LAND CAPABILITY ASSESSMENT

Lot 119 DP 1088125
Nottingham Road
WEE JASPER NSW

19 November 2024 (V01)

FRANKLIN CONSULTING AUSTRALIA PTY LTD
GPO Box 837 Canberra ACT 2601
www.soilandwater.net.au

SOIL AND WATER

Franklin Consulting Australia Pty Limited, trading as Soil and Water, offers expert advice and services to the agriculture, development and environmental conservation sectors. We provide soil and water management advice, undertake land capability and soil assessment, erosion and sediment control, and soil conservation, catchment and property management planning. We have extensive experience in both government and private sectors in senior management and consulting roles. We provide our services to individual land holders, sub-division developers, surveyors, commercial business owners, and land development and regulatory agencies.

Principal Consultant *John Franklin M App Sc, BSc, EIANZ*

Contact details: GPO Box 837
Canberra ACT 2601
P 02 6179 3491
M 0490 393 234
soil.land.water@gmail.com
www.soilandwater.net.au

CONTENTS

SUMMARY

The proposed development is a 4-lot subdivision at Lot 119 DP 1088125, Nottingham Road, Wee Jasper, NSW.

Lot 1	75 ha with Building Envelope
Lot 2	145 ha with Building Envelope
Lot 3	388 ha with Building Envelope
Lot 4	1,405 ha with Building Envelope and including existing cottage (Pims Hut).

There are adequate areas within the Building Envelopes for on-site disposal of effluent and dwelling construction, see below and the summary table for specific comments.

Water supplies

Potable water supply for new lots will be through capture and storage of roof water in potable water tanks. It is recommended that the minimum tank storage requirement for the dwelling lots 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 additional dams, bores or riparian water extraction. The lots will dispose of domestic effluent on-site.

Constraints Assessment

The Land Capability Assessment is designed to determine the suitability of the proposed subdivision to support new lots based on the capacity of the lots 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 corridor buffers.

Key Effluent Constraints

There is an adequate unconstrained area available (>1,200m2) for effluent disposal within each of the building envelopes for the on-site disposal of effluent. The building envelopes on the proposed lots 2-4 are constrained by the buffer distances required between drainage depressions and watercourses and effluent disposal practices. The most constrained lot is Lot 4 which is constrained by both the Micalong Creek watercourse buffer of 100 metres, and the 40-metre buffer required from the minor drainage depression adjacent to the building envelope.

Key Constraints to Dwelling Construction

There is an adequate unconstrained area available for dwelling construction within the building envelopes. The building envelopes on the proposed lots 2 and 4 are constrained by the riparian corridors required within which the construction of dwellings is generally not permissible. The most constrained lot is Lot 4 which is constrained by both the 4th or Higher Order Micalong Creek riparian corridor of 40 metres, and the 10-metre corridor required from the 1st Order Stream adjacent to the building envelope.

Recommended effluent management systems

Effluent treatment on the proposed lots may include **primary or secondary treatment systems (septic tanks or Aerated Wastewater Treatment Systems) provided these are supported by an On-Site Sewage Management Report (OSSM) which is specific to the final design of the dwelling and associated infrastructure, and consistent with the recommendations contained in this report.**

Options for the disposal of treated effluent may include surface or subsurface irrigation or subsoil absorption where suitable soil conditions exist.

REPORT SCOPE AND TECHNICAL REFERENCES

The report incorporates the results of an assessment of land capability for the new dwelling lots. The development proposal involves 4 new dwelling entitlements and associated infrastructure.

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

- **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; and
- **General land management recommendations** for constrained and sensitive areas. These will include effluent disposal areas, steep slopes, riparian zones, poorly drained waterlogged soils and areas of native vegetation. Recommendations will be general in nature and are designed to assist in determining appropriate land management practices for different parts of the site.

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.
- *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 Local Environmental Plan (2013)*

LOCATION AND DEVELOPMENT INFORMATION

Address: Lot 119 DP 1088125, Nottingham Road, Wee Jasper, NSW

LGA: Yass Valley Council

Owner/Developer: C/- Craig McGaffin, Catalyze Property Consulting.

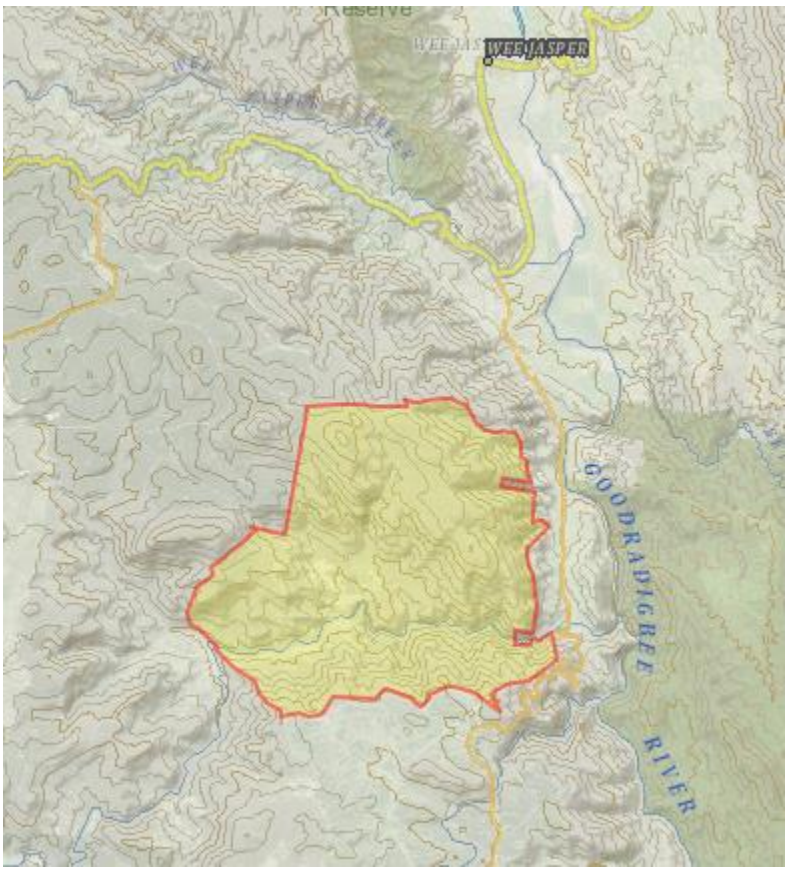

Figure 1: Regional location

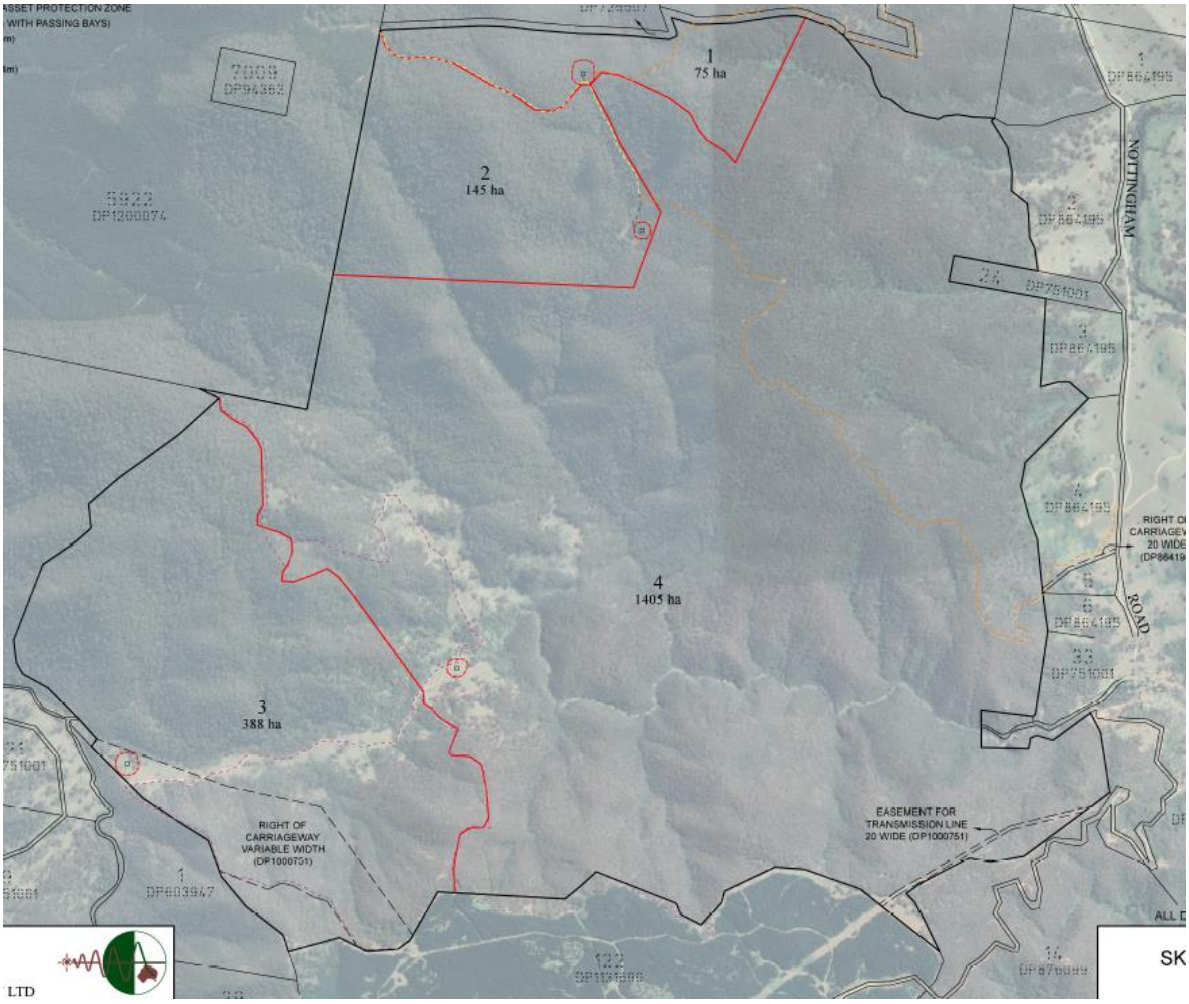

Figure 2: Sub-division layout (refer to final surveyed client plans).

Intended water supply: Water for new lots is to be provided through roof catchment and tank storage.

It is recommended that the minimum tank storage requirement for the dwelling lots 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 additional dams, bores or riparian water extraction.

Proposed Effluent Management: The development will rely on the onsite treatment and disposal of effluent on the dwelling lots.

Effluent disposal on each new dwelling lot will be restricted to unconstrained areas within the building envelopes on each lot.

Effluent will be managed on-site by a combination of a NSW Health accredited treatment system with effluent dispersal via irrigation or subsoil absorption.

Primary and secondary treatment systems combined with subsoil absorption or irrigation systems are considered appropriate for the development provided these are supported by an On-Site Sewage Management System report.

Local experience: Many rural developments in the area share similar site and soil constraints. The constraints identified do not present any significant problems for the establishment of new dwellings or the associated on-site disposal of effluent.

Figure 3: Looking north across proposed Lot 1.

Figure 4: Looking east across proposed Lot 1.

Figure 5: Looking west across Lot 1.

Figure 6: Looking south across Lot 1.

Figure 7: Looking west from Lot 2 towards adjacent dam.

Figure 8: Looking north across Lot 2.

Figure 9: Looking east across Lot 2.

Figure 10: Looking south across Lot 2.

Figure 11: Looking north over proposed Lot 4.

Figure 12: Looking east over Lot 4.

Figure 13: Looking south over Lot 4.

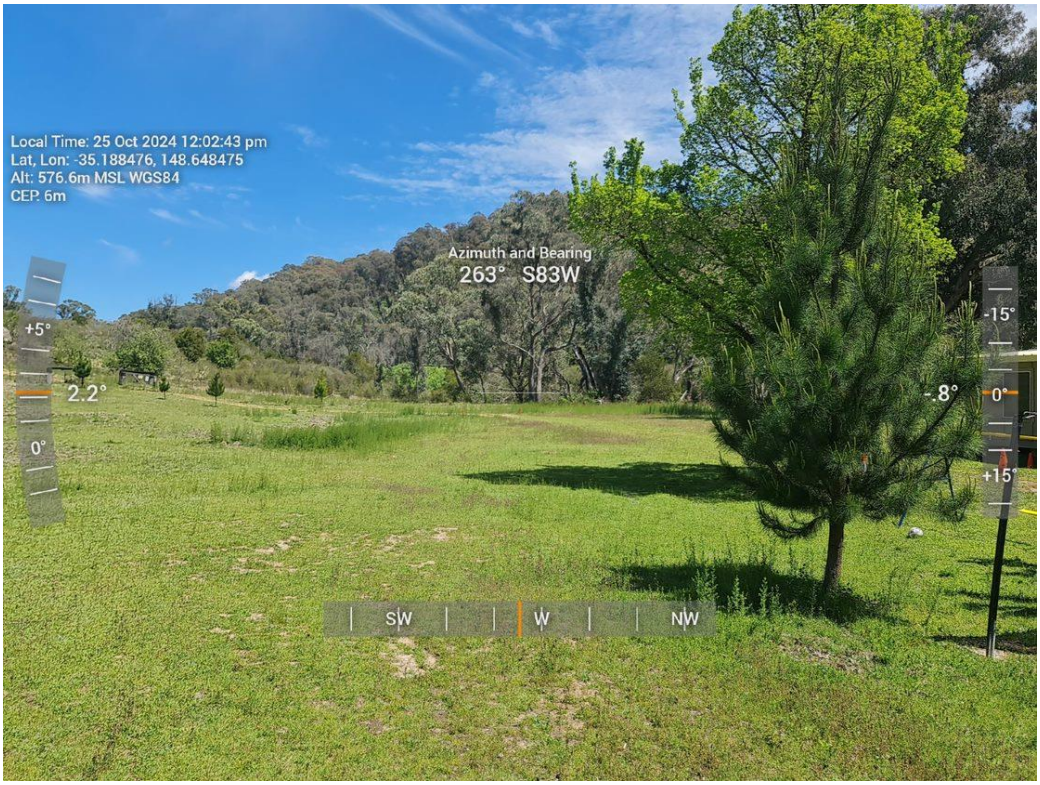

Figure 14: Looking west over Lot 4.

Figure 15: Looking north over Lot 3.

Figure 16: Looking west over Lot 3.

Figure 17: Looking south over Lot 3.

Figure 18: Looking east over Lot 3.

SITE AND SOIL ASSESSMENT

Climate

Cool temperate climate with mean annual rainfall of approximately 650 mm, pan evaporation 1200 mm; large moisture deficit typically occurs in summer months, small moisture surplus typically occurs in winter months.

Climate is suited to dispersal of primary or secondary treated, effluent by subsoil absorption or irrigation (secondary treated only).

Exposure

The proposed building envelopes lots have a reasonable level of exposure which will be improved through clearing to establish the required asset protection zones. Groundcover is predominantly native trees and shrubs and perennial grassland.

The level of exposure within the building envelopes is favorable for the onsite disposal of effluent via subsoil absorption or irrigation.

Slope

The lots display a range of slope gradients, from gentle to moderate: The gentle to moderately sloping areas are not constrained for effluent dispersal and dwelling construction.

Areas suited to effluent disposal and dwelling construction are located on gentle to moderate slopes of <12% which are not otherwise constrained for effluent disposal or building construction.

There is an adequate area of land within each new dwelling lot which is not slope constrained for dwelling construction or effluent dispersal.

Landscape/ Landform

The majority of the area within the new dwelling lots are on upper and lower mid slopes with divergent slope form. This slope form is suited to the subsoil absorption or irrigation of treated effluent.

There are areas of convergent slope form on the property which generally correspond to the lower slopes and drainage depressions which are already constrained for effluent disposal practices.

There are adequate areas within the new dwelling lots with divergent slope form 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

Surface rock and outcropping bedrock is not common in this landscape and these features do not present a major constraint to effluent disposal within the unconstrained areas of the building envelopes.

Rock outcrop and surface stone is not a constraint to effluent disposal on the proposed building envelopes.

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 issues.

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. The low density of new dwelling lots to be created (less

than 1 dwelling per 500 hectares), results in limited potential for changes to local hydrology.

Effluent disposal will need to be appropriately designed and located 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. There is an adequate area of suitable soils within the unconstrained areas of the dwelling lots.

It is recommended that areas of suitable site and soil conditions for effluent dispersal be identified on each new dwelling lots in the individual Effluent System Design Reports to be submitted as part of the Development Application to construct future dwelling(s).

Soils

A detailed soil profile description is provided in **Appendix 2** of this report.

Soils are described as the Oak Creek Soil Landscape in the Soil Landscapes of the Goulburn 1:250,000 Sheet (Hird 1991). This landscape includes Red Chromosol on crests and side slopes with poorer drained Yellow Chromosols in drainage depressions. The soils in the steeper areas and on ridges/crests include Tenosols and Rudosols in the areas mapped as suitable for effluent dispersal are Red and Yellow Chromosols and Kandosols formed on Duoro Volcanics parent material.

They comprise a weakly structured silty or sandy loam upper layer overlying a bleached massive silty or sandy loam above a moderately structured clay loam to clay subsoil. Depth is variable from 50 – >100cm.

The representative analytical data from the Soil Landscape 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.

Soil profiles from within each dwelling lots were assessed and are described in detail in **Appendix 2.**

Soil in the new dwelling lots are generally unconstrained for effluent dispersal and dwelling construction. A site classification in accordance with AS 2870 should be undertaken to determine the suitability of soils for dwelling construction.

CONSTRAINTS ANALYSIS

SOIL EROSION

The soil types which dominate the site are a high erosion risk. Therefore, steeper slopes and areas where runoff is concentrated are highly susceptible to erosion.

The proposed building envelopes are generally located outside the areas mapped as high soil erodibility in the Yass LEP 2013 *(refer* ***Figure 19****).*

Figure 19: Yass Valley Local Environmental Plan 2013

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 of erosion also pose some risk to dwelling construction due to potential instability and the undermining of dwelling foundations and associated infrastructure by erosion.

Minor rill erosion was observed on the back batter of the Lot 2 building platform which was constructed prior to the inspection. There were no areas of erosion identified on Lots 1,3 & 4 within the nominated building envelopes.

RECOMMENDATIONS

- Effluent disposal should not be undertaken within areas of erosion.
- Dwelling construction should avoid areas of erosion.
- Greater than 70% groundcover be maintained far across the property (refer **Figure 25 & 26**).
- Groundcover by maintained at 100% in areas nominated for effluent disposal.

- Erosion control measures should be implemented to address any areas of active erosion detected on the property.
- The construction of dwellings or other buildings or infrastructure should include appropriate soil and water management measures.

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.

There are no areas of the proposed building envelopes mapped as salinity effected land mapped in the Yass Valley LEP (2013), refer **Figure 19** above**.**

No areas of salinity were observed during the inspection.

RECOMMENDATIONS

- Effluent disposal should not be undertaken within areas of salinity related erosion and seasonal waterlogging.
- Dwelling construction should avoid areas of salinity related erosion and seasonal waterlogging.
- The area of deep-rooted perennial species should be maintained across the property including retaining existing trees and shrubs.

GROUNDWATER

The site is mapped as low to moderate groundwater vulnerability on the Department of Land and Water Conservation (2001) Groundwater Vulnerability Map of the Murrumbidgee Catchment.

No areas of the property are mapped on the Yass Valley LEP 2013 Groundwater Vulnerability Map, see **Figure 20** below.

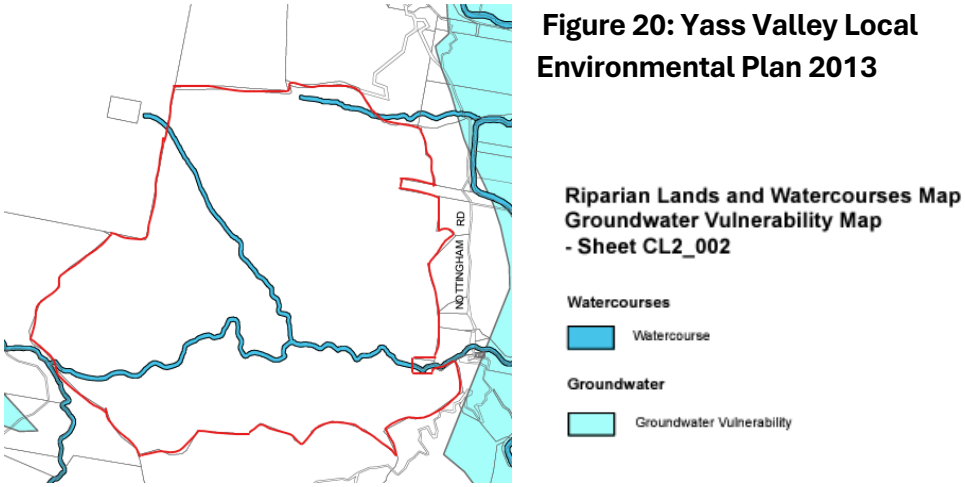

Figure 20: Yass Valley Local Environmental Plan 2013

Figure 21: Bores https://realtimedata.waternsw.com.au/water.stm

There is one bore within 500m of the Building Envelope on Lot 4. Bore GW009906 has a depth of 35.2m and no information on water bearing zones. A bore buffer for effluent dispersal will be required in the building envelope on this lot.

The risk of contamination or any other adverse impacts to quantity and quality of groundwater available for other users resulting from the on-site effluent dispersal practices on other lots related to the development, are considered minor due to:

- vertical separation of greater than 100 metres between effluent diposal areas and existing bores,

- low density of development across the property with less than 1 dwelling per 500 hectares,

RECOMMENDATIONS

- Maintain a minimum 100m buffer between existing bores and effluent dispersal areas on Lot 4.
- Maintain a minimum 250m buffer between future bores and effluent dispersal areas on Lots 1,2 and 3.
- Require a water supply work approval to be sought prior to constructing a bore or well.

RIPARIAN LANDS

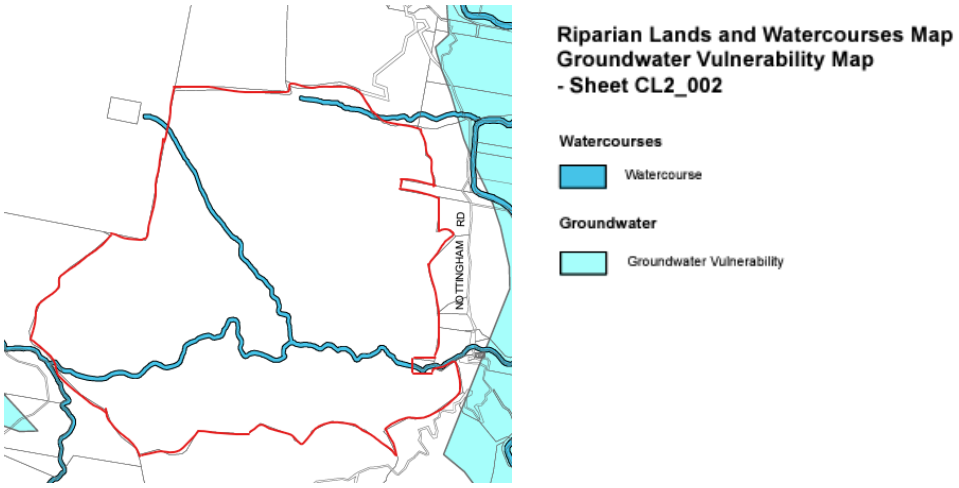

Figure 22: Yass Valley Environmental Plan 2013 – Riparian Lands

Lots 1-4 include areas mapped on the Riparian Lands and Watercourses Map-Sheet CL2_005 (refer above) which include the Micalong, Waterfall and Racecourse Creeks.

NSW DPI Office of Water (Guidelines for riparian corridors on waterfront land) also define the riparian corridors required for different stream orders, to maintain the integrity of these sensitive riparian areas, refer **Figure 23.**

Figure 2. The Strahler System

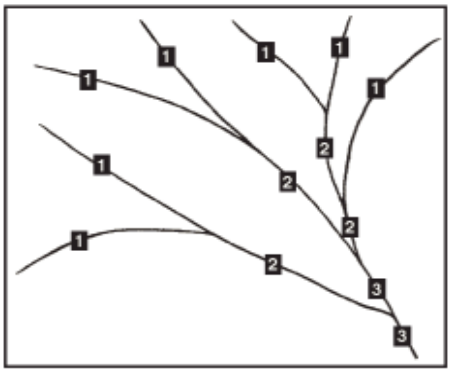

Table 1. Recommended riparian corridor (RC) widths

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

Figure 23: Stream ordering and riparian corridor widths (NSW DPI Water Guidelines)

Lot 1 Building Envelope	upslope of 1st order stream
Lot 2 Building Envelope	upslope of 1st and 2nd order stream
Lot 3 Building Envelope	upslope of 4th order stream (Micalong Ck)
Lot 4 Building Envelope	upslope of 1st and 4th order stream (Micalong Creek)

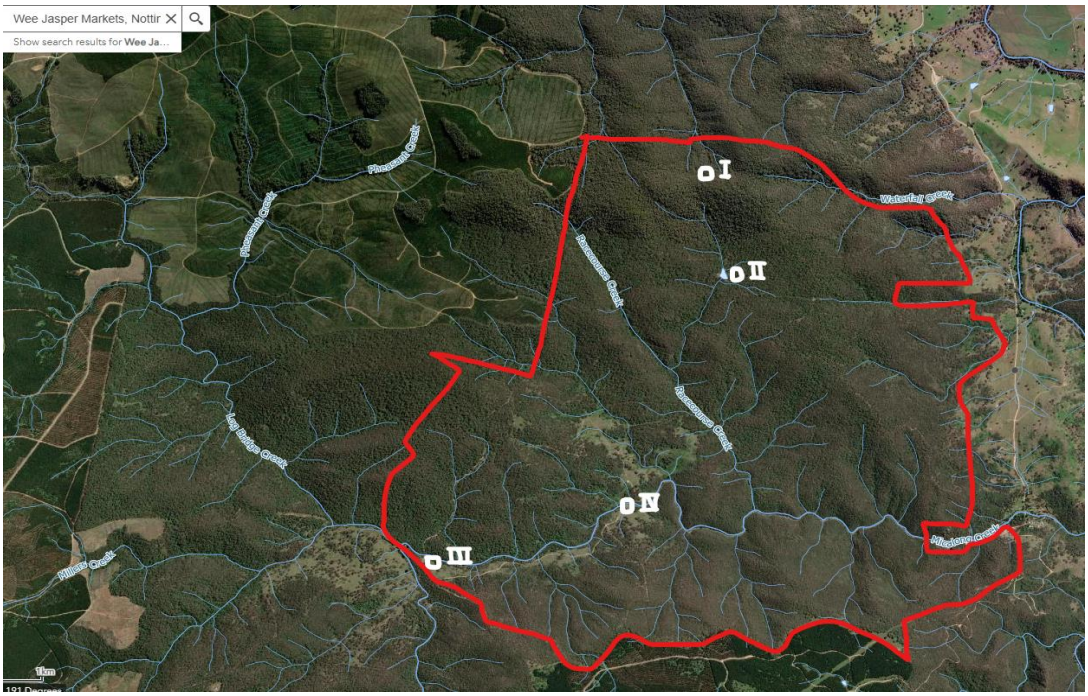

Figure 24: NSW Hydroline Mapping showing streams requiring riparian corridors

The mapped drainage features within and adjacent to the building envelopes will require riparian corridors, within which construction of buildings or associated infrastructure is inconsistent with Water NSW Guidelines for riparian management. These riparian corridor areas are mapped as constrained for building construction, refer **Figure 26.**

RECOMMENDATIONS

- No dwelling or related infrastructure construction is to occur within the 10m buffer from the 1st Order stream within the building envelope on Lot 1.
- No dwelling or related infrastructure construction is to occur within the 10m buffer from the 1st Order stream and 40m buffer required from the 4th or Higher Order stream within the building envelope on Lot 4.
- Any watercourse crossings should be designed in accordance with NRAR guidelines and any necessary approvals.

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.

Buffers required include a 100 metre buffer from permanent surface waters including Micalong, Racecourse and Waterfall Creeks, and a 40m buffer from any other watercourses including intermittent waterways, dams and drainage channels.

Approximate locations for drainage buffers are shown in **Figure 25**. There are adequate areas within each proposed building envelope outside these buffers which is considered suitable for effluent disposal.

The most constrained lot is Lot 4 which has >1,200m2 of unconstrained land which is considered adequate for on-site effluent disposal.

Recommendations

- All land designated for effluent dispersal will be located outside 100m watercourse buffer from Micalong, Waterfall and Racecourse Creeks as mapped in **Figure 25**.
- All land designated for effluent dispersal will be located outside the 40m drainage depression buffers as mapped in **Figure 25**.

- All land designated for effluent dispersal will be located outside the 40m buffer from farm dams a mapped in **Figure 25**.
- The buffers required between effluent dispersal practices and drainage depressions and dams do not apply to dwellings or other built infrastructure.

MANAGEMENT OF EFFLUENT

Summary

This report assesses the general availability of an adequately sized area of land within the proposed dwelling lots.

A minimum area of 1,200 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 and guidelines require that an equal size reserve effluent disposal area is also available. The location of future buildings, paths, tanks, pools and other infrastructure will also need to allow for the required buffers within the unconstrained areas of the dwelling lots.

Key constraints to effluent dispersal on the lots are the Micalong, Waterfall and Racecourse Creeks watercourse buffers of 100m and dam and drainage buffers of 40m.

The proposed new dwelling lots have an adequate area of land that is no constrained and is therefore suited to effluent dispersal. There is also 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 25**.

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. This type of system is not ideally suited to off-grid dwellings due to the requirement for continuity of power supply. This type of system is also not ideal for dwellings used intermittently as infrequent loading can reduce the treatment efficiency of the system.

Primary treatment systems combined with subsoil absorption trenches/beds are more suited to off-grid power supply and/or intermittent occupancy patterns.

There are also 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.

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 on lots be semi fixed installations which limit the potential for effluent irrigation within constrained areas. 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 3**, the sizing of the irrigation area is shown below:

Three bedrooms	360m^2
Four bedrooms	450m^2

Five bedrooms	550m^2
Six bedrooms	620m^2

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

NSW Health accredited primary treatment systems treat effluent to a primary standard and do not include disinfection. As a result, effluent can only be disposed of through subsoil absorption in a dedicated trench(s) or bed(s).

The sizing of the treatment system is based on the estimated daily effluent load with the minimum treatment tank capacity being 3,000L and a 4-bedroom dwelling requiring 3,500L.

Sizing of subsoil beds/trenches is based on soil type and estimated effluent loading. A subsoil absorption bed for a 4-bedrooom dwelling on moderately structured clay loam soils is 60m^2 in size.

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 dwelling entitlements and the prescriptions of this report should be applied to the design process of the lot.
- Management prescriptions for on-site effluent management should be detailed in specific On-Site Sewage Management report(s) to be provided with Development Application(s) for the construction of dwelling(s).
- Any effluent disposal practices should be confined to within building envelopes which are not mapped as constrained for this purpose on new dwelling lots, refer **Figure 25**.
- 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 bores (except for 100 m from existing bore on Lot 4)
  - 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)
- Effluent management systems suitable for the lots must bed NSW Health accredited primary or secondary systems, dispersing effluent to irrigation (secondary treatment only) or subsoil absorption. The effluent dispersal area size should be based on occupancy derived from bedroom number.
- As a guide, the following irrigation areas would be appropriate for the soil and site conditions of the site:
  - Three bedrooms.....360m^2
  - Four bedrooms.....450m^2
  - Five bedrooms.....550m^2
  - Six bedrooms.....620m^2
- Subsoil absorption beds range include:
  - Three bedrooms..... 50m^2
  - Four bedrooms.....60m^2
  - Five bedrooms.....80m^2
  - Six bedrooms.....90m^2
- To ensure effective distribution of secondary treated effluent, and provide protection of irrigation lines, the minimum requirement for irrigation dispersal should be buried distribution lines attached to a moveable surface sprinkler line. Alternatively, a fully fixed system comprising decoupling sprinkler heads and a minimum of two runs of distribution lines connected by a manual valve to allow for alternating dispersal areas.

- Subsoil absorption trenches/beds should be properly designed and constructed in accordance with AS1547:2012 and council requirements.
- 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.

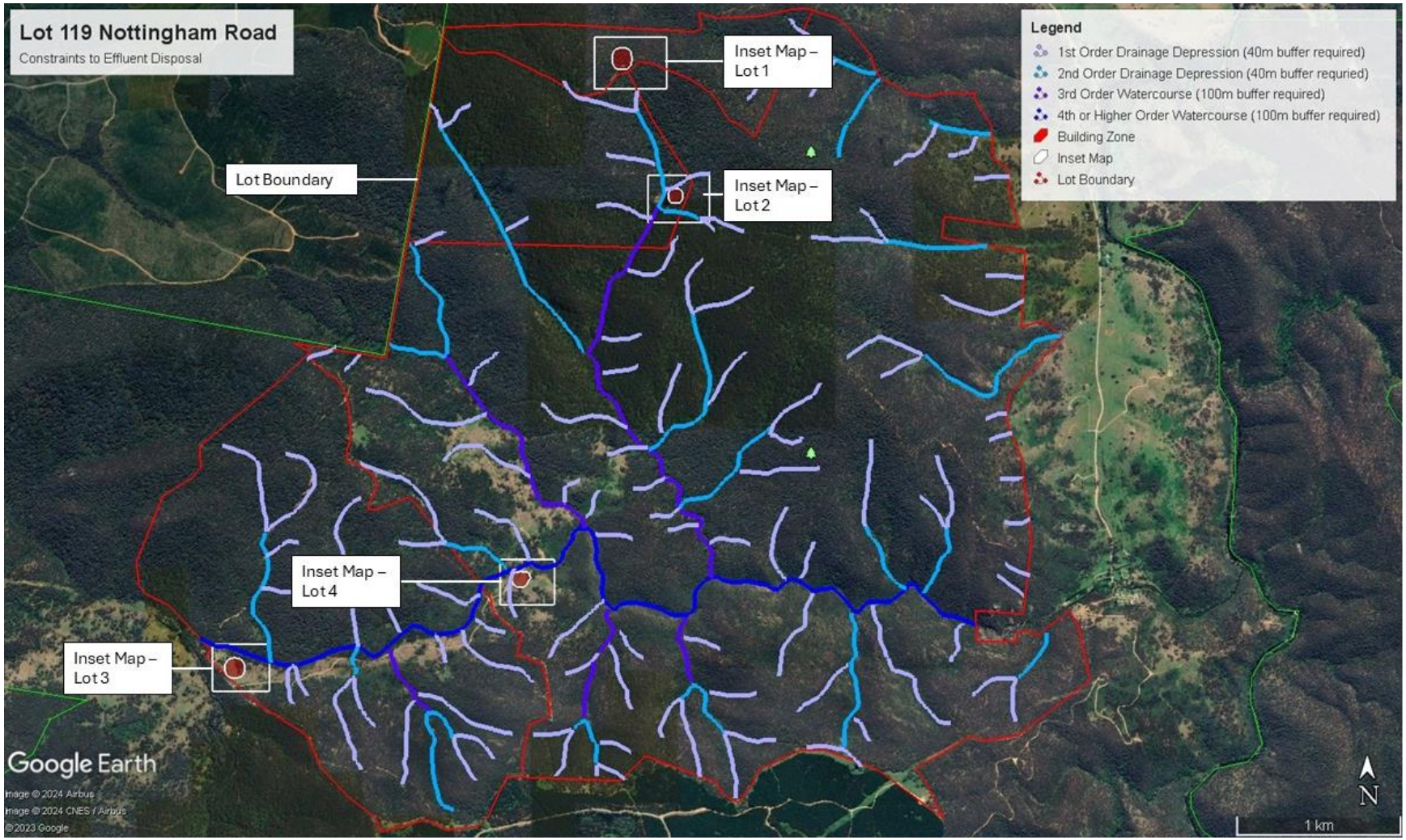

Figure 25a: Constraints to effluent dispersal.

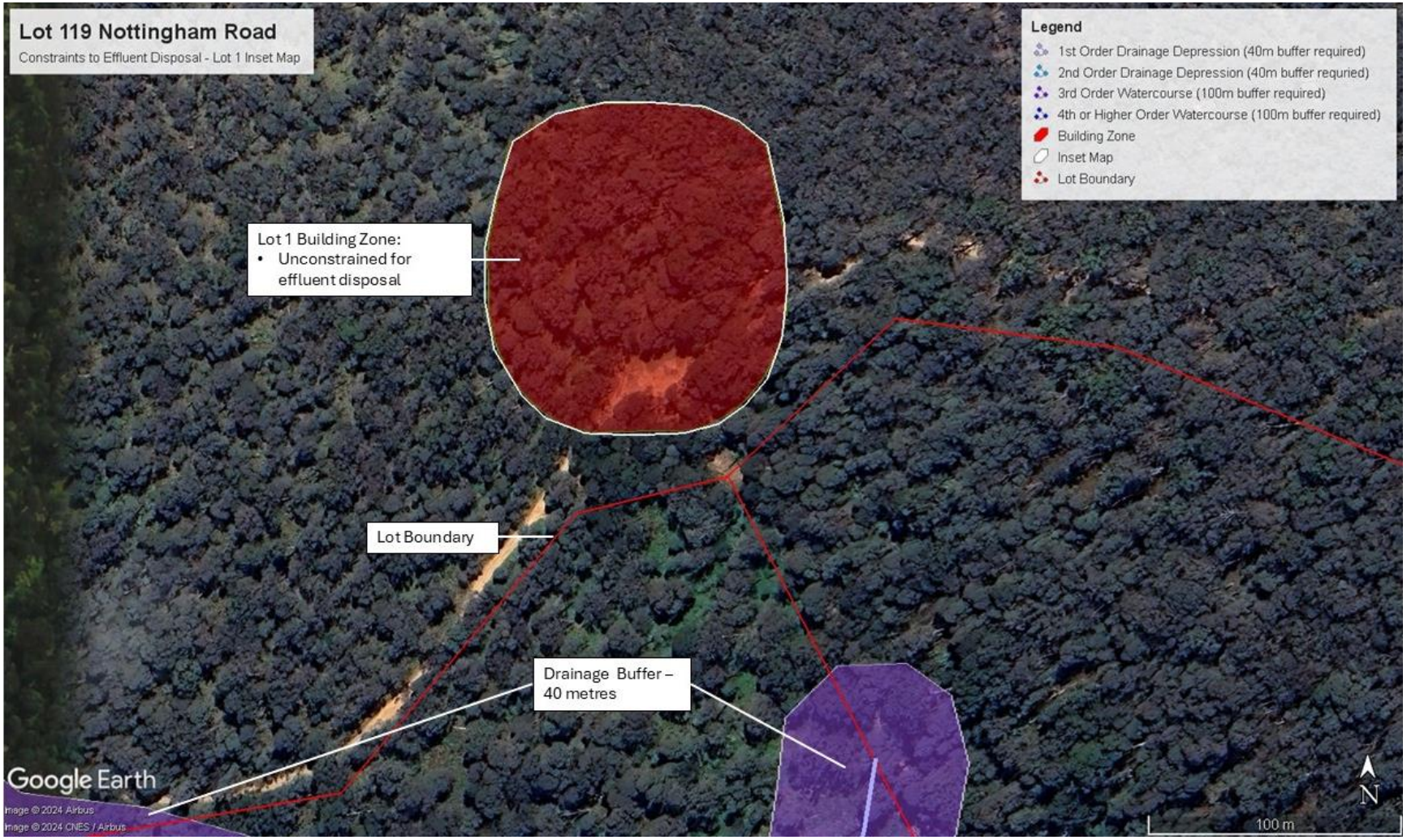

Figure 25b: Constraints to effluent disposal - Lot 1

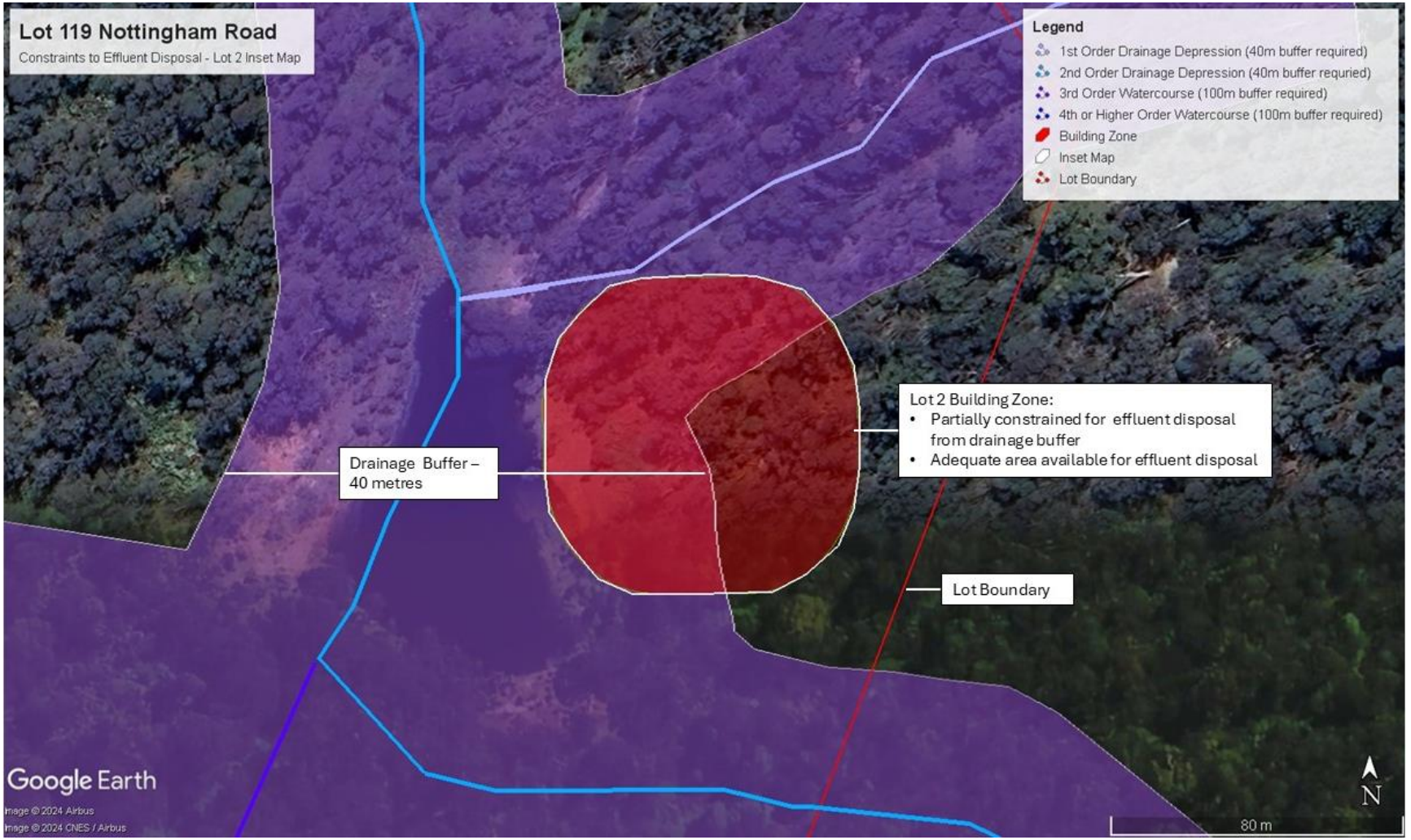

Figure 25c: Constraints to effluent disposal - Lot 2

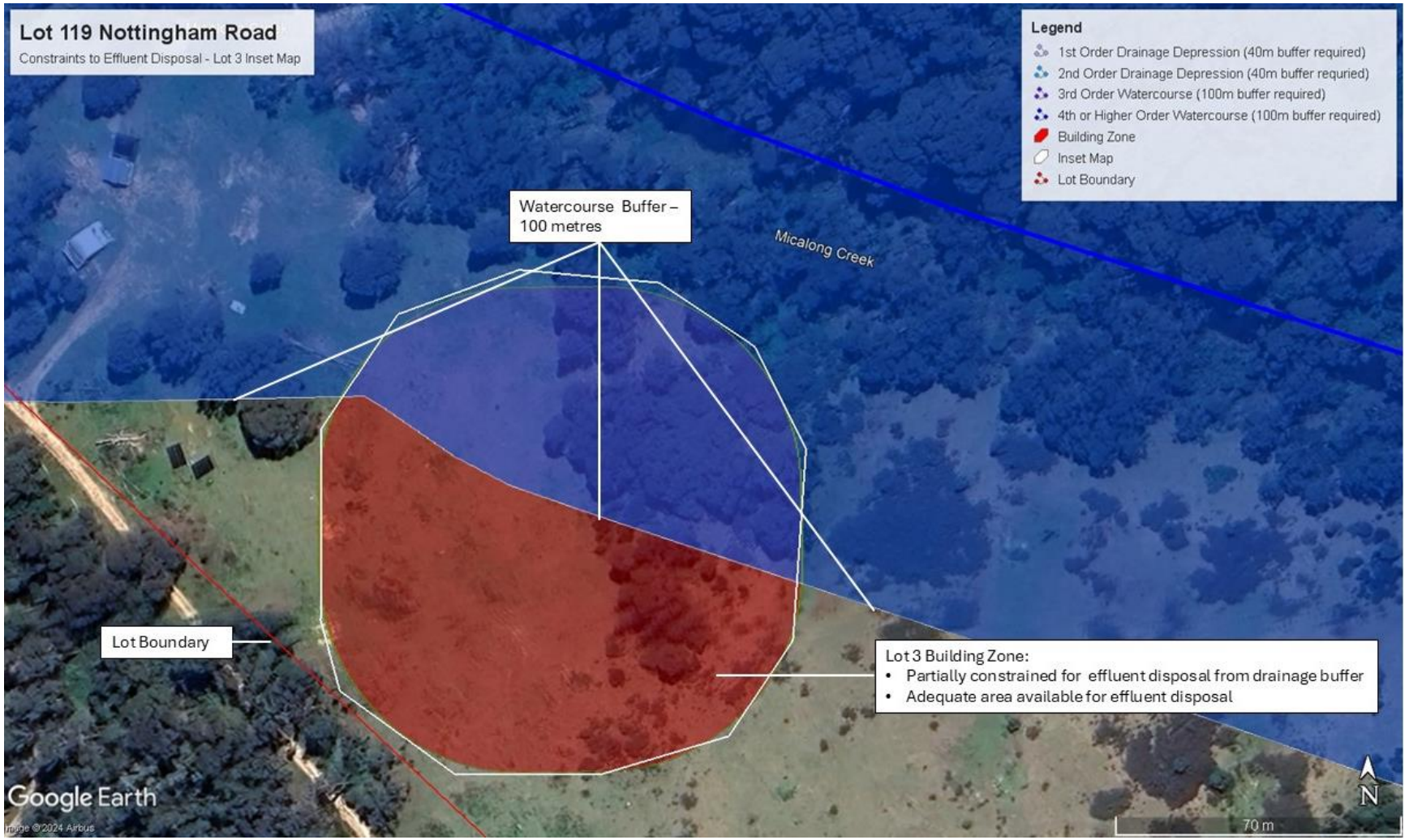

Figure 25d: Constraints to effluent disposal - Lot 3

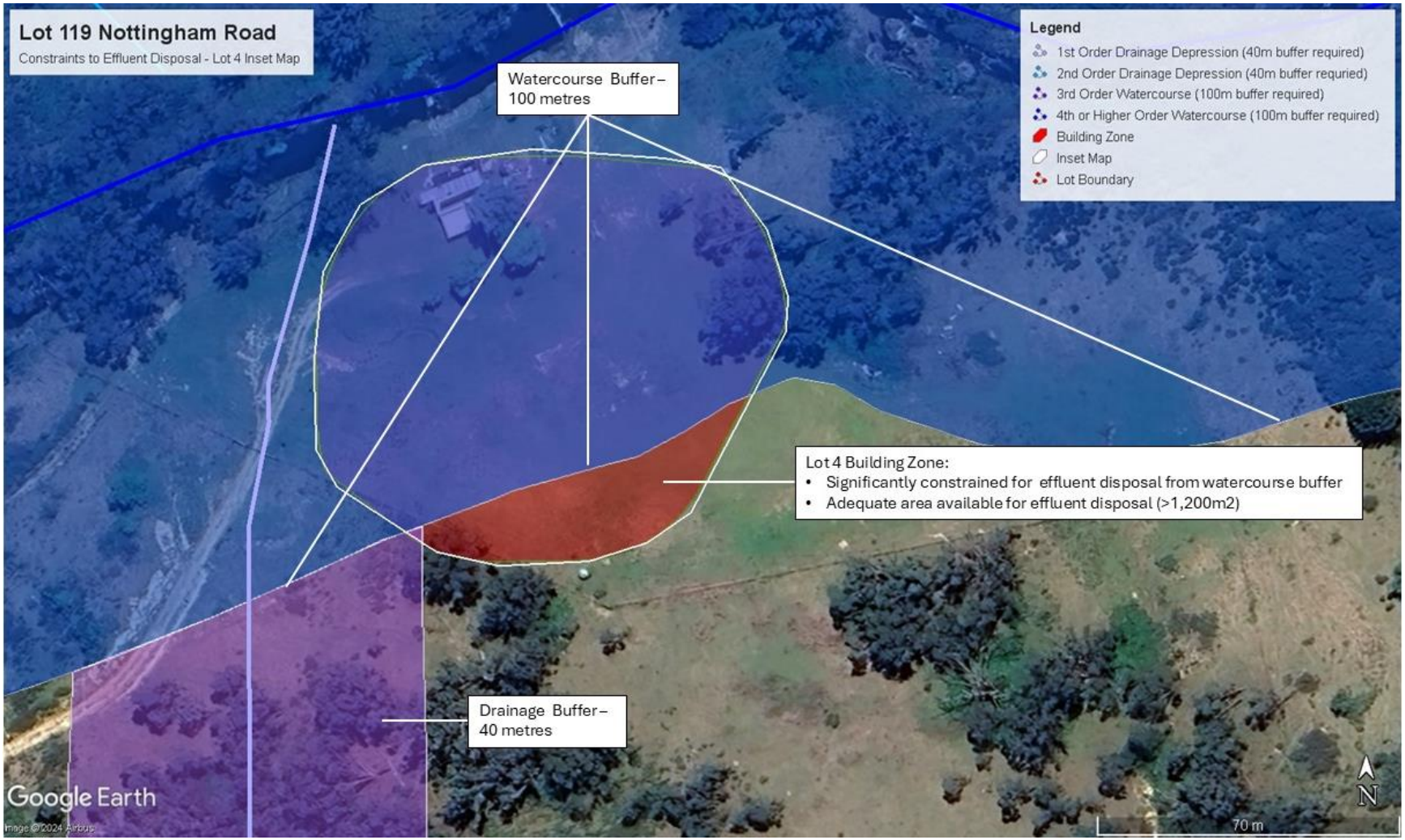

Figure 25e: Constraints to effluent disposal - Lot 4

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)
- areas of active erosion, refer **Figure 26**
- 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 26**.

The 100m buffer from watercourses and the 40m buffer on minor drainage lines and dams required for effluent disposal areas, do not apply to dwelling construction.

The proposed building envelopes have adequate areas of generally unconstrained land suitable for dwelling construction.

Dwelling construction

Recommendations

- Building construction will be restricted to land within new dwelling lots which are shown in this report as unconstrained, refer **Figure 26**.
- A Site Classification shall be conducted prior to the construction of any additional buildings within the dwelling lots to confirm the suitability of soil for construction.

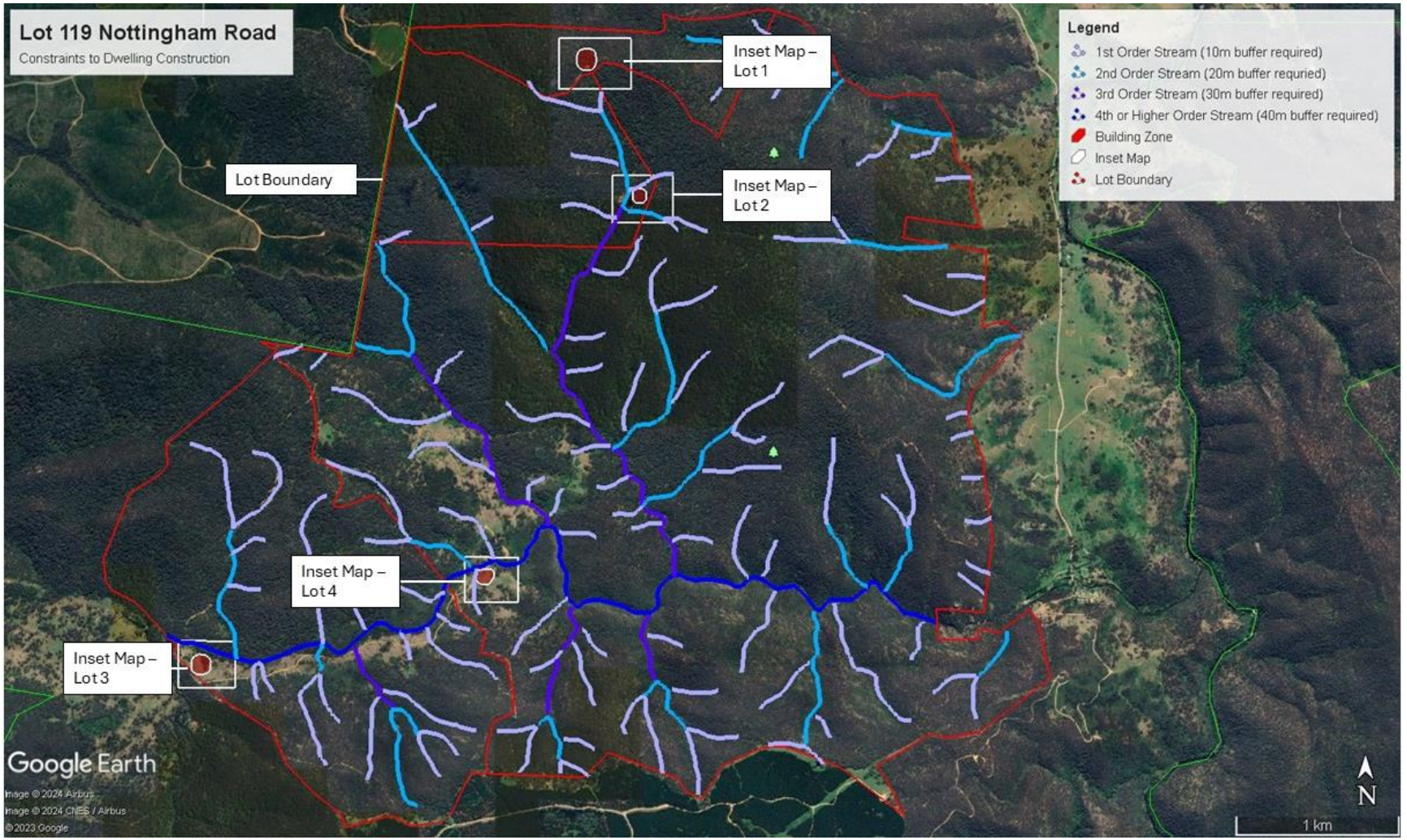

Figure 26a: Constraints to dwelling construction.

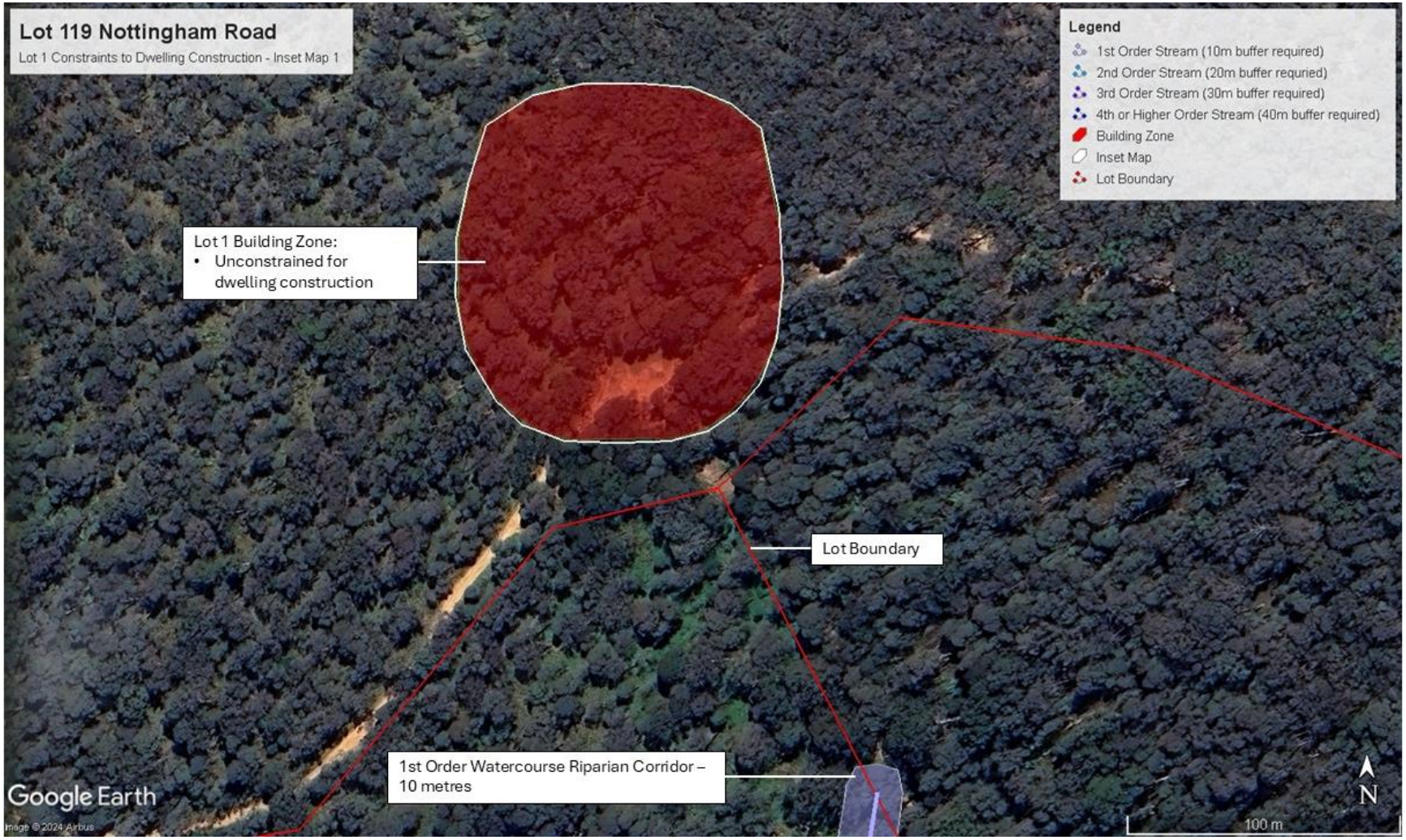

Figure 26b: Constraints to dwelling construction – Lot 1.

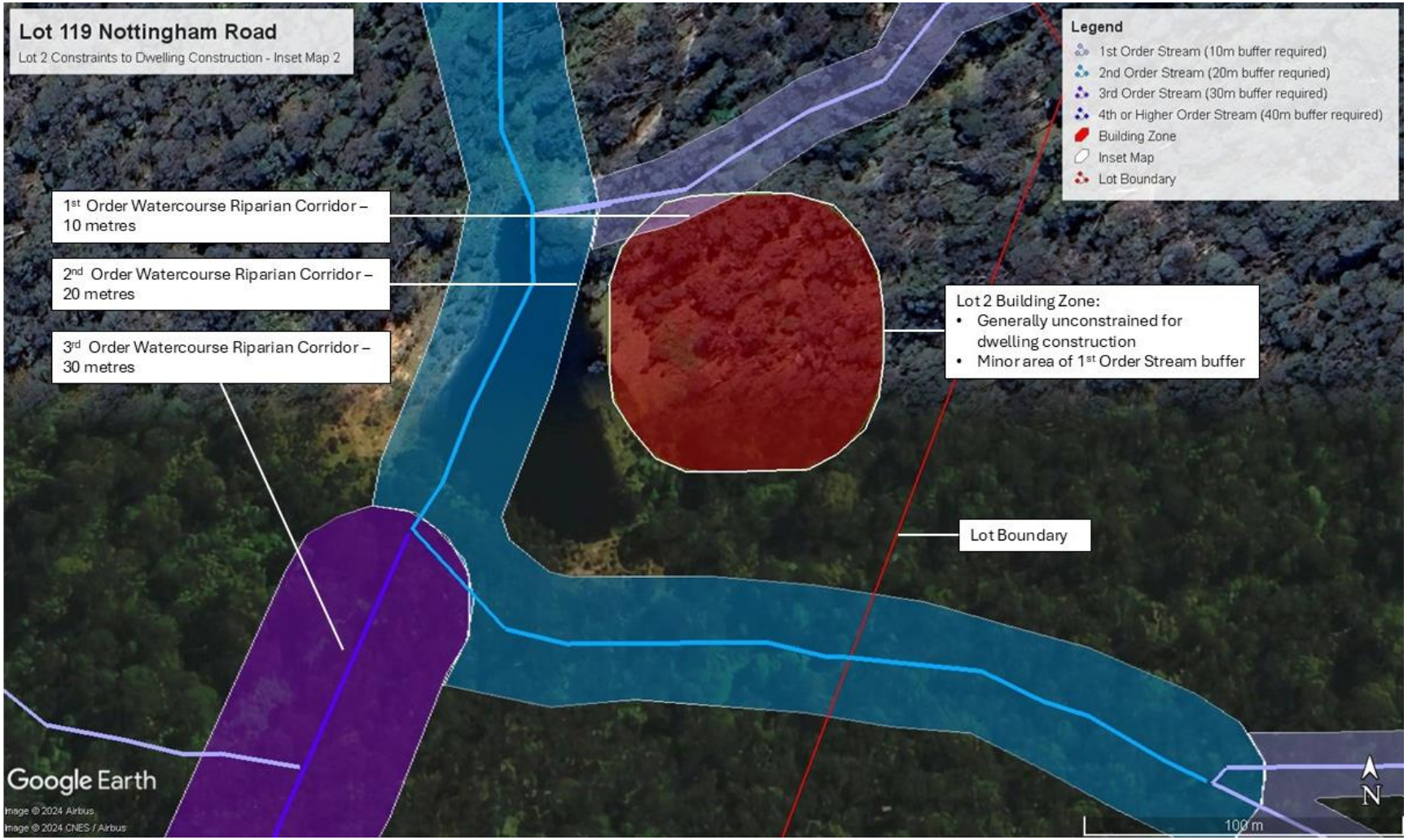

Figure 26c: Constraints to dwelling construction – Lot 2.

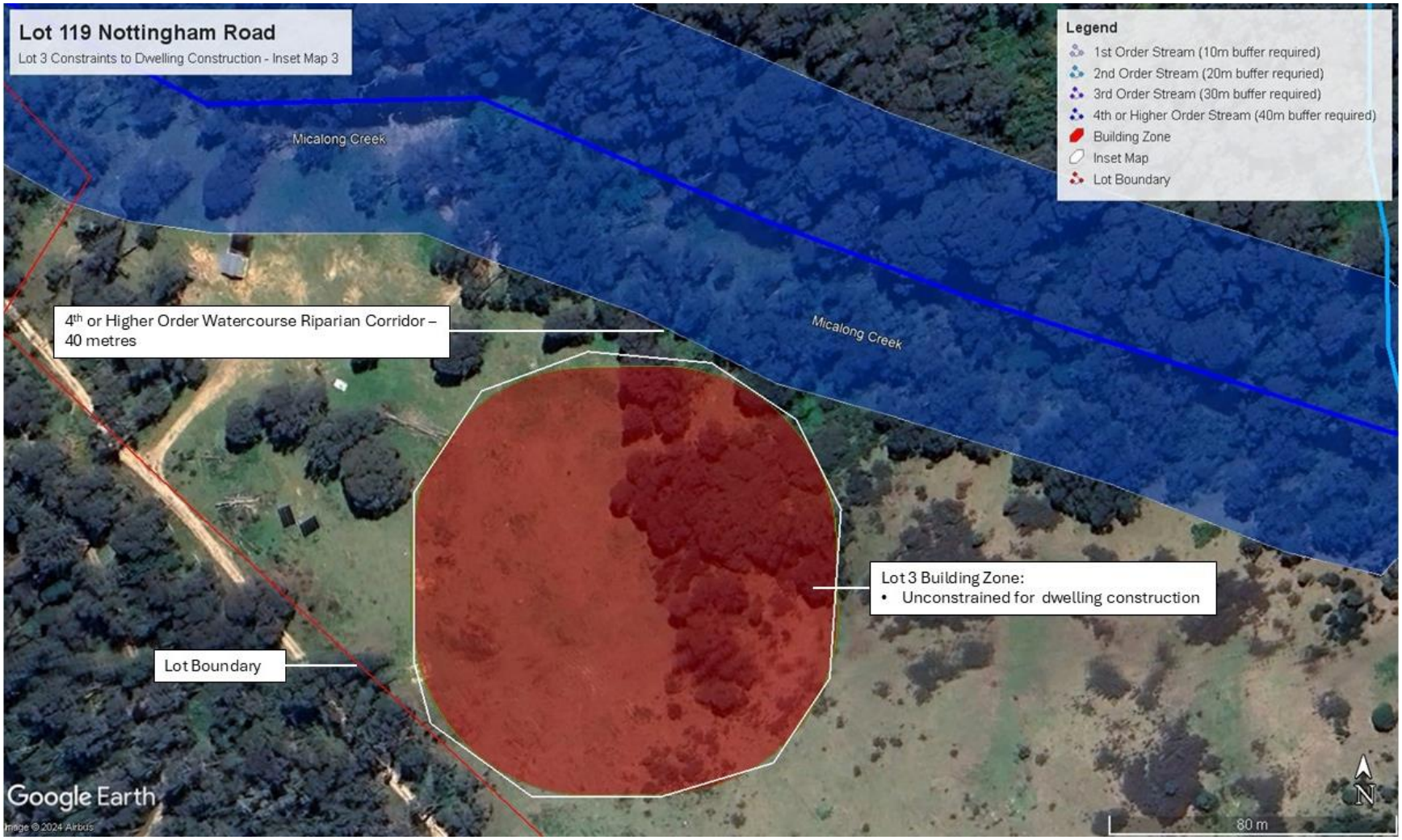

Figure 26d: Constraints to dwelling construction – Lot 3.

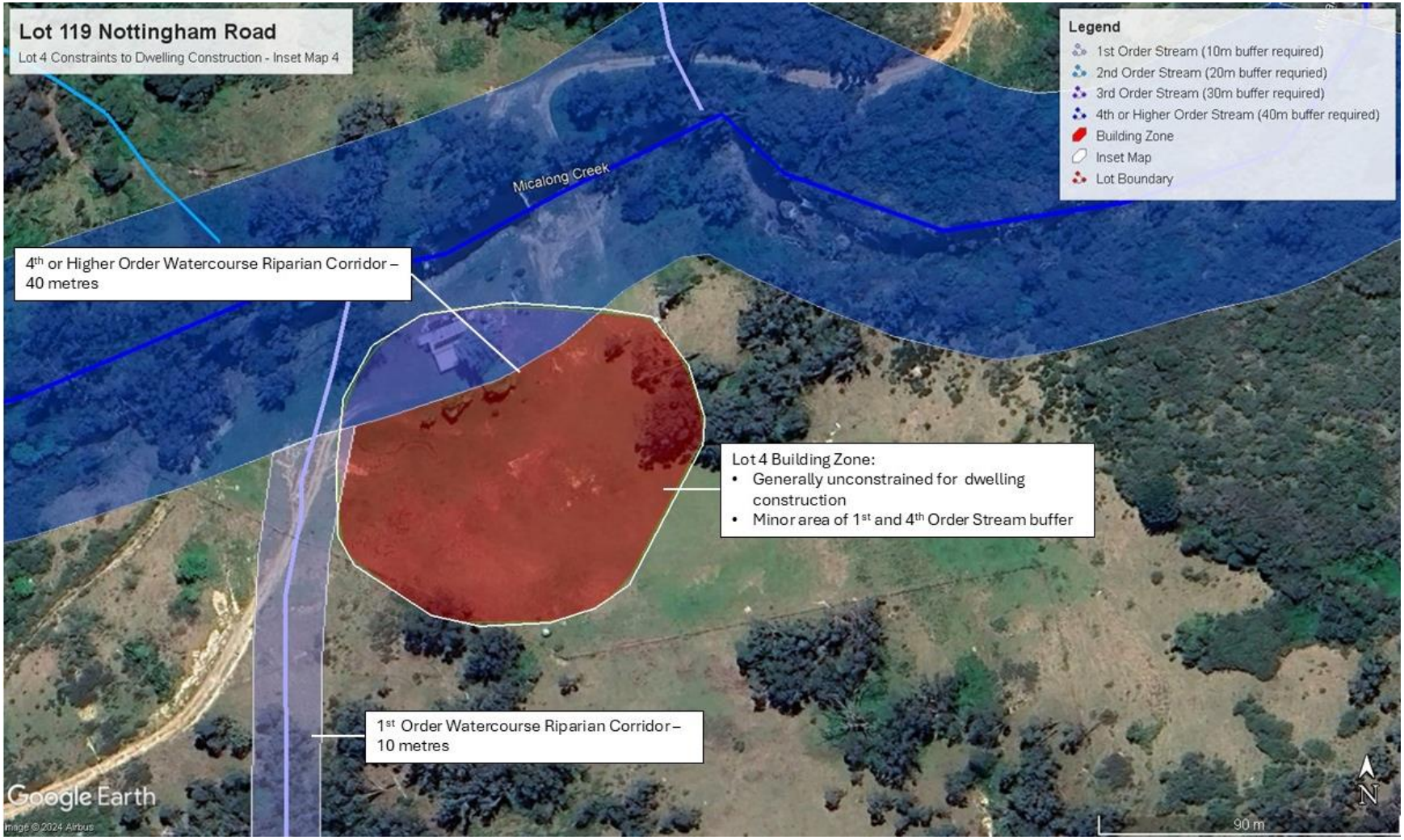

Figure 26e: Constraints to dwelling construction – Lot 4.

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: Building Envelope Lot 1

Soil classification	Depth (cm)	Properties
KANDOSOL	0-30	A Brown silty loam, moist and friable, weak structure, <5% coarse fragments
	30->100	B Red, silty clay loam, moist and friable, weak to moderate structure, <5% as stones 40-50mm in diameter. .

Figure 27: Soil profile 1 Building Envelope Lot 1

Soil Profile 2: Building Envelope Lot 2

Soil classification	Depth (cm)	Properties
CHROMOSOL	0-20	A Brown silty loam, moist and friable, massive to weak structured, <5% coarse fragments,
	20 - 85	B Silty clay loam, moist and friable, weak structured, <5% coarse fragments

Figure 28: Soil profile 2 - Building Envelope Lot 2

Soil Profile 3: Building Envelope Lot 3

Soil classification	Depth (cm)	Properties
CHROMOSOL	0-30	A Light brown fine sandy loam, dry and friable, massive to weak structured, no coarse fragments, strong break to
	30 - 80	B Red silty clay loam, moist and friable, weak to moderate structured, <5% coarse fragments, occasional stones 20-60mm in diameter.

Figure 29: Soil profile 3 - Building Envelope Lot 3

Soil Profile 4: Building Envelope Lot 4

Soil classification	Depth (cm)	Properties
CHROMOSOL	0-25	A1 Brown silty loam, moist and friable, massive to weak structured, no coarse fragments,
	25 – 40	A2 Bleached light brown silty loam, moist and friable, massive to weak structured, no coarse fragments.
	40-65	B1 Orange/grey fine sandy clay loam, moist & friable, weak structure, no coarse fragments.
	65->100	B2 Orange silty clay loam, friable to firm, >5% coarse fragments, moist & friable.

Figure 30: Soil profile 4 - Building Envelope Lot 4

APPENDIX 3: EFFLUENT IRRIGATION AREA DESIGN

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:

Water balance

- **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 = 9,900mg/m^2/yr (ie 99kg/ha/yr, for perennial grasses)
A = 480 X 20 X 365/9,900 = 353m^2
Area required = 360 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} = 3.0mg/m^2/day X 365 X 50 = .05475kg/m^2
P_{sorb} = 2,164kg/ha = .216kg/m^2
A = 87.6/(.055+ .216) = 323 m^2
Area required = 350 m^2

Design effluent disposal area

Therefore, a land application area of 360 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 720m^2.

Alternative Dwellings

The size of the effluent irrigation area required to service dwellings with 4, 5 & 6 bedrooms are provided below:

- 4 bedrooms – 450 m^2
- 5 bedrooms – 550 m^2
- 6 bedrooms – 620 m^2

SOILANDWATER

www.soilandwater.net.au