LAND CAPABILITY ASSESSMENT

80 MURRUMBATEMAN ROAD
MURRUMBATEMAN NSW 2582

SOILANDWATER

07 October 2019 (V01)

FRANKLIN CONSULTING AUSTRALIA PTY LTD

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SUMMARY RECOMMENDATIONS

The proposed subdivision will create eight additional lots of approximately 2 hectares each and a residual lot of approximately 2.04 hectares (see **Figure 3**). The newly created lots will have a building entitlement to be exercised in a designated building envelope.

The lots (including the residual lot) will comprise:

Lot 1 2.02 hectares located in the north of the property with existing access from Murrumbateman Road.

Lot 2 2.01 hectares located close to the north western boundary of the property.

Lot 3 2.04 hectares including the existing dwelling, shed and other infrastructure. Existing access from Murrumbateman Road.

Lot 4 2.04 hectares with proposed new access (Entry 1) from Murrumbateman Road.

Lot 5 2.00 hectares on the western boundary of the property with access from proposed new access (Entry 1) from Murrumbateman Road.

Lot 6 2.00 hectares on the eastern boundary of the property adjacent to Murrumbateman Road with access from proposed new access (Entry 1) from Murrumbateman Road.

Lot 7 2.00 hectares on the south western portion of the property with access from proposed new access (Entry 1) from Murrumbateman Road.

Lot 8 2.04 hectares on the southern portion of the property with access from proposed new access (Entry 1) from Murrumbateman Road.

Lot 9 2.00 hectares on the south eastern portion of the property with access from proposed new access (Entry 2) from Murrumbateman Road.

Potable water supply for the proposed new Building Envelopes will be through capture and storage of roof water in potable water tanks. All new dwelling lots will dispose of domestic effluent on-site through secondary treatment systems (Aerated Wastewater Treatment System [AWTS]) combined with surface spray, drip or subsurface drip irrigation.

The existing dwelling on Lot 3, is serviced by a septic tank and absorption trench. This system is failing with the absorption trench discharging at the surface during periods of heavy load. The absorption trench is also located within the 40-metre buffer required from the adjacent dam. This system will be replaced with a secondary treatment system (AWTS) combined to surface spray or drip or subsurface drip irrigation system.

The land capability assesses the suitability of the planned rural residential dwelling lot based on the capacity to sustainably manage effluent on-site, as per Council requirements and Australian

Standards. The suitability and constraints for dwelling construction are also considered in this assessment.

Constraints to on-site effluent management and dwelling construction have been assessed in accordance with:

- assessment of on-site effluent capability, based on Appendix C of ANZ Standard 1547:2012, *Site and Soil Evaluation for Planning, Rezoning and Subdivision of Land* and also the NSW guideline*, The Silver Book*;
- assessment of land capability for dwellings is based on excluding land which is greater than 15% slope, seasonally waterlogged, salt effected or within riparian buffers.

The major constraints to on-site effluent disposal are the buffer distances required from drainage depressions, dams, boundaries and bores. The 250-metre buffer from bores on adjacent properties presents a major constraint to on-site effluent disposal on many of the new dwelling lots. It is proposed to provide a 100-metre buffer from surrounding bores which are located upslope of the effluent disposal areas as the risk of contamination to these bores from downslope on-site effluent disposal practices, is minimal. The 100-metre buffer is also consistent with Sydney Catchment Authority guidelines and is twice the maximum buffer required in the Australian Standard for onsite effluent disposal practices (AS 1547:2012).

There are two downslope bores which are located within 250 metres of the development, one of which is located on the property and will be decommissioned. The other is located on land which will become part of the Murrumbateman Bypass road corridor and will therefore not be used for stock and/or domestic purposes. The notional 250-metre buffer distance from these two bores is therefore not considered to be a constraint to on-site effluent disposal on the development.

It is considered that there are adequate areas of suitable site and soil conditions located on the proposed Building Envelopes to enable the on-site disposal of effluent generated by any future dwellings. Areas of 550m^2 have been nominated within each building envelope to demonstrate the availability of an adequate area on each lot, this is an adequate area to service a 6-bedroom dwelling.

Effluent will be managed by secondary treatment (AWTS), including disinfection, with dispersal through surface spray or drip irrigation or subsurface drip irrigation. Primary treatment and subsoil effluent disposal is generally not suited to the site due to the sensitive groundwater receiving environment in the area.

LAND CAPABILITY ASSESSMENT

PROJECT DESCRIPTION

Soil and Water was engaged by Ms Maggie Ziemski, Pixiu Holdings Pty Ltd to assess land at 80 Murrumbateman Road, Murrumbateman, NSW, Lot 10 DP 1218866, in the Yass Valley Local Government Area, to determine the feasibility of the planned rural residential dwelling lot based on the suitability of the site for land uses related to development such as domestic on-site effluent disposal, road construction, servicing infrastructure and the construction of dwellings.

The assessment includes the identification of the following constraining attributes which may limit site suitability for development related land uses including:

i. General suitability of site/soils for on-site effluent disposal (consistent with the NSW Government "Silver Book" and the Australian Standard 1547:2012).
ii. Areas of outcropping rock
iii. Areas of existing vegetation
iv. Watercourses, water storages and riparian buffer areas
v. Areas of steep or otherwise unsuitable land for construction due to erosion and other risks
vi. Areas of land degradation including salinity, gully, sheet, rill or streambank erosion

The proposal includes recommendations managing constraints and sensitive areas. Recommendations are general in nature and are designed to assist in determining appropriate land management practices for the development and the site.

REPORT SCOPE AND TECHNICAL REFERENCES

The report assesses land in the vicinity of the proposed development to identify constraints which may limit the suitability of the land for on-site sewage management systems.

This involves excluding land with major physical constraints such as steep slopes, rocky outcrops, poor drainage, areas within buffer distances of property boundaries watercourses, storages, flow lines and existing and proposed buildings.

All information required by the approving authority, usually regional Councils, is contained in this report, including suitable types of sewage management systems, management prescriptions, site plan and photographs, with supporting information in this report including nutrient balance and limitation tables.

The report also refers to, or relies on, standards and technical references listed below.

On-site Sewage Management for Single Households (The Silver Book) NSW Govt, 1998.

AS/ANZ Standard 1547:2012 On-site Domestic Wastewater Management.

Soils and Construction: Managing Urban Stormwater - 4th Ed. Landcom NSW Government, 2004.

ANZ Standard 1547:2012 On-site Domestic Wastewater Management

Yass Valley Local Environmental Plan (2013)

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, NSW.

The report also assesses the existing effluent management system on proposed Lot 3 to determine if it is suitable for continuing use and/or if it will be adversely impacted by the proposed subdivision. Recommendations for system upgrades required to make the existing system compliant with Council requirements are included.

METHODOLOGY

A detailed on-site assessment was undertaken on the proposed Building Envelopes.

The assessment included measurements of slope, aspect, exposure, visual appraisal of landform and soil conditions. The location of constraints identified during the site inspection are included in **Figures 6 & 7** in this report.

The buffer distances required from drainage lines have been mapped and are also provided in this report.

The report includes a preliminary assessment of the suitability of soils for on-site effluent management. Soil profiles were augured in the different geophysical landscapes which exist on the property and which correspond to the various landscape units on which the Building Envelopes are located. The soil profiles are described in **Appendix 1.**

It should be noted that this report does not constitute a detailed Effluent Management Design Report as required by Council to approve the installation of systems for a new dwelling. It is expected that such a report will be required for the new lots prior to the construction of dwellings. An Effluent Management Design Report will also be required to accompany an application to install a new system on the existing dwelling on Lot 3.

SITE INFORMATION

Local Government Area:	Yass Valley Council
Address/locality:	80 Murrumbateman Road Murrumbateman NSW 2582 Lot 10 DP 1218866
Owner/Developer:	Maggie Ziemski, Pixiu Holdings Pty Ltd, Hamilton, Qld

Figure 1: Block location

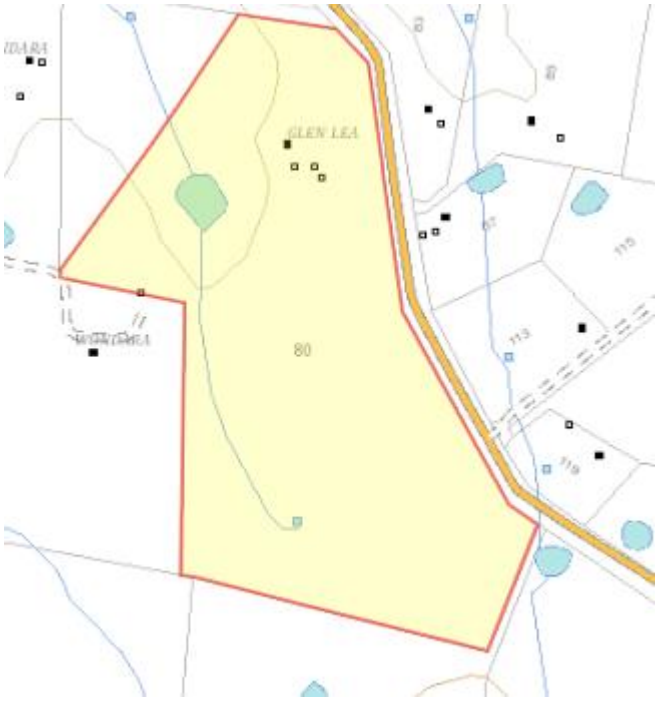


Figure 2: Block configuration, Lot 10 DP 1218866

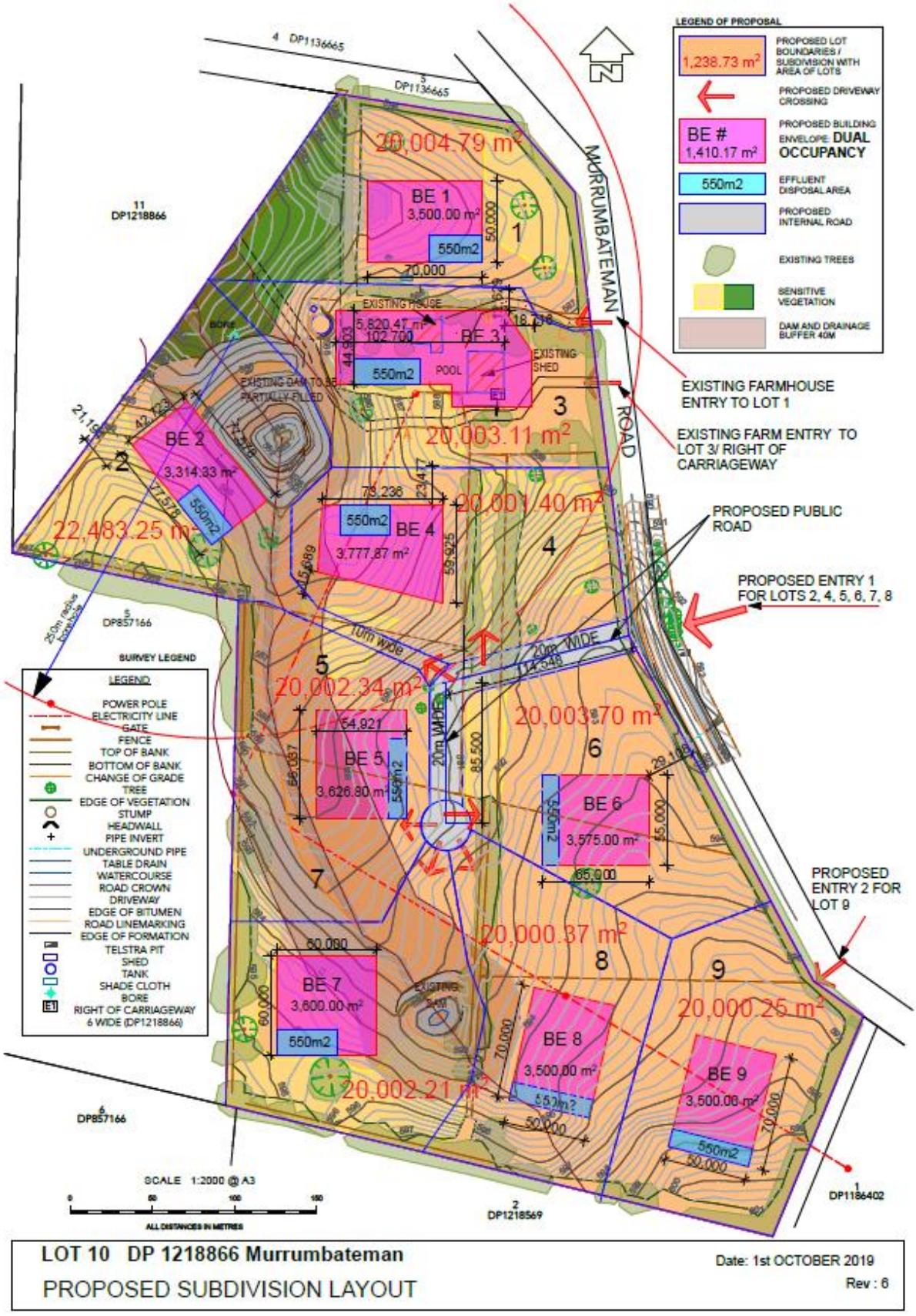


Figure 3: Proposed subdivision lot layout with building envelopes and effluent disposal areas

Intended water supply:	Non-reticulated: roof catchment with tank storage for domestic water.
Effluent management:	Effluent for the new Building Envelopes will be managed on-site via a combination of a secondary treatment system (AWTS including disinfection) and effluent disposal through either surface spray or drip irrigation or subsurface drip irrigation. (NB The primary treatment of effluent with disposal through subsoil absorption is not considered suitable for the site due to the proximity to sensitive groundwater receiving environments. The effluent management system installed on the existing dwelling (Lot 3) has been assessed and determined to be inadequate for continued use due to surface discharge from trench during high load periods, and proximity to the adjacent downslope dam. This system will be replaced with a secondary treatment system (AWTS including disinfection) and effluent disposal through either surface spray or drip irrigation or subsurface drip irrigation
Local experience:	The major constraints related to on-site effluent dispersal are the buffer distances required from drainage depressions, dams, bores and boundaries. Many similar rural residential developments have been established in the region which share a similar range of constraints. Generally, these have not posed significant problems to the successful establishment and operation of rural residential land use and related infrastructure.

Figure 4a: Looking North West from proposed Lot 4 Building Envelope.

Figure 4b: Looking West across proposed Lot 5 Building Envelope.

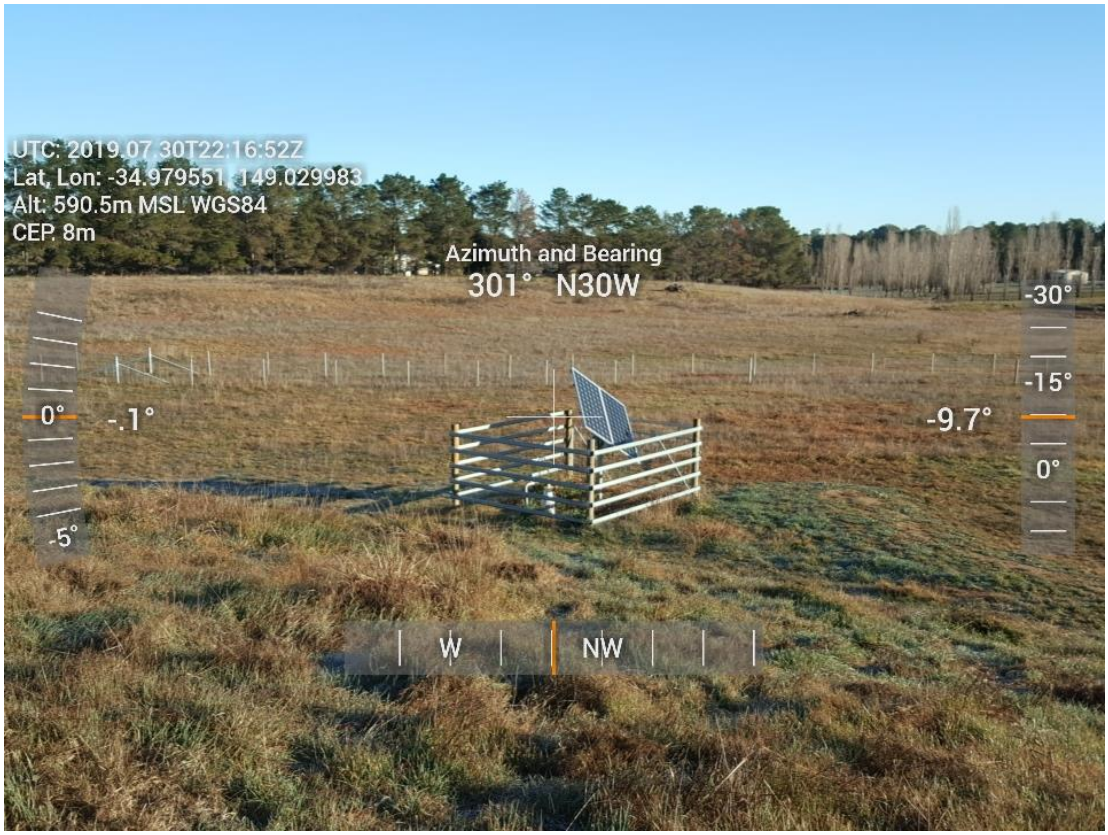


Figure 4c: Bore to be decommissioned on Lot 2

Figure 4d: Looking North along drainage depression on Lot 5 towards Lot 4

Figure 4e: Looking South towards from Lot 6 towards Lot 5

Figure 4f: Looking along proposed access road

Figure 4g: Looking West towards existing dam on Lot 2

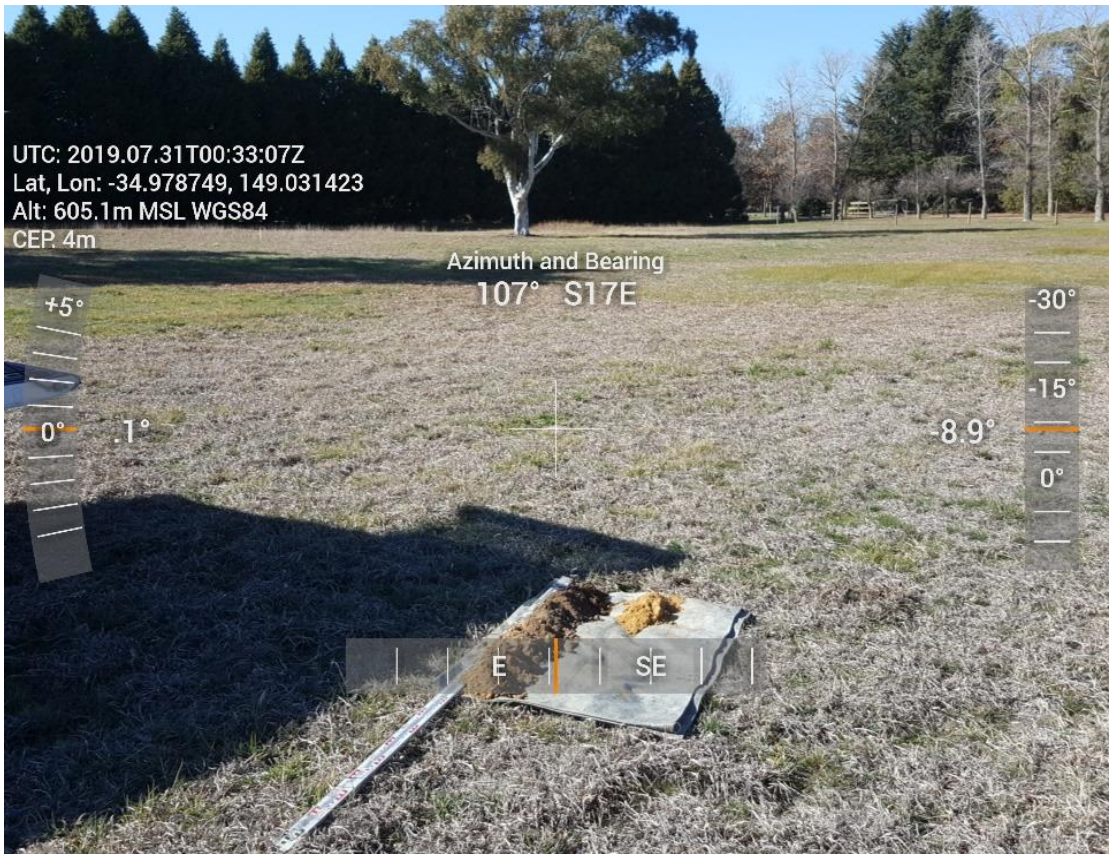


Figure 4h: Looking East across Lot 1 Building Envelope

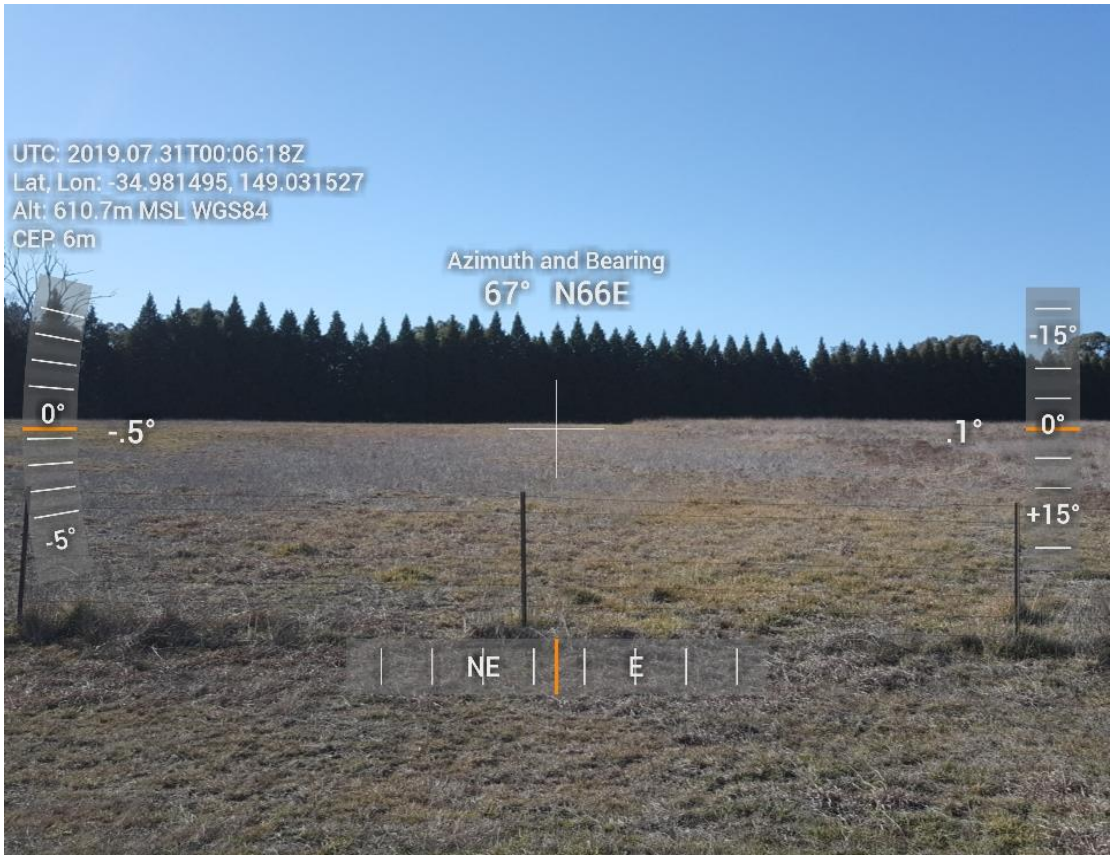


Figure 4i: Looking North East across Lot 9

Figure 4j: Looking North East from Lot 7 Building Envelope across farm dam

Figure 4k: Looking North from Lot 7

Figure 4l: Farm dam on Lot 7

Figure 4m: Absorption trench on Lot 3

Figure 4n: Septic Tank on existing dwelling on Lot 3.

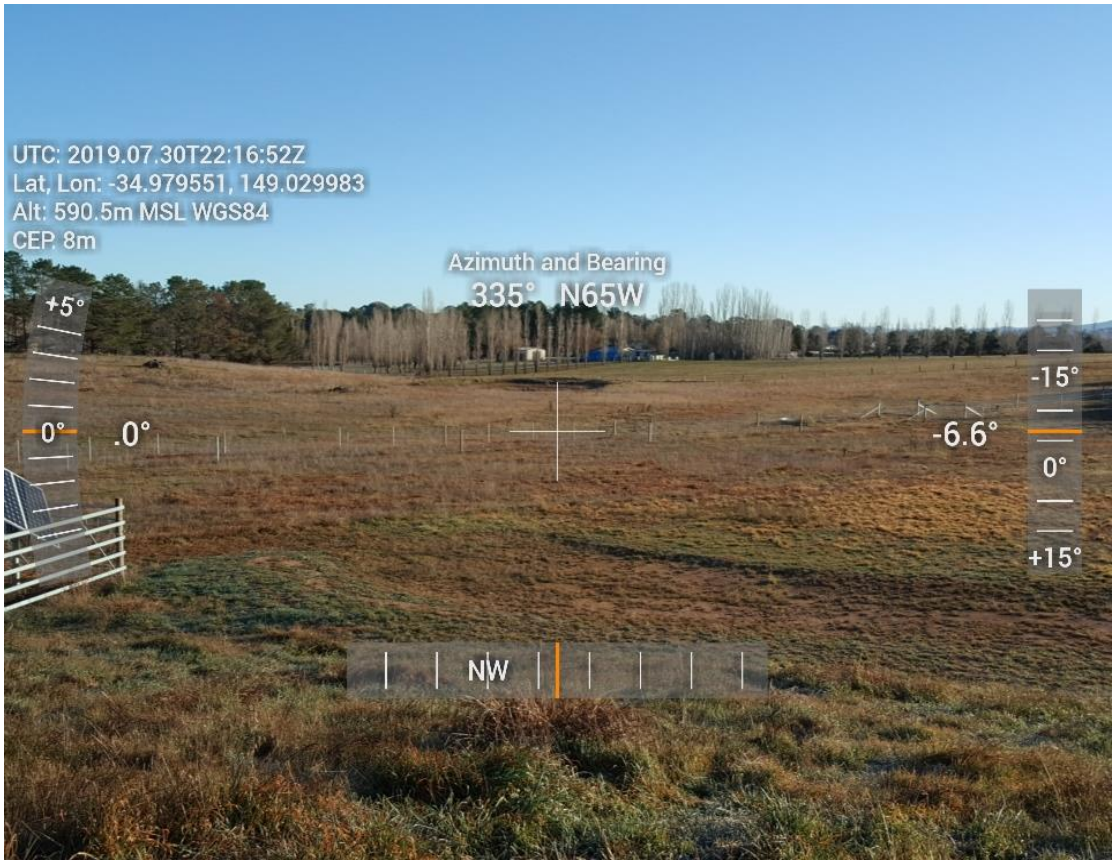


Figure 4o: Looking from Lot 2 North West across adjacent downslope properties

Figure 4p: Farm Dam on Lot 2

SITE & SOIL ASSESSMENT

Climate

The climate is typically a cool and moderately dry climate. Average rainfall for the area is 600 – 800 mm. Warm summers with large evaporative deficit, cool winters with small evaporative deficit; median summer monthly rainfall for Canberra airport 49 mm; median monthly winter rainfall 38 mm; mean monthly summer evaporation is 177 mm, mean monthly winter evaporation is 60 mm.

Climate is suitable for the dispersal of secondary treated effluent through surface spray or drip irrigation.

Exposure

All new building envelopes have good levels of exposure. Some have limited vegetative shading. Lot 3 with the existing dwelling has extensive shading from landscape plantings but retains adequate exposure for onsite effluent disposal in the area proposed.

Exposure is suitable for the surface irrigation of effluent within the Building Envelopes on each lot.

Slope

Slopes in this landscape are gentle with ranges of <3 -7%.

Slopes are not a constraint to the construction of dwellings or the dispersal of effluent within the proposed Building Envelopes.

Landscape

Undulating rises on Duoro Volcanics. Slopes generally between 5-10%. Local relief is between <30m with elevations ranging 530- 600m. Drainage form is convergent.

Extensively cleared woodland vegetation communities with highly modified pasture grazing the dominant landuse.

The local landscape is dominated by small rural and rural residential properties. Locally the landscape consists of the gentle sideslopes on associated with the minor 1st Order Stream valley which flows south to north through the property. Drainage is via overland flow to this central drainage depression and includes two farm dams.

The slope form is generally divergent in areas considered suitable for effluent dispersal on Lot 2 (i.e. spreading rather than concentrating flows). Areas of convergent slope form generally coincide with drainage depressions and are therefore already constrained for effluent disposal.

Slope form is suited to the dispersal of secondary treated effluent through surface irrigation or shallow subsurface irrigation.

Surface rock and outcrop

The underlying geology is Duoro Volcanics. The area includes significant surface stone as cobbles. There is no surface cobble or rock outcrops.

Rock is not a constraint to effluent dispersal or dwelling construction.

Hydrology

The silty loam textured topsoil across the site has a moderate permeability, of 0.5 to 1.5 m/day. The silty clay loam subsoils which occur on midslopes and lower slopes 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. The areas of steeper slopes and shallow soils will generally convert a greater proportion of rainfall into surface runoff than flatter areas with deeper soils.

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.

The upslope subsurface flows move perpendicular to the contour of the slope and concentrate in lower parts of the landscape creating areas of seasonal waterlogging. This is compounded by the naturally slower drainage associated with lower parts of the landscape.

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 provided these are located outside areas of potential seasonal waterlogging.

Effluent disposal will need to be properly designed and located on suitable soil types (including depths) to minimise hydrological impacts from surface irrigation, such as effluent run-off or rapid effluent drainage through permeable soil profiles into groundwater systems.

Adequate areas of suitable soils exist within the proposed Building Envelopes to limit these risks.

Potential hydrological impacts associated with increasing the amount of impermeable surface are considered to negligible due to:

- ***divergent slope form spreading surface water flows associated with the Building Envelopes***
- ***low density of development resulting in limited increase in impervious area associated with infrastructure,***
- ***extensive buffering area of good groundcover vegetation downslope of proposed Building Envelopes, and upslope of the central drainage depression, with capacity to intercept and assimilate surface water flows***

Soils

Detailed soil profile descriptions are provided in **Appendix 1** of this report.

Soils in this landscape include Kandosols and Red/Brown Chromosols on lower sideslopes with poorer drained Yellow Chromosols in drainage depressions.

The soils in the areas mapped as suitable for effluent dispersal are Kandosol or Brown Chromosols formed in situ from Duoro Volcanics parent material.

They comprise a weakly structured silty loam upper layer overlying a bleached massive sandy loam which overlays a moderately structured silty light clay loam subsoil. Total depth is typically greater than 100 cm.

Extrapolating from the soil survey of the Canberra 1:100,000 sheet (Jenkins 2000), the soils on the gently sloping side slopes fit the Williamsdale soil landscape. 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.

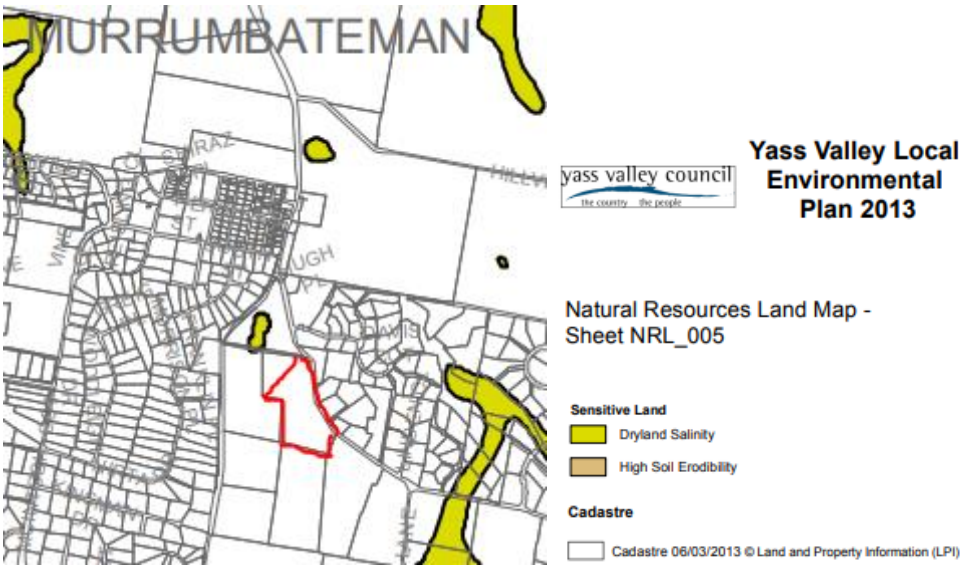
Soils are generally unconstrained for dwelling construction. Site Classification of the Building Envelope will be required to ensure foundations are appropriate for soil reactivity and wet bearing strength.

Soil depth in lower slopes are generally not constrained for effluent disposal and are suited to surface spray or drip, or shallow subsurface drip irrigation

CONSTRAINTS ANALYSIS

Soil erosion

The soil types on the site are not mapped as highly erodible, see below.



The Building Envelopes will not require additional clearing and there are no existing areas of erosion that present a constraint to effluent disposal or dwelling construction. There is no active or historic erosion located on the property.

Recommendations

- 100% groundcover be maintained in areas designated for effluent irrigation.
- Remaining areas should maintain groundcover >70%
- Properties should be monitored for erosion and remedial measures implemented should erosion be detected.

Salinity

Dryland salinity is a significant issue across parts of the Yass Valley Council area and is related to changed landscape hydrology, climate, geology, soils and land management.

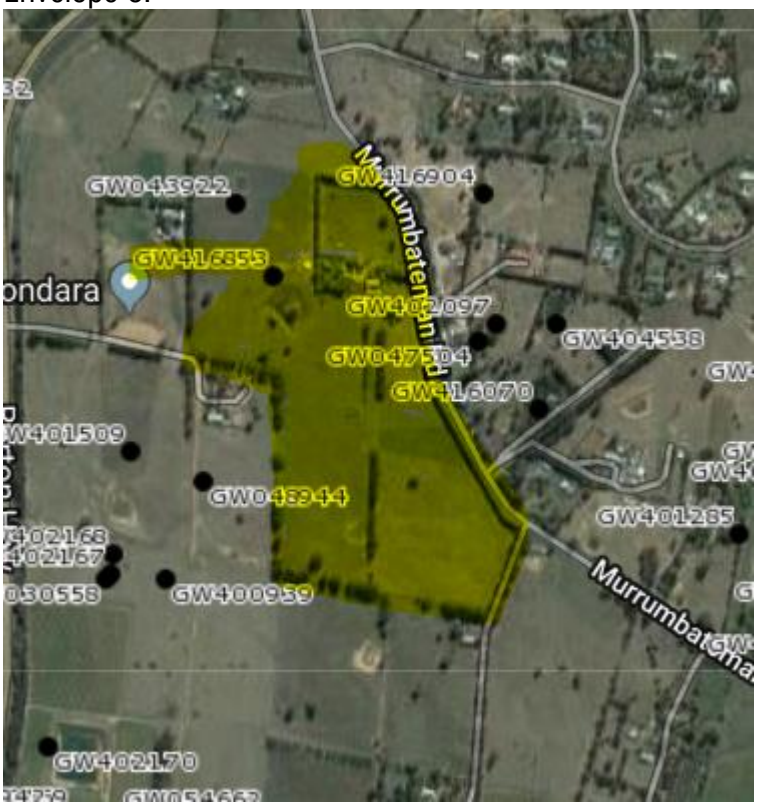
No areas of the property are mapped as Salinity in the online mapping portal. No areas of salinity were detected on the property during the inspection of the site.

Recommendations

- The area and vigour of deep-rooted perennial pasture should be maximised as far as practical.
- Trees and shrubs should be retained as far as practical.

Groundwater

There is 1 bore on the property (GW416853) on proposed Lot 2, refer image below. It is recommended that this bore be decommissioned. There are up to 15 other sites within 500m of the 9 Building Envelopes. The closest sites are detailed below, several are Monitoring or Test Bores. The closest Bore (GW043922) to a Building Envelope is approx. 177m from Building Envelope 1. The next closest bore is GW048944 which is approx. 194m from Building Envelope 5.



https://realtimedata.waternsw.com.au/

	Type	Depth	Water Bearing Zones
GW416853	Stock & Dom	46.0m	23-27, 32-38m
GW043922	Stock	NA	NA
GW47504	Irrigation	38.10m	10.10-11.60m
GW48944	General	31.10m	25.90-28m
GW402097	Stock &Dom	56m	16-16.50, 36-37, 48-49, 51-52m
GW416904	Stock &Dom	90m	51-51.10, 73-73.10, 86-86.10m
GW401509	Test	140m	40-40.2, 55-55.10, 110-110.3m
GW416070	Domestic	102m	NA
GW085115	Monitoring	11m	7-10m
GW085114	Monitoring	27m	18-24m
GW085110	Monitoring	50m	25-30m
GW400939	NA	61.89m	28.96-28.96, 61.89-61.89m
GW404538	Domestic	42m	NA

The area is mapped as Moderate Groundwater Vulnerability on the Murrumbidgee Catchment Groundwater Vulnerability Map (DLWC).

The area is not mapped as Vulnerable Groundwater on the Yass Valley Local Environment Plan (2013) Riparian Lands and Watercourses Map

The 250-metre buffer from bores required by *On-site Sewage Management for Single Households* (The Silver Book) NSW Govt, (1998), presents a major constraint to on-site effluent disposal on many of the new dwelling lots, refer **Figure 5a**. It is proposed to provide a 100-metre buffer from surrounding bores which are located upslope of the effluent disposal areas, as the risk of contamination to these bores from downslope on-site effluent disposal practices is minimal, refer **Figure 5b**. The 100-metre buffer is also consistent with Sydney Catchment Authority guidelines and is twice the maximum buffer required in the Australian Standard for onsite effluent disposal practices (AS 1547:2012).

There are two downslope bores which are located within 250 metres of the development, the closest of which is located on the property and will be decommissioned. The other is located on land which will become part of the Murrumbateman Bypass road corridor and will therefore not be used for stock and domestic purposes. Therefore, the 250-metre buffer distance from these two bores is not considered to be a constraint to on-site effluent disposal on the development, refer **Figures 5a-b**.

There is a low risk of contamination to the groundwater system given:

- horizontal separation of > 100m from upslope bores, and
- vertical separation of >30m to water bearing zones
- low rate of secondary treated and disinfected effluent applied to the surface or shallow subsurface
- low transmissivity of fractured rock groundwater aquifers as underlay the area.

Recommendations

- Maintain a minimum 100 m buffer between effluent disposal practices associated with the new Building Envelopes and upslope bores,
- Maintain a minimum 250 m buffer between effluent disposal practices associated with the new Building Envelopes and downslope bores (excluding the bore to be decommissioned and the bore which will be located on the Murrumbateman Bypass land),
- Ensure that an Effluent System Design Report is produced prior to the installation and operation of on-site effluent disposal systems and that these reports include a minimum 100 m buffer from any upslope bores and 250 m from any downslope bores (excluding the bore to be decommissioned and the bore which will be located on the Murrumbateman Bypass land),

- Ensure a water supply works approval is sought prior to constructing a bore (the application is available at www.water.nsw.gov.au and the fee is currently $241.83).

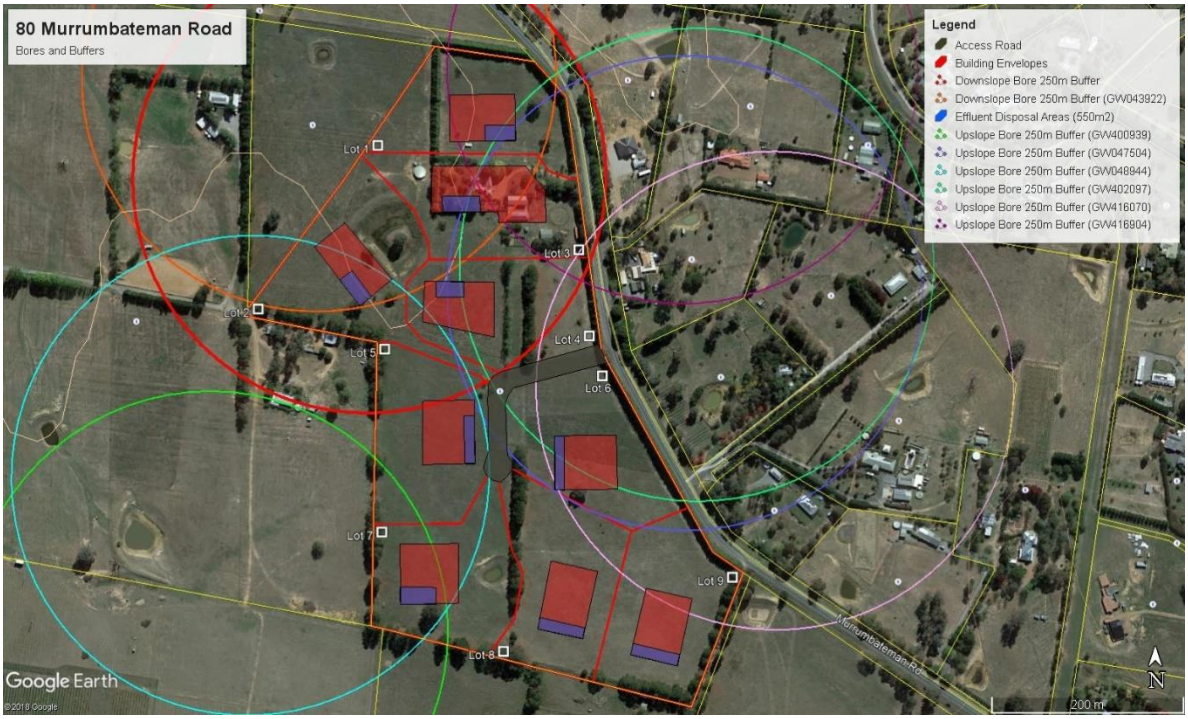
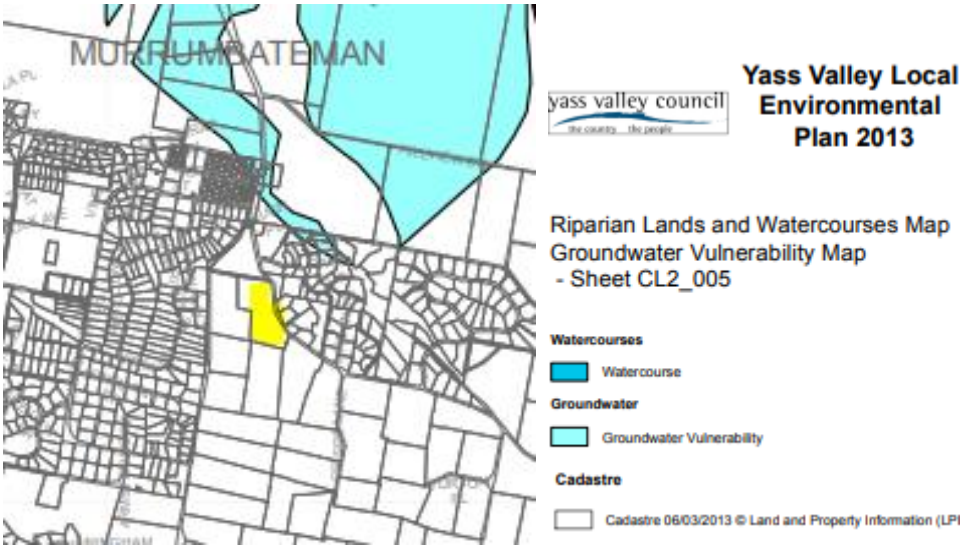


Figure 5a: Bore in the vicinity of the development shown with 250m buffers

Figure 5b: Upslope bores in the vicinity of the development shown with 100m buffers, downslope bore to be decommissioned and located within the proposed bypass shown with no buffer.

Riparian lands

The Yass Valley Local Environment Plan (2013) Riparian Lands and Watercourses Map does not include any portion of the property although there is a drainage depression and two existing small farm dams on the property, see below. There is no proposed development-related riparian impacts in this area.



NSW DPI Office of Water (Guidelines for riparian corridors on waterfront land) defines the riparian buffers required for different stream orders, to maintain the integrity of these areas, see below:

Figure 2. The Strahler System

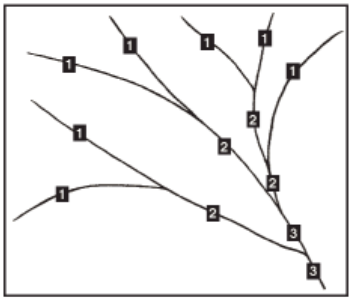


Table 1. Recommended riparian corridor (RC) widths

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

There is a 1st Order Stream flowing south to north parallel to the western boundary of the property through Lots 7, 5, 4 and 2, which will require a 10m riparian corridor within which the development of infrastructure (dwellings etc) would be inconsistent with the Office of Water Guidelines.

The proposed Building Envelopes which will contain most of the infrastructure related to the development including effluent management systems, will not impact the riparian corridors recommended by NSW DPI Office of Water, refer **Figure 7.**

The access to Lot 2 and Lot 7 will require crossing of the 1st Order Stream and associated riparian corridor. NSW DPI Office of Water should be consulted regarding any approvals which may be necessary to construct crossings of this watercourse.

Recommendations

- Building Envelopes will be located outside the mapped riparian corridors shown in **Figure 7.**
- Approval should be sought from NSW DPI Office of Water to construct the access roads to Lot 2 and Lot 7 which require crossing of the 1st Order Stream and associated riparian corridor.

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 m buffer from major or permanent surface waters including rivers, streams and creeks, and a 40 m buffer from any other water including dams, minor intermittent waterways and drainage channels.

The required buffers have been mapped in **Figure 6**.

The areas identified as suitable for effluent disposal within each of the Building Envelopes are located outside the 40m buffer required from the farm dams and associated minor drainage depression, refer **Figure 6**. All areas within the Building Envelopes and outside the mapped buffer areas are considered suitable for effluent disposal. The area nominated (550m^2) is indicative only and intended to demonstrate that an adequate unconstrained area exists within each Building Envelope on each lot.

The existing effluent management practices on the existing dwelling on Lot 3, is located within the dam and drainage buffers however this will be replaced and the new effluent management system will be located within the nominated area in the Building Envelope which is outside the mapped buffer, refer **Figure 6**.

Recommendations

- There will be no effluent disposal within the 40 m buffers required from the adjacent drainage depressions and dams.

MANAGEMENT OF EFFLUENT

Summary

This report assesses the general availability of an adequately sized area of land within the proposed new Building Envelopes on Lots 1-9 (including the proposed new effluent management infrastructure associated with the existing dwelling on Lot 3).

Generally, the lots are well drained, gently sloping and with moderately deep soil cover and suitable site conditions for the dispersal of effluent.

A minimum area of 550 m^2 has been used as the benchmark for the area required for the effluent dispersal. This is a conservative approach, given that an irrigation area for a six-bedroom dwelling will be around 520 m^2. The location of future buildings, paths, tanks, pools and other infrastructure will also need to allow for the required buffers from the nominated effluent disposal areas within the Building Envelopes.

Key constraints to effluent dispersal on the property are drainage depression and dam buffers of 40m.

The proposed Building Envelopes have an adequate area of land that is suited to effluent dispersal and an adequate remaining area that is available for the construction of dwellings and associated infrastructure, including an allowance for the necessary buffers between these features, refer **Figure 6**.

The most widely used form of effluent treatment on relatively unconstrained rural residential developments in the region is a NSW Health accredited aerated wastewater system, with the secondary treated, disinfected effluent irrigated onto the surface. Reliability and maintenance issues with such systems are well known and the risk of failure is relatively low.

There are a number of more innovative options for effluent treatment and disposal. The most promising of these is the Wisconsin sand mound, of which there are a small number in the region. These systems have a small footprint, (less than 150m^2), have a high degree of reliability and have a low energy requirement. There is however a lack of experienced installers for such systems in the region and the climate presents some issues in terms of maintaining grass cover through hot dry summers if effluent is not being regularly loaded into the mound. This is generally only an issue if the attached dwelling is not permanently or fully occupied.

In general, the area is not suited to the subsoil absorption of primary treated effluent due to the proximity of sensitive groundwater receiving environment around and north of Murrumbateman. As a result, both subsoil absorption

and evapotranspiration/absorption beds for primary treated effluent are not recommended for the site.

The use of subsoil irrigation beds for dispersal of wet composting closet treatment systems (eg worm farms) are also considered unsuited to the site due to the soil depth constraint.

The following section addresses the specific requirements for a number of suitable effluent management options in order to show that on-site effluent can be achieved sustainably on the subdivision.

This report assumes that a detailed planning for effluent management will occur at the time of submitting building plans to council. At this stage the exact location, footprint, occupancy and usage patterns of the proposed dwelling will be known. These are all critical elements of the final design process which cannot be addressed by this report.

Secondary treatment system and surface irrigation

NSW Health accredited systems treat effluent to a minimum secondary standard, suitable for disposal by surface or subsurface irrigation (see list at http://www.health.nsw.gov.au/PublicHealth/environment/water/wastewater.asp). This includes aerated wastewater treatment systems (AWTS), sand and textile filters and biological filters.

The sizing of the effluent irrigation area is based on nutrient balance which gives a general guide to a sustainable area required for irrigation.

It is preferable that effluent irrigation systems be fixed installations. Surface spray irrigation systems can be significantly improved by having at least two or three lines of sprinklers on risers attached to rigid supports, 30-50cm above ground level, with each riser tied into the delivery line. A manual valve on each line allows all or some of the lines to be used. The buried distribution lines with risers minimises the risk of damage by mowing and encourages the irrigation area to be better managed than current practice.

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 2**, the sizing of the irrigation area is shown below:

Three bedrooms	300m2
Four bedrooms	370m2
Five bedrooms	450m2
Six bedrooms	520m2

Council also requires adequate suitable land for a reserve effluent dispersal area. Additionally, buffers of 15m are required from dwellings (for surface

spray), 6m from downslope buildings, property boundaries and driveways and 3m if these features are located upslope and 6m from swimming pools.

Primary treatment and subsoil absorption

Generally, not suitable due to proximity of sensitive groundwater receiving environment around Murrumbateman

Innovative effluent management systems

A Wisconsin mound pump dosed from a septic tank may be suited to the site and soil conditions. Mound design would need to be developed on a site by site basis, including a soil profile at the mound site. Indicatively, based on the soil profiles for this assessment, the Basal Loading Rate would be 16mm/day and Linear Loading rate 47mm/day. The footprint would be slightly less than 150m2 on a flat or gently sloping site.

Effluent management

Recommendations

- A lot specific *site and soil assessment for on-site effluent management* will be required at the time of submitting building plans to Council for the new Lots and the prescriptions of this report should be applied to the design process of the lot.
- The effluent dispersal system should be located within the nominated area within each Building Envelope, refer **Figure 6**.
- Effluent dispersal practices may occur outside the nominated 550m2 area within each Building Envelope provided these areas are not mapped as constrained, (**Figure 6**) and are outside the required buffer distances from other infrastructure.
- Buffers to be applied to effluent dispersal areas will include:
  - 40 m from all dams and drainage depressions
  - 100 m from any existing or future upslope bores
  - 250 m from any downslope bores (excepting the bore to be decommissioned and the bore on Murrumbateman Bypass land)
  - 15 m from dwellings (for surface spray irrigation)
  - 6 m from property/lot boundaries (3 m if these are upslope)
  - 6 m from buildings and driveways.(3 m if these are upslope)
- The effluent management system suitable for the lots include an aerated wastewater treatment system (including disinfection) with NSW Health accreditation, dispersing effluent to a designated effluent surface or shallow subsurface irrigation area. The irrigation area size should be based on potential occupancy derived from bedroom number.
- As a guide, the following areas would be appropriate for the soil and site conditions of the site:
  - Three bedrooms……...300m^2
  - Four bedrooms……370m^2
  - Five bedrooms……..450m^2
  - Six bedrooms……520m^2
- To ensure effective distribution of treated effluent, and provide protection of irrigation lines, the minimum requirement for irrigation

dispersal should be buried distribution lines with decoupling sprinkler heads. There should be a minimum of two runs of distribution lines connected by a manual valve to allow for alternating dispersal areas.

- More innovative systems such as a Wisconsin sand mound treating primary effluent from a septic tank, or a recirculating sand filter with a subsurface irrigation field, are also suitable.
- A subsoil absorption bed receiving primary treated effluent is generally not considered suitable for the site.
- The existing effluent management system installed on Lot 3 is to be replaced with a secondary treatment system (AWTS) combined with surface spray or drip, or subsurface drip irrigation and will be maintained in accordance with Council requirements.

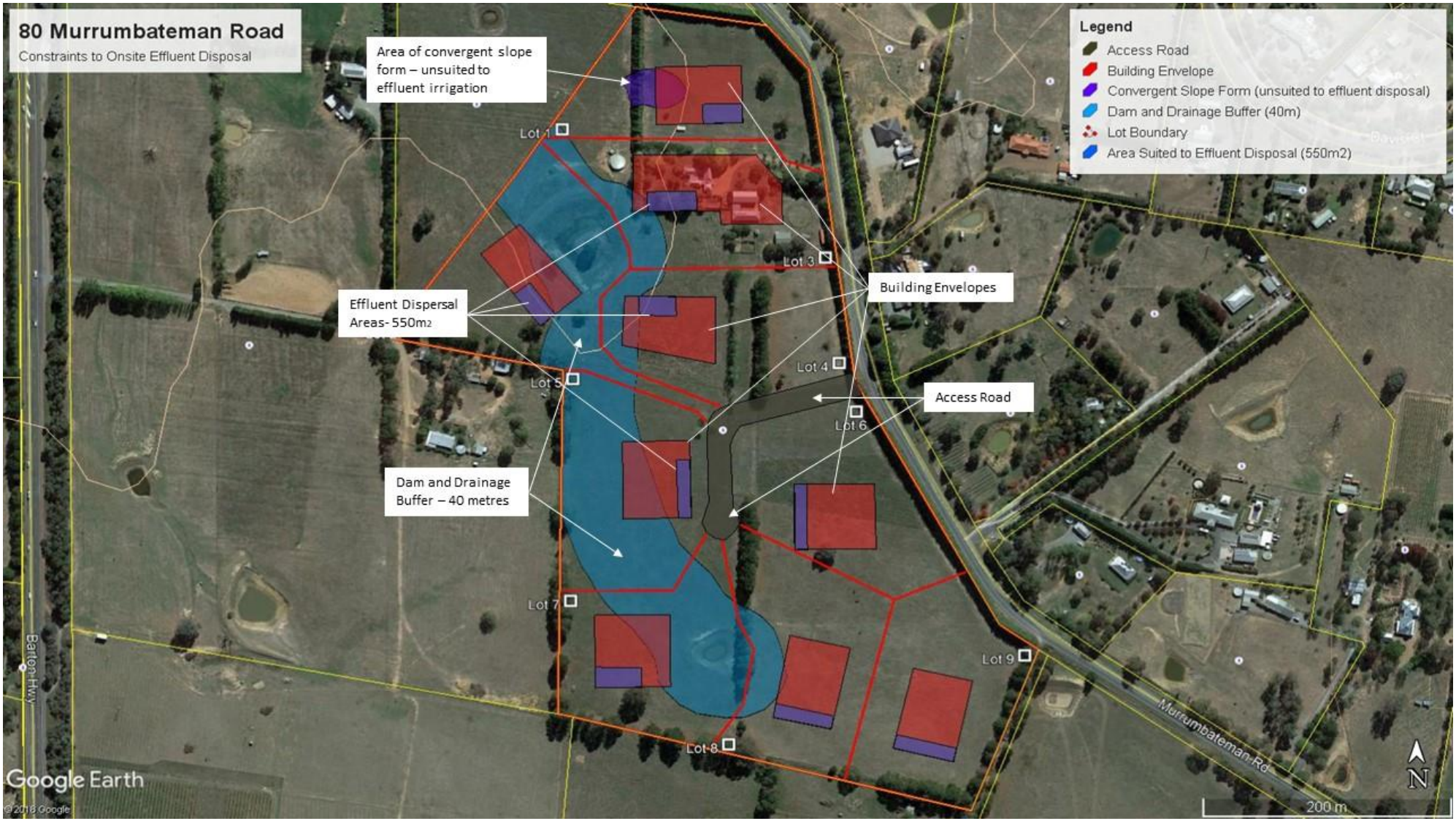


Figure 6: Constraints to Effluent Disposal

CAPABILITY FOR DWELLING CONSTRUCTION

Summary

Land considered unsuitable or constrained for the construction of dwellings generally consists of areas with the following attributes:

- a slope grade of 15% - the threshold is consistent with many building codes and Council requirements and also corresponds to the slope above which erosion hazard significantly increases (Landcom, 2004)
- seasonally waterlogged or flood prone land - including the minor flow lines which drain the site and dams
- unsuitable soils – including highly erodible dispersive soils, low wet bearing strength soils and unstable soils prone to movement
- areas within NSW DPI Office of Water Guidelines for riparian zone management, refer **Figure 7**.

The 40m buffer on intermittent drainage lines and the 40m buffer from dams required for effluent disposal areas, do not apply to dwelling construction.

The remaining gently sloping, free draining land can be considered as suitable for dwelling construction.

Dwelling construction

Recommendation

- Building envelopes will be restricted to land within the designated Building Envelopes which are shown in this report as suitable, based on excluding areas of seasonal waterlogging and land within the 10m riparian corridors identified for the 1st order streams, refer **Figure 7**.

Figure 7: Constraints to Dwelling Construction

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 which may be considered suitable for effluent application in the vicinity of the Building Envelopes, has only slight to moderate limitations, and no major 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 (sub surface drip)	>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
Erosion potential	All land application systems	No sign of erosion potential	Limited signs of erosion	Indications of erosion e.g. rills, mass failure	Soil degradation and off-site impact

Site feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
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		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

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
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
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 1: SOIL PROFILE DESCRIPTIONS

Representative Building Envelope Soil Profile – Lot 2

Soil classification	Depth (cm)	Properties	
CHROMOSOL	0-20	A1	Medium brown silty loam, moist and friable consistence, massive to weak crumb structure, no coarse fragments, grades to
	20-55	A2	Bleached light brown silty loam, moist and friable consistence, massive to weak crumb structure, no coarse fragments
	55->100	B	Yellow sandy clay earth loam, moist and friable consistence, massive to weak structure, no coarse fragments, continues

Figure 8: Lot 2 Building Envelope Soil Profile.

Representative Building Envelope Soil Profile - Lot 1

Soil classification	Depth (cm)	Properties	
KANDOSOL	0-15	A	Dark to medium brown silty loam, moist and friable consistence, weak crumb structure, no coarse fragments, grades to
	15->100	B	Red silty clay loam, moist and friable consistence, weak to moderate structure, no coarse fragments, continues

Figure 9: Lot 1 Building Envelope Soil Profile.

APPENDIX 2: SOIL PROFILE DESCRIPTIONS

Water balance	Using the DIR for irrigation on clay loam soils of 3.5 mm/day and adopting the design loading of 480 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 = 480 l/day; DIR = 3.5 mm/day A = 480/3.5 = 137 m^2 **Area required = 150 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 = 480 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 = 480 X 20 X 365/15,000 = 234m^2 **Area required = 250 m^2**
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 480 X 365 X 50 = 87.6kg P_{uptake} = 4.4mg/m^2/day X 365 X 50 = .080kg/m^2 P_{sorb} = 2,164kg/ha = .216kg/m^2 A = 87.6/(.08+ .216) = 296 m^2 **Area required = 300 m^2**
Design effluent disposal area	Therefore, a land application area of **300 m^2** will account for phosphorous, nitrogen and water applied based on estimated connections and usage patterns associated with the construction of a 3-bedroom house. An allowance of a reserve land application area will double this area to **600m^2**.
Alternative Dwellings	The size of the effluent irrigation area required to service dwellings with 4, 5 & 6 bedrooms are provided below: • 4 bedrooms – 370 m^2 • 5 bedrooms – 450 m^2 • 6 bedrooms – 520 m^2

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