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Wee Waa High School Proposal

Soil and Water Quality Investigation and Report

NSW Department of Education

George Street, Sydney NSW 2000

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NSW Department of Education
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1 Introduction

The NSW Department of Education is proposing to construct a new high school in Wee Waa to replace the existing high school which has been identified as having issues of concern relating to the buildings.

SMK Consultants have been engaged by School Infrastructure NSW to prepare a Soil and Water Quality Report. This report is to accompany an Environmental Impact Study to be submitted as part of a development application for the construction and operation of the school. The proposal is classed as State Significant Development.

1.1 Scope of Report

The scope of this report as requested by the Department is detailed in Table 1.

Table 1: Requested scope of works

Assessment Parameter	Section
Details of an adequate and secure water supply for the life of the project, including confirmation water can be sourced from an appropriately authorised and reliable supply. This must also include an assessment of the current market depth where market entitlement is required to be purchased	Section 4
A detailed site water balance	Section 4.5
An assessment of potential impacts on surface and groundwater (quality and quantity), soil, related infrastructure and watercourse(s) where relevant	Section 5.3
Details of measures and procedures to minimise and manage the generation and off-site transmission of sediment, dust and fine particles into water bodies	Section 5
An assessment of salinity and acid sulphate soil impacts, including a Salinity Management Plan and/or Acid Sulphate Soils Management Plan, where relevant.	Section 6

This report also aims to provide information in response to specific sections of the SEARs, which are included in Table 2 below.

Table 2: Sections of the SEARs for the proposal addressed in this report

Agency and requirements	
NSW EPA	
5 Water	
5.1	The EIS must demonstrate how the proposed development will meet the requirements of section 120 of the POEO Act.
5.2	The EIS must include a water balance for the development including water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.

Agency and requirements	
5.3	If the proposed development intends to discharge waters to the environment, the EIS must demonstrate how the discharge(s) will be managed in terms of water quantity, quality and frequency of discharge and include an impact assessment of the discharge on the receiving environment. This should include: ➢ Description of the proposal including position of any intakes and discharges, volumes, water quality and frequency of all water discharges. ➢ Description of the receiving waters including upstream and downstream water quality as well as any other water users. ➢ Demonstration that all practical options to avoid discharge have been implemented and environmental impact minimised where discharge is necessary
5.4	The EIS must refer to Water Quality Objectives for the receiving waters and indicators and associated trigger values or criteria for the identified environmental values of the receiving environment. This information should be sourced from the ANZECC (2018) Guidelines for Fresh and Marine Water Quality, available at: https://www.waterquality.gov.au/anz-guidelines
5.6	The EIS must describe how stormwater will be managed in all phases of the project, including details of how stormwater and runoff will be managed to minimise pollution. Information should include measures to be implemented to minimise erosion, leachate and sediment mobilisation at the site. The EIS should consider the guidelines Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC, 2008).
5.7	The EIS must describe any water quality monitoring programs to be carried out at the project site. Water quality monitoring should be undertaken in accordance with the Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004) available at: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/water/approvedmethods-water.pdf
NSW Department of Planning Industry and Environment - Water	
	The identification of an adequate and secure water supply for the life of the project. This includes confirmation that water can be sourced from an appropriately authorised and reliable supply. This is also to include an assessment of the current market depth where water entitlement is required to be purchased.
	A detailed and consolidated site water balance.
	Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.

Agency and requirements	
	Proposed surface and groundwater monitoring activities and methodologies
	Consideration of relevant legislation, policies and guidelines, including the NSW Aquifer Interference Policy (2012), the Guidelines for Controlled Activities on Waterfront Land (2018) and the relevant Water Sharing Plans (available at https://www.industry.nsw.gov.au/water).

1.2 Authors

The persons involved in the preparation of this investigation, report and its appendices are:

- **Peter Taylor** BSc MEIANZ CIAg LAA

1.3 Consultation

Preparation of this report required consultation with Narrabri Shire Council for the purpose of obtaining water quality data for the Wee Waa Municipal water supply system and water quality delivered by Council. Council provided this information which is referenced within this document.

2 Proposed Development

Students and staff were evacuated from the current Wee Waa High School site due to ongoing health issues in late 2020. Students are currently collocated within the town's primary school, resulting in overcrowding of the site. A Ministerial announcement made on 3 June 2021 committed to the construction of a new High School at Wee Waa on existing Department of Education owned land and adjacent Crown land as an urgent priority. The site is located on Mitchell Street/Kamilaroi Highway and is legally described as Lot 1 DP577294, Lot 2 DP550633 and Lots 124-125 DP757125.

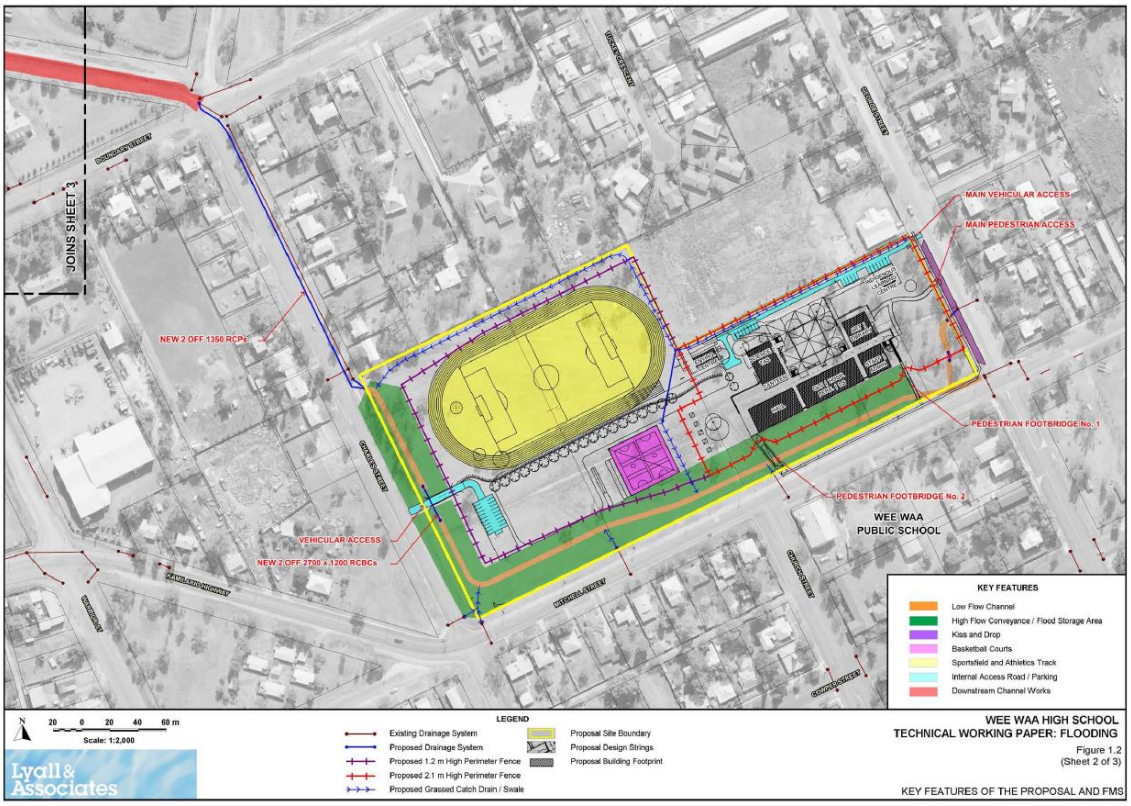
This report accompanies a State Significant Development Application which seeks consent for the construction of a new high school. The school will service 200 students with potential to grow to a total capacity of 300 students, subject to further funding and service need, and 61 staff. The school will include an Agricultural and Environment Centre and an Indigenous Cultural Centre.

A detailed project description is available in the EIS prepared by Ethos Urban.

The development site identified for construction of the new High School is located at 105-17 Mitchell Street in Wee Waa. The land includes approximately 6.03 Ha within the central part of Wee Waa's residential area.

A concept layout has been prepared for the school development. The following image presents the concept layout of the school proposal.

Figure 1: Indicative Layout of Wee Waa High School proposal



The plan included as Figure 2 presents an aerial image of the development site showing the existing Lot boundaries. Local stormwater infrastructure in the form of shallow drains along the southern side of the property can be observed in this image.

The proposed development will result in the school buildings to be located in the eastern sector of the property. Sporting fields are to be developed on the western section. The school will utilise their existing facilities in the eastern part of Wee Waa for agricultural activities.

The existing open grassy woodland area will be retained in the eastern sector of the land. Additional landscaping and tree planting will be carried out to enhance the facility.

It is expected that the buildings will be constructed on raised mounds for drainage and foundation purposes. A new stormwater drainage system will be required to capture stormwater and drain the site. This will connect into the existing stormwater management system in Wee Waa.

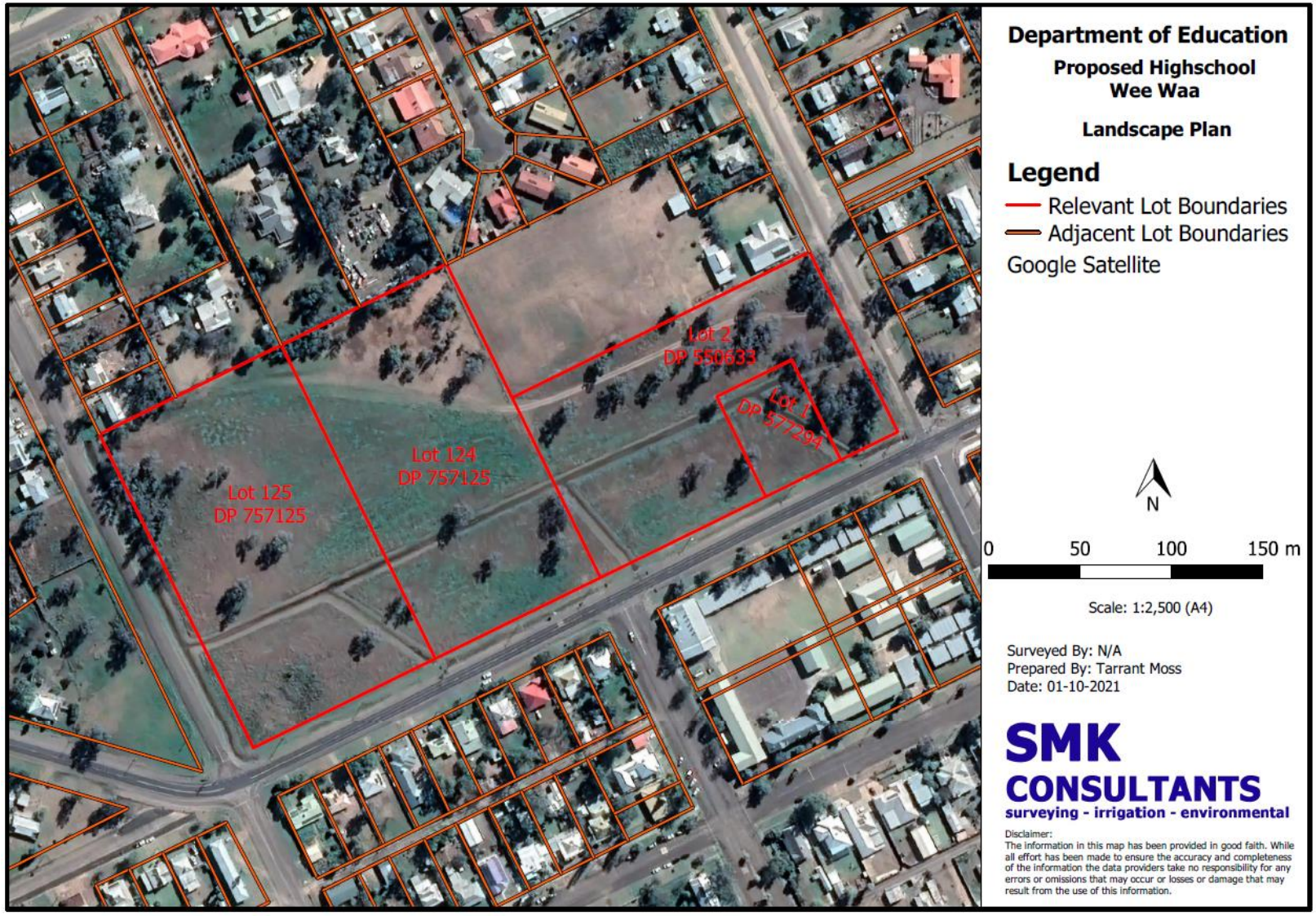


Figure 2: Aerial Image showing Lot boundaries for Wee Waa High School Site

3 Details of an adequate and secure water supply

Wee Waa has a municipal water supply which is based on groundwater from beneath the town area, referred to as the Lower Namoi Alluvium. The Lower Namoi Groundwater Source is made up of sediments that form an extensive alluvial fan deposited by the Namoi River and its tributaries, comprised of clay, silt, sand and gravel. This water source is administered under the *Water Sharing Plan for the Namoi Alluvium Groundwater Sources 2020*. The Plan covers groundwater within the alluvial deposits of the upper and lower Namoi River and its major upstream tributaries. Operation of the Lower Namoi Groundwater Source has been compliant since 2010 according to NSW Government publications.

The Namoi Alluvium is composed of four sustainable diversion limit resource units. Wee Waa is located within the Lower Namoi Alluvium unit. The Water Resource Plan is structured to manage the water source as a sustainable system. Management includes monitoring of groundwater extractions, groundwater depth trends, the movement of entitlements (sale/purchase) within the water source, and overall monitoring of the water source.

An annual extraction limit of 88,255 ML has been established as the sustainable extraction limit for this water source. Local water utilities have access to approximately 4,407 ML of this overall entitlement for municipal use. Total annual extraction can be varied as the plan assesses long-term recharge of the aquifer as a key parameter to determine annual extraction trends. The majority of the groundwater extractions are for irrigation.

Recent publications by the NSW Government indicate a decline in water levels. This is being closely monitored through numerous monitoring bores managed by Government. The monitoring bore data shows regular recharge events which are mainly associated with flood events. Decline in water levels can be closely related to extended periods of dry weather where irrigators use more groundwater due to a lack of surface water from the Namoi River. At present, the NSW Government are indicating that average extractions since the plan was gazetted is in the order of 80,000 ML which is under the sustainable extraction limit.

Water level declines in the past 10-years or more in the Wee Waa area are in the order of between 2m and 4m on average.

In the 2019/20-year, Local Water Utilities (Narrabri Shire Council) used 2,618 ML of their entitlement. Under the Plan, Local Water Utilities do not have a carryover entitlement into the following water balance year and therefore in 2019/20, Council forfeited 1,789 ML of entitlement.

Groundwater entitlement can be temporarily traded and sold within specific zones. In the period 2019/20, approximately 27,000 ML of groundwater entitlement was subject to temporary trade in the Lower Namoi Groundwater Source.

Data published on the NSW Water Register includes trading data, for permanent trades of groundwater in the Lower Namoi Aquifer. For the period of July 2020 - June 2021, the register indicates that permanent trading of 2,456 ML of groundwater occurred in this aquifer. The price of these trades ranged from $3,500 to $4,282.96 per ML where a monetary sale was recorded. Trading, either temporary or permanent, will continue to occur in the aquifer as a result of rules within the Plan.

It should be noted that Council as the local water utility have been allocated more water than they use for supplies to Narrabri, Wee Waa and other towns in their Shire. This local water utility entitlement has a priority over general aquifer entitlements and therefore would not be threatened by other water use. The only potential threat to limitations on the use of local utility water relates to lack of recharge and a significant decline in the aquifer condition during periods of extended drought which would result in a reduction in aquifer recharge. Under such conditions, NSW Government can enact limitations of use to ensure local water utilities are not threatened.

3.1 Wee Waa Town Water Supply

Narrabri Shire Council holds WAL12216 for the municipal town water supply in Wee Waa. WAL12216 has an entitlement of 900 ML. According to Council records, average use for Wee Waa from this supply is 713 ML. This is obtained from two bores drilled to a depth of approximately 58m.

The water supply is chlorinated at the bore heads and then pumped into two reservoirs. The water supply is then gravity fed to the town from the reservoirs.

Council analyses the water quality on a regular basis. This includes weekly analysis of chlorine, E.coli and total coliform levels to check that that no exceedances are occurring. For E. coli and total coliforms, the Australian Drinking Water Guidelines establish a value of zero (0). For the 2019-20 reporting year, Council data shows no exceedances for either parameter, meaning that the water is not affected by localised bacterial contamination. For Chlorine, NSW Health have an exceedance limit of 0.2 mg/L of free chlorine for reporting purposes. Council data shows no exceedances have occurred in the reporting period since 2020/21.

Appendix 2 presents the Annual Report summary table prepared by Council for the period 2019-2020. Council tests the water in Wee Waa three (3) times per year for an extensive range

of parameters in accordance with Australian Drinking Water Guidelines. The data shows no exceedances. All parameters are within the limits set under guidelines.

3.2 Water Available to Wee Waa High School

The Wee Waa High School has two options for a water supply. Option 1 would involve obtaining all of their water requirements for the school, sporting fields, and landscaped areas from the town water supply. This would mean purchasing this water through Council's municipal water supply system. This would be treated potable water.

Alternatively, the school could utilise two sources of water, mainly a potable supply delivered through the municipal town water supply system and an onsite bore with a non-treated water supply for watering of sporting fields, gardens and other landscaped areas.

The potable supply would be deemed as part of the local utility entitlements held by Council and would therefore be highly secure based on the available use data prepared by the NSW Government, where approximately 1,789 ML of this entitlement was not used in the 2019-20 period. This unused water remains available for expansion of water use in Wee Waa if Council needs to transfer the water. At present, Council holds a 900 ML WAL (WAL12216) for Wee Waa and uses an average of 713 ML. This indicates that 187 ML of municipal water remains available in Wee Waa without the need for Council to undertake temporary or permanent transfers from other local utility entitlements.

If the school determined that it wishes to utilise a non-treated supply for watering of fields and landscaped areas, they would need to drill a new bore. The new bore would be considered as a private bore and is unlikely to be licensed as a Local Water Supply or Municipal water supply, thus coming under the entitlements or any exemptions available to the local authority (Council). The school would need to obtain a works approval for construction of the bore and an irrigation or commercial water access entitlement for extraction of water from the aquifer. This is referred to as a water access licence (WAL) under the *Water Management Act 2000*. Once a water entitlement was secured on the open water trading market, the school would then need to apply for an investigation bore licence approval to drill an exploratory bore.

Based on available data, a suitable water supply would be found at a depth of between 35m and 65m below ground level. Once this test bore confirmed a suitable supply, two additional applications would need to be submitted to Water NSW. The first application would be for a production bore which would involve re-drilling of the test bore to an appropriate bore casing size and installation of appropriate bore screens and a pump for extraction of the water. The second application would involve an application to transfer an entitlement to the bore at the school. This second application for the transfer of water would be subject to a review by Hydrogeologists within Water NSW. The parameters of review would include the potential

impact on surrounding water users, the potential impact on the local aquifer, and the permissibility of the transfer under the Plan. The process would involve waiting until Water NSW has completed the review before it is likely that the works approval to develop the bore would be approved.

Based on preliminary assessment, the potential for extraction of groundwater from beneath the school site would be subject to impacts on existing bores. These impacts would primarily relate to drawdown of the local water table and the impact on bores in the local area. The following section of this report describes the local aquifer.

4 Potential impacts on surface and groundwater

4.1 Aquifer Description

Wee Waa is located over an alluvial aquifer (sub-artesian) and an artesian aquifer. The alluvial aquifer is generally located between 10m and 60m. The top of the artesian aquifer is at a depth of 360m and extends to depths of up to 800m or more. Due to the presence of the sub-artesian aquifer, few if any artesian bores have been drilled within the Wee Waa local area. Artesian water is more applicable for stock water supplies outside of the river based sub-artesian aquifers.

The sub-artesian aquifer beneath and around Wee Waa is relied upon for town water, private residential water for mainly gardens within Wee Waa, stock & domestic supplies for local farm residences, and irrigation water outside of the town area.

Appendix 1 presents an aerial image showing the location of registered bores within Wee Waa. A listing of bores has been obtained from the NSW Water Register. This contains records of bores that have been registered through an application process submitted to Water NSW. Some bores do not get registered and therefore they are not recorded on the plan. Such bores may have been drilled prior to a requirement for registration. The database is not updated regularly and therefore the potential exists that some newer bores are not noted on the plan.

The following table presents a sample of bore logs from several of the bores identified on the plan presented in appendix 1. The data has been obtained from the Water NSW Water Information Hub which presents a groundwater map of NSW with registered bore details that have been uploaded into this data base. The data includes location, water source details, drillers log, standing water level, and yield. The data is generally provided by the driller of the bore. Not all drillers log the complete data set.

It should be noted that most bores are drilled to a depth where the required water supply is obtained. For bores within Wee Waa, the majority have been drilled to obtain a supply of water for garden watering. Some may have been drilled prior to the town having a water supply. Some of these bores may be inactive at present.

Two town bores with information on aquifer depth and standing water level have been included in the table. GW057942 is located on the corner of Mitchell and George Streets. The records show that this bore is backfilled. This bore is relatively close to the school site and is therefore representative of the aquifer beneath the school area. GW019905 is located at the public tennis courts in Alma Street and remains active for the town water supply. The bore was drilled in 1962 and encountered three aquifer levels. No yield data is available for this bore but it must have been considered sufficient to provide a suitable water supply for the town.

Table 3: Sample of bores within Wee Waa showing purpose, depth, aquifer depths and standing water levels

Bore Number	Purpose	Final Depth (m)	Aquifer Depth (m)	Standing Water Level (m)
GW021479	Monitoring	153.64	20.1-24.4, 32-35, 48.8-54.9, 70.7-76.8	13.4
GW059728	Stock, Domestic	42.4	35-39.6	15.2
GW902000	Stock, Domestic	45	10.1-20.3, 28.8-36	17.5
GW965523	Domestic	61.8	46.3-47.8, 49.6-52.7, 53.9-57.3	Not recorded
GW966826	Stock	33.5	26.2-30.8	
GW057942	Town Water	59	29-30.5, 34.1-39.1, 43.7-51.8	16.8
GW019905	Town water	29.4	16.7-18.9, 21-22.2, 28-29.3	11.8

Yield from the stock and domestic bores is limited to the bore casing sizes. The casing is generally less than 150mm and yield required for a garden supply is less than 5 litres per second. Yields from the above bores ranged between 2.5 to 3.9 litres per second for stock and domestic use. No records are available on yield from the larger municipal bores. Yield from 300mm diameter irrigation bores outside of the levee bank area are in excess of 25 litres per second.

Based on a search of available bore logs, the sub-artesian aquifer consists of layers of fine and coarse sand with some small gravel. The aquifer is generally recharged from gravel layers in the bed of the Namoi River and some small sand outcrops on the floodplain. Water quality is described as fresh, meaning it has a salinity level of less than 300 µS/cm and fit for all purposes. The aquifer is at a sufficient depth to have a limited risk from surface contamination from sources such as fuel leaks or sewage leakage. The local aquifer is used for the municipal supply with a chloride treatment to ensure the system does not include bacterial or algal contamination.

4.2 Current and future water supplies

As discussed above, the school has two options for obtaining water supplies. The primary water supply with guarantees of being delivered in a potable form and meeting NSW Health standards is the municipal water supply system. This is managed by Council and under regular scrutiny for quality. Based on data presented in section 3.1.1 above, the municipal water supply meets all required standards for domestic consumption.

Based on consumption records, Narrabri Shire has been allocated more local water utility entitlement than what is required to supply towns in the Shire. There is no potential for a future supply of water this system. The Wee Waa town entitlement has an average of 187 ML additional water available for any town water use increase.

If the school determines that they require an onsite water supply, the Lower Namoi Aquifer has an extensive history of water entitlement trading. This will be ongoing and open to the school to purchase an entitlement for primarily use for irrigation of sporting fields, gardens and landscaped areas.

The following plan shows the Trading Management Zones for the Lower Namoi Groundwater Source. The rules of trading limit the trade of entitlements between these Zones.

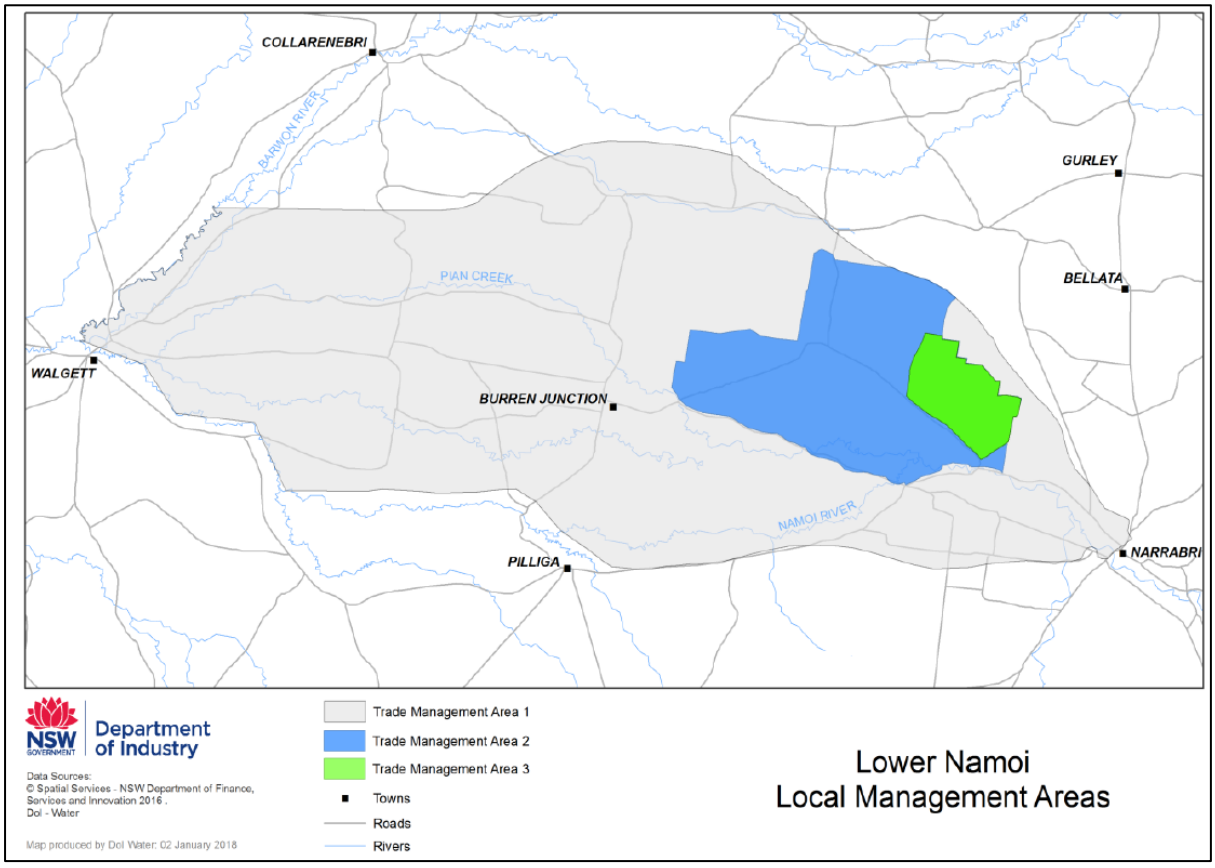


Figure 3: Water Trading Zones in the Lower Namoi Alluvial system.

Wee Waa is located in Trade Management Area 1 according to the plan. The trade of water in this area can occur from a major part of the Lower Namoi aquifer.

In relation to installation of a bore (water supply works), the following rules are listed in the Water Sharing Plan for the Namoi Alluvial Groundwater Sources Order 2020 (Division 2 Access Rules – Part 9 Clause 42):

(3) A water supply work approval must not be granted or amended in the Lower Namoi Groundwater Source or Upper Namoi Groundwater Sources if the water supply work is located within any of the following—

(a) 200 metres of a water supply work that is—

(i) located on another landholding, and

(ii) authorised to take water solely for basic landholder rights from the same groundwater source,

(b) 400 metres of a water supply work that is—

(i) located on another landholding, and

(ii) nominated by another access licence to take water from the same groundwater source,

(c) 200 metres from the boundary of the landholding on which the water supply work is located, unless the owner of the landholding adjoining the boundary has provided consent in writing,

(d) 500 metres of a water supply work that is nominated by a local water utility access licence or a major utility access licence authorised to take water from the same groundwater source, unless the holder of the local water utility access licence or major utility access licence has provided consent in writing,

(e) 400 metres of a Government monitoring or observation bore.

(f) 400 metres of a water supply work located that is nominated by another access licence authorised to take water from the Great Artesian Basin.

The above rules would restrict the location for drilling a new bore on the school grounds. Based on the access rules presented in the Plan, it may be possible to drill a new bore in the southwest sector of the school property to meet the required separation distances. This location is primarily based on the required 500m separation distance from the closest registered town water supply bore. However, it is noted that this closest local water utility access licenced bore is backfilled and no longer in use by Council. In accordance with the above rules, written permission from adjoining landholders would be required.

It is noted that an old house was once located in the northeast corner of Lot 124 DP757125. This house was potentially the original home on a small farm area. A bore remains on this site. The bore once had a windmill. The bore has been abandoned. Debris has been lodged in the casing at a depth of approximately 1m below ground level, making it impossible to investigate the depth or condition of this bore.

Figure 4: Old Bore on Lot 124 DP757125

This bore does not appear on the groundwater register and therefore it has never been registered. Redevelopment of this bore would require extensive flushing and cleaning, which may result in the failure of the bore casing due to age. The Namoi Alluvial Groundwater Sources Order 2020 includes provisions for replacement groundwater works which allow a bore to be redrilled. This provision may allow this bore site to be registered and redrilled, subject to Water NSW approval.

The potential yield from the bore of this size is estimated to be between 3 and 5 litres per second. If this was pumped into a tank at this lower rate, there is potential to use this groundwater to irrigate the sporting field. Registration or redrilling of this bore would be subject to assessment by Water NSW as there is a registered bore on an adjoining property within 80m of this abandoned bore and it is within 400m of the abandoned town water supply bore on Lot 1 DP721486 (Cnr. Mitchell and George Street).

Based on this initial assessment, it is unlikely that approval would be provided for redevelopment of this bore as its use would impact standing water level in the bore located on the adjoining property. If approval was obtained, the extraction rate would potentially be limited to less than 2 L/s in order to avoid impacts on the adjoining bore.

4.3 Water quality

Section 3.1.1 and appendix 2 presents a summary of water quality for the groundwater from beneath Wee Waa obtained from Narrabri Shire Council. The data presented in appendix 2 includes Australian Drinking Water Guidelines limits adopted for town water supplies. These

limits include a range of parameters such as metals, salts, nitrogen compounds, pH, total dissolved solids, hardness, colour, turbidity, E. coli, and total coliforms. The data presented in appendix is a summary of water quality testing for 2019-20 undertaken by Narrabri Shire Council. In total, three water samples were tested for all parameters and 53-samples were tested for E.coli, free chlorine, total chlorine and total coliforms. All test results were within the drinking water limits established under the Guidelines by NSW Health.

Water quality is considered good and relatively consistent. The data presented in appendix 2 is from a period of drought where there was limited recharge occurring to flush or fill the aquifer. This data therefore represents poorer quality water when compared to periods with higher aquifer recharge rates.

The water samples were taken from the town water supply system after treatment. The metals and nutrients should not be impacted by chlorination of the water and therefore offer raw data. The levels of E. coli, chlorine and total coliforms would be impacted by chlorination of the water supply. The data indicates that the chlorination process is working in that no exceedances of E. coli or total coliforms occurred in this reporting period.

If the school relied upon a private bore for its water supply, the level of metals and nutrients would be expected to be the same or similar to the water quality data provided by Council. The potential exists that some localised bacterial contamination may be present in shallow aquifers. This would result from old septic waste disposal systems within the town area or other sources of bacterial contamination. Other sources may include old bores that do not have an appropriate seal around the bore casing which allows local drainage water to seep into the aquifer via the gravel packing around the bore casing. An example of this is the bore identified on the proposed high school property. This bore is abandoned and currently open at the top. Inspection of the bore indicates that a range of waste material has been thrown into the bore which is now blocked with plastic and other unidentifiable objects. This old open bore provides a potential source of contamination. This on occasion includes animals such as snake and frogs. This presents a risk to the potable water supply.

Not all old bores are decommissioned appropriately and therefore the risk of aquifer contamination from uncontrolled or poorly managed bores would be ongoing. Such water would be suitable for irrigation purposes but presents a minor risk for a clean potable water supply required at the school facilities.

4.4 Groundwater Quality Restrictions

Water quality for irrigation purposes is potentially consistent and of good quality with low salinity and no issues of other salts (i.e. Mg) which may impact grass or plant growth.

Consistent water quality for drinking purposes is uncontrolled unless a chlorination system is installed to control the risk of bacterial contamination. However, it should be noted in most cases, local sub-artesian aquifers are consumed without issue of bacterial infection other than in densely populated areas with uncontrolled onsite septic waste disposal systems. The presence of such uncontrolled septic waste disposal systems within Wee Waa would be limited as the town has a sewage waste disposal system and based on available data, all premises within Wee Waa are connected to this system and therefore have no requirement to dispose of wastewater onsite.

The town water supply offers a consistent quality of potable drinking water. Use of this for drinking water at the school would have a significantly lower risk than using bore water pumped from a private bore.

4.5 Water demand at School

The school will require water for students, staff, landscaping irrigation, and water for irrigation of sporting fields. The school is predicted to service 200 students and 61 staff in its current form. An additional master plan module allows this to increase to 300-students.

Based on AS/NZS 1547:2012 Onsite domestic wastewater management (The Silver Bullet), students and staff of a school will generate between 15 and 30 litres per person per day of wastewater. This is based on an unlimited water supply. With an average daily population of 250-staff and students, the school would therefore use between 3.75 KL and 7.5 KL per day. Allowing for 40-weeks of school per year, annual water use is estimated to be in the order of between 750 KL and 1,500 KL per year. This may increase to between 1,050 KL and 2,100 KL for the master plan module stage with an average daily attendance of 350-staff and students.

Based on preliminary plans, the sporting ovals will cover an area of approximately 2.5 Ha. An additional half hectare of the school will be landscaped which would require some water through a controlled irrigation system.

Irrigation of the sporting field would be required throughout winter and summer to maintain the grass cover. The amount of water required will depend on many factors. It is assumed that a turf species will be planted, and an automatic spray irrigation watering system is to be installed. The volume of water applied will depend on the technology included in the watering system. The potential is available to reduce water requirements through mulching and soil improvements as well as an appropriate fertilizer program. The grasses around the field may include more native species such as couch grass. These external areas would require less water but would still require some water to maintain a grass cover.

An overall site water balance is presented in appendix 3. This is based on replacement of evapotranspiration which is simply a calculation of evaporation losses minus average rainfall inputs. The water balance indicates a potential water use of 10.5 ML per Ha. This has been compared to data available from metering records for water of the Moree Golf course, which was determined to be in the order of 8.25 ML per Ha. This included watering of turf and native species. On this basis, the 10.5 ML/Ha as calculated in the water balance can be regarded as a high irrigation rate and therefore maximum probable use of irrigation water to maintain the sporting field and adjoining areas of more native grasses.

Irrigation and water use for landscaping would vary more as a result of the control of irrigation water and seasonal influences. Based on area, there is a potential to utilise up to 4 ML per Ha for native grasses and landscaped areas. The landscaped area may cover an area of 0.25 Ha allowing for pathways, shelters and buildings. This may require 1 ML of water per year, subject to the efficiency of an irrigation system.

Based on the above calculations, the following table provides a potential water use summary for the proposed high school.

Table 4: Potential Annual Water Use

Description	Volume (KL)
Student and Staff use (250-people average)	1,125 (average)
Sporting field (1.6 Ha)	16,800
Landscaping	1,000
Annual water use	**18,925**

Based on the above annual water use, the school would require an average of 1,125 KL of treated water for student and staff consumption and potentially 17,800 KL of water that does not specifically require treatment as it will not be consumed as drinking water. The maximum potential requirement for treated water if the school reaches an average daily population of 350-staff and students, will be up to 2,100 KL.

Peak daily irrigation requirement for irrigation of a sporting oval will be in the order of between 10 and 12mm per day. Based on an irrigation area of 16,000 square metres, peak daily use would therefore be in the order of 192 KL. If this is applied at night over a period of 4-hours, flow rate would be in the order of 13.3 L/s.

4.5.1 Onsite Water Balance for Irrigation

Development of the school has an option to utilise a private water supply via a new bore drilled on the property. Based on the above figures, peak extraction rate from the bore for irrigation of turfed sporting fields would be in the order of 13 L/s or more. Local bores used for domestic purposes have limited extraction rates due to bore casing sizes of 115m to

150mm, and maximum yield would be in the order of 5 L/s. This is due to the potential pump size that can be installed and the area of intake screens. A bore diameter capable of yielding up to 13 L/s or more would need to be in the order of 200mm or larger. Local drawdown may influence a radius of 200m or more around the site. This would need to be assessed by Water NSW as part of a works application and transfer of entitlement to such a bore.

The option available to the school development is to install storage tank/s to balance the water supply system. For preliminary purposes, the sizing of the water tank can be based on an irrigation system applying peak daily demand every 4-days. (4-day watering cycle) For irrigation of the sporting field, one irrigation would utilise approximately 192 KL. Allowing 4-days to pump this water into a tank at a constant low rates, the potential is available to fill the tanks at a rate of 0.55 litres per second over 96-hours. This rate of extraction should have minimal impact on local aquifer water levels or volumes. This may be achievable using a solar pump in preference to a mains powered pump.

Irrigation could occur direct from the tank system. This optional system required for irrigation of the sporting fields and potentially landscaped areas could include:

- Establish a solar powered pump in the southwest or west side of the school ground to pump up to 1.1 L/s (12-hours of daylight);
- Establish a storage tank onsite to provide irrigation water for a peak irrigation event (>192 KL);
- Include potential backup water storage capacity for landscape irrigation (75 KL/week)
- Provide a backup connection to the tank storage from town water supplies in the event of a failed bore pump or water extraction restrictions.

5 Onsite Stormwater and Runoff Management

5.1 Watercourses and Flooding around Wee Waa

Wee Waa is located within the Namoi River floodplain with the Namoi River located to the north of the town and sweeping around to the west of the town. The Namoi River flows in a general southwest direction. Floodwater flows in a westerly direction.

Wee Waa Gully flows along the southern side of the town area and sweeps around the southwest part of the town to link with the Namoi River to the west. Wee Waa Lagoon is located along the south-southeast side of the town along the edge of the levee bank. The lagoon is part of Wee Waa Gully.

Various natural Billabongs associated with the Namoi River are located on the northern side of the town, outside of the town levee. This includes Quinn's Billabong located to the north of the show ground area.

Wee Waa is in the lower Namoi floodplain area. The floodplain is relatively flat and therefore floods which break the bank of the river spread over a large area. The largest recorded flood was the 1955 flood event which peaked at a gauge height of 8.26m at the Mollee gauge. The 1 in 100 (1% AEP) flood event is predicted to reach a level of 8.04m at the Mollee gauge.

Wee Waa is protected from the Namoi River by a levee bank. A 2019 Narrabri Shire Council – Wee Waa levee Risk management study, indicated that the levee at its current height would protect the town from a 1% AEP flood event without severe wind creating waves or a structural failure of the levee bank.

Rainfall falling within the Wee Waa levee bank system is captured within the levee. The levee infrastructure includes outlets to drain this stormwater or if a flood is present outside of the levee, stormwater needs to be pumped over the levee bank. The following sections discuss the levee and management of stormwater within Wee Waa in more detail.

5.2 Wee Waa Stormwater Management Infrastructure

Wee Waa is located on a relatively flat area of land within a surrounding flood protection bank. Stormwater infrastructure within the town area consists of open table drains and sections of pipe culverts beneath roads and to link larger stormwater drains. Several sections of the stormwater system include below ground pipes for a limited distance of up to 200m or less.

Stormwater generally flows in a west and northwest direction. The stormwater drains in the eastern part of the town area, consist of small and shallow table drains associated with roads.

The stormwater travels through these table drains to fourteen (14) flood gates to drain the water through the levee bank which surrounds the town area. Internal detention pond areas are present within the levee banked area to provide a surge capacity during storm events.

Five (5) of the flood gates include a pump to lift the water out of the levee banked area. These pumps are normally activated in a severe rainfall event or a flood event.

Stormwater within Wee Waa drains slowly away because of the flat nature of the town area. The runoff peak discharges over several hours but the stormwater drains remain wet, and ponding remains within drains for several weeks, subject to soakage and evaporation. Most stormwater systems are grassed lined drains which are occasionally mown to improve flow. The presence of grass in the drains has a two-fold effect, mainly to reduce scour but also the grass captures silt and debris within the drains.

The following series of aerial images present historical photographs of the proposed High School site for the purpose of showing some history of the drainage system associated with the proposed high school site.

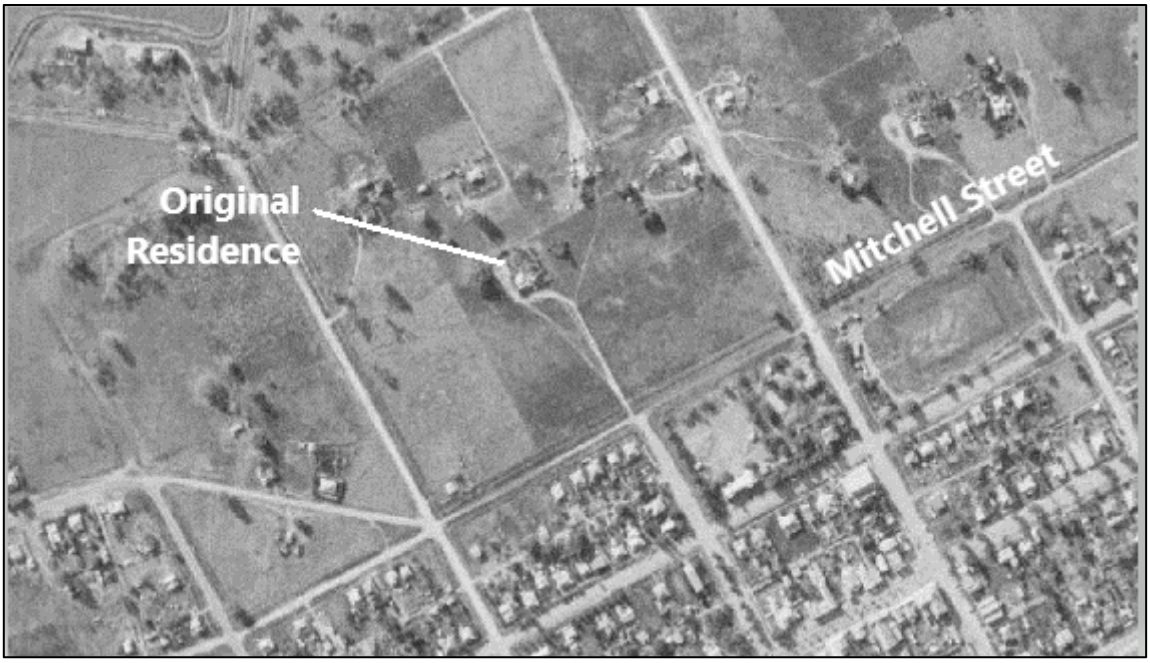


Figure 5: 1964 Aerial Image showing residence and Mitchell Street stormwater drain

The 1964 image shows a driveway and residence on the land under investigation for the High School. This residence is no longer present. The image also shows a drain along the northern side of Mitchell Street. According to local anecdotal knowledge, (Pers. Comm. with Council staff), an open concrete pipe (half pipe) drain was present along the northern side of Mitchell Street. This was decommissioned due to safety issues.

The following 1983 aerial image shows that the original residence is gone. The image shows darker areas of vegetation along Mitchell Street and to the northwest corner of the land chosen for the school. This darker vegetation identifies wetter ground where stormwater may have ponded. This water appears to have originated from George Street to the east.

Figure 6: 1983 Aerial image showing drainage issue on the school site

The following 1989 aerial image shows a stormwater drain running east to west through the middle of the land identified for the school site. This drain remains in place and forms an integral part of the stormwater management system for Wee Waa. Based on observation of table drains and culverts in the current stormwater system after a rainfall event on the 29th of September 2021, the area bound between George Street directly east of the site, Rose Crescent to the south, Maitland Street to the east and John Grey Avenue to the north, drains onto the proposed high school property.

Figure 7: 1989 Aerial image with central stormwater drain

Figure 8: 1998 Aerial image showing central stormwater drain

The 1998 image shows the presence of the central drain through the proposed school property. More current imagery presented in figure 2, shows table drains from Church and Charles Streets enter the Council stormwater drain through the property.

Once the stormwater system reaches Charles Street on the western side of the property, water flows north in a deeper drainage channel, through 200m of buried pipe, under Boundary Street to the north and then flows to Flood Gate-02 and Flood Pump site 02, to be

discharged either through or over the flood protection bank. This water then drains through a stormwater channel, carrying the water directly to the Namoi River to the northwest of Narrabri.

5.2.1 Flood Risk

Lyall and Associates undertook an investigation to assess flooding related issues associated with construction and operation of the Wee Waa High School. This report is included in the overall environmental impact statement for assessment of the school.

Principally, the Lyall and Associates report undertook a review of existing flood conditions, potential impacts from Namoi River flooding, and the potential impact of local catchment runoff from stormwater generated within the town levee bank system.

The outcome of this Lyall and Associates investigation identified a potential risk of stormwater flooding on this site that may pose a risk to construction works, people and adjoining landowners. The investigation has resulted in the design of flood mitigation works (FMW) as part of the school development.

The proposed FMW would result in a significant reduction in the extent and depth of inundation across the local area, including on the proposed school site and adjoining landowners. The flood risk on this site would not be completely eliminated but significantly reduced to an acceptable level.

5.2.2 Proposed Onsite Management of Stormwater

The proposed development site is recognized as an area subject to stormwater flows and inundation. Stormwater is directed to the property by current stormwater drains constructed and managed by Council.

A Construction Soil and Water Management Plan will be prepared as part of the Construction Environmental Management Plan for the proposal. These plans will identify requirements for management of runoff during construction works to avoid erosion or scour from bare surfaces in addition to avoiding wash of materials such as building waste from the site. The actions proposed will include avoidance of storing materials and machinery in lower sections of the site during construction works.

The proposed development is to include redevelopment of existing stormwater drains. The redirected drains will include moving the main central drain impacting the site at present, to the southern side of the property. This drain will carry stormwater arriving on the site from east of George Street and collect stormwater directed to the property from Church Street and

Charles Street. This proposed work will redirect stormwater from Wee Waa into the existing Wee Waa stormwater system.

The system as proposed will include a low flow channel to concentrate smaller storm events. An allowance for a high flow conveyance open-grassed channel is also included in the proposed stormwater drainage works. This larger high flow conveyance channel will involve excavation to a depth of up to 0.8m to create a 20m to 25m wide flood storage area. This will be grassed to provide a non-scouring surface.

The larger conveyance channel has been adopted on this site to provide a stormwater detention area that will store stormwater below levels as predicted in the 2019 Narrabri Shire Risk Assessment report. The system will be enhanced by replacement of two existing stormwater pipes in Charles Street, which are partially blocked at present. These two pipes will be replaced with two 1350mm pipes. This will substantially increase the capacity for stormwater discharge in this sector of Wee Waa. The pipes are to be installed to carry stormwater that has historically accumulated on the property to the pipe outlets referred to as Flood Gate 2 by Council. The pipes at flood gate 2 will be replaced with two 1500mm pipe outlets.

Modelling of the proposal presented in the EIS indicates that the school buildings, and sporting ovals will become flood free in a 1% storm event. At present, such an event would potentially inundate the whole site.

The intent of the high school development is to establish a full grass cover across the property for all areas that are not paved or occupied by a building or structure. This will therefore stabilise the soil surface and avoid any scouring and soil particle removal from the property during a storm event.

The larger conveyance channel is designed to alleviate a requirement for onsite stormwater detention. The alternative option for stormwater management would involve construction of a stormwater detention pond to capture and hold stormwater for a short period. Such a pond would be designed to avoid any significant increase in stormwater discharge rate from the property that could be in excess of current stormwater discharge rates. The purpose of such a pond would also include capturing silt eroded from the property.

A stormwater detention pond on this site would be considered problematic from several perspectives. Firstly, it would create a safety issue for the protection of students and others, if the water depth exceeded 300mm. Secondly, the pond would potentially provide a breeding site for pests such as mosquitos and other insects. Thirdly, a pond may capture uncontrolled flows from the other parts of Wee Waa which would create a potential for weeds and other contaminants to accumulate onsite.

In preference to onsite detention, the proposal for stormwater management on the property involves an upgrade of the stormwater system downslope of the school. The benefit of this will be a significant reduction in potential inundation of the school facilities from stormwater and a resolution to an existing stormwater problem within the Wee Waa town area.

5.3 Stormwater Quality Risks

The proposed stormwater system to be developed on the high school site will receive stormwater from the northeast sector of Wee Waa. This will include open space runoff, and residential runoff. The quality of this water is uncontrolled; however it does not include runoff from any commercial or hazardous areas such as industrial facilities. The runoff is predicted to include dispersed soil and a minor amount of litter. The dispersed soil cannot be controlled as this is a soil property which cannot be changed. The presence of litter in the runoff is also uncontrolled.

Runoff from the high school property will include roof runoff and general runoff from vegetated areas, including the sports oval. The proposal involves capturing this in grassed catch drains in preference to a fully piped stormwater system. The runoff will drain into the grassed channels to be carried west into the existing stormwater system flowing to Flood Gate 2 to be discharged into a larger grassed stormwater drain which then enters the Namoi River.

Open areas of the school are to be grassed or paved. This will cover the soil and therefore protect the soil from some erosion. The soil is naturally dispersive which will result in generation of some silt material, but this cannot be controlled as it is a natural property of the soil. The grass and pavement areas will minimise the amount of soil debris entering the stormwater system.

Predicted maximum water velocities in the stormwater channel system have been modelled by Lyall and Associates to be a maximum of 0.6 m/s in probable maximum flood event. This is considered below scouring velocity for grassed areas and therefore the risk of erosion and loss of soil from the school site is considered minimal. The risk of additional silt or turbidity in stormwater discharging from the site is therefore limited. The impact on water quality leaving the site will be negligible.

No other hazardous materials or substances will be exposed on this site that could potentially enter the stormwater system.

The stormwater system consists of open grassed drains. Lyall and Associates Flood Report included with the EIS states "*due to the relatively flat nature of the land upon which the proposal would be located, flow velocities under operational conditions would be relatively*

mild. As a result, once the area has been fully landscaped, which would include the rock lining of the Low Flow Channel, there would be limited opportunity for scour to occur during a flood event."

The grassed drains will capture some heavier soil particles if parts of the property are disturbed. Water quality in stormwater runoff is predicted to be unaffected by activity on the school property.

The potential for litter entering the stormwater drainage system can be controlled by school management. Such litter may include paper and rubbish dropped on the ground by students. The Wee Waa stormwater system does not include any gross pollutant traps. Rubbish deposited in open areas and roadways is generally collected and cleaned up by Council staff. The issue of litter entering the stormwater system is considered minor.

6 An assessment of salinity and acid sulphate soil impacts,

6.1 Soil Salinity

Surface soils on the Namoi River floodplain near Wee Waa are not noted to have salinity issues. This is reflected in the highly productive cropping land around Wee Waa. Soil salinity is generally classified as a low hazard in the fertile vertosol soils on the floodplain. The exception to this includes areas of raised water table beneath some irrigation farms with poor irrigation management issues which have raised the water table. The raised water table has brought saline issues to within the root zone of the cropped areas.

For Wee Waa town area, no cropping has been undertaken. The vertosol soils have not been affected by a rising water table. Some sodic soils are visible in the eastern sector of Wee Waa. These are mainly associated with the show ground, but this is potentially a result of land use and loss of vegetation cover.
The high school area has a consistent black cracking clay surface soil which extends to a depth of more than 1m. Four selective soil samples were taken from the site to analyse soil salinity, pH and soil dispersion characteristics (Emerson Class number). An aerial image and the certificate of analysis are presented in appendix 4.

pH ranged between 6.8 and 8. The soils in this region are generally slightly alkaline. The pH of 6.8 is slightly low but close to neutral. No acidity issues are present in this region.

Soil salinity ranged between 28 and 60 µS/cm which shows a non-saline soil. This is expected. No salinity issues are present.

The Emerson class number is a representation of dispersibility, with a class 1 soil being highly dispersive and a class 7 soil being non-dispersive. The black or darker clays in the region are considered to be slightly dispersive. The results for the four tests ranged between class 2 and 3. This class of soil will slake in water and disperse once becoming saturated. The dispersed soil will remain in suspension for a prolonged period until the particles settle. Under storm flow conditions, the dispersed soil could not be settled in a detention pond, and therefore flow with the water and settle elsewhere.

The soils on this property have had little or no disturbance for an extended period other than mowing of the grass cover. The soils have an extensive mulch layer and organic matter content in the top 300mm depth. The soils are a heavy cracking clay mostly described as a self-mulching clay.

6.2 Acid Sulphate Soils in Wee Waa

The are no acid sulphate soil issues ever recorded in the Wee Waa region. Acid sulphate soils are more associated with coastal areas. The soils in the Wee Waa region do not have any probability of acid sulphate soil risk.

Appendix 1: Map of registered bores in Wee Waa

Appendix 2: Narrabri Shire Water Quality Summary for Wee Waa town water supply

A.1.2 Verification monitoring – Wee Waa

Summary of NSW Health's Drinking Water Monitoring Program data 2019/20

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Annual Report Narrabri Shire Council 2019-2020

Parameter	Location	Minimum	Average	Maximum	ADWG Limit	No. exceed-ances	No. samples
Aluminium	Wee Waa	0.005	0.005	0.005	0.2	0	3
Antimony	Wee Waa	0.00005	0.0001	0.00005	0.003	0	3
Arsenic	Wee Waa	0.001	0.001	0.001	0.01	0	3
Barium	Wee Waa	0.0588	0.0591	0.0598	2	0	3
Boron	Wee Waa	0.0316	0.0347	0.0402	4	0	3
Cadmium	Wee Waa	0.00005	0.0001	0.00005	0.002	0	3
Calcium	Wee Waa	25.3	26.6667	29.3	10000	0	3
Chloride	Wee Waa	30	32.3333	34	250	0	3
Chromium	Wee Waa	0.0005	0.0005	0.0005	0.05	0	3
Copper	Wee Waa	0.033	0.047	0.062	2	0	3
Fluoride	Wee Waa	0.11	0.1333	0.15	1.5	0	3
Iodine	Wee Waa	0.01	0.02	0.03	0.5	0	3
Iron	Wee Waa	0.005	0.005	0.005	0.3	0	3
Lead	Wee Waa	0.0011	0.0013	0.0014	0.01	0	3
Magnesium	Wee Waa	13.53	14.1533	15.08	10000	0	3
Manganese	Wee Waa	0.00015	0.0003	0.0007	0.5	0	3
Mercury	Wee Waa	0.0004	0.0004	0.0004	0.001	0	3
Molybdenum	Wee Waa	0.0001	0.0002	0.0002	0.05	0	3
Nickel	Wee Waa	0.0002	0.0002	0.0002	0.02	0	3
Nitrate	Wee Waa	6	6.3333	7	50	0	3
Nitrite	Wee Waa	0.05	0.05	0.05	3	0	3
pH	Wee Waa	6.9	7.1	7.3	6.5 - 8.5	0	3
Selenium	Wee Waa	0.0035	0.0035	0.0035	0.01	0	3
Silver	Wee Waa	0.0001	0.0001	0.0001	0.1	0	3
Sodium	Wee Waa	38	39.3333	42	180	0	3
Sulfate	Wee Waa	14	15.6667	17	500	0	3
Total Dissolved Solids (TDS)	Wee Waa	229	304.3333	453	600	0	3
Total Hardness as CaCO3	Wee Waa	119.1	124.8667	135.3	200	0	3
True Colour	Wee Waa	1	1.3333	2	15	0	3
Turbidity	Wee Waa	0.05	0.3167	0.6	5	0	3
Uranium	Wee Waa	0.00005	0.0001	0.0001	0.017	0	3
Zinc	Wee Waa	0.07	0.08	0.09	3	0	3
E. coli	Wee Waa	0	0	0	0	0	53
Free Chlorine	Wee Waa	0.55	0.7457	0.99	0.2 - 5	0	53
Total Chlorine	Wee Waa	0.56	0.7981	0.94	5	0	53
Total Coliforms	Wee Waa	0	0	0	0	0	53

Appendix 3: Water Balance for Sporting Field

Table 5: Water Balance for sporting field based on complete replenishment of evapotranspiration losses

Month	Days	Mean monthly evaporation (mm)	Crop factor	Evapotranspiration (mm)	Area of sports field	Mean monthly rainfall (mm)	Irrigation Potential (mm/month) (Evapotranspiration - rainfall)	Irrigation requirement (KL/month)
Jan	31	316.2	0.7	221.34	16,000	67.3	154.04	2,465
Feb	28	254.8	0.7	178.36	16,000	62.6	115.76	1,852
Mar	31	235.6	0.7	164.92	16,000	64.3	100.62	1,610
Apr	30	171	0.7	119.7	16,000	27.4	92.3	1,477
May	31	111.6	0.7	78.12	16,000	25.2	52.92	847
Jun	30	78	0.55	42.9	16,000	51.1	-8.2	-131
July	31	80.6	0.55	44.33	16,000	29.9	14.43	231
Aug	31	120.9	0.65	78.585	16,000	29.7	48.885	782
Sep	30	168	0.7	117.6	16,000	31.5	86.1	1,378
Oct	31	229.4	0.7	160.58	16,000	39.2	121.38	1,942
Nov	30	267	0.7	186.9	16,000	67.7	119.2	1,907
Dec	31	306.9	0.7	214.83	16,000	69.7	145.13	2,322
Total	365	2340				565.6		16,681

Appendix 4: Certificate of Analysis for Soil Samples

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: ES2135438	Page	: 1 of 2
Client	: SMK CONSULTANTS PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR PETER TAYLOR	Contact	: Customer Services ES
Address	: P.O.Box 774 39 FROME STREET MOREE NSW, AUSTRALIA 2400	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 6752 1021	Telephone	: +61-2-8784 8555
Project	: 21 - 325 Wee Waa High School	Date Samples Received	: 01-Oct-2021 07:25
Order number	: ----	Date Analysis Commenced	: 05-Oct-2021
C-O-C number	: ----	Issue Date	: 11-Oct-2021 16:27
Sampler	: ----		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 4		
No. of samples analysed	: 4		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

RIGHT SOLUTIONS | RIGHT PARTNER

Page : 2 of 2
Work Order : ES2135438
Client : SMK CONSULTANTS PTY LTD
Project : 21 - 325 Wee Waa High School

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	21-325-1	21-325-2	21-325-3	21-325-4	----
				Sampling date / time	30-Sep-2021 00:00	30-Sep-2021 00:00	30-Sep-2021 00:00	30-Sep-2021 00:00	----
Compound	CAS Number	LOR	Unit		ES2135438-001	ES2135438-002	ES2135438-003	ES2135438-004	--------
					Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		6.8	8.0	7.9	7.3	----
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		45	57	60	28	----
EA058: Emerson Aggregate Test									
Color (Munsell)	----	-	-		Very Dark Brown (10YR 2/2)	Very Dark Gray (2.5Y 3/1)	Very Dark Brown (10YR 2/2)	Very Dark Brown (10YR 2/2)	----
Texture	----	-	-		Medium Clay	Light Medium Clay	Medium Clay	Medium Clay	----
Emerson Class Number	EC/TC	-	-		3	2	2	3	----

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EA058: Emerson Aggregate Test