SOILANDWATER

LOT 5 DP 838497, SUTTON

Land Capability Assessment

Version 4
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Servicing the agriculture, conservation and development sectors with soil and water management advice, land capability and soil assessment, erosion control and soil conservation planning, catchment and property planning, and natural resource management policy advice.

Contents

ASSESSOR DETAILS

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John Franklin has over 26 years' experience in natural resource management in the ACT and Upper Murrumbidgee region. This experience includes providing extensive soil and water management advice to State and Local Government and the urban / rural residential development sector across the region. John has detailed knowledge of water resource policy and developed the NSW Farm Dams Policy in 1999 for the Department of Land and Water Conservation and provided strategic support and direction to the NSW water reform process.

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PROJECT DESCRIPTION

Summary

The report incorporates the results of an assessment of land capability for rural and residential subdivision on Lot 5, DP 838497 located on the Sutton road on the edge of Sutton village.

The development proposal involves creating a variety of lot sizes which recognise site and soil constraints, accommodate biodiversity values and reflect the proximity and nature of the existing village, refer **Figure 1**.

The range of lot sizes proposed include:

- **Extended Village Core** – extending from the edge of the current village along Sutton Road and Guise Street with a proposed minimum lot size of 5,000m^2
- **Rural Residential Lots** – radiating out from the Extended Village Core to the south and east with a proposed minimum lot size of 4,000m^2 and an average of more than 2.5 hectares
- **Stewardship Lots** – encompassing areas with identified biodiversity value and allowing for management practices designed to maintain and improve biodiversity values on each lot.

This assessment looks at the capability of the site to support the proposed development based on:

- **Assessment of land capability for on-site effluent management,** based on Appendix C of ANZ Standard 1547:2012, *Site and Soil Evaluation for Planning, Rezoning and Subdivision of Land* and *The Silver Book*;
- **Assessment of land capability for dwelling construction,** based on excluding land within riparian buffer zones, areas of gully erosion or steep land.

Key constraining features investigated include:

- shallow soil/outcropping rock;
- seasonal water logging;
- areas of salinity;
- steep slopes;
- areas of erosion;
- watercourse, riparian and dam buffers;
- stock and domestic bore buffers.

The assessment also considered the potential implications of the development at the local (village) and regional scale. This contextual approach recognises the important issues associated with the adjacent Sutton village with no sewer and a high reliance on bore water for non-potable domestic use.

Additional assessment work has been undertaken to address the riparian issues related to the Yass River and groundwater vulnerability as these are both highlighted in the Yass Local Environment Plan (2013). This assessment work is included as Appendices to this report, refer **Appendix 6 & 7**.

	Complimentary studies also have been undertaken to assess the compatibility of the proposed development with biodiversity values identified on the site and to assess the potential for contaminated land issues on the site. These are both available as separate reports.
Key Findings	The assessment considers that the proposed Extended Village Core minimum lot size of 5,000 m^2, is adequate to sustain on-site effluent dispersal in areas with no significant constraints. In areas which are constrained through drainage, dam or bore buffers, the lot size required to sustainably support on-site effluent dispersal is likely to be larger than 5,000 m^2. A flexible approach which includes a variety of lot sizes ranging upward from the minimum, in response to site specific issues and constraints, is considered an appropriate planning response. The Rural Residential and Stewardship zones are located in more constrained areas than the Extended Village Core. The larger lot sizes of minimum 4,000 m^2, with an average size of 2.5 hectares, are likely to provide a sufficient area of land suitable for effluent dispersal provided that lot boundaries and sizes reflect the constraints identified across these zones, refer **Figure 3**. To minimise the potential impact to the sensitive downslope receiving environments which include Sutton village, vulnerable groundwater aquifers and the Yass River, the following specific management measures are recommended in conjunction with the development: • on-site effluent management is to be limited to secondary treatment systems which include disinfection to maximise the quality of effluent produced and minimise potential detrimental impact to surface or groundwater systems • on-site effluent dispersal is to be limited to surface spray or drip irrigation or shallow subsurface drip irrigation to maximise evapotranspiration and evaporation and minimise potential drainage to groundwater systems • suitable effluent dispersal areas shall be identified for all lots in conjunction with the identification of building envelopes • effluent irrigation systems shall be permanent – fixed or semi-fixed systems which cannot be moved to areas outside the identified effluent dispersal areas to minimise the contamination risk to surface or groundwater systems or neighboring properties • minimum tank storage requirements for roof catchments shall include provisions for all firefighting, potable and non-potable requirements thereby minimising the requirement for the installation of individual groundwater bores It is further recommended that this land capability and constraints assessment be considered in conjunction with the complimentary biodiversity assessment and other planning issues, to refine the development proposal and inform the final location and size of lots across each of the zones.

References	*On-site Sewage Management for Single Households* (The Silver Book) NSW Govt, 1998. *Soils and Construction: Managing Urban Stormwater - 4th Ed. Landcom NSW Government, 2004.* *ANZ Standard 1547:2012 On-site Domestic Wastewater Management* *Soil Landscapes of the Goulburn 1:250,000 Sheet*. Hird,C. (1991) Soil Conservation Service of NSW *Soil Landscapes of the Canberra 1:100,000 Sheet*. Jenkins, B.R. (2000) Department of Land and Water Conservation *Yass Valley Environmental Plan (2013)*
Methodology	The site was inspected on 3 May 2017 and key constraining features with potential to impact on-site effluent disposal and/or dwelling construction were identified and mapped. Slope measurements were taken using a hand-held clinometer. Other constraints were assessed visually The site was stratified into broad soil landscapes within which soil types were considered to be relatively homogenous. Soil from within these soil landscapes were assessed on-site using a hand auger and field tests to determine attributes relevant to effluent disposal (As per AS 1547:2012). In the Village Core Extension area, a soil sample was taken and sent to a NATA accredited laboratory for analysis, refer **Appendix 3**. Testing included: • Cation exchange capacity and exchangeable cations • Electrical conductivity • Emerson aggregate test • pH • Phosphorous sorption capacity • Texture Soil testing was required to validate field testing and ensure the assessment of suitability for on-site effluent disposal in the area of highest lot density, was accurate.

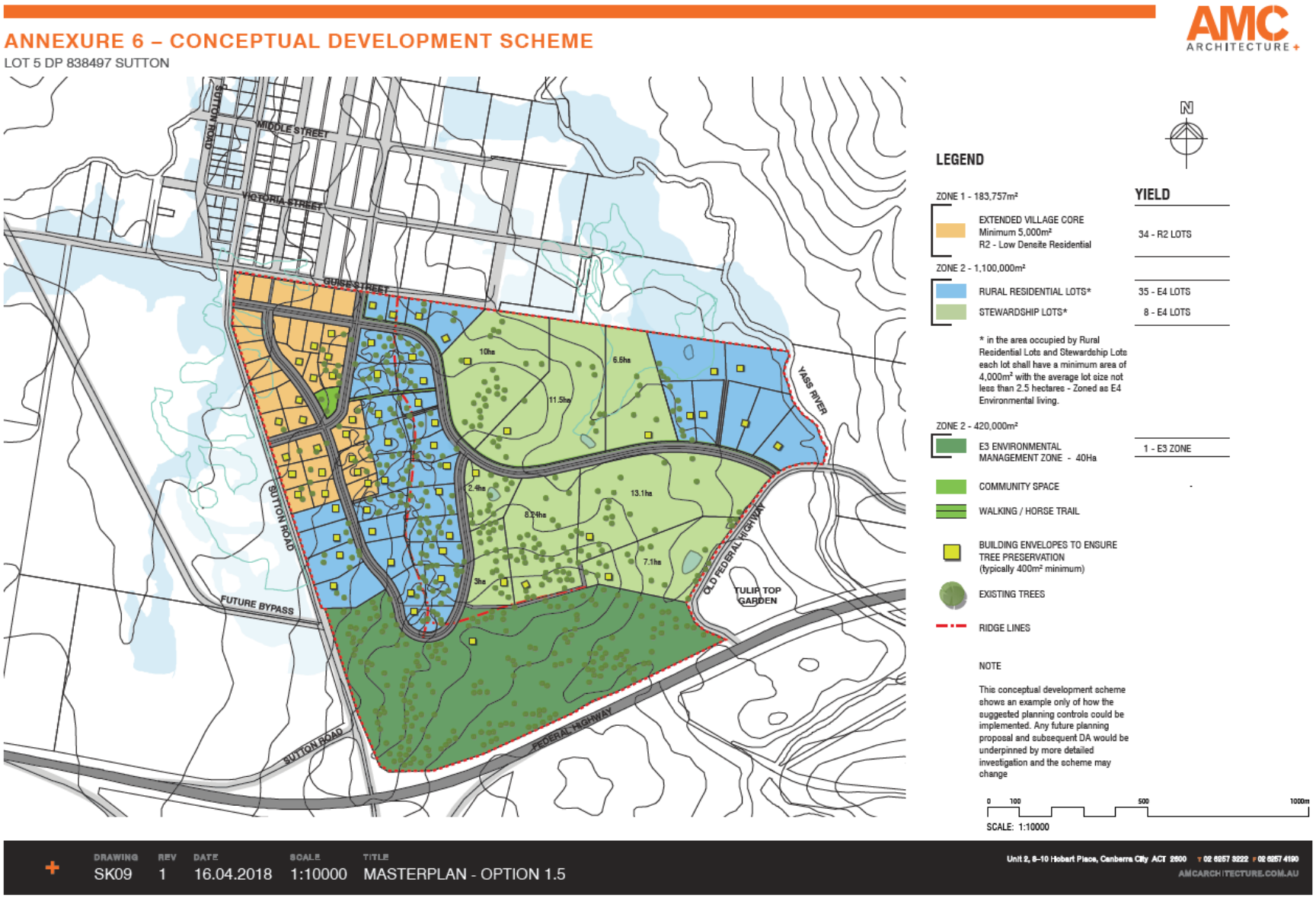


Figure 1: Proposed Subdivision Layout

SITE & DEVELOPMENT INFORMATION	
Local Government Area	Yass Valley Council.
Address	Lot 5 - DP 838497, Sutton Road, Sutton, NSW
Site Location (six.nsw.gov.au)	
Developer(s)	Cartwright Family C/- Tony Carey Consulting <tonycareyconsulting@gmail.com>
Intended water supply	Potable water provided through roof catchment and tank storage. Non-potable water provided through roof catchment and tank storage. Some lots may have access to existing dams. ***It is recommended that the minimum tank storage requirement for each dwelling be sufficient to satisfy potable, non-potable and firefighting requirements and thereby reduce the need for each lot to develop individual additional non-potable water infrastructure such as bores***

Proposed Effluent Management	The development will rely on the individual treatment and disposal of effluent for each lot created by the subdivision. ***To ensure effluent management is sustainable both within and across development lots, it is recommended that a building envelope and separate effluent disposal area be nominated for each block.*** Effluent will be managed on-site by a combination of a NSW Health accredited secondary treatment system with effluent dispersal via surface spray or drip or subsurface irrigation. ***Primary treatment and subsoil absorption systems are not considered appropriate for the development due to potential impacts to groundwater systems and the location of a groundwater reliant Sutton village downslope and adjacent to the development site, and in the same groundwater aquifer system.*** ***It is recommended that effluent disposal systems be fixed, or of limited mobility, to ensure effluent disposal is retained within the area identified as suitable.***
Local experience	Many rural residential developments exist in the area on sites sharing a similar range of constraints. The constraints identified in this assessment should not present any significant problems for the establishment and operation of rural residential land uses and related infrastructure.

Figure 1: Woodland landscape typical of the Rural Residential and Stewardship areas

Figure 2: Cleared low slope lands typical of the Village Core Extension area

SITE & SOIL ASSESSMENT	
Climate	Cool temperate climate with mean annual rainfall of approximately 650 mm, pan evaporation 1200mm; large moisture deficit typically occurs in summer months, small moisture surplus typically occurs in winter months. ***Climate is well suited to dispersal by surface and subsurface irrigation of secondary treated, disinfected effluent.***
Exposure	The majority of the site has a good level of exposure with minimal shading and topographic shelter. The area proposed for Extended Village Core is extensively cleared with scattered mature paddock trees occurring across the site. Likewise, the Rural Residential and Stewardship areas have scattered mature remnant native vegetation which is not dense or extensive enough to present a constraint to the disposal of effluent through reduced evapotranspiration and evaporation. The intent of the development is to retain as far as practical the existing remnant native vegetation on the site therefore the existing levels of exposure are not expected to change as a result of development. If anything, the minimal amount of clearing that may be required to develop infrastructure, and provide suitable Asset Protection Zones for managing bush fire, will increase levels of exposure. The gently undulating nature of the site does not significantly reduce exposure through topographic shading or sheltering. ***Generally, the level of exposure is highly favorable for dispersal of secondary treated effluent via surface or shallow subsurface irrigation.***
Slope	The site displays a range of slope gradients, from very gentle (<3%) to moderate sloping areas (10-15%). These slopes gradients are generally not constraining for effluent dispersal. Slopes above 10% are a moderate constraint for surface and sub-surface effluent irrigation however these slopes only occur in limited parts of the Rural Residential and Stewardship area where larger lot sizes will generally provide an adequate area of suitable slopes for effluent dispersal. In any case, a moderately slope constrained effluent dispersal site can be managed through allowances in the design process to accommodate the reduced efficiency of irrigation on grades >10%. Elevations range between 600 m near the Yass River boundary and 670 m in the south-western corner near the Federal Highway and Sutton Road interchange. ***The area is generally not constrained by slope for dwelling construction or effluent dispersal.***

Landscape/Landform	The landscape is dominated by the elevated area in the south -western corner with two prominent ridges running down from the higher ground to the north and to the north-east. The Extended Village Core is extensively cleared lower slope country with broad minor drainage depressions and a generally divergent landform. The Rural Residential and Stewardship areas are more undulating landscapes with more extensive remnant native vegetation and some more defined minor drainage depressions. Landscapes are generally divergent with broad ridges. Small areas of convergent landscape exist around some of the more defined drainage depressions in lower parts of this landscape. The Soil Landscape on the majority of the site is described as the Bywong Unit in the *Soil Landscapes of the Canberra 1:100,000 Sheet*. Jenkins, B.R. (2000) Department of Land and Water Conservation. This landscape is typified by rolling to undulating low hills, rises and minor flats with gently to moderately inclined slopes (3-20%). Local relief is 30-90 m with elevations ranging between 600-920 m. Vegetation in this landscape ranges from open forest to woodland communities and has been extensively cleared to allow for grazing. There are small areas of the Winnunga and Gundaroo Soil Landscapes associated with the flatter alluvial river flats adjacent to the Yass River boundary. ***The majority of the area has a divergent landscape which is unconstrained for dwelling construction and effluent disposal. Limited areas of convergent landscapes exist and are generally associated with drainage depressions and are therefore already constrained for dwellings and effluent dispersal.***
Surface rock and outcrop	The underlying geology is Ordovician metasediments of the Pittman formation and includes interbedded sandstone, siltstone, shale and minor black shale, chert and impure calcareous sandstone, spotted and prophyroblastic hornfels. The intrusion of the Sutton Granodiorite is evident on this property as areas of outcropping rock. Loose surface rock is also common in areas of the property where rock is close or at the surface. Outcropping surface rock covering more than >10% of the surface shallow rock less than 1 m deep presents a moderate constraint to the dispersal of effluent by surface or shallow subsurface irrigation as proposed for the development. This moderate constraint occurs only in the Rural Residential and Stewardship areas where larger lot sizes will generally provide an adequate area of suitable soils for effluent dispersal. ***There are some areas of rock outcrop or shallow stone which would moderately constrain effluent dispersal. This constraint is restricted to the***

	Rural Residential and Stewardship areas where the localised nature of the constraint can be managed through the provision of the larger lot sizes. The rock outcrop and shallow stone is not generally a constraint to dwelling construction.
Hydrology	The fine silty/sandy loam textured topsoil across the site has a moderate permeability, of 0.5 to 1.5 m/day. The clay loam to light clay subsoils have a lower permeability in the range of 0.06-0.5 m/day (from table M1 of ANZ STD 1547:2012). Approximately 5-10% of annual rainfall forms surface runoff, although in individual high intensity storm events over 50% of rainfall may form runoff. Rainfall that does not form surface runoff is either lost through evaporation and transpiration or infiltrates the soil. Rainfall which infiltrates soil generally drains vertically through the soil profile until it meets a less permeable subsoil layer (e.g. hard pan or clay layer), where a significant proportion drains laterally downslope as subsurface flows. In very permeable highly fractured and vertically dipping bedrock a substantial amount of rainfall infiltrating the soil can move into the local groundwater table. Local groundwater tables can then rise to the point that discharge of groundwater occurs on the surface at points of topographical change (i.e. break of slope) or subsurface bottle necks caused by topography and / or geology. These cause local seasonal waterlogging issues which are compounded by upslope subsurface flows which generally move perpendicular to the contour of the slope and also concentrate in lower parts of the landscape. Drainage in the lower parts of the landscape is inherently slower due to lower slopes. The cumulative impact of the concentration of surface water, groundwater discharge and subsurface flows in these parts of the landscape can be considerable seasonal waterlogging. Development within catchments can change the hydrology by increasing the amount of compacted and non-permeable hard stand areas thereby reducing infiltration and subsurface flows. This is balanced by an increase in surface water runoff. ***Hydrological factors are not a constraint to the construction of dwellings. Effluent disposal will need to be properly designed and located on suitable soil types (including depths) to minimise hydrological impacts from surface or shallow sub-surface irrigation such as effluent run-off or rapid effluent drainage through permeable soil profiles into groundwater systems. Adequate areas of suitable soils exist on the site to mitigate these risks. It is recommended that areas of suitable site and soil condition favourable for effluent dispersal be identified for each newly created lot.***
Soils	A detailed soil profile description is provided in **Appendix 2** of this report.

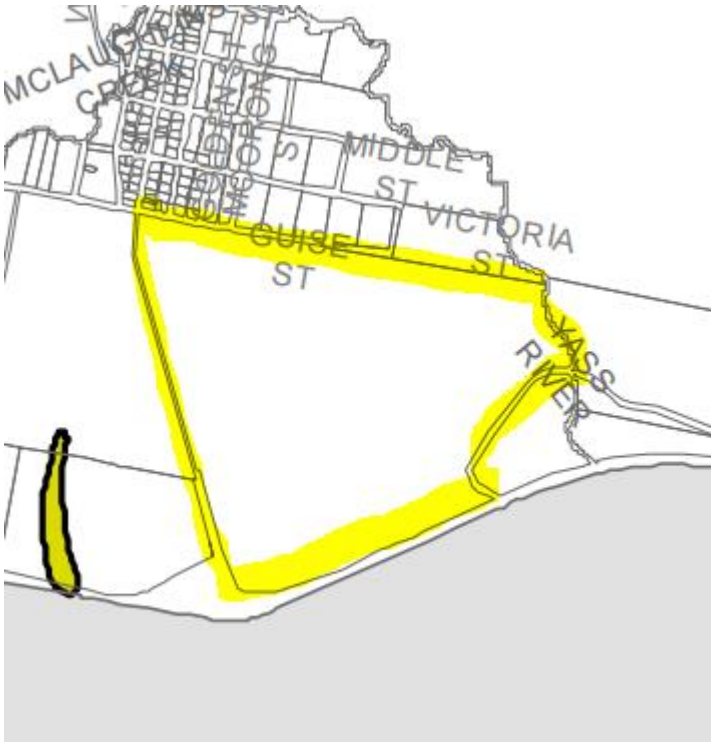
	The soils on the land which is considered generally suitable for effluent dispersal are yellow and brown chromosols. Red Chromosols occur in upper slopes with Brown Chromosols occurring on lower slopes in the landscape These were formed in situ and on alluvial and colluvial material derived from the metamorphosed Ordovician and Silurian sedimentary parent material. Soils comprise a massive, fine sandy loam to silty loam textured upper layer overlying a weak to moderately structured yellow-brown -grey coloured silty to sandy light clay loam subsoil. Soil depth varies considerably but is typically 60-100 cm, with shallower soil in the localised areas of rock outcrop. The undulating to hilly areas coincide with Ordovician and some Devonian and Lower Silurian metasediments which are heavily folded and in parts isoclinal resulting in the occurrence of deep and very shallow soils in the same landform element. Extrapolating from the soil survey of the Canberra 1:100,000 sheet (Jenkins, B.R, 2000), the soils on the gently sloping upper slopes suitable for dwelling construction and effluent dispersal fit the Bywong Soil Landscape Unit. The representative analytical data in the survey report shows a moderate phosphorous sorption level, non-saline subsoils and low exchangeable sodium. As such the soils are free of any significant chemical limitations to effluent dispersal. A soil sample taken from the Extended Village Core area was sent to a NATA accredited Soil Laboratory for testing to validate the suitability of the soil for effluent dispersal as inferred from field testing and Soil Landscape data. The results are presented in **Appendix 3** and confirm that soils are generally unconstrained for effluent dispersal. ***Soils are generally unconstrained for dwelling construction. Soils across most of the development are unconstrained for effluent dispersal.*** ***Soil depth in some upper slopes and crests associated with the Rural Residential and Stewardship areas may be a moderate limitation for some forms of effluent disposal but are well suited to surface or shallow subsurface irrigation recommended for the development.*** ***Lower permeability subsoils (high in clay) are a constraint to effluent disposal by absorption, however this form of effluent dispersal is not recommended for the development due to potential impact to groundwater aquifers important for downslope non-potable water supply in Sutton village.***

CONSTRAINTS ANALYSIS	
Soil erosion	The soil types which dominate the site on the lower slopes and drainage lines are susceptible to erosion, particularly in the topsoil. The undulating areas are also highly susceptible to erosion in both the topsoil and subsoil – combined with the increased slope in these areas results in a considerable erosion risk. Yass LEP 2013 does not map any areas of erosion on the property. The site does however include historic gully erosion associated with minor drainage depressions, refer **Appendix 5**. The majority of these areas are relatively stable because of more conservative stocking practices and the resultant increase in groundcover. Some erosion control earthworks have also been constructed to address some gully erosion sites. Areas of erosion are constrained for the dispersal of effluent due to the potential of effluent irrigation practices to exacerbate erosion and the reduced capacity of eroded soil profiles to assimilate nutrients due to the loss of productive topsoil. Areas near eroded gully lines with depths exceeding 1 m, pose some risk to dwelling construction due to potential instability and the undermining of dwelling foundations by gully head or sidewall collapse. The areas constrained for effluent dispersal and/or dwelling construction due to soil erosion are limited and are generally within the required buffer distances for effluent dispersal and dwelling construction in riparian areas in any case, and therefore already constrained.
	Recommendations • Greater than 70% groundcover be maintained as far as practical in areas mapped as erosion sites (refer **Figure 3**). • The integrity of all erosion control structures be maintained or replaced by site drainage works • Treated effluent should not be dispersed in proximity to erosion control structures as these structures are designed to collect and concentrate flow which is inconsistent with the design intent of effluent dispersal through irrigation. • Areas of erosion should be monitored and remedial measures implemented should erosion persist or worsen. • The construction of dwellings or other buildings should not occur within 10m of gully erosion with depths >1m.
Salinity	Dryland salinity is a significant issue across many parts of the Yass River Catchment and is related to changed landscape hydrology, climate, geology, soils and land management. Salinity impacts grazing and crop production, water quality and contributes to increased erosion which in turn further reduces production and water quality. It is caused by changed land use, including clearing of native perennial deep rooted vegetation and agricultural land management activities, resulting in increased

accessions (recharge) to groundwater tables from rainfall. This results in groundwater tables rising and bringing salts which are contained in geology and subsoil stores into the root zone of vegetation impacting growth and production. In certain parts of the landscape groundwater tables may discharge on the surface in what are called discharge sites. These are particularly vulnerable to reduced vegetative growth and can eventually deteriorate until they are denuded of groundcover and become saline scalds. Once bare, these sites are prone to erosion, particularly given they often coincide with drainage lines and areas of overland flow.

Salinity management often involves the reinstatement of deep rooted perennial vegetation in recharging parts of the landscape in conjunction with reinstating or maintaining good groundcover on saline discharge areas to prevent erosion.

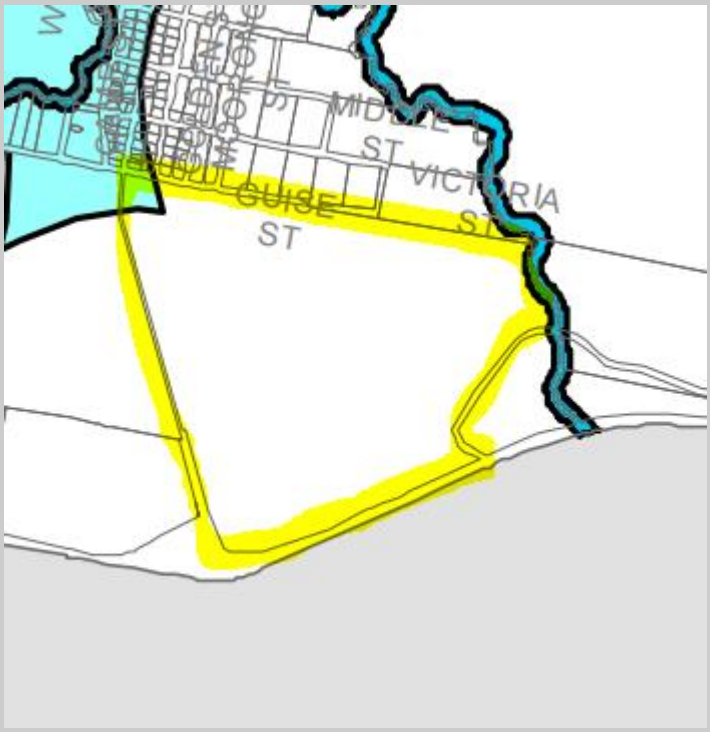
No areas of salinity effected land mapped in the Yass Valley LEP (2013) occur on the property, refer map below. Although none of these areas fall within the property the similar soil types, land uses, geology and landform suggest that it is a potential issue.

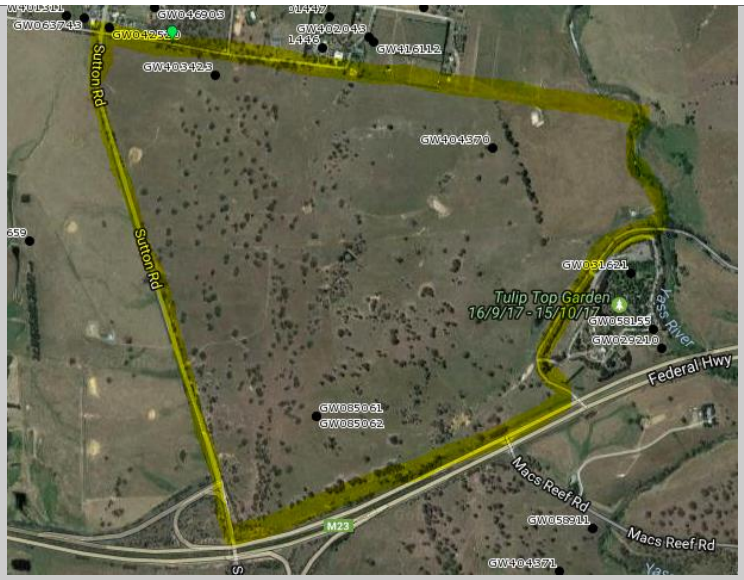


Salinity areas represented by yellow shading

Recommendations

- As far as is practical deep rooted perennial groundcover should be maintained across the property including retaining existing trees and shrubs.
- Effluent irrigation shall not occur in mapped erosion areas, refer **Figure 3**, which could contribute to increased groundwater recharge.

Groundwater	The site is mapped as Moderate groundwater vulnerability on the Department of Land and Water Conservation (2001) Groundwater Vulnerability Map of the Murrumbidgee Catchment. The north-west corner of the property is included on the Yass Valley LEP 2013. Groundwater Vulnerability Map, see below. Yass Valley LEP 2013 includes the following section on groundwater for areas mapped as Groundwater Vulnerable: **6.4 Groundwater vulnerability** (2) This clause applies to land identified as "Groundwater vulnerability" on the Groundwater Vulnerability Map, (see below) (3) Before determining a development application for development on land to which this clause applies, the consent authority must consider the following: (a) the likelihood of groundwater contamination from the development (including from any on-site storage or disposal of solid or liquid waste and chemicals), (b) any adverse impacts the development may have on groundwater dependent ecosystems, (c) the cumulative impact the development may have on groundwater (including impacts on nearby groundwater extraction for a potable water supply or stock water supply), (d) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.  There are approximately 10 stock and domestic bores located within 500m of the groundwater vulnerable north -west boundary of the site, including 2 which are located on the property, see below map. GW 404370 is a registered stock bore with a depth of 101 m and GW 403423 is a registered stock and domestic with a final depth of 66m and water bearing zones at 42-46m and 52-54m.



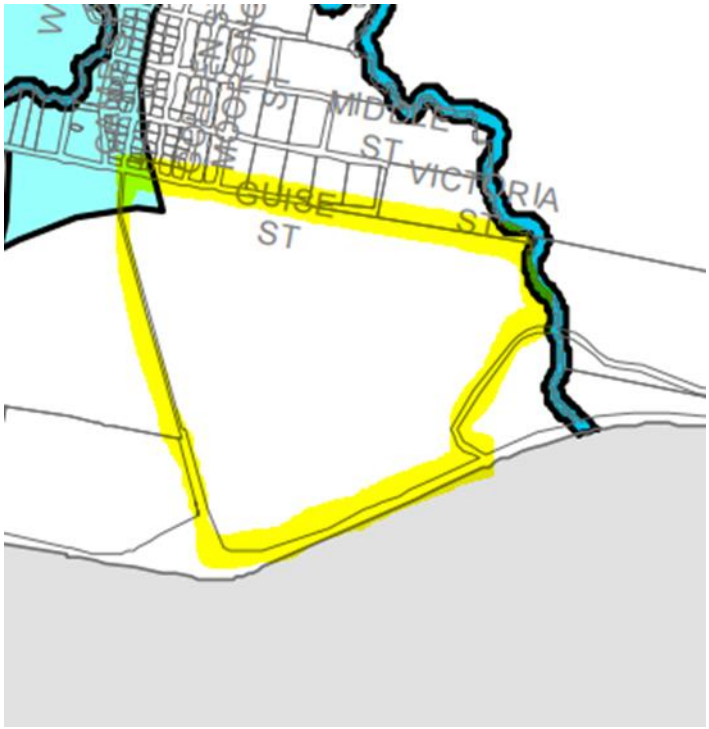
The risk of contamination to the groundwater system resulting from the on-site effluent dispersal practices related to the development are considered manageable due to:

- ability to implement a minimum effluent dispersal buffer distances from existing bores of 50m (maximum as per AS/NZS 1547:2012)
- vertical separation of greater than 40m, including deep cover of low permeability clay subsoil and bedrock, between effluent dispersal areas and water yielding zones
- relatively low application rate of secondary treated disinfected effluent
- application of high quality effluent to the surface or near surface through irrigation maximizing evapotranspiration and minimising opportunity for deep drainage

Recommendations

- Maintain a minimum 50 m buffer between the effluent dispersal areas and any proposed or existing bore
- Minimise the area of effluent disposal to occur within the area mapped as Groundwater Vulnerable in Yass Valley LEP (2013)
- Reduce reliance on new bores for non-potable water supply on the development by maximizing the tank storage of roof catchment required for each dwelling
- Identify suitable effluent dispersal areas for each newly created lot and require irrigation systems to be permanent installations with no or limited mobility
- A water supply work approval must be sought prior to constructing a bore or well even though each landholder is entitled to take water from an aquifer which is underlying their land for domestic consumption and/or stock watering without the need for a water access licence under basic landholder rights (the application is available at www.water.nsw.gov.au and the fee is currently $241.83)

Riparian lands	Yass Valley LEP 2013 includes Yass River and associated riparian areas, which lie adjacent to the eastern section of the property, on the Riparian Lands and Watercourses Map-Sheet CL2_005.



For these areas the Yass Valley LEP (2013) states:

6.5 Riparian land and watercourses

(2) This clause applies to all of the following:

(a) land identified as "Watercourse" on the Riparian Lands and Watercourses Map

(b) all land that is within 40 metres of the top of the bank of each watercourse on land identified as "Watercourse" on that map.

(3) Before determining a development application for development on land to which this clause applies, the consent authority must consider:

(a) whether or not the development is likely to have any adverse impact on the following:

(i) the water quality and flows within the watercourse,

(ii) aquatic and riparian species, habitats and ecosystems of the watercourse,

(iii) the stability of the bed and banks of the watercourse,

(iv) the free passage of fish and other aquatic organisms within or along the watercourse,

(v) any future rehabilitation of the watercourse and riparian areas, and

(b) whether or not the development is likely to increase water extraction from the watercourse, and

(c) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

NSW DPI Office of Water (Guidelines for riparian corridors on waterfront land) also defines appropriate riparian buffers for various stream orders, to maintain the integrity of these sensitive areas, as below:

Figure 2. The Strahler System

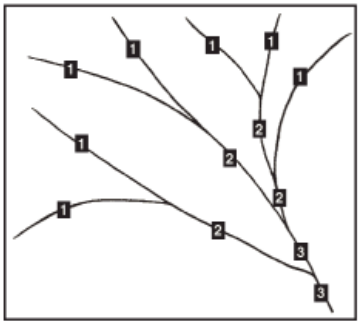


Table 1. Recommended riparian corridor (RC) widths

Watercourse type	VRZ width (each side of watercourse)	Total RC width
1st order	10 metres	20 m + channel width
2nd order	20 metres	40 m + channel width
3rd order	30 metres	60 m + channel width
4th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width

Recommendations

- No effluent disposal is to occur within the 40 m buffer from drainage depressions and water storages as included in **Figure 3**.
- No effluent disposal is to occur within the 100 m buffer from the Yass River as included in **Figure 3**
- No dwelling or related infrastructure construction is to occur within the 10m buffer from first order streams (drainage depressions mapped in **Figure 3**).
- No dwelling or related infrastructure construction is to occur within the 40m buffer from the 4th or higher order stream (Yass River).
- Vegetation and ground disturbance should be minimal within the 10 m buffer from first order streams (drainage depressions in **Figure 3**)
- Vegetation and ground disturbance should be minimal within the 40 m buffer from 4th or higher order streams (Yass River) as mapped in **Figure 3.**

Drainage buffers - effluent dispersal

The *ANZ Standard 1547:2012 On-site Domestic Wastewater Management and On-site* and *Sewage Management for Single Households* (The Silver Book) NSW Govt, 1998, require appropriate buffers between drainage depressions, creeks and rivers and effluent dispersal areas. These include a 100 metre buffer from permanent surface waters including rivers, streams and creeks and a 40 metre buffer from any other water including intermittent waterways, dams and drainage channels.

Approximate locations for drainage buffers are shown in **Figure 3.** It should be noted that the location of drainage buffers associated with the development may change as road and drainage infrastructure is developed. This will be particularly relevant in to the Extended Village Core area. The buffer distance of 40 m from drainage depressions will remain relevant to any new or constructed drainage depressions associated with the development. Where existing drainage depressions, as expressed in **Figure 3**, are altered or removed then the requirement for 40m buffers shall be likewise altered or removed.

	Recommendations • All land designated for effluent dispersal will be located outside 40m drainage depression buffers as mapped in **Figure 3**, or as may be altered or created through the subsequent construction of road and drainage infrastructure for the development**.** • All land designated for effluent dispersal will be located outside 100m major watercourse buffer (Yass River) as mapped in **Figure 3.**
Terrestrial Biodiversity	The existence of remnant native vegetation with specific biodiversity value (as mapped) poses a constraint to effluent disposal as the excessive loading of nutrients associated with effluent disposal practices, can be detrimental to some native vegetation which has specifically adapted to a low nutrient, natural environment. In addition, high nutrient loading can benefit invasive weed species which can then dominant and change the species diversity in an area of biodiversity value. Native vegetation of high terrestrial biodiversity value can also present a constraint to the construction of dwellings and associated infrastructure which often require some vegetation clearing for construction and maintenance, including the provision of bushfire Asset Protection Zones as required by Council. This issue has been specifically assessed in a separate complimentary study which has been provided to Yass Valley Council. The property contains areas mapped as **Terrestrial biodiversity** in the Yass Valley LEP 2013, see below. 

	The Yass Valley Local Environment Plan includes in section **6.3 Terrestrial biodiversity** the requirement for developments to be considered in terms of: (a) whether the development is likely to have: (i) any adverse impact on the condition, ecological value and significance of the fauna and flora on the land, and (ii) any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna, and (iii) any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land, and (iv) any adverse impact on the habitat elements providing connectivity on the land, and (b) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development. Specific recommendations have been designed to address the constraint for effluent disposal posed by terrestrial biodiversity. **Recommendations** • As far as practical effluent disposal areas will not be located within the dripline of significant remnant native trees and vegetation (as may be identified in Council mapping or in complimentary biodiversity studies undertaken for this development.

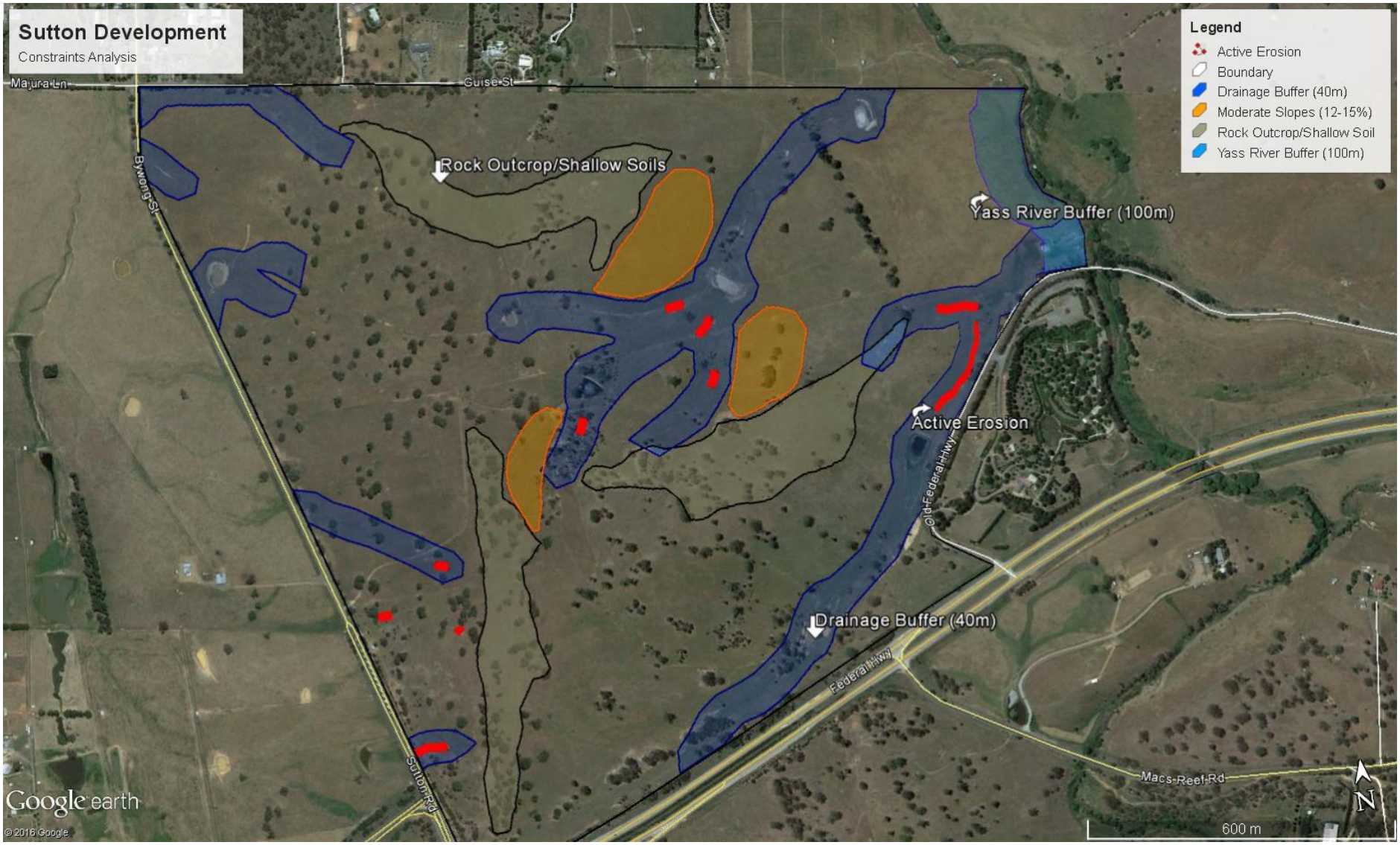


Figure 3: Land Capability Constraints – Effluent Disposal (buffers locations shown are approximate)

CAPACITY OF THE SITE FOR THE ONSITE MANAGEMENT OF EFFLUENT	
Summary	This section evaluates the capacity of the site to sustainably manage effluent onsite through individual effluent management systems developed on each proposed dwelling lot. The evaluation considers the following: • Availability of adequate areas of unconstrained land which are well drained, gently sloping, moderately deep soils and occur outside of mandatory or recommended buffer distances from bores, drainage depressions, dams or rivers cover and therefore suitable for the dispersal of effluent. • Lot density associated with the different forms of development proposed across the site. • Area required for onsite effluent management per dwelling lot based on soil types and the type of effluent management system recommended for the site. • Sensitivity of adjacent and downslope receiving environments including Sutton village, fractured rock groundwater aquifer and Yass River The evaluation includes conclusions as to the capacity of the site to sustain onsite effluent dispersal across the different forms of development proposed for the site.
Availability of suitable land	The majority of the proposed development area is relatively unconstrained for dispersal of secondary treated disinfected effluent by surface or shallow subsurface irrigation, as recommended in this report. The main constraints relate to mandatory buffers from drainage depressions and dams. This constraint potentially impacts the Extended Village Core most significantly due to higher proposed lot densities and coincidence of existing dams and drainage depressions. The development of road and drainage infrastructure associated with the Extended Village Core area may alter the current location and extent of drainage depressions and dams and this may alter the location and extent of constrained areas. Areas of shallow soil and/or outcropping rock are a significant constraint in the Rural Residential and Stewardship areas. The localised nature of these combined with the lower lot densities, result in this being manageable. Some moderately sloping parts of the Rural Residential and Stewardship zones area a moderate constraint for effluent dispersal. This constraint can be managed by location of effluent dispersal outside these areas.

	Areas of erosion are a minor constraint across the site. This is generally gully erosion associated with drainage depressions and is therefore already constrained due to location within the mandatory 40m drainage depression buffers.
Lot densities	The proposed minimum lot size of 5,000 m^2 in the Extended Village Core is the highest lot density proposed for the development. The area where this style of development is proposed generally corresponds to the least constrained land which is extensively cleared, low slope, has minimal outcropping rock, limited erosion and moderately deep soil profiles. In areas within the Extended Village Core zone that coincide with drainage depression, dam and /or bore buffers lot sizes will most likely need to be varied (increased) to accommodate these buffers. Flexibility to vary lot sizes from the minimum 5,000 m^2 to accommodate variability in site and soil conditions, and to generally provide for a range of lifestyle options, is an appropriate planning response to manage the issue in the Extended Village Core zone. The development of final lot layout should accommodate the minimum size required for the sustainable onsite dispersal of effluent as well as biodiversity and other site specific considerations Lot density for the Residential and Stewardship areas includes a minimum lot size of 4,000 m^2 with an average of 2.5 hectares. The areas where these forms of development are planned include the constraints of drainage and dam buffers, erosion, rock outcrops and shallow soils. The localised nature of these constraints should be adequately managed by the proposed flexible block size, larger minimum, and average size of 2.5 hectares. As these areas include the highest biodiversity, a flexible approach will be valuable in accommodating the range of potential constraints in conjunction with maintaining biodiversity values.
Area required for effluent management	The effluent management system considered most appropriate for the site and soil conditions is a NSW Health accredited secondary treatment system which includes disinfection and is connected to surface or subsurface irrigation. The sizing of the effluent irrigation area is based on nutrient balance which gives a general guide to a sustainable area required for effluent irrigation. The size of the area required for effluent irrigation will vary according to the number of bedrooms in the dwelling, which determines the design effluent loading. Based on the hydraulic and nutrient balance shown in **Appendix 3**, the sizing of the irrigation area is shown below:

	Three bedrooms……...325m^2 Four bedrooms……400m^2 Five bedrooms……475m^2 Six bedrooms……550m^2 Council also requires adequate suitable land for a reserve effluent dispersal area. Additionally, buffers with the boundary are required. *The Silver Book* prescribes 6 m from a downslope boundary and 3 m with a cross or upslope boundary. For assessment purposes, a **minimum area of 1,300 m^2** has been used as the benchmark for the area required for the effluent disposal. This is a conservative approach based on an irrigation area for a six-bedroom dwelling of approximately 550 m^2, and accounts for a reserve area and buffers from buildings, boundaries and driveways. This minimum area does not account for drainage, dam or bore buffers nor site specific constraints such as rock outcrops, shallow soils or erosion.
Sensitive receiving environments	The development area is located upslope and adjacent to village of Sutton. Sutton is not sewered and therefore all dwellings currently rely on the on-site treatment and dispersal of effluent. Sutton does not have a reticulated water supply therefore all dwellings also rely on roof catchment and tank water for potable supply and many have bores for non-potable water supply. The high concentration of on-site effluent management systems and non-potable water supply bores, increases the potential for contamination and risks to both public health and the environment. Therefore, it is important that the vulnerability of the groundwater aquifer be considered when evaluating the sustainability of the development. The development also drains to the Yass River which flows along the eastern boundary. The river provides the potable water supply for Yass, Murrumbateman, Bowning and Binalong and is therefore a critically important regional asset. This report developed specific recommendations to ensure that sensitive receiving environments are protected.
Conclusions and recommendations	The following conclusions have been drawn from constraints analysis: • It is considered that the minimum lot sizes proposed for the Extended Village Core area of 5,000 m^2 are adequate for lots located in areas unconstrained by buffers required from drainage depressions, dams and/or bores

	• In Extended Village Core areas which are constrained by drainage, dam and /or bore buffers or other site specific issues, lot sizes will need to be increased to accommodate mandatory buffers or other constraints and provide an adequate area of suitable land for effluent dispersal • In the Rural Residential and Stewardship areas, the minimum lot size of 4,000 m^2 (with an average of 2.5 hectares) should yield an adequate area of suitable land for effluent dispersal provided lot boundaries recognise the significant areas potentially constrained by rock outcrop and/or shallow soils • Lot sizes in Rural Residential and Stewardship areas should incorporate both effluent management and biodiversity needs • Effluent management systems should be restricted to secondary treatment with disinfection connected to surface or shallow subsurface irrigation to minimise the risk of contamination to groundwater aquifers • Effluent dispersal areas should be identified for each lot and dispersal systems should be fixed to ensure dispersal is restricted to the nominated area • Bore construction within the development should be minimised through emphasis on the use of roof catchment and adequate storage

Appendix 1: Site and Soil Limitation Assessment

The following two limitation tables are a standardised guide to the site and soil characteristics which may limit the suitability of the site for effluent disposal and which would require attention through specific management practices. The tables have been reproduced from *On-site Sewage Management for Single Households* (tables 4 and 6, Anon, 1998). The highlighted categories represent site and soil conditions of the land covered in this report. The tables show that the land designated for effluent application has slight to moderate limitations, but no severe limitations.

Site limitation assessment

Site feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Flood potential	All land application systems	> 1 in 20 yrs.		Frequent, below 1 in 20 yrs	Transport in wastewater off site
	All treatment systems	components above 1 in 100 yrs.		Components below 1 in 100 yrs.	Transport in wastewater off site, system failure
Exposure	All land application systems	High sun and wind exposure		Low sun and wind exposure	Poor evapo-transpiration
Slope %	Surface irrigation	0-6	6-12	>12	Runoff, erosion potential
	Sub-surface irrigation	0-10	10-20	>20	Runoff, erosion potential
	Absorption	0-10	10-20	>20	Runoff, erosion potential
Landform	All systems	Hillcrests, convex side slopes and plains	Concave side slopes and foot slopes	Drainage plains and incised channels	Groundwater pollution hazard, resurfacing hazard
Run-on and seepage	All land application systems	None-low	Moderate	High, diversion not practical	Transport of wastewater off site

Site feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Erosion potential	All land application systems	No sign of erosion potential	Minor stabilized sheet and gully erosion	Indications of erosion e.g. rills, mass failure	Soil degradation and off-site impact
Site drainage	All land application systems	No visible signs of surface dampness		Visible signs of surface dampness	Groundwater pollution hazard, resurfacing hazard
Fill	All systems	No fill	Fill present		Subsidence
Land area	All systems	Area available		Area not available	Health and pollution risk
Rock and rock outcrop	All land application systems	<10%	10-20%	>20%	Limits system performance
Geology	All land application systems	None	Small areas of isoclinal fractured regolith outcrop	Major geological discontinuities, fractured or highly porous regolith	Groundwater pollution hazard

Soil limitation assessment

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Depth to bedrock	Surface and sub surface irrigation	> 1.0	.5-1.0	< 0.5	Restricts plant growth
or hardpan (m)	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Depth to seasonal water table (m)	Surface and sub surface irrigation	> 1.0	0.5-1.0	< 0.5	Groundwater pollution hazard
	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Permeability	Surface and sub surface irrigation	2b, 3 and 4	2a, 5	1 and 6	Excessive runoff and waterlogging
Class	Absorption	3, 4		1, 2, 5, 6	Percolation
Coarse fragments %	All systems	0-20	20-45	>40	Restricts plant growth, affects trench installation
Bulk density (g/cc) **SL** **L, CL** **C**	All land application systems	 < 1.8 < 1.6 < 1.4		 > 1.8 > 1.6 >1.4	restricts plant growth, indicator of permeability
pH	All land application systems	> 6.0	4.5-6.0	-	Reduces plant growth
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Restricts plant growth

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Sodicity (ESP)	Irrigation 0-40cm; absorption 0-1.2mtr	0-5	5-10	> 10	Potential for structural degradation
CEC mequiv/100g	Irrigation systems	> 15	5-15	< 5	Nutrient leaching
P sorption kg/ha	All land application systems	> 6000	2000-6000	< 2000	Capacity to immobilise P
Aggregate stability	All land application systems	Classes 3-8	class 2	class1	Erosion hazard

Appendix 2: Soil Profile Descriptions

Soil Profile 1: Mid slope location suitable for effluent dispersal in Extended Village Core area

Soil classification	Depth (cm)	Properties
Red Chromosol	0-20	A Medium brown fine sandy loam, no coarse material, weakly structured, moist and friable consistency, gradational colour change to
	20-80	B1 Red with occasional yellow mottles, silty clay, <5% coarse material as iron rich nodules, weakly structured, moist and firm consistency, gradational colour and textural boundary to
	80->100	B2 Yellow/grey heavy clay, moderate structure, <5% coarse material, moist and firm, continues

Soil Profile 1: Extended Village Core area

Soil Profile 2: Upper slope location constrained for effluent dispersal in Rural Residential area

Soil classification	Depth (cm)	Properties
Tenosol	0-10	A1 Light to medium brown sandy loam, <5% coarse material, weakly structured, dry and friable consistency, gradational colour change to
	10-30	B1 Orange/red-brown sandy loam, 5-10% coarse material, weakly structured, dry and friable consistency, gradational colour and textural boundary to
	30-40	B2/C Grey/white gravelly earth, massive structure, 10% coarse material, moist and firm

Soil Profile 2: Upper slope Rural Residential area

Appendix 3: Soil Test Results

Department of Industry
Soil Conservation Service

SOIL TEST REPORT

Page 1 of 2

Scone Research Centre

REPORT NO:	SCO17/074R1
REPORT TO:	John Franklin Soil and Water GPO Box 837 ACT 2601
REPORT ON:	Two soil samples Your ref:
PRELIMINARY RESULTS ISSUED:	Not Issued
REPORT STATUS:	Final
DATE REPORTED:	24 May 2016
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED
THIS DOCUMENT MAY NOT BE REPRODUCED EXCEPT IN FULL

L Dunn
Scone Laboratory

Scone Research Centre, PO Box 283 Scone 2337, 709 Gundy Road Scone 2337
Ph: 02 6545 1666 Fax: 02 6545 2520

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO17/074R1
Client Reference: John Franklin
Soil and Water
GPO Box 837
ACT 2601

Lab No	Method	C1A/5	C2A/4	C2B/4	C8B/1	P9B/2	
	Sample Id	EC (dS/m)	pH	pH ($CaCl_2$)	P sorp (mg/kg)	EAT	Texture
1	B1 Horizon	0.01	6.7	5.8	730	5	Silty clay
2	B2 Horizon	0.12	8.2	7.6	700	2(1)	Heavy clay

nt=not tested

END OF TEST REPORT

Appendix 4: Effluent Area Design

Water balance	Using the same DIR for spray irrigation on clay loam soils of 3.5 mm/day and adopting the most conservative (i.e. largest) estimate of additional design loading of 720 L/day, the following land application areas are required to manage additional hydraulic loading, nitrogen and phosphorous generated: • **Sizing based on hydraulic loading:** A = Q (l/day)/DIR (mm/day) where A = area; Q = 720 l/day; DIR = 3.5 mm/day A = 720/3.5 = 206 m^2 **Area required = 206 m^2**
Nitrogen balance	• **Sizing based on nitrogen balance:** A = Q(l/day) X TN (mg/l)/L_n (critical loading of TN, mg/m^2/day) where A = area; Q = 720 l/day; TN = 25mg/l (from Silver Book) Assume 20% loss by denitrification; 25mg/l – (25 X .2) = 20mg/l L_n = 15,000mg/m^2/yr (ie 150kg/ha/yr, for introduced species) A = 720 X 20 X 365/15,000 = 350m^2 **Area required = 350 m2**
Phosphorous balance	• **Sizing based on phosphorous balance** A = P_{gen}/(P_{uptake} + P_{sorb}) [P sorption capacity in upper 50cm & 50 year design period] P_{gen} = 10mg/l X 720 X 365 X 50 = 131.4kg P_{uptake} = 4.4mg/m^2/day X 365 X 50 = .080kg/m^2 P_{sorb} = 2250kg/ha = .225kg/m^2 A = 131.4/(.08+ .205) = 461 m^2 **Area required = 475 m^2**
Design effluent disposal area	Therefore, a land application area of approximately **475 m^2** will account for phosphorous, nitrogen and water applied based on estimated connections and usage patterns associated with the construction of a 5-bedroom house. An allowance of a reserve land application area will double this area to **950m^2**. Allowing for up to a 6 bedroom houses (7 occupants) and buffer distances from Lot boundaries, buildings and other infrastructure a typical effluent disposal area of **1,300m^2** has been adopted for the purposes of this assessment.

Appendix 5: Site Photographs

The following photographs have captured some of the key attributes of the proposed development site.

Water logged drainage depression area adjacent to Sutton Road

Erosion control dam in Extended Village Core area upslope of Sutton Road

Undulating landscaped typical of Rural Residential areas

Low slope area of alluvial flats adjacent to the Yass River

Active erosion in minor drainage depression in Stewardship area

Active gully erosion upslope of Sutton Road in Stewardship area

Appendix 6: Yass River Riparian Impact Assessment

Background

The development proposal involves the subdivision of Lot 5, DP 838497 located on the Sutton road on the edge of Sutton village, to create a variety of lot sizes across the following distinct zones:

- **Extended Village Core** – extending from the edge of the current village along Sutton Road and Guise Street with a proposed minimum lot size of 5,000m^2
- **Rural Residential Lots** – radiating out from the Extended Village Core to the south and east with a proposed minimum lot size of 4,000m^2 and an average of more than 2.5 hectares
- **Stewardship Lots** – encompassing areas with identified biodiversity value and allowing for management practices designed to maintain and improve biodiversity values on each lot.

The nature and location of these different zones are designed to accommodate site constraints related to biodiversity, onsite effluent disposal, sensitive riparian areas (Yass River) and vulnerable groundwater systems.

A general assessment of the land capability of the site to support the proposed development investigated key constraining features including:

- shallow soil/outcropping rock;
- seasonal water logging;
- areas of salinity;
- steep slopes;
- areas of erosion;
- watercourse, riparian and dam buffers;
- stock and domestic bore buffers.

Whilst the land capability assessment did not identify major constraints to the development, it focused on the potential for onsite effluent disposal and dwelling construction across the site and not on the range of potential impacts the development may have on the Yass River. Given the sensitive nature of the Yass River riparian zone and downstream receiving environments, and the scale of development and landuse change proposed, it is considered appropriate to specifically assess the developments potential impact to the Yass River riparian zone.

Purpose and Scope

The purpose of this assessment is to identify and analyse the potential impact of the proposed subdivision of Lot 5 DP on the riparian area of the Yass River which forms the north eastern boundary of the lot, refer **Figure A 6.1**.

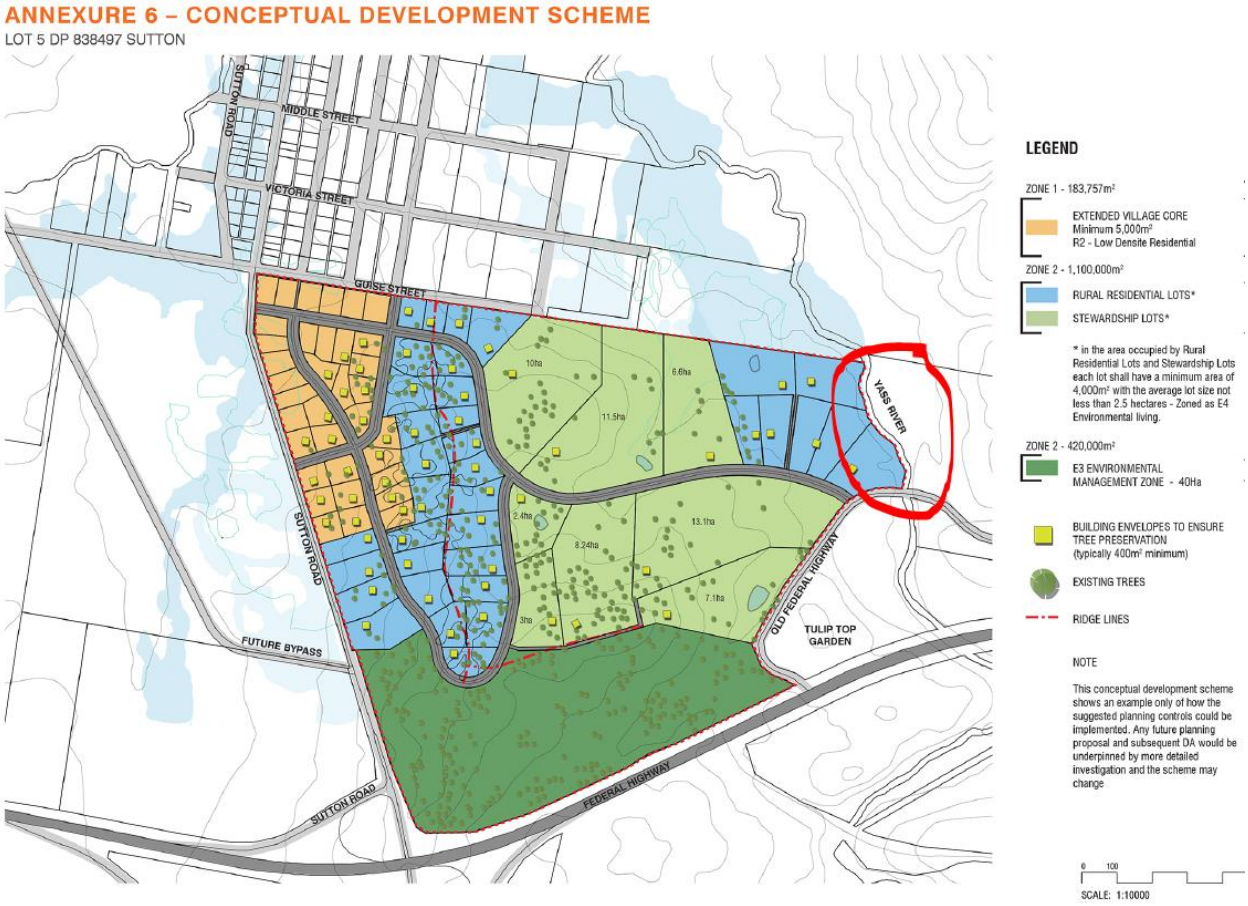


Figure A 6.1: Section of Yass River on the north east boundary of Lot 5

The assessment is intended to provide Yass Valley Council with the information they require to properly consider the proposal given that the area has been identified as Watercourse on the Yass Valley Local Environmental Plan (2013) on the Riparian Lands and Watercourses Map-Sheet CL2_005 (refer **Figure A 6.2)** and therefore requires that the consent authority (Yass Valley Council) consider the following issues:

(a) whether or not the development is likely to have any adverse impact on the following:

(i) the water quality and flows within the watercourse,

(ii) aquatic and riparian species, habitats and ecosystems of the watercourse,

(iii) the stability of the bed and banks of the watercourse,

(iv) the free passage of fish and other aquatic organisms within or along the watercourse,

(v) any future rehabilitation of the watercourse and riparian areas, and

(b) whether or not the development is likely to increase water extraction from the watercourse, and

(c) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

Figure A 6.2: Section of Yass River on the boundary of Lot 5 which is mapped as Watercourse in Yass Valley LEP (2013)

The scope of this report is based on the heads of consideration listed in the Yass Valley LEP (2013) (see previous points a. & b.). For each of the heads of consideration the report considers:

1. potential development related impacts
2. likelihood, consequence and significance of potential impacts identified
3. avoidance and/or mitigation measures available

The report draws conclusions as to the overall impact of the development on the Yass River riparian zone, including downstream riparian environments and water users, and recommends any actions required to avoid or mitigate impacts to acceptable levels.

Findings

The heads of consideration listed in section **6.5 Riparian land and watercourses** of the Yass Valley LEP (2013) are addressed separately in the following sections

water quality and flows within the watercourse

1. potential development related impacts

The development has the potential to impact water quality, particularly in the construction phase, through sediment mobilisation (erosion) on bare and disturbed areas associated with road, infrastructure and dwelling construction. There is also potential for spills of fuel and lubricants from earthmoving equipment and vehicles which could impact water quality if in the upslope catchment of the Yass River. Flows may be impacted during this phase through the direct extraction of water from the system for dust suppression and other construction activities.

Water quality may be impacted in the longer term through the onsite disposal of effluent associated with each of the new dwellings given the development will not be sewered.

Water quantity may be impacted through the direct extraction of water from the river as a Basic Landholder Riparian Right for the newly created lots which have river frontage. Water quantity could be impacted should new lots exercise their Basic Landholder Right to construct Harvestable Rights Dams and intercept runoff before it reaches the Yass River.

Water quantity may also be impacted (increased) through increased runoff associated with the construction of roads and roofs and other hard stand areas.

2. likelihood, consequence and significance of potential impacts identified

The likelihood of impacts to water quality and water quantity associated with the construction phase are considered low to moderate given the majority of intensive activity and infrastructure construction will be outside of the section of the lot which drains to the Yass River, refer **Figure A 6.3**.

Potential extractions from the Yass River for construction would have a negligible and very short-term impact on water quantities and flows available for downstream users and the environment.

The likelihood of significant water quality consequences from onsite effluent disposal is considered low, given the relatively low density of development in the sub-catchment draining to the Yass River and the distance between effluent disposal areas and the riparian zone (including the mandatory buffers of 100m from the Yass River required by Council and the Australian Standards).

Water quantity impacts associated with the creation of additional riparian Stock and Domestic water entitlements on the Yass River are considered low given the limited number of additional blocks with riparian frontage (and therefore a Basic Landholder Right to extract water), and the limited extraction volumes associated with stock and domestic use on small lots. Similarly, the water quantity impact associated with the construction of additional Harvestable Right dams is considered low as there are only a limited number of lots which have a Harvestable Right large enough to enable a feasible dam storage to be constructed, (generally only lots larger than 11 hectares), some of which already have farm dams.

The likelihood of the development to significantly increase flows in the watercourse as a result of increased runoff is considered low due to the limited hard surface infrastructure to be developed in the portion of the lot draining directly to the Yass River.

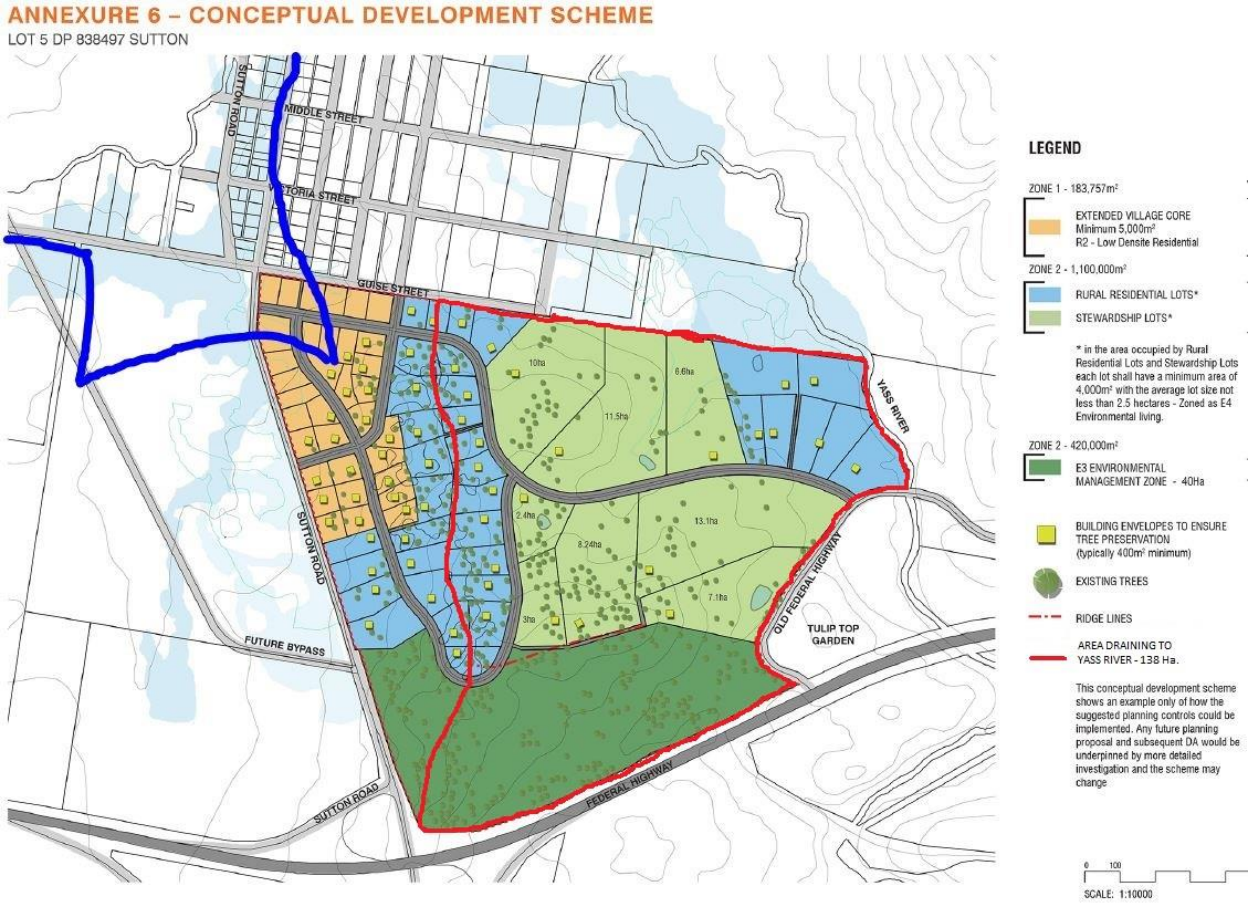


Figure A 6.3: Section of Lot 5 draining directly to Yass River

3. avoidance and/or mitigation measures available

Measures to avoid or mitigate potential water quality and quantity impacts include:

- Soil and Water Management plans for the construction phase detailing temporary and permanent sediment and erosion control structures
- Bunded storage of any fuels, lubricants or chemicals stored on site during construction
- All water extractions for construction are to be appropriately licensed with cease to pump conditions to protect flows during dry periods for downstream users and the environment (including the Yass town water supply)
- Onsite effluent disposal areas to be identified for each lot prior as part of the final subdivision layout
- Onsite effluent assessments to be required for each dwelling lot
- Onsite effluent disposal systems to be restricted to secondary treatment systems with disinfection

- Effluent irrigation systems on lots fronting the Yass River to be permanent (fixed) or semi-permanent systems which cannot be extended to within the 100m buffer zone of the Yass River
- Final lot layout should minimise the creation of lots with riparian frontage and/or create a riparian corridor along the river which avoids the creation of additional riparian stock and domestic rights
- A reticulated non-potable water supply could be developed for the subdivision which would remove the need for individual lots to access their own water source from Yass River or surface water storages (dams)
- Water sensitive urban design principles could minimise changes to the balance between infiltration and runoff resulting from the development, for example grass swale road drainage

aquatic and riparian species, habitats and ecosystems of the watercourse

1. *potential development related impacts*

The development has very limited potential to impact aquatic and riparian species, habitats and ecosystems within the watercourse as there are no requirements for crossings or the development of any infrastructure within the riparian zone.

The increased number of domestic dwellings in the vicinity of the riparian corridor may increase the potential for domestic (garden) weed species to escape and impact natural riparian systems. Domestic pets, particularly cats, could also impact native fauna species within the riparian zone. Increased human visitation could impact riparian habitats and ecosystems through damage to sensitive vegetation or the disruption to the natural life cycle of native fauna species.

2. *likelihood, consequence and significance of potential impacts identified*

The likelihood that the increase in domestic dwellings and human interaction with the riparian zone will result in significant impact on aquatic species, habitats or ecosystems, is considered to be low. This is due to the majority of the higher density development being located some distance from the riparian zone, therefore the likelihood of significantly increased visitation or a large increase in the number of, and impacts associated with domestic weeds and pets is low.

3. *avoidance and/or mitigation measures available*

Measures to avoid or mitigate impacts include:

- Restricted public access to the riparian zone as it is to be retained in freehold ownership of the adjoining lots
- Public education about the importance of restricting the free movement of domestic animals
- Public education about the importance of weed control
- Improving the resilience and ecological value of the riparian zone through the development and implementation of a Riparian Landscape Management Plan (see section on future rehabilitation of watercourse and riparian areas).

stability of the bed and banks

1. *potential development related impacts*

There is limited potential for the development to impact on the stability of the bed and banks as there is no requirement for crossings or the development of any infrastructure within the riparian zone. There is small potential for the development to impact the stability of the bed and banks should the new lots adjacent to the riparian zone install pump pads on the steep banks to access stock and domestic water from the Yass River. The access of livestock to the riparian area also has potential to impact the stability of the steep banks through stock tracking and erosion. The existing condition of the bed of the watercourse is stable and consists of a series of large waterholes providing refuge and habitat for aquatic species even during periods of low flow, refer **Figure A 6 4.** The banks of the watercourse are also relatively stable with only a small section of bank erosion towards the northern end of the reach, refer **Figure A 6 5**.

Figure A 6 4: Stable watercourse bed with a series of large waterholes

Figure A 6 5: Small section of bank erosion in the northern end of the reach

2. likelihood, consequence and significance of potential impacts identified

The likelihood that there will be a significant impact to the stability of the bed and banks of the watercourse is low as there is no requirement for the installation of major infrastructure and limited potential for small scale pumping infrastructure to adversely impact the site as practical installation sites will generally be on level ground above the steep banks. The likelihood that new lots will allow stock access to the riparian zone is low as the river does not provide a stock proof boundary and stock allowed into this area may be lost.

3. avoidance and/or mitigation measures available

The small potential that exists for impacts to the stability of the bed and banks can be further mitigated through:

- Requirement to have Controlled Activity Works Approval prior to the installation of any pump site within the riparian zone
- Provision of new stock proof riparian fencing for lots adjacent to the Yass River
- Managing the riparian zone to achieve 100% groundcover (vegetation) as part of the implementation of a Riparian Landscape Management Plan (see section on future rehabilitation of watercourse and riparian areas).

free passage of fish and other aquatic organisms

1. potential development related impacts

The development has very limited potential to impact the passage of fish and other aquatic organisms as there is no requirement for crossings or the development of any infrastructure within the riparian zone. The current condition of the watercourse in the section adjacent to the development provides few restrictions to fish passage and consists of a series of large waterholes which are linked in periods of low-medium flows. There is a potential risk to continued fish passage from the proliferation of willows in the riparian zone which can impact extent of, and water quality in the large water holes. Whilst this impact is unrelated to the development it is important as the Yass River is identified as key fish habitat therefore the maintenance of the current unrestricted fish passage is critical, refer **Figure A 6 6**.

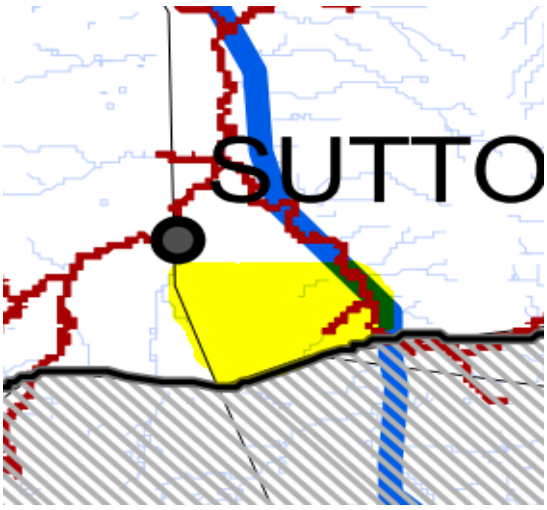


Figure A 6 5: Key Fish Habitat Mapping (NSW DPI) indicating Yass River as key habitat

2. likelihood, consequence and significance of potential impacts identified

There is a very low likelihood that the development will impact fish passage or the movement of aquatic organisms. The impact (not related to the development) of willows reducing fish passage and aquatic habitat value is likely to eventuate (assuming willows remain uncontrolled) and have a significant impact in the longer term (>10years).

3. avoidance and/or mitigation measures available

The potential impact of willows reducing aquatic habitat value and fish passage (not specifically related to the development) could mitigated by:

- Managing vegetation in the riparian zone for ecological outcomes including the removal of problematic willow species as part of the implementation of a Riparian Landscape Management Plan (see section on future rehabilitation of watercourse and riparian areas).

future rehabilitation of the watercourse and riparian areas

1. potential development related impacts

The subdivision of riparian land along Yass River to create multiple lot has the potential to make future rehabilitation efforts more complicated due the need to get the cooperation and involvement of multiple landholders in order to be rehabilitate the entire riparian corridor. Conversely, the level of motivation and financial capacity of new landowners with off-farm incomes, may lead to greater momentum for riparian rehabilitation projects.

The current condition of the riparian corridor is geomorphologically stable (very limited erosion of the bed or banks) however the riparian vegetation is dominated by weed species including willows, blackberries and gorse interspersed with few remnant native trees and shrubs, refer **Figure A 6 7**. There are also some aquatic native plants such as Cumbungi and Phragmites.

Figure A 6 7: Riparian vegetation dominated by willows, blackberries and gorse.

2. likelihood, consequence and significance of potential impacts identified

On balance the likelihood of future riparian rehabilitation being undertaken is unlikely to be impacted by the development. The consequence of riparian rehabilitation not being undertaken however, would be significant as the dominance of exotic weed species in the riparian corridor will continue to degrade the already depleted ecological and habitat values of the area.

3. avoidance and/or mitigation measures available

The following measures could avoid the possible increased complexity in undertaking riparian rehabilitation and the associated negative outcomes of not undertaking this work:

- The developer could develop a Riparian Landscape Management Plan which details:
    - Riparian Land Management Goals
    - Ecological values of the area
    - Key Threatening Processes
    - Short-Term Actions required to deliver the Land Management Goals and address the Key Threatening Processes; e.g. revegetation with native trees and shrubs, willow control, weed management, rabbit control
    - Long-Term Actions required to maintain the riparian zone and continue to deliver improved ecological and habitat outcomes; e.g. weed management program, feral animal control program, fire suppression
    - Monitoring and Maintenance Program
- The developer could implement the Short-Term Actions identified in the Plan which would address the major issues across the riparian zone efficiently and effectively and result in a stable riparian zone which was within the capacity of the new landowners to manage
- New landholders could implement the Long-Term Actions in the Plan to maintain and improve the ecological values of the area.

increase water extraction

1. potential development related impacts

The potential for the development to result in increased water extraction from the Yass River have been discussed in the 'water quality and flows within the watercourse' section. They include water extraction for dust suppression and construction related uses, extraction by the newly created lots with riparian frontage for stock and domestic use and interception of run-off in farm dams constructed on new lots for stock and domestic water use.

2. likelihood, consequence and significance of potential impacts identified

The extraction of water for construction purposes (if required and approved) will have a minor and very short-term impact. Increased extraction for stock and domestic purposes on lots adjacent to the river will have a longer term but relatively minor impact given the small number of lots with riparian rights to extract from the river (i.e. those which have river frontage) and the small volumes involved in stock and domestic use on small lots. The likelihood that additional Harvestable Rights farm dams will be constructed is low given the low number of lots with sufficient size to support a viable dam storage (>11 hectares).

3. avoidance and/or mitigation measures available

Avoidance and mitigation options include:

- All water extractions for construction are to be appropriately licensed with cease to pump conditions to protect flows during dry periods for downstream users and the environment (including the Yass town water supply)
- Final lot layout should minimise the creation of lots with riparian frontage and/or create a riparian corridor along the river which avoids the creation of additional riparian stock and domestic rights
- A reticulated non-potable water supply could be developed for the subdivision which would remove the need for individual lots to access their own water source from Yass River or surface water storages (dams).

Conclusions

The layout of the proposed subdivision, including the location and nature of the three distinct zones, has been effective in avoiding and mitigating many potential impacts to the Yass River riparian zone by locating the majority of the higher density development in a separate sub catchment which doesn't drain directly to the Yass River. Whilst the entire development ultimately drains to the Yass River, the physical separation between the more intensive rural residential landuse and the sensitive receiving environment (Yass River) assists in mitigating impacts, particularly those related to water quality.

The development related impacts which have been identified generally have a low to moderate potential to significantly impact the Yass River riparian zone. The issues with greatest potential impact are the onsite disposal of effluent and increased water extractions from stock and domestic water use on riparian lots.

There are a multitude of suitable avoidance and mitigation measures available for all impacts identified which would reduce the likelihood and significance of these impacts to reasonable levels.

There is an opportunity for the proposal to deliver a net environmental benefit to the Yass River riparian zone through the development and implementation of a Riparian Landscape Management Plan. This would help address the existing degraded riparian environment, resulting mainly from the prevalence of weed species, and increase ecological and habitat values through revegetation with endemic native species.

Recommendations

It is recommended that the impact avoidance and mitigation measures listed be considered in the final subdivision design and lot layout and that a suitable suite of measures be adopted to adequately manage all potential impacts.

Particular consideration should be given to those measures which can help address multiple impacts such as the provision of a reticulated non-potable water supply and the development of a Riparian Landscape Management Plan.

Appendix 7: Groundwater Impact Assessment

Background

The development proposal involves the subdivision of Lot 5, DP 838497 located on the Sutton road on the edge of Sutton village, to create a variety of lot sizes across the following distinct zones:

- **Extended Village Core** – extending from the edge of the current village along Sutton Road and Guise Street with a proposed minimum lot size of 5,000m^2
- **Rural Residential Lots** – radiating out from the Extended Village Core to the south and east with a proposed minimum lot size of 4,000m^2 and an average of more than 2.5 hectares
- **Stewardship Lots** – encompassing areas with identified biodiversity value and allowing for management practices designed to maintain and improve biodiversity values on each lot.

The nature and location of these different zones are designed to accommodate site constraints related to biodiversity, onsite effluent disposal, sensitive riparian areas (Yass River) and vulnerable groundwater systems.

A general assessment of the land capability of the site to support the proposed development investigated key constraining features including:

- shallow soil/outcropping rock;
- seasonal water logging;
- areas of salinity;
- steep slopes;
- areas of erosion;
- watercourse, riparian and dam buffers;
- stock and domestic bore buffers.

Whilst the land capability assessment did not identify major constraints to the development, it focused on the potential for onsite effluent disposal and dwelling construction across the site and not on the range of potential impacts the development may have on the underlying groundwater system. Given the vulnerable nature of the groundwater system in this location, the strong reliance that the adjacent Sutton village has on this resource to meet non-potable water needs, and the scale of development and landuse change proposed, it is considered appropriate to specifically assess the developments potential impact on the groundwater system.

Purpose and Scope

The purpose of this assessment is to identify and analyse the potential impact of the proposed subdivision of Lot 5 DP on the vulnerable groundwater systems which underlay a small part of the site and upon which the adjacent village of Sutton rely for non-potable water supply, refer **Figure A 7.1**.

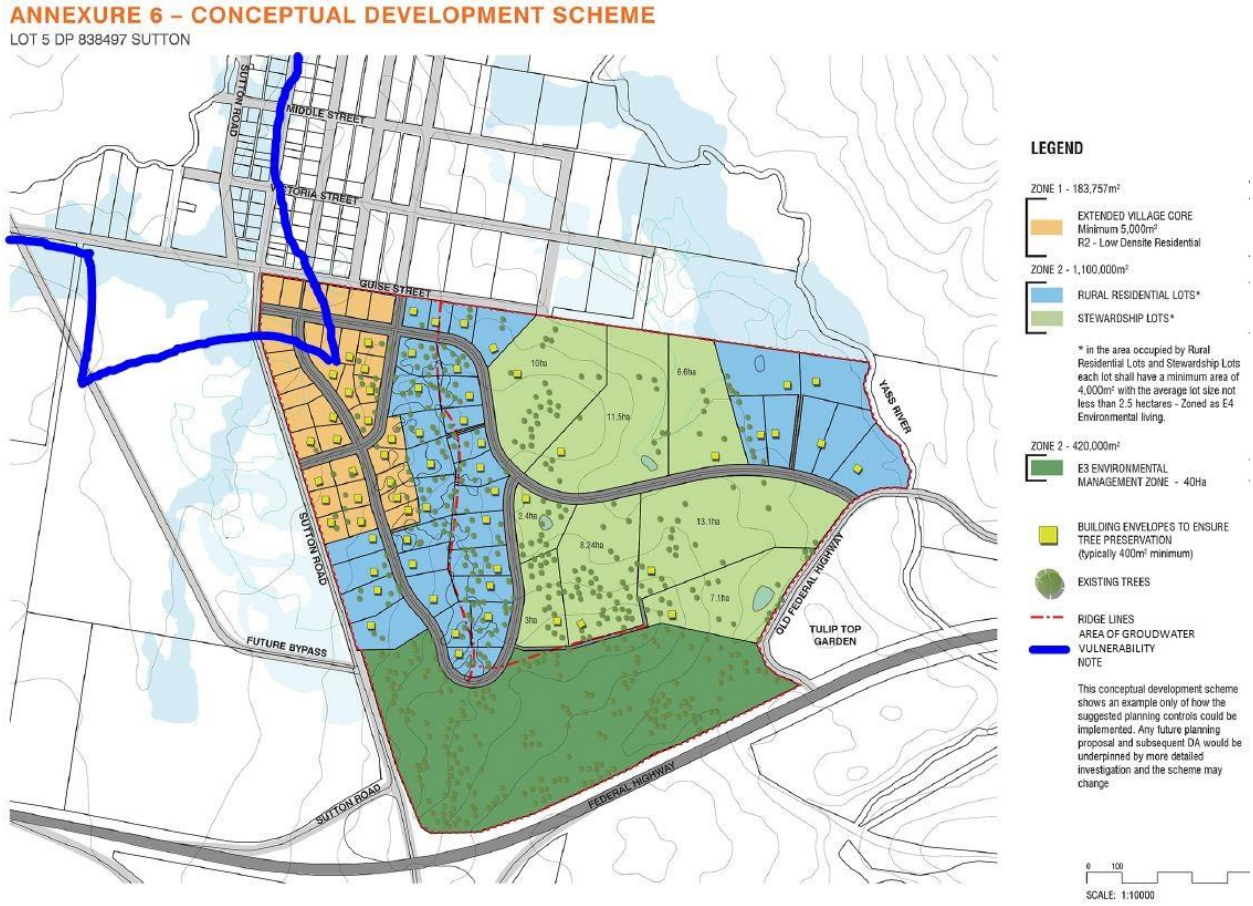


Figure A 7.1: Section of groundwater vulnerability in the north west corner of Lot 5

The assessment is intended to provide Yass Valley Council with the information they require to properly consider the proposal given that a small part of the area has been identified as having Groundwater Vulnerability on the Yass Valley Local Environmental Plan (2013) on the Groundwater Vulnerability Map-Sheet CL2_005 (refer **Figure A 7.2)** and therefore requires that the consent authority (Yass Valley Council) consider the following issues:

(a) the likelihood of groundwater contamination from the development (including from any on-site storage or disposal of solid or liquid waste and chemicals),

(b) any adverse impacts the development may have on groundwater dependent ecosystems,

(c) the cumulative impact the development may have on groundwater (including impacts on nearby groundwater extraction for a potable water supply or stock water supply),

(d) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

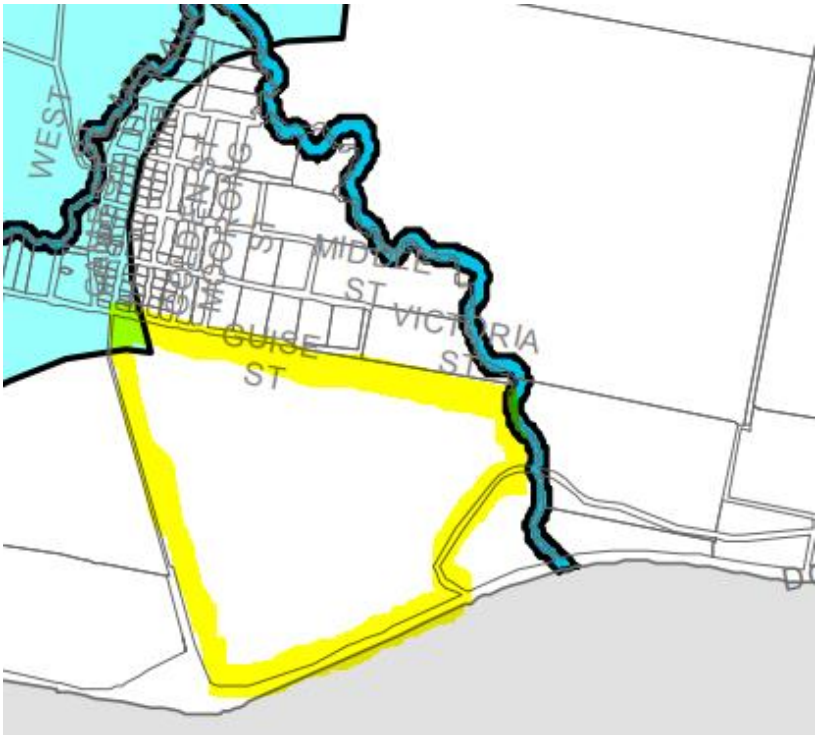


Figure A 7.2: Section in north west of Lot 5 which is mapped as having Groundwater Vulnerability in Yass Valley LEP (2013)

The scope of this report is based mainly on the heads of consideration listed in the Yass Valley LEP (2013) (see previous points a., b. & c.). For each of the heads of consideration the report considers:

1. potential development related impacts
2. likelihood, consequence and significance of potential impacts identified
3. avoidance and/or mitigation measures available

The report draws conclusions as to the overall impact of the development on the local and regional groundwater system and recommends any actions required to avoid or mitigated impacts to acceptable levels.

Findings

The heads of consideration listed in section **6.4 Groundwater vulnerability** of the Yass Valley LEP (2013) are addressed separately in the following sections

groundwater contamination

1. potential development related impacts

The development has the potential to contaminate groundwater in the construction phase through fuel/lubricant spills associated with earthmoving equipment, vehicles and fuel stores.

The greatest post construction potential for development related groundwater contamination comes from the onsite disposal of effluent.

2. likelihood, consequence and significance of potential impacts identified

The likelihood of fuel/lubricant spills leading to significant contamination is low given the that is unlikely to occur, and should it occur the small volumes involved are unlikely to move beyond surface soil and low permeability subsoil layers to eventually percolate into the deeper groundwater aquifer used for non-potable water supply in the adjacent Sutton village.

Groundwater contamination resulting from onsite effluent disposal is a low to moderate risk. This is because the main source of contamination comes from surface water contaminated with effluent (runoff from poorly managed surface effluent irrigation areas) moving across the landscape and contacting existing surface water bores then moving down the casing of the bore directly into the deep groundwater system. Surface water drainage from Lot 5 drains in two directions from the central ridge, to the north east and to the north west, refer **Figure A 7 3.** This drainage pattern results in potentially contaminated surface water from the developed areas of the lot, moving away from most bores in Sutton village, and eventually draining to directly to Mclaughlins Creek or Yass River without intersecting many groundwater bores.

The risk of direct contamination from effluent disposal area into the groundwater table below and/or downslope of the point of application, is considered low due to the depth of the water bearing zones accessed for non-potable use in the area, which ranges between 9 and 52 metres, refer **Table A 7 1**, and the low permeability of the heavy clay subsoils, refer soil test results in **Appendix 3**.

3. avoidance and/or mitigation measures available

Measures to avoid or mitigate potential contamination of the groundwater system include:

- Bunded storage of any fuels, lubricants or chemicals stored on site during construction
- Onsite effluent disposal areas to be identified for each lot prior as part of the final subdivision layout
- Onsite effluent assessments to be required for each lot
- Onsite effluent disposal systems to be restricted to secondary treatment systems with disinfection
- Effluent dispersal systems be restricted to surface or shallow subsurface irrigation
- The installation of bores on new lots could be discouraged through the provision of a reticulated non-potable water supply to lots or incentives provided for larger tank storage.

Bore Number	Bore Depth (metres)	Yield (litres/second)	Water Bearing Zones (m)
GW 401311	32	0.315	9-15
GW 063743	36.9	0.6	7-8 16.9-17 33.8-34
GW 042520	38.4	0.65	22.8-23.1 30.7-31.3 35.9-36.8
GW 405027	20	-	-
GW 068501	54	1.0	27-28 39-40 51-52

Table A 7 1: Detail of bores down gradient of the proposed development

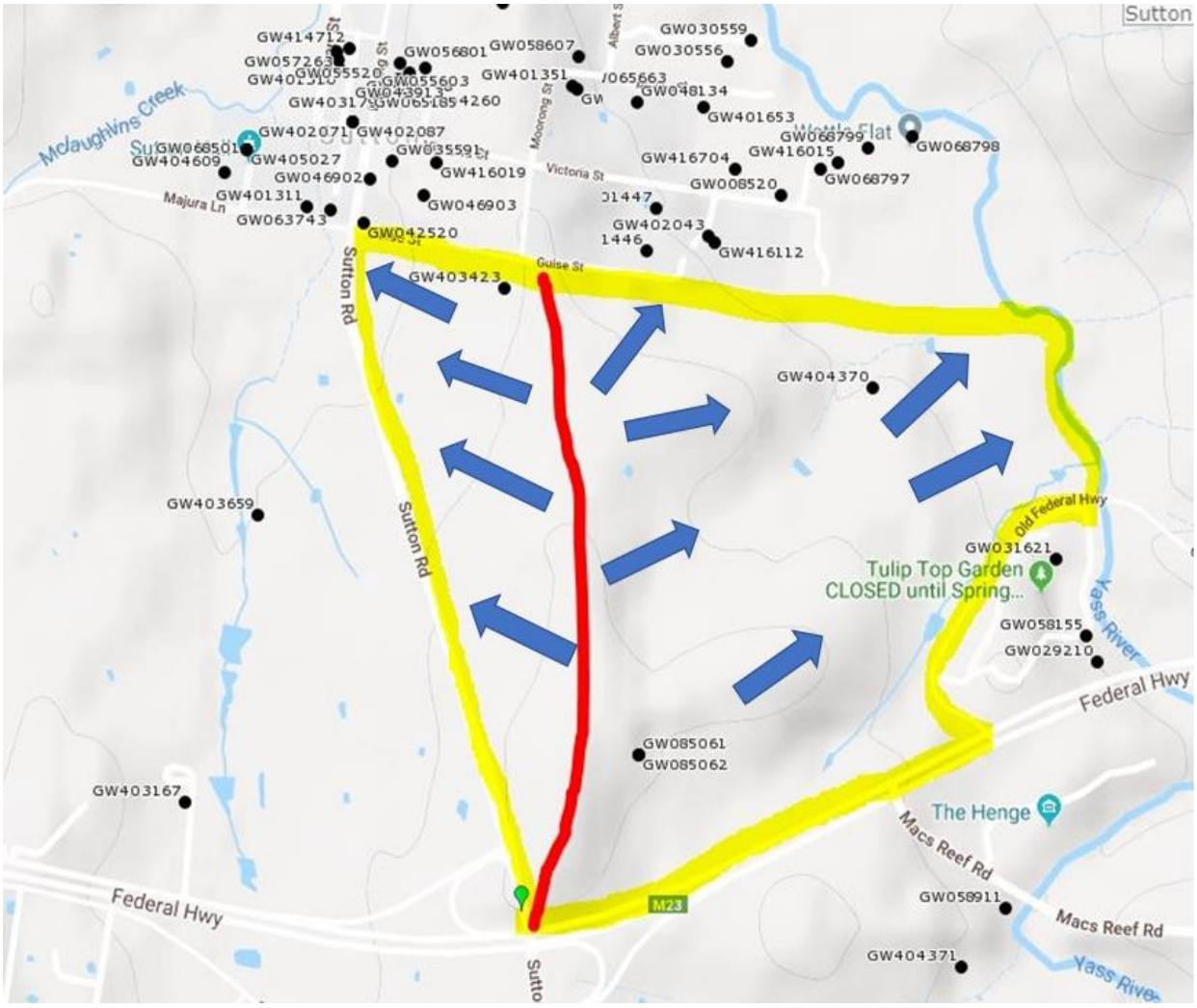


Figure A 7 3: Drainage patterns on the development site and registered bores in the area

impacts on groundwater dependent ecosystems

1. potential development related impacts

Groundwater dependent ecosystems are classified into six types including: karst and caves; groundwater dependent wetlands; aquifers; baseflow rivers and streams; terrestrial vegetation and; estuarine and near shore marine ecosystems

There are no priority groundwater dependent ecosystems identified in the area, refer **Figure A 7 4**. The Yass River does however rely partly on connectivity with the groundwater system to maintain base flows in the system during dry periods (even though connectivity between surface water and groundwater systems in the Yass Catchment is classed as low-moderate in the *Water Sharing Plan for the NSW Murray-Darling Basin Fractured Rock Groundwater Sources,* NSW Office of Water (2012)). Development related impacts to groundwater levels, through increased extraction, may therefore impact the partly dependent aquatic ecosystems of the Yass River.

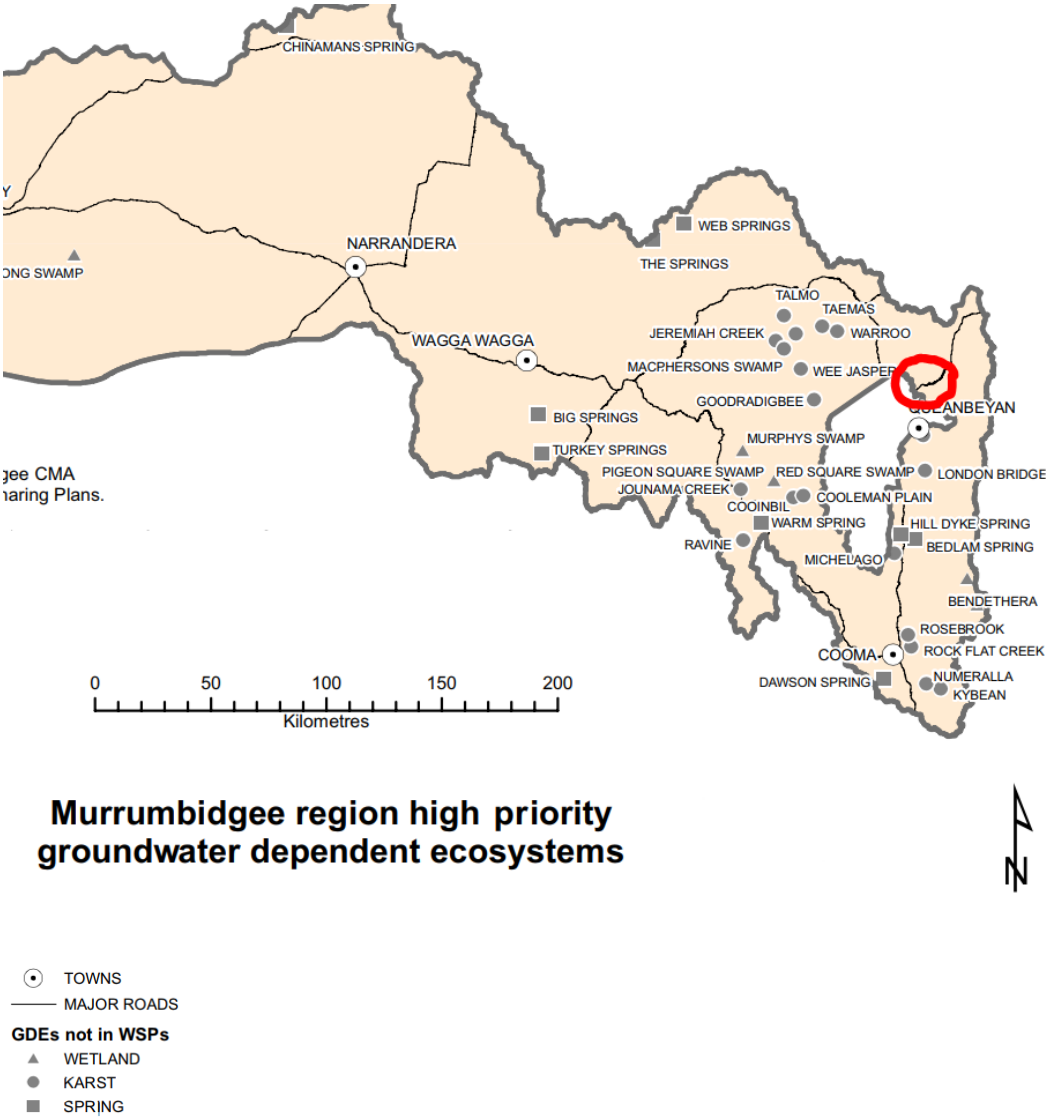


Figure A 7 4: State of the Catchments Report (2010)

2. likelihood, consequence and significance of potential impacts identified

There is a low likelihood that an increase in groundwater extraction related to the development will have a significant impact on the Yass River. This is because the amount of increased extraction related to the development is likely to be small, the connectivity of groundwater with Yass River is low, and the instream environment of the Yass River consists of numerous large pools which are inherently resilient to dry periods and provide a refuge for aquatic species when base flows are low.

3. avoidance and/or mitigation measures available

The following measures may mitigate any potential for the development to impact groundwater dependent ecosystems:

- The installation of bores on new lots could be discouraged through the provision of a reticulated non-potable water supply to lots
- The provision of incentives for larger tank storage would reduce the need to install a bore.

cumulative impact the development may have on groundwater (including impacts on nearby groundwater extraction for a potable water supply or stock water supply

1. potential development related impacts

The development could contribute to cumulative impact on the local and regional groundwater systems including the ability for existing groundwater users in Sutton, through increased extraction reducing the overall availability of groundwater locally, and potential reduction in groundwater quality through contamination from onsite effluent disposal systems, as previously addressed. There is also potential for the development to cumulatively impact the local availability of groundwater by changing the balance between runoff and infiltration with increased area of impervious surfaces, reducing the recharge rates of local groundwater aquifers and thereby the availability for existing users.

2. likelihood, consequence and significance of potential impacts identified

The likelihood of the development having a significant cumulative impact on the availability of groundwater for existing users is moderate. This is because the capacity to stop new lots installing groundwater bores is limited because access to groundwater for stock and domestic purposes is considered a Basic Landholder Right. Also considered is the existing condition of the local groundwater systems which was determined to be extracting groundwater at 150-300% sustainable levels the *Yass Snapshot on Sustainability,* Franklin, J & Parker, B. (DIPNR 2004), refer **Figure A 7 5.** Therefore,a relatively minor reduction in the availability of groundwater may have a magnified impact on the system because it is over allocated. This is somewhat moderated because the cone of depression associated with bores in fractured rock aquifer systems is relatively small- meaning that pumping of a bore will have a very small local drawdown effect and therefore a limited potential to impact other users.

The likelihood that the development will alter recharge to the groundwater enough to reduce groundwater availability to existing users is low. This is because of the limited connection between surface water and the deep groundwater system, and the relatively small change in the infiltration to runoff ratio likely as a result of the development

3. avoidance and/or mitigation measures available

The following measures will avoid or mitigate potential impacts on the availability of groundwater resources for existing and future users:

- The installation of bores on new lots could be discouraged through the provision of a reticulated non-potable water supply to lots
- The provision of incentives for larger tank storage would reduce the need to install a bore
- Water sensitive urban design principles would help maintain the balance between runoff and infiltration and therefore the recharge rate to the groundwater system

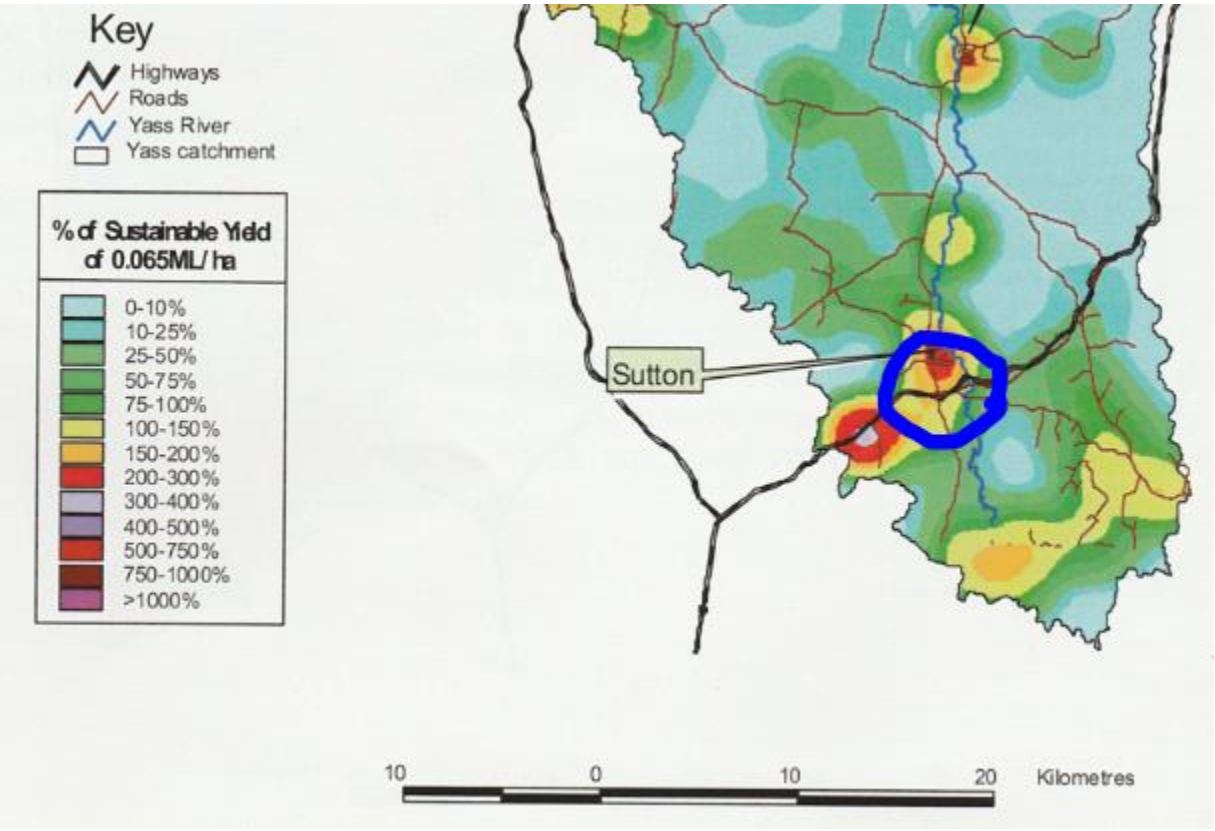


Figure A 7 5: Sustainability of groundwater extractions around Sutton

Conclusions

The location of the proposed subdivision and the associated surface water drainage patterns will minimise the low to moderate risk of groundwater contamination related to onsite effluent disposal as potentially contaminated surface water generally drains directly to surface water drainage features (Yass River and Mclaughlins Creek) and does not intersect the numerous groundwater bores located in and around the Sutton.

The moderate cumulative risk to the availability of groundwater for existing users is moderated by the relatively local drawdown impacts associated with fractured rock aquifer systems. The likely demand for new bores on the development is also considered to be low given the general adequacy of roof catchment and tank storage for most water needs, particularly on the smaller lots closer to the village.

The inability to limit the construction of new bores, which are considered a Basic Landholder Right under the legislation, does raise the potential for groundwater usage to significantly increase following development. To limit the potential demand for new stock and domestic bores a reticulated non-potable water supply could be developed for all lots, or incentives be provided to increase tank storage to cover both potable and non-potable water requirements.

It is considered that there are an adequate range of avoidance and mitigation measures available for the impacts identified to reduce the likelihood and significance of these impacts to reasonable levels.

Recommendations

It is recommended that the impact avoidance and mitigation measures listed be considered in the final plans for subdivision and that a suitable suite of measures be adopted to adequately manage all potential impacts.

Particular consideration should be given to those measures which can help address multiple impacts such as the provision of a reticulated non-potable water supply or the provision of incentives to install adequate tank storage to satisfy all water requirements.