader NSW community.
7) Be a valuable physical asset for the duration of the Operating Phase and beyond.
8) Be operated in such a way as to keep pace with best correctional practice over the term of its operational life.
9) Be operated so that it links with the broader management strategies and operational needs of the CSNSW network.

1.5 Report structure

This Land Capability and Soil Salinity Working Paper supports the EIS that is required for the Proposal under Division 4.1, Part 4 of the EP&A Act. The structure of the report is summarised in **Table 1-2**.

Table 1-2 : Report structure

Section reference	Section heading	Description
Executive summary	Executive summary	Concise summary of this technical paper and the key findings
1	Introduction • Background • Locality • Proposal description • Proposal objectives • Report structure • Assessment requirements	Description of the Project relevant to potential impacts on soils. Provides an overview of the study objectives and structure of working paper. Identifies the key legislation that this technical study must follow.
2	Existing environment • Soil survey • Land capability assessment	Establishes local soil and baseline soil conditions and outlines the results of the soil survey and soil classification. Soil mapping units are established and a land capability assessment complete for the respective mapping units.
3	Soil salinity assessment	Assesses the salinity risk of the soil mapping units.

Section reference	Section heading	Description
4	Assessment and management of construction impacts • Relevant construction activities • Construction related impacts • Management of construction related impacts	Identifies key soil disturbance related construction activities and assesses the potential impacts on the local environs. Establishes management measures to manage construction impacts associated with soil disturbance.
5	Assessment and management of operational impacts • Relevant operational activities • Local operational impacts • Regional operational impacts • Management of construction related impacts	Identifies key soil disturbance related construction activities and assesses the potential impacts of the Project. Establishes operational quality management measures.
6	Summary of mitigation measures	Summary of construction and operational mitigation measures includes details of when the measures are to be implemented.
7	Conclusions and recommendations • Conclusions • Recommendations	Concise statement of key findings of the construction and operational impacts of the Project on the land resource.

1.6 Assessment requirements

The Project satisfies the criteria of Clause 16, Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011*, as it is for the purposes of a new correctional centre that has a capital investment value of more than $30 million. As such, the Project is declared to be State Significant Development (SDD) in accordance with Section 89C of the EP&A Act. The Minister for Planning, or his delegate, is the consent authority for the SSD under Section 89D of the EP&A Act.

A staged development application is being made for the Project in accordance with Section 83B and Section 89D of the EP&A Act. The EIS, and this working paper, provides an assessment of the concept design and Stage 1 of the Project. Subsequent applications will be made for future stages of the Project.

Under Section 78(8A) of the EP&A Act, an EIS must accompany an application for SSD. The SEARs for the Project were issued by DPE on 21 December 2015 in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

There are no specific legislative requirements for land capability and soil salinity assessments; however, both assessments were undertaken in line with the relevant guidelines.

The land capability assessment has been prepared in line with the *Soil and land constraint assessment for urban and regional planning* (Department of Environment, Climate Change and Water 2010). Additionally, the soil salinity assessment has been completed as per the requirements outlined *in Site Investigations for Urban Salinity* (Department of Land and Water Conservation 2002).

2. Land capability

2.1 Existing environment

2.1.1 Climate

The Grafton region experiences a humid, subtropical climate with temperatures ranging from 20 to 30°C in Summer and 6 to 20°C in Winter. Mean annual rainfall for the region is 1080 millimetres (mm) per year and, although rainfall is lower than that of coastal areas, monthly rainfall can exceed 300 mm. During periods of anti-cyclonic control and strong westerly winds however, monthly rainfall can be as low as 0.3 mm (July 1972).

Rainfall across the Grafton region is Summer dominant, with most rainfall occurring during thunderstorms which develop as weak tropical lows move toward land from adjacent warm tropical oceans. The region often experiences drought conditions.

Historical climate data are available from the Grafton Olympic Pool station (#058130), with averages provided in **Table 2-1**.

Table 2-1 : Grafton climate statistics

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	141	151	129	88	80	69	38	41	38	76	104	121
Mean maximum temperature (°C)	30.1	29.3	28.2	26.2	23.1	20.8	20.5	22.1	24.9	26.8	28.2	29.6
Mean minimum temperature (°C)	19.8	19.7	18.0	14.9	11.2	8.1	6.4	7.3	10.4	13.8	16.4	18.5

2.1.2 Geomorphology

The Project Site borders the riparian zone of the Clarence River. Known as the Clarence Lowlands, the site is dominated by coastal lowlands overlying weak sedimentary rocks, with littoral and alluvial plains (ASRIS 2016). Regolith materials consist of moderately weathered bedrock (>50 percent) and alluvial sediments (<20 percent).

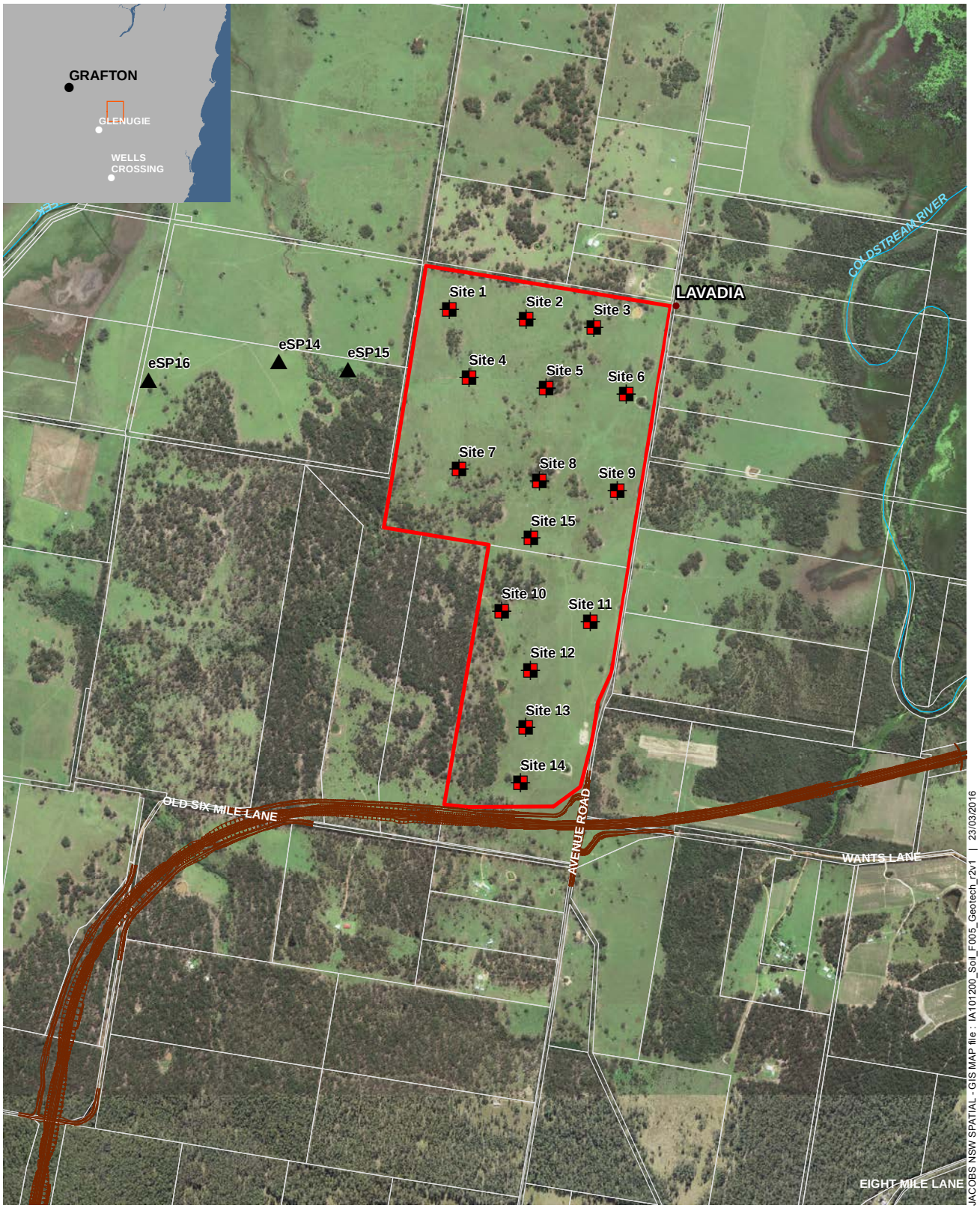
The undulating hills and rises are dominated by texture-contrast soils, which typically increase in depth from hill crest to the lower slopes. The alluvial plains are dominated by alluvial deposits and are a result of the erosion, transport and deposition of soil materials by water.

2.1.3 Soils

There are limited data on the soils of the Grafton region and no existing land systems, soil landscapes or land resource mapping are available for the Project Site. The available soil and land information is sourced from eSPADE, an information system that hosts all available soil and land data for New South Wales. Three eSPADE data sets were identified to the west of the northern section of the Project Site, refer to **Figure 2-1**.

The soils of the site are described as Earths and Podzolics according to the Great Soil Groups (GSG) classification of Stace et al. (1968). The Earths of the GSG would include the Kandosols of the Australian Soil Classification (ASC), and are described as soils that lack strong texture-contrast, have massive or only weakly structured B horizons, and are not calcareous. In addition to Kandosols, Prairie Soils (GSG) which would include the Dermosols of the ASC, are also present. Similar to Kandosols, Dermosols lack a strong texture-contrast but have structured B horizon.

The Podzolics (GSG) would include the Kurosols of the ASC, and are described as acidic soils (pH<5.5 in the B horizon) with a strong texture-contrast.



Legend

The Project

Grafton Bypass (proposed)

Jacobs investigations

eSpade Profile

Geotechnical pits

0 250 500 Metres

1:25,000 @ A4

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Figure 2-1 | Geotechnical investigations

Data sources

Jacobs 2015

LPI 2015

RMS 2013 (W2B Alliance)

The Kandosols, Kurosols and Dermosols, which typically occur higher in the landscape, are associated with younger soils (Rudosols) lower in the landscape that have formed due to the reworking of soil materials by the actions of local rivers and creeks (alluvial plains).

Additional information available for the area indicates the soils have inherent low soil fertility and very slow infiltration rates when thoroughly wetted.

2.2 Soil Survey

2.2.1 Method

An integrated soil survey was conducted by Jacobs in February 2016 at 1:25,000, a scale suitable for moderately intensive land use at the 'field' level and for detailed project planning (McKenzie et al. 2008). The integrated survey component is based on aerial photography interpretation of the landscape and soil, landform, geological and vegetation associations (Hewitt et al. 2008).

Fifteen locations across the Project Site were pre-determined for investigation following aerial photo interpretation and located by Global Position System (GPS) in the field, refer to **Figure 2-1**. A test pit was excavated by backhoe at each location. The test pits were approximately 1.5 metres (m) wide and were extended as deep as deemed necessary by the Geotechnical and Soil Scientist to collect the required information.

Site information and soil morphology were recorded at each location according to the *Australian Soil and Landscape Survey Field Handbook* (NCST 2009) and the soils were classified using the *Australian Soil Classification* (Isbell 2002). Two samples were collected at each location, including a sample from the diagnostic (B) horizon, and submitted for laboratory analysis. In total, 34 samples (including two quality control samples) were analysed by a National Association of Testing Authority (NATA) accredited laboratory in Sydney.

2.2.2 Results

The Project Site may be described topographically as gently undulating slopes and rises. Slope gradient across the 15 locations investigated ranged from two to 11 percent, and several of the locations were surrounded by micro relief typical of gilgai (mounds and depressions formed as a result of the shrink-swell properties of clays). There was no evidence of rock outcrop in the vicinity of the 15 locations investigated across the site.

Ground cover was observed to be 80 percent or greater, consisting of several dominant grass species such as *Capillipedium spicigerum*, *Themeda australis*, *Paspalum dilatatum* and *Eucalyptus tereticornis*. Areas of open forest occur along the south-east boundary of the Project Site and scattered across about 10 percent of the northern part of the site. As a result of the ground cover, bare soil areas were minimal with erosion recorded at one location only, and classified as minor and stabilised.

Soil surface condition is described as firm (dry), with two locations described as poached (soil that has been extensively trampled in a wet condition by hoofed animals). The topsoils (A horizon) were predominantly silty clay loams, overlying subsoils (B horizon) of medium to heavy clay. Roots were abundant from 0-0.1 m and decreased in size and abundance down the profile.

The majority of the soils investigated may be described as imperfectly drained (water is removed from the soil slowly in relation to supply). The remaining soils were moderately well-drained (soils where water is removed somewhat slowly in relation to supply). Mottling (staining) is evident in the majority of soil profiles, which can be an indicator of seasonally waterlogged soils. Soil descriptions conducted at each location are provided in **Appendix A**.

Results from the laboratory analysis are provided in **Table 2-2** with additional salinity results presented in **Table 3-2**. Full laboratory reports are provided in **Appendix B**.

Table 2-2 : Soil survey laboratory results

Sample No.	pH (H_2O)	EC	ESP	Emerson	Particle size distribution (%)				
	pH units	dS/m	%	Class	Gravel (>2.36 mm)	Coarse Sand (2.36 – 0.3 mm)	Fine Sand (0.3 – 0.075 mm)	Silt (0.075 – 0.002 mm)	Clay (>0.002 mm)
Site 1 A	5.9	74	3	8	-	-	-	-	-
Site 1 B	5.4	210	16	1	-	- -		-	-
Site 2 A	5.8	49	6	8	5	4	30	40	21
Site 2 B	5.2	270	26	1	0	9	31	39	21
Site 3 A	5.1	210	22	3b	-	-	-	-	-
Site 3 B	4.9	490	32	3b	-	-	-	-	-
Site 4 A	5.7	85	6	3b	2	5	24	37	32
Site 4 B	5.6	330	19	2	1	1	16	35	47
Site 5 A	5.9	44	14	3a	-	-	-	-	-
Site 5 B	5.3	190	20	3a	-	-	-	-	-
Site 6 A	5.4	62	9	3a	3	4	55	15	22
Site 6 B	4.8	480	39	3b	0	2	47	14	37
Site 7 A	5.4	130	24	3a	-	-	-	-	-
Site 7 B	4.8	490	33	6	-	-	-	-	-
Site 8 A	5.3	100	11	3b	0	0	54	20	24
Site 8 B	4.8	560	24	6	0	0	53	20	26
Site 9 A	5.6	100	2	5	-	-	-	-	-
Site 9 B	4.9	290	17	6	-	-	-	-	-
Site 9 C	4.7	640	27	6	-	-	-	-	-

Sample No.	pH (H_2O)	EC	ESP	Emerson	Particle size distribution (%)				
	pH units	dS/m	%	Class	Gravel (>2.36 mm)	Coarse Sand (2.36 – 0.3 mm)	Fine Sand (0.3 – 0.075 mm)	Silt (0.075 – 0.002 mm)	Clay (>0.002 mm)
Site 10 A	5.6	130	3	5	0	3	42	40	15
Site 10 B	5.8	73	9	3b	4	1	48	18	29
Site 11 A	5.7	120	7	8	-	-	-	-	-
Site 11 B	5.3	300	29	1	-	-	-	-	-
Site 12 A	5.9	35	4	8	6	18	25	38	13
Site 12 B	4.9	550	35	2	4	2	44	19	31
Site 13 A	6.1	110	2	8	-	-	-	-	-
Site 13 B	5.2	430	21	3b	-	-	-	-	-
Site 14 A	5.1	600	20	6	0	4	34	35	27
Site 14 B	5.1	430	15	6	0	1	46	21	32
Site 15 A	5.7	79	2	8	-	-	-	-	-
Site 15 B	5.8	57	3	8	-	-	-	-	-
Site 15 C	6.9	470	18	5	-	-	-	-	-

The majority of topsoil samples are moderately acidic, overlying strongly acidic subsoils. In addition, all subsoil samples are sodic with an exchangeable sodium percentage (ESP) greater than six, indicating the potential to for clays to disperse. The cation exchange capacity of the topsoil and subsoil samples were generally moderate (12 – 25 meq/100g), indicating the soils have a capacity to buffer against changes in pH, available nutrients and soil structure (Hazelton & Murphy 2007). Salt concentrations have an increasing trend down the profile, but are generally considered to be low. Additional information on salinity can be found in **Section 2.4**.

Particle size distributions for the majority of locations indicate (on average) a high proportion of fine sand (39 percent), silt (28 percent) and clay (27 percent). Larger fraction sizes were present in lower proportions, with averages of four percent for coarse sand and two percent for gravel. Emerson results indicate a range of stability classes across the samples, from very high dispersivity to complete stability. Topsoil samples were generally stable to slightly dispersive. Subsoil samples varied from very highly dispersive to slightly dispersive, with an overall trend of high dispersivity. Soils with low aggregate stability are likely to be compact and susceptible to erosion.

2.2.3 Soil classification

The soil description sheets for each of the 15 locations investigated are provided in **Appendix A**. The soil orders (assigned after the completion of the soil survey) identified as occurring within the Project Site are presented in **Table 2-3** and **Figure 2-2.**

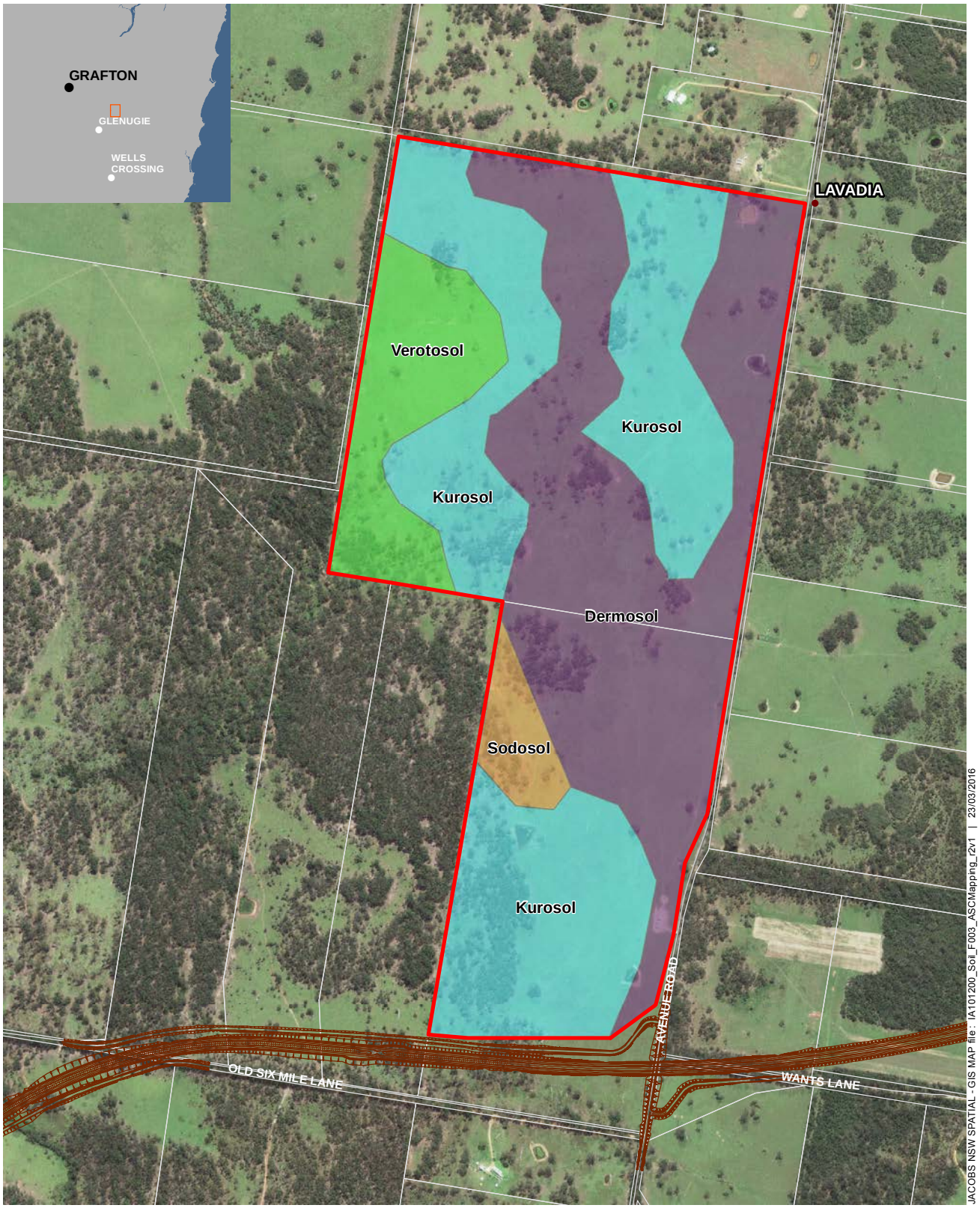
Table 2-3 : The Field Verified Soil Orders (ASC) of the Project Site

Field Verified Soil Order (ASC)	Concept
Kurosol	Soils with a strong texture contrast between A horizons and strongly acid subsoils.
Sodosol	Soils with a strong texture contrast between A horizons and sodic subsoils which are not strongly acid.
Dermosol	Gradational or uniformly textured non-cracking clays with structured subsoils
Vertosol	Gradational or uniformly textured cracking clays with structured subsoils

Note that while the desktop review indicated the presence of Kandosols, the field investigation indicated that the gradational soils were structured, in line with a Dermosol classification. This is based on the state of the soils at the time of investigation.

2.2.4 Soil mapping units (SMU)

The soil mapping unit (SMU) is the basic geographic component of a soil map, and can be associated with a single or multiple soil types with definable characteristics. This allows for management strategies to be targeted at soils with similar characteristics. The SMUs were developed on the basis of recurring landscape and soil attributes, with minor variations in soil properties within the units. Three distinct map units were identified on site as part of the soil survey and these mapping units are summarised in **Table 2-4** and shown in **Figure 2-3**, with typical soil mapping unit profiles outlined below.



Legend

- The Project
- Grafton Bypass (proposed)

Australian Soil Classification

- Dermosol
- Kurosol
- Sodosol
- Verotosol

0 250 500 Metres

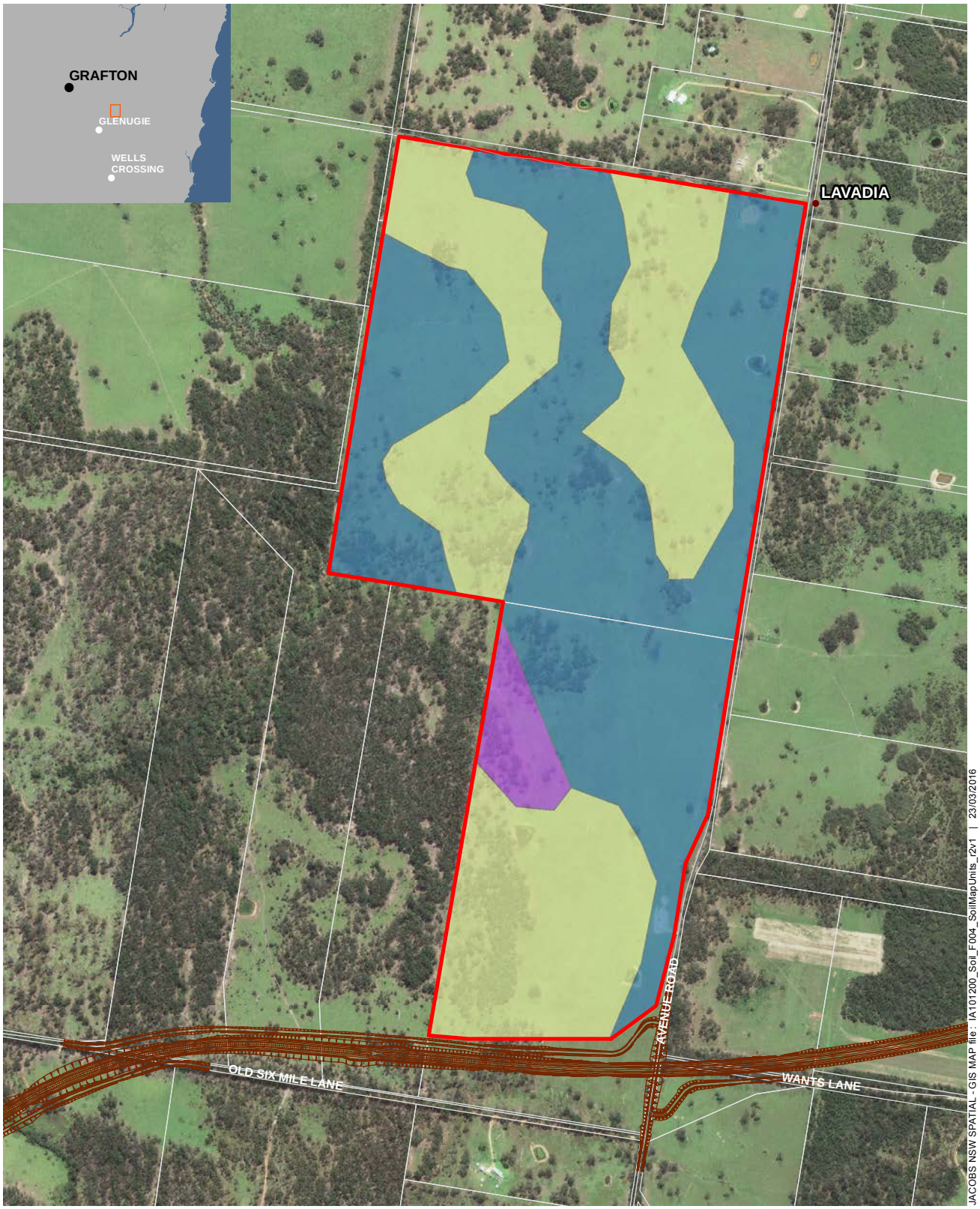
1:15,000 @ A4

N

Data sources

Jacobs 2015
LPI 2015
RMS 2013 (W2B Alliance)

Figure 2-2 | Australian Soil Classification



Legend

- The Project
- Grafton Bypass (proposed)

Soil Mapping Units

- Acidic Texture Contrast Soils
- Sodic Texture Contrast Soils
- Uniform and Gradational Soils

0 250 500 Metres

1:15,000 @ A4

N

Data sources

Jacobs 2015
LPI 2015
RMS 2013 (W2B Alliance)

Figure 2-3 | Soil Mapping Units

Table 2-4 : Soil Mapping Units of the Project Site

SMU	Soil concept	ASC	Area and % of the Project Site	Associated Sites
Acidic Texture-Contrast Soils	Texture-contrast soils with strongly acidic B-horizons (pH <5.5)	Kurosols	83 ha (42%)	1, 3, 5, 7, 9, 12, 13, 14
Uniform and Gradational Soils	Uniform or gradational soils with structured B-horizons, and are sodic and acidic.	Dermosols/ Vertosols	105 ha (55%)	2, 4, 6, 8, 11, 15
Sodic Texture-Contrast Soils	Texture-contrast soils with sodic subsoils that are not strongly acidic	Sodosols	6 ha (3%)	10