July 2015

Domestic Wastewater Management Plan

Volume 2 - Technical Reports

Golden Plains

rmcg.com.au

Table of Contents

Land Capability for Onsite Domestic Wastewater Management

Assessment Manual

Golden Plains Shire - DWMP

July 2015

1 Background

Golden Plains Shire is currently reviewing and updating their Domestic Wastewater Management Plan, with support from RMCG. A component of the review has been to consider and provide advice on some of the key technical issues for onsite wastewater management within the Shire area.

Technical issues addressed in this document are:

- Determining minimum lot size for new subdivisions
- Development of existing small lots
- Application requirements for installation or alteration of an onsite wastewater management system.

This document focuses on streamlining and improving the processes relevant to residential development (houses); non-residential development should be subject to full land capability assessment.

2 Determining Minimum Subdivision Lot Size

2.1 Introduction

Within Golden Plains Shire there is pressure for development of low-density residential style living, particularly in proximity to Ballarat and Geelong. As sewerage is generally not available there is a need to ensure the developments can manage domestic wastewater sustainably onsite.

Consequently, consideration has been given to the minimum lot size that can sustain onsite wastewater management, with a focus on the key towns of Bannockburn and Meredith. These towns have been considered due to development pressure, existing onsite wastewater issues and availability of relatively detailed soil mapping. The lessons from these towns can be applied across the Shire more broadly.

2.2 Methodology

A desktop land capability assessment has been undertaken using the following resources:

- 1:25,000 land systems mapping from *A Study of the Land Capability in the Shire of Bannockburn*, Jeffery & Costello, 1981, Soil Conservation Authority.
- Previous LCA reports undertaken for individual lots or subdivisions in Bannockburn and Meredith. Including the *Land Capability Assessment of Glen Avon Estate* by van de Graaff and Associates Pty Ltd, 2004.
- GIS information relating to topography and so on.

This land capability information was used to determine the land application areas required for common combinations of treatment and land application system. Calculations were based on wastewater flow rates, design loading/irrigation rates, setback distances and so on, as outlined in:

- EPA Victoria Publication 891.3, *Code of Practice Onsite Wastewater Management*, 2013
- Australian/New Zealand Standard, AS/NZS 1547:2012, *On-site domestic wastewater management*

The land application areas were converted to minimum lot sizes assuming <15% of the area of each lot is to be set aside for wastewater irrigation/disposal. This allows space for house, sheds, driveways, play areas and so on. This limit has been set based on RMCG experience elsewhere in Victoria and consideration of what is working for existing developments in Bannockburn and Meredith.

2.3 Bannockburn

2.3.1 Land Capability Assessment

The LDRZ within and surrounding Bannockburn is:

- relatively flat
- comprises low permeability soils, as described in Table 2-1, that are generally dispersive
- depth of soil is generally >1.5 m, but can be as low as 0.5 m
- the watertable is at reasonable depth (>10 m)
- rainfall is relatively low, averaging just over 500 mm per annum.

Table 2-1: Assessment of Soil Category – Bannockburn

Land System	Notes	Soil Category (as per Code)[1]	% of Bannockburn LDRZ
Qbf	Plain with clay soils (black medium to heavy uniform clay, self mulching) and duplex soils (mottled clay loam over heavy clay) on quaternary basalt. Very low permeability.	50% 6a 50% 6b	Bulk
Qded	Depressions with heavy clay soils on recent sediments. Dark uniform clay soils. Low permeability. Periodic waterlogging.	6b	Small area at northern end of LDRZ
Qbgs	Stony plains with duplex soils on quaternary basalt.	6b	Southern edge

[1] Soil category selected based on most limiting layer. There are instances of clay loam and sandy loam topsoils, but only to limited depth. Subsoils are generally medium to heavy clay.

	Mottled dark grey sodic duplex soils. Clay loam over heavy clay. Low permeability.		
Tgs	Plains with duplex soils on tertiary sediments. Sandy loam over yellowish brown medium clay. Moderate to low permeability.	6a	Between town zone and Bruce's Ck
Tcg	Steep valley sides with duplex soils. Associated with Bruce's Creek.	6a	Beyond LDRZ
Tsm	Steep valley sides with clay soils. Along Moorabool River.	6b	Beyond LDRZ

The key constraint for onsite wastewater management is the low soil permeability. In places, depth of soil can also be an issue.

2.3.2 Land Application Area Calculations

Assumptions:

1. Daily wastewater volume for a 4 bedroom house with water reduction fixtures and fittings is 750 L/day. Based on 5 people and 150 L/person/day.
2. Setback distances as per Table 5 of EPA Code of Practice. Wastewater field needs to be 3 m up-slope and 1.5 m down-slope of allotment boundary for secondary treated effluent (6 m up-slope and 3 m down-slope for primary treated effluent).
3. Absorption trenches/beds and LPED (low pressure effluent distribution) are not considered suitable for these heavy and relatively impermeable soils.
4. Spray irrigation is not permitted by Golden Plains Shire due to spray drift risk.
5. Subsurface drip irrigation requires 1 m spacing between drip lines.
6. ETA beds are assumed to have a width of 1 m and spacing between beds is at least 3 m. The maximum bed length is set at 30 m. A wick trench and bed system has also been considered, assuming 1.6 m width, 3 m spacing between beds and 30 m maximum bed length.
7. The Design Irrigation Rate for drip irrigation is 2 mm/day. Design Loading Rate for ETA beds, Wick trench/bed systems and for mounds is 5 mm/day. These are based on Category 6 soils as described in Table 2-1.

Table 2-2: Land Application Area – Bannockburn

Parameter	Secondary Treatment + Subsurface Drip Irrigation	Secondary Treatment + ETA beds	Secondary Treatment + Wick Trench/Bed	Primary Treatment + ETA Beds	Primary Treatment + Mounds
DIR/DLR	2 mm/day	5 mm/day	5 mm/day	5 mm/day	5 mm/day
Irrigation Area (m^2)	375				
Bed Length (m)		150	113	150	
Basal Area (m^2)					150
Area with Setbacks (m^2)	580	742	649	1014	465
Reserve Area Required	No	Yes	Yes	Yes	Yes

2.3.3 Minimum Lot Size

The minimum lot size recommended for onsite wastewater management in the Bannockburn area is 4,000 m^2. This is based on a land application area of 580 m^2 taking up <15% of the total lot. Achieving this minimum requires relatively restrictive controls to ensure sustainable onsite wastewater management – secondary treatment, subsurface drip irrigation and limiting the size of the dwelling.

It is recommended that the average lot size should be higher than this. This provides greater flexibility for landholders and a degree of conservatism that will minimise risk and the management input from council.

This outcome accords with the VCAT assessment for Glen Avon Estate – *Glenavon Pastoral (Vic) Pty Ltd v Golden Plains SC [2006] VCAT 510 (27 March 2006)*, as follows:

> *the greater emphasis should be on lots that are at the 1 hectare minimum with those below this size being closer to it. The number of lots toward the smaller size range should be very minor.*

The following table provides recommendations for achieving sustainable onsite wastewater management for various lot sizes.

Table 2-3: Onsite Management Requirements by Lot Size – Bannockburn

Lot size range m^2	Specific Requirements	General Requirements
4000 – 6000	Max flows 750 L/day (max 4 bed house[2], water saving fixtures, no spas). Secondary treatment – 20/30. Subsurface drip irrigation.	Gypsum application to manage dispersive, sodic or heavy clay based soils. Stormwater cut off drains up-slope of application area.
6000 – 8000	Max flows can increase to 1200 L/day if drip irrigation used. Secondary treatment – 20/30. Subsurface drip irrigation or ETA beds[3,4]	
8000 – 10,000	Max flows can increase to 1800 L/day if drip irrigation used. Secondary treatment – 20/30. Subsurface drip irrigation or ETA beds[2] Primary treatment possible combined with mounds or ETA beds[2].	
>10,000	Primary[5] or secondary treatment. Subsurface drip irrigation, mounds or ETA beds[6].	

[2] Larger houses could be built where wastewater flows can be reliably limited to 750 L/day (e.g. if greywater is treated for reuse within the house – toilet flushing, clothes washing cold water supply)
[3] Assuming reserve area is provided in 3m space between beds/trenches.
[4] Wick trench and bed systems require slightly (~10%) less space than ETA beds.
[5] Only when combined with ETA beds or mounds.
[6] Full reserve area available for ETA beds

2.4 Meredith

2.4.1 Land Capability Assessment

The TZ and LDRZ within and surrounding Meredith is:

- relatively flat, with the exception of the creek valley sides
- comprises generally low permeability soils, as described in Table 2-4
- depth of soil is generally 1–4 m, but can be as low as 0.3 m
- the watertable is at reasonable depth (>5 m)
- rainfall is moderate, averaging 700 mm per annum.

Table 2-4: Assessment of Soil Category – Meredith

Land System	Notes	Soil Category (as per Code)[7]	% of Meredith LDRZ and TZ
Qbg	Plain with duplex soils on quaternary basalt. Clay loam over heavy clay. Mottled dark-grey sodic soils. Low permeability. Periodic waterlogging.	6b	Bulk
Tgn	Plains with duplex soils on tertiary sediments. Sandy loam over medium clay. Moderate permeability.	6a	Eastern edge
Orm	Moderate slopes with duplex soils on Ordovician sedimentary rock. Clay loam over medium clay. Mottled yellowish brown. Moderate-low permeability.	6a	Eastern edge
Qbb	Steep sided valleys with duplex soils on quaternary basalt. Shallow soils on steep valley side – clay loam over medium clay. Moderate permeability. Creek bed has uniform clay soils with low permeability.	6a	Along creek
Qya	Terraces with variable soils on quaternary sediments. Higher terraces have duplex soils. Middle terraces have variable texture but uniform soils and mainly clay loams. Moderate-low permeability.	6a	Along creek

The key constraint for onsite wastewater management is the low soil permeability. In places depth of soil can also be an issue.

2.4.2 Land Application Area Calculations

Assumptions are the same as for Bannockburn (refer to 2.3.3), plus:

- Given rainfall is moderate at 700 mm, calculated irrigation areas or trench lengths are increased by 10% based on outcomes of water balance modelling.

[7] Soil category selected based on most limiting layer. There are instances of clay loam and sandy loam topsoils, but only to limited depth. Subsoils are generally medium to heavy clay.

Table 2-5: Land Application Area – Meredith

Parameter	Secondary Treatment + Subsurface Drip Irrigation	Secondary Treatment + ETA beds	Secondary Treatment + Wick Trench/Bed	Primary Treatment + ETA Beds	Primary Treatment + Mounds
DIR/DLR	2 mm/day	5 mm/day	5 mm/day	5 mm/day	5 mm/day
Irrigation Area (m^2)	375				
Bed Length (m)		150	113	150	
Basal Area (m^2)					150
10% Rainfall Adjustment	413	165	124	165	165
Area with Setbacks (m^2)	627	816	717	1095	491
Reserve Area Required	No	Yes	Yes	Yes	Yes

2.4.3 Minimum Lot Size

The minimum lot size recommended for onsite wastewater management in the Meredith area is 4,000 m^2. Note that this pushes the limit outlined in Section 2 that states <15% of the area of each lot is to be set aside for wastewater irrigation/disposal. Here a land application area of 627 m^2 takes up 15.7% of a 4,000 m^2 lot. Achieving this minimum lot size requires relatively restrictive controls to ensure sustainable onsite wastewater management – secondary treatment, subsurface drip irrigation and houses with a maximum of 4 bedrooms.

It is recommended that the average lot size should be higher than this. This provides greater flexibility for landholders and a degree of conservatism that will minimise risk and the management input from council.

The following table provides recommendations for achieving sustainable onsite wastewater management for various lot sizes.

Table 2-6: Onsite Management Requirements by Lot Size – Meredith

Lot size range m^2	Specific Requirements	General Requirements
4000 – 6000	Max flows 750 L/day (max 4 bed house, water saving fixtures, no spas). Secondary treatment – 20/30. Subsurface drip irrigation.	Gypsum application to manage dispersive, sodic or heavy clay based soils. Stormwater cut off drains upslope of application area.
6000 – 8000	Max flows can increase to 1050 L/day if drip irrigation used. Secondary treatment – 20/30. Subsurface drip irrigation or ETA beds[8,9]	

[8] Assuming reserve area is provided in 3m space between beds/trenches.
[9] Wick trench and bed systems require slightly (~10%) less space than ETA beds.

8000 – 10,000	Max flows can increase to 1500 L/day if drip irrigation used. Secondary treatment – 20/30. Subsurface drip irrigation or ETA beds[8] Primary treatment possible if mounds used.	
>10,000	Primary[10] or secondary treatment. Subsurface drip irrigation, mounds or ETA beds[11].	

Lots close to the creek need to ensure a 30 m setback is provided where secondary treatment is used, or a 60 m setback for primary treatment.

2.5 Conclusions

Bannockburn and Meredith have similar requirements for onsite wastewater management due to the prevalence of relatively impermeable clay subsoils. The land application area required is slightly higher (10%) at Meredith as a result of the higher average rainfall.

It has been determined that the minimum lot size acceptable for new subdivisions at both towns is 4,000 m^2. To achieve sustainable onsite wastewater management on a lot of this size requires relatively restrictive controls – water use of <750 L/day (i.e. a house size limit) and use of secondary treatment with subsurface drip irrigation.

It is recommended that the average lot size for new sub-divisions should be larger than 4,000 m^2. This will enable larger houses and a wider range of wastewater treatment and disposal approaches – giving residents lower cost wastewater options and reducing ongoing monitoring requirements.

This outcome accords with the VCAT assessment for Glen Avon Estate at Bannockburn.

2.6 Recommendations

1. The minimum lot size recommended for Meredith and Bannockburn is 4,000 m^2, subject to:
   - Limiting dwelling size and using water reduction fixtures/fittings to achieve 750 L/day wastewater generation, and
   - Secondary treatment and drip irrigation with a land application area of 375 m^2 at Bannockburn and 413 m^2 at Meredith (a 10% increase due to higher rainfall), and
   - Stormwater cut-off drains upslope of land application area, and
   - Soil preparation to provide at least 150 mm depth of good quality topsoil (in situ or imported), and
   - Application of gypsum to dispersive, sodic or heavy clay based soils
2. For new subdivisions in the vicinity of Meredith and Bannockburn (outside the sewered area) target an average lot size larger than 4,000 m^2.

[10] Only when combined with ETA beds or mounds
[11] Full reserve area available for ETA beds

3. Apply Recommendations 1 and 2 across the whole shire, unless they can meet Recommendation 4. This is a conservative approach. Meredith and Bannockburn are both dominated by impermeable clay subsoils (Category 6) requiring relatively large land application areas.
4. Where there is evidence of more permeable soils – e.g. soil survey data at an appropriate scale (1:25,000) or a site (or town) specific land capability assessment – restrictions detailed in Recommendation 1 may be varied.

3 Existing Small Lots

3.1 The Issue

The previous section focuses on minimum lot size for new subdivisions. Within Golden Plains Shire, a number of small lots already exist – smaller than the recommended minimum above of 4000 m^2. This is particularly the case for the central parts of older towns such as Meredith and Linton.

These small vacant lots are identified on Map 9 within the *Spatial Risk Assessment*.

Here consideration is given as to whether these lots can be developed and the development rules that could be applied.

3.2 Discussion

Development of small lots (<4000 m^2) is considered appropriate only where it is permitted in the planning scheme for the zoning and where:

- Soil analysis provides evidence of higher permeability than clay dominated Category 6 soils (as are common in Meredith and Bannockburn). For example, with Category 4 clay loam soils a lot size of 2,700 m^2 would allow development of a 4 bedroom house with secondary treatment and drip irrigation.
- The wastewater volume to be generated is minimised through construction of a small house, indoor recycling of treated greywater or another alternative approach. For example, a 2-bedroom house (450 L/day) with water reduction fixtures/fittings, secondary treatment and drip irrigation could be constructed on a 2,800 m^2 lot in Meredith.

The suggested process for ensuring that existing small lots are developed appropriately is:

- Explore the possibility of acknowledging wastewater management risk on Section 32 Vendor Statements and recommend that EHOs are contacted for assistance prior to undertaking site development.
- Any lots smaller than 4000m^2 in size will require a Land Capability Assessment prior to installation or alteration of an onsite wastewater management system (as outlined in 4.1).

3.3 Recommendations

1. Prioritise monitoring and audit of existing systems to small lots (<4000 m^2) as there is a greater risk that wastewater cannot be managed sustainably onsite.
2. Take any opportunity to upgrade existing wastewater management systems on small lots (<4000 m^2) – in response to planning permit applications, complaints, audit results.

3. For small lots (<4000 m^2) explore the possibility of acknowledging wastewater management risk on Section 32 Vendor Statements and recommend that EHOs are contacted for assistance prior to undertaking site development.
4. New development can occur on small lots (<4000 m^2) only where:
   – soil analysis provides evidence of higher permeability than clay dominated Category 6 soils, OR
   – wastewater volume generated can be minimised through construction of a small house, indoor recycling of treated greywater or another alternative approach.

4 Installation or Alteration of an Onsite Wastewater Management System

4.1 Introduction

Golden Plains Shire has in place a *Guide for Installation or Alteration of a Septic Tank System*. It is recommended that this guide is updated to reflect the guidance provided in the following three sections.

4.2 LCA Requirements

Applications to install or alter an onsite wastewater management system need to be accompanied by a Land Capability Assessment (LCA) where any of the following conditions are met:

a) Site is smaller than 4000m^2

b) Site is within a designated Open Potable Water Supply Catchment Area

c) Site is classified as high risk for groundwater – water table is <5 m below the surface and the groundwater is of high quality (within Beneficial Use Class A, <1000 mg/L TDS).

d) Site is classified as high risk for topography – slope is steeper than 20%

e) Site is covered by 50% or more FO (Flood Overlay)

f) Site is smaller than 2 ha, a primary treatment system is proposed and there is evidence of clay based soils being dominant (e.g. soil mapping is available for the area

g) All non-residential developments that will generate wastewater.

Note that these areas have been mapped within the spatial risk assessment and it is recommended that these layers be added into Council's spatial mapping system.

To reduce the number of LCAs required within the Shire the following could be undertaken:

- Where soil mapping is available at an appropriate scale this could be used as an alternative to an LCA. An example is the mapping available in *A Study of Land Capability in the Shire of Bannockburn*. This would first need to be analysed to classify each mapping unit according to the soil categories used in AS/NZS 1547:2012 and the EPA Code of Practice.
- Where an LCA is available at a subdivision scale this could be used to set minimum standards so LCAs are not required for individual lots in that subdivision.

LCAs undertaken should include as a minimum:

- Analysis of soil type to enable classification based on the soil categories used in AS/NZS 1547:2012 and the EPA Code of Practice.
- Constant head soil permeability test conducted in situ for clay soils (Categories 5b, 5c and 6) when using absorption/transpiration trenches.
- A nutrient balance assessment for high permeability soils (Categories 1, 2 and 3a) that are located <100 m from a freshwater lake or where good quality (Beneficial Use Class 1) groundwater is <5 m below the ground surface.
- Projected water use, determined based on house size, plus details on any reduction measures to be taken.

Note that use of a water balance has not been recommended for any specific sites. The water balance approach appears relatively simple, but it is actually difficult to ensure that accurate and consistent data is used, and therefore results can be misleading. This is particularly the case for evaporation data which is not measured at many sites and therefore interpolation is required for most locations. In addition, the assumptions outlined in the MAV LCA Framework are considered overly conservative as they assume no site run-off, which is not realistic. Where average annual rainfall is <600 mm and some runoff is assumed (i.e. effective rainfall factor of 0.7 – the standard assumption used in determining irrigation requirements for agriculture), the water balance gives a similar result to the land application areas calculated from the Design Irrigation/Loading Rate for each soil category (refer to EPA Code of Practice). For higher rainfall areas a 10% increase in land application area can be used (see notes to Table 4-1 below) rather than a more complicated model approach.

4.3 Land Application Area (Disposal Field Sizing)

To assist property owners who are not required to provide a LCA, the following table outlines the recommended minimum land application area (often referred to as the disposal field) for onsite wastewater management. These figures have been calculated based on AS/NZS 1547:2012 and the EPA Code of Practice. They are based on a clay dominated (Category 6) soil type and therefore provide a conservative approach to wastewater management.

The land application areas provided in the tables are the minimum that will be approved within Golden Plains Shire, unless additional evidence (e.g. a LCA) is provided to support the reduction of the recommended area.

Table 4-1: Land Application Area Sizing Guide

Number of Habitable Rooms	Daily Wastewater Volume	Absorption/transpiration trenches		Subsurface irrigation (secondary treated wastewater only)
	L/day	Trench length (m)	LAA (m^2)	LAA (m^2)
1	300	60	150	150
2	450	90	270	225
3	600	120	390	300
4	750	150	510	375
5	900	180	630	450

Notes:

- A study with a door is classed as a habitable room.
- Daily wastewater volume assumes standard water reduction fixtures and fittings resulting in an output of 150 L/person/day. Number of people is based on number of bedrooms plus 1.
- The installation of high water use features, such as spas, will require additional land application area to be installed.
- Where average annual rainfall exceeds 600 mm the disposal area should be increased by 10%.
- Absorption/transpiration trenches are assumed to have a width of 1 m and spacing between beds is at least 3 m. The maximum bed length is set at 30 m.
- A reserve area is required for absorption/transpiration trenches.
- Subsurface irrigation lines are assumed to be at 1 m spacing.

The land application area must be a permanent dedicated area within the property boundary. It is to be protected from vehicle and livestock access. Paving, driveways, fences, building extensions, sheds, children's playgrounds, and utility service trenching must not be built over or encroach on the disposal/recycling area.

Land application areas should:

- have adequate depth of good quality topsoil (in-situ or imported). At least 150 mm is recommended.
- be vegetated immediately after installation with suitable plants or lawn
- include stormwater diversion upslope of the area
- have gypsum applied where dispersive, sodic or heavy clay based soils are present
- not exceed 15% of the total area of the lot.

4.4 Sand filter systems

Sand filters can be used to provide secondary treatment of wastewater. They must be used in addition to an EPA approved primary treatment system.

When installing a sand filter system it needs to be sized appropriately to ensure the reduction process remains balanced to the hydraulic and organic load for the proposed system. To assist property owners who are considering a sand filter system, the following table provides recommended minimum sand filter sizes.

These have been calculated based on the EPA Code of Practice.

The size provided in the tables is the minimum that will be approved within Golden Plains Shire, unless additional evidence is provided to support a reduction in the size of the sand filter.

Table 4-2: Sand Filter Sizing Guide

Number of habitable rooms	Daily Wastewater Volume (L/day)	Sand filter size
1	300	6 m^2
2	450	9 m^2
3	600	12 m^2
4	750	15 m^2
5	900	18 m^2

Notes:

- A study with a door is classed as a habitable room.
- Daily wastewater volume assumes standard water reduction fixtures and fittings resulting in an output of 150 L/person/day. Number of people is based on number of bedrooms plus 1.

It is recommended that sand filters are lined where the in-situ soils are highly permeable. This includes soils that fit within Categories 1, 2 and 3 in the EPA Code of Practice – gravels, sands, sandy loams and loams.

This report has been prepared by:

RMCG

135 Mollison Street, BENDIGO VIC 3550

PO Box 2410, BENDIGO DC VIC 3554

P: (03) 5441 4821

E: rm@rmcg.com.au

W: www.rmcg.com.au

ABN: 35 154 629 943

Offices in Bendigo, Melbourne, Torquay, Warragul and Penguin (Tasmania)

Key Project Contact

Duncan Wallis
M: 0429 145 169
E: duncanw@rmcg.com.au]

ISO 9001
International Standards
Certifications

Document review and authorisation

Job Number: 29-G-11

Doc. Version	Final/Draft	Date	Author	Reviewed by	Quality check	Release approved by	Issued to	Copies
1.0	Draft	10/10/2014	A Kelliher	D Wallis	P. Mawson	D. Wallis	S. McLay	1(e)
2.0	Revised draft	19/01/2015	A Kelliher	D Wallis	P. Mawson	D Wallis	S McLay	1(e)
3.0	Second revised draft	19/2/2015	A Kelliher	S McLay	P. Mawson	A. Kelliher	S.McLay	1(e)
4.0	Third revised draft	7/5/2015	A Kelliher	S McLay	P. Mawson	A Kelliher	S McLay	1(e)
5.0	Final	10/7/2015	A Kelliher	S McLay and public	P Mawson	A Kelliher	S McLay	1(e)

Note: (e) after number of copies indicates electronic distribution

Domestic Wastewater Spatial Risk Assessment

Final Report

Golden Plains Shire

May 2015

1 Overview

This report presents the method and results of a spatial risk assessment undertaken to inform domestic wastewater management in Golden Plains Shire. Drawing on various spatial data sets, the risk assessment includes a set of maps designed to illustrate the spatial nature of various factors that affect domestic wastewater management.

This report firstly discusses the risk assessment process (method), then presents the results (maps) and draws conclusions in relation to the management of onsite systems. The main focus of the risk assessment is on existing systems. However, consideration is also given to potential future development.

2 Spatial risk assessment process

2.1 Introduction

The spatial risk assessment was tailored to suit the Golden Plains Shire. It draws on recent approaches used by other councils including Mansfield and Mitchell. The initial step was to develop a database of onsite systems, then to overlay the database on top of relevant spatial base layers, such as soils, topography and lot size.

2.2 Database of onsite systems

Council records have been used to identify which parcels in the shire have houses on them and what type of onsite systems are in place. These data sets are not complete because some older onsite systems were built before septic permits came into force and some new houses are not identified in the spatial system yet because they haven't been through the initial valuation process.

Two databases were blended to form a spatial layer representing all existing onsite systems[1]:

[1] Note that in this study the onsite systems are not mapped at the exact co-ordinates where the actual house, septic tank or disposal field is located (this information was not readily available). Instead they are spatially represented at the centroid of the property parcel. The centroid of the parcel is a good approximation for the location of the onsite system for this strategic planning document but should not be used for any property or neighbourhood scale analysis.

- House Points database – from Council's property valuation system, provided information about many houses (year of construction, valuation, assessment number).
- Septic Permit database – from Council's environmental health system, provided information about many onsite systems (such as type, permit number and assessment number).

Barwon Water and Central Highlands Water provided information about the location of reticulated sewerage and this was used to identify the extent of the sewerage areas. Reticulated sewerage is available in Smythesdale, Bannockburn and Enfield only – all other properties in the Shire rely on onsite systems for treatment and disposal of their domestic wastewater. House Points in the three sewered areas were then removed from the analysis.

By combining the house points and the septic permit databases, and stripping out those connected to sewer, we have developed a workable version of an onsite system database which has been useful for the development of this domestic wastewater management plan, particularly the spatial risk assessments. It is, however, recommended that Council integrates an onsite system database that includes all systems across the shire into its property and geographic databases.

There are about 6,700 houses in the Golden Plains Shire reliant on onsite systems. The database of onsite systems was used as a key input into the spatial analysis.

2.3 Method

The risk of a particular onsite system depends upon a number of factors:

- **Land area / parcel size.** The amount of land available on a particular parcel is probably the key factor affecting domestic wastewater management. If an onsite system is located on a lot greater than (say) 1.2 ha, then even if other factors are unfavourable, the overall risk is unlikely to be high, as there is expected to be plenty of space available for larger disposal fields, increased setbacks and so on.
- **Soil type.** Soil texture and structure determines soil permeability and thereby the rate at which wastewater will be absorbed. The Mansfield DWMP Pilot[2] adopted the Australian Soil Resource Information System (ASRIS) as a basis for soil type and applied a risk factor method developed by Edis[3] as shown in Figure 2-1. This method was applied to Golden Plains. ASRIS soil codes are based on a 250 m raster grid (1:250,000 scale) so while it does give an overall picture of soil related risk, ASRIS is not suitable for assessing lot scale soil types (so it cannot be used to determine the land application area required and negate the need for an LCA). Finer scale data (e.g. from Soil Conservation Authority 1981 in the old Shires of Bannockburn and Buninyong) could be used to establish a more detailed risk assessment. However, the 1981 soils data is not available in a reliable digital format, or across the whole Shire.

[2] Mansfield Shire Domestic Wastewater Management Plan Pilot Project, Part 2 Domestic Wastewater Management Plan, Draft Mansfield Shire Council, May 2014.

[3] Approaches for Risk Analysis of Development with On-site Wastewater Disposal in Open Potable Water Catchments (April 2014) Dr Rob Edis.

Risk Factor	Low (1)	Medium (2)	High (3)
Soil type	Chromosols Ferrosols Dermosols	Vertosols Kurosols Kandosols Rudosols	Anthoposols Organosols Podosols Hydrosols Sodosols Calcarosols Tenosols

Figure 2-1: Risk factors for soil types (from Edis 2014)

- **Slope.** Increasing land gradient increases the risk of soil erosion and offsite wastewater discharge, and make installation of disposal trenches and irrigation more difficult. Slope was included in the Mansfield risk assessment and a similar method has been followed for Golden Plains, where 10 m contours were used to identify areas steeper than 20%.
- **Age of onsite system.** The age of the house (not necessarily the same as the onsite system) is known for more than 90% of the unsewered houses. This has been used as a de-facto indicator of onsite system age, and therefore risk.
- **Density of onsite systems.** The cumulative impact of wastewaters needs to be taken into account. Risk increases when the density of onsite systems across the landscape increases. The Mansfield DWMP Pilot adopted a rating scale that less than 20 houses/km^2 is "low", between 20 and 40 is "medium" and greater than 40 houses/km^2 is "high" risk. Densities for each onsite system and a heat map (200 m x 200 m grid) have been prepared for Golden Plains Shire.
- **Average rainfall.** The risks associated with onsite systems increase with increasing rainfall. The average rainfall varies slightly across Golden Plains Shire from 550 mm in the south to 750 mm in the north. We have adopted a risk scale for Golden Plains where rainfall below 600 mm/year is considered low risk, between 600 and 900 mm/year is moderate risk and above 900 mm/year is high risk. (Note there are no areas in Golden Plains with average rainfall greater than 900 mm/year, so there are no areas of "high" rainfall risk.)
- **Designated water supply catchments.** Onsite systems in this area are considered "high" risk. Only 2% of the Shire (60 km^2 of the total area of 2700 km^2) is covered by proclaimed water supply catchment and only 0.8% (57 of the total 6675) of the existing onsite systems are located in this area.
- **Proximity to watercourses.** While proximity to watercourses is an important consideration when designing new onsite systems, it **has not been used** in this risk assessment because the location of watercourses and the existing onsite systems is not sufficiently precise and also because most of the Shire is not a declared catchment (i.e. the watercourses are not for potable supply). This aspect will continue to be addressed at an individual subdivision and/or allotment scale.
- **Performance.** Recorded failures of onsite systems provide a real-world baseline indicator of the performance of the current fleet of existing onsite systems. These have been mapped, but note that there are only a small number. This suggests the fleet is performing well. However, the data is anecdotal and perhaps based only on recent experiences rather than an accumulation of observations over time.
- **Groundwater depth and salinity.** Government published maps (http://www.vvg.org.au) indicate depth and quality of groundwater across the state. Risks associated with onsite systems increase when the water table is close to the surface and when the quality is high (suitable for potable use).

2.4 Risk assessment map series

The results of the spatial analysis are illustrated by a series of sixteen maps shown on the following pages. Table 2-1 summarises the maps. The maps are presented in A3 format for better viewing of the fine detail. Whilst the report can be printed and read as a hardcopy, reading on a computer screen will provide better clarity and image resolution (it also enables the viewer to zoom in to areas of interest). Each map has an identical whole-of-Shire view, so the reader can flick back and forward to compare the data and for orientation. For clarity locality names are not shown on all maps.

Table 2-1: List of maps

Map	Name
1	Overview roads and locality names
2	Aerial image
3	Planning zones and designated catchment area
4	Onsite systems by treatment type and sewered areas
5	Onsite system risk by house age
6	Onsite system performance (recorded failures)
7	Onsite system risk by parcel area
8	Onsite system density heat map
9	Potential future dwelling sites as points by lot area
10	Onsite systems risk by ASRIS soil type
11	Onsite systems by slope risk
12	Onsite system by rainfall risk
13	Onsite system by groundwater risk
14	Onsite systems for audit program
15	ASRIS soil risk rating areas
16	High risk groundwater catchment and slope areas

3 Observations from risk assessment maps

1. There are three sewered areas and they cover 10 km^2, which represents less than 0.4% of the land area of the Shire.
2. There are approximately 6,700 domestic wastewater onsite systems in the Shire. The treatment type is unknown for about half of these, but of the half that is known, septic tanks dominate in the north and sand filters in the south.

3. Almost 75% of the onsite systems are on parcels greater than 1.0 ha so are considered to be low risk in this climate irrespective of most other risk factors (an exception is the designated water supply catchment area).
4. The housing stock is a mix of new and old. (38% are older than 30 years, 38% are 10–30 years old, 17% are less than 10 years old and 7% are age unknown.)
5. 820 onsite systems (12%) are located on parcels smaller than 0.4 ha in area and by comparing the parcel area and house age maps, it can be seen there is a high correlation between these small lots and older houses located in the central parts of Inverleigh, Teesdale, Lethbridge, Maude, Meredith, Rokewood, Linton and Scarsdale.
6. There are 57 existing houses in the Moorabool River (Sheoaks) and Stony Creek (Geelong WTP) designated water catchment within 15 km upstream of the Moorabool River diversion point. 13 of these are within 2 km upstream of the diversion point.
7. The topography of the developed parts of Golden Plains Shire is relatively flat. Very few houses (about 140 or 2%) are on land where the centroid of the parcel has a slope >20%. Typically these are located away from the built up urban areas and on large parcels of land. Slope is not considered a critical strategic issue for the Shire, but will need to be addressed at an individual allotment scale when new installations occur.
8. Broad scale soil risk assessment using ASRIS indicates that 17% of houses are on parcels where the property centroid overlies soil types with a high risk factor (31% are medium and 52% are low). As noted the soil mapping is not at sufficient detail to be used for determining LCA requirements or setting minimum land application areas. However, it will be used to target the proposed auditing program (refer to Section 4).
9. The densities of onsite systems (as illustrated by the heat map and the onsite system density) indicate that there are a number of areas (particularly Bannockburn, Batesford, Inverleigh, Teesdale, Lethbridge, Meredith, Linton and Scarsdale) where density is greater than 40 No./km^2, and thereby considered high risk. High density when combined with small allotments (<0.4 ha) further increases this risk and the audit program will be targeted to these areas.
10. The concentration of small vacant lots in residential type planning zones (i.e. town zone, low density residential zone) correlates well with the areas where there is a high density of existing onsite systems on small lots.
11. Recorded onsite system failures are few and don't exhibit a spatial pattern. These do not indicate a significant issue for the Shire at a strategic level, but will continue to be addressed on an individual basis. It is proposed that the level of monitoring/auditing undertaken by EHOs is increased and data available (e.g. from routine maintenance certificates) is better linked with the centralised onsite system database (subject to sufficient funding). As such, future consideration of failures at a regional scale may indicate trends.
12. Rainfall increases gradually across the shire from south to north. However, from a statewide perspective Golden Plains rainfall is towards the lower band of rainfall so the risks to onsite system management have been assessed as low or medium. Impact of average rainfall on the land application area required has been addressed within the *Minimum Lot Size Assessment Manual*.
13. While multiple areas in the Shire have shallow groundwater (according to modelling results available from Visualising Victoria's Groundwater), there are only a few small patches where this shallow groundwater coincides with low salinity, good quality groundwater. This area is considered high risk.

4 Audit program

Council proposes to undertake an audit program of existing onsite systems. To ensure this program targets the highest risk systems, the risk ratings developed in the previous sections have been used to create a listing of high-risk houses from which the audit program should be selected.

Map 14 shows the onsite systems recommended to be part of the sample population. The logic for selecting existing systems for the audit program is described in Table 4-1. Properties for audit will include all systems in the designated potable water supply catchment area and the remainder selected at random from the three other groups.

Table 4-1: Logic for selecting onsite systems for the audit program population

Risk factors	Threshold for inclusion in audit program population	Number of systems
Designated catchment	All onsite systems in the potable water supply catchment are included in the program.	57
Parcel area and density	Onsite systems on lots smaller than 4000 m^2 and with a density of onsite systems greater than 40 No/km^2.	631
Soil type and parcel area	Onsite systems on lots smaller than 10000 m^2 and with high risk ASRIS soil type.	331
Watertable depth and groundwater salinity	Onsite systems in areas where depth of groundwater is less than 5 m and groundwater salinity is less than 1000 mg/L.	102
All factors combined		**976**[4]

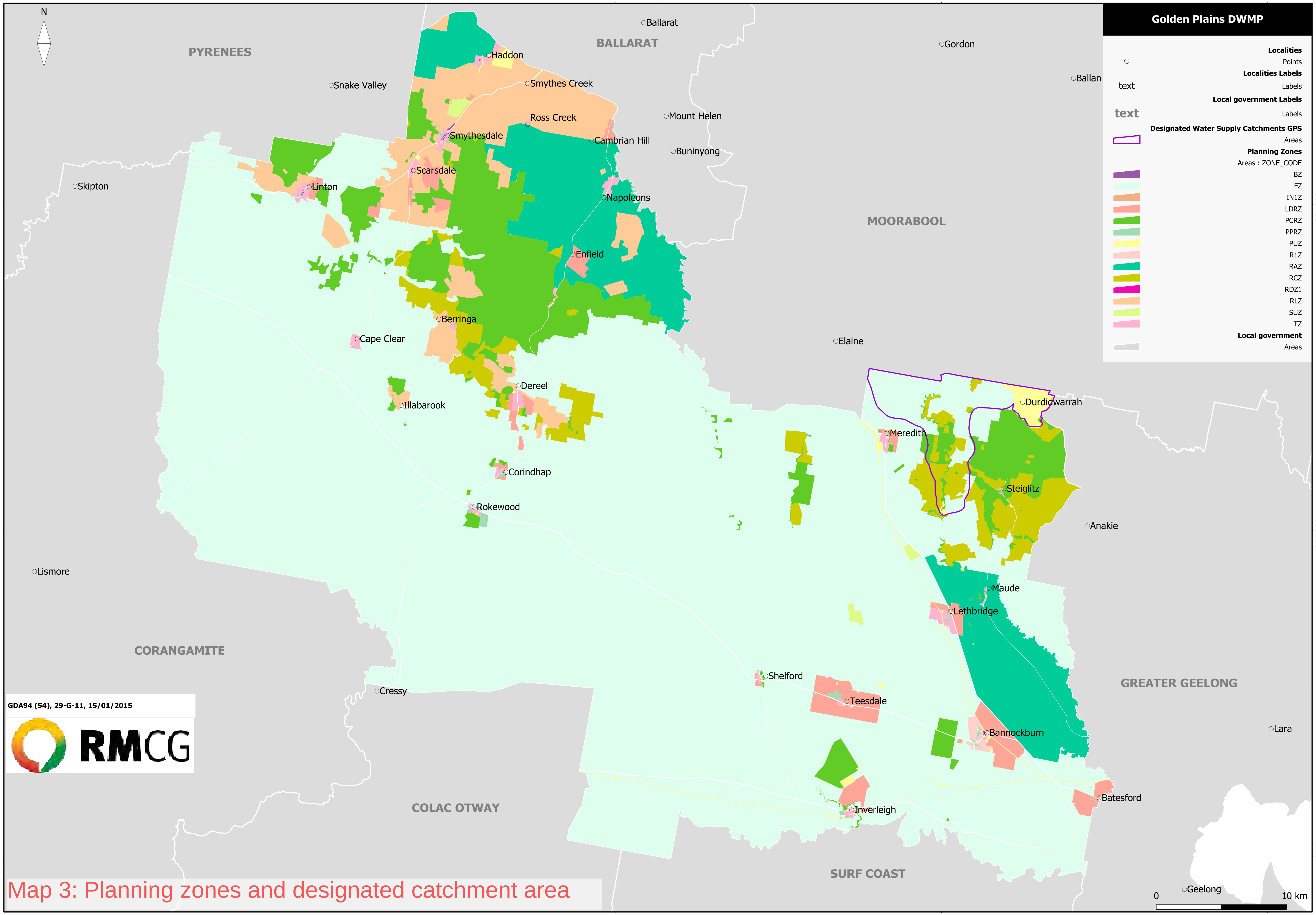
5 Recommendations from spatial risk assessment

1. Integrate the onsite system database with Council's septic tank and valuations databases and spatial system.
2. Focus audits on high risk systems as identified in the spatial risk assessment.
3. Source spatial soil layers at better resolution ASRIS, if available, and refine the soil risk rating.

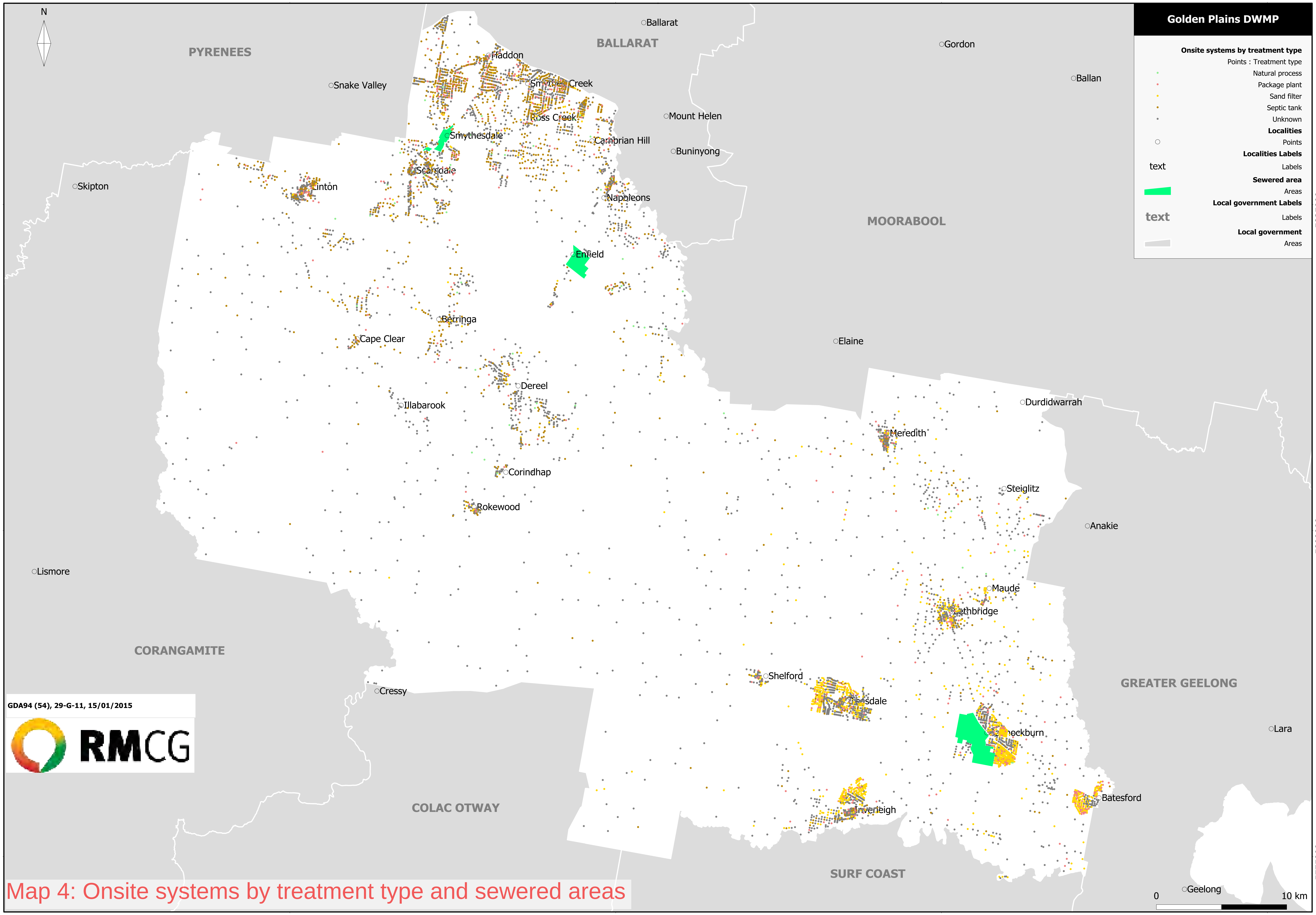
[4] There are 6675 onsite systems in the Shire. A total number of 976 systems are included in the audit program. 122 of these trigger both the soil type and density threshold, and 24 trigger both the density and the groundwater threshold.

Map 1: Overview roads and locality names

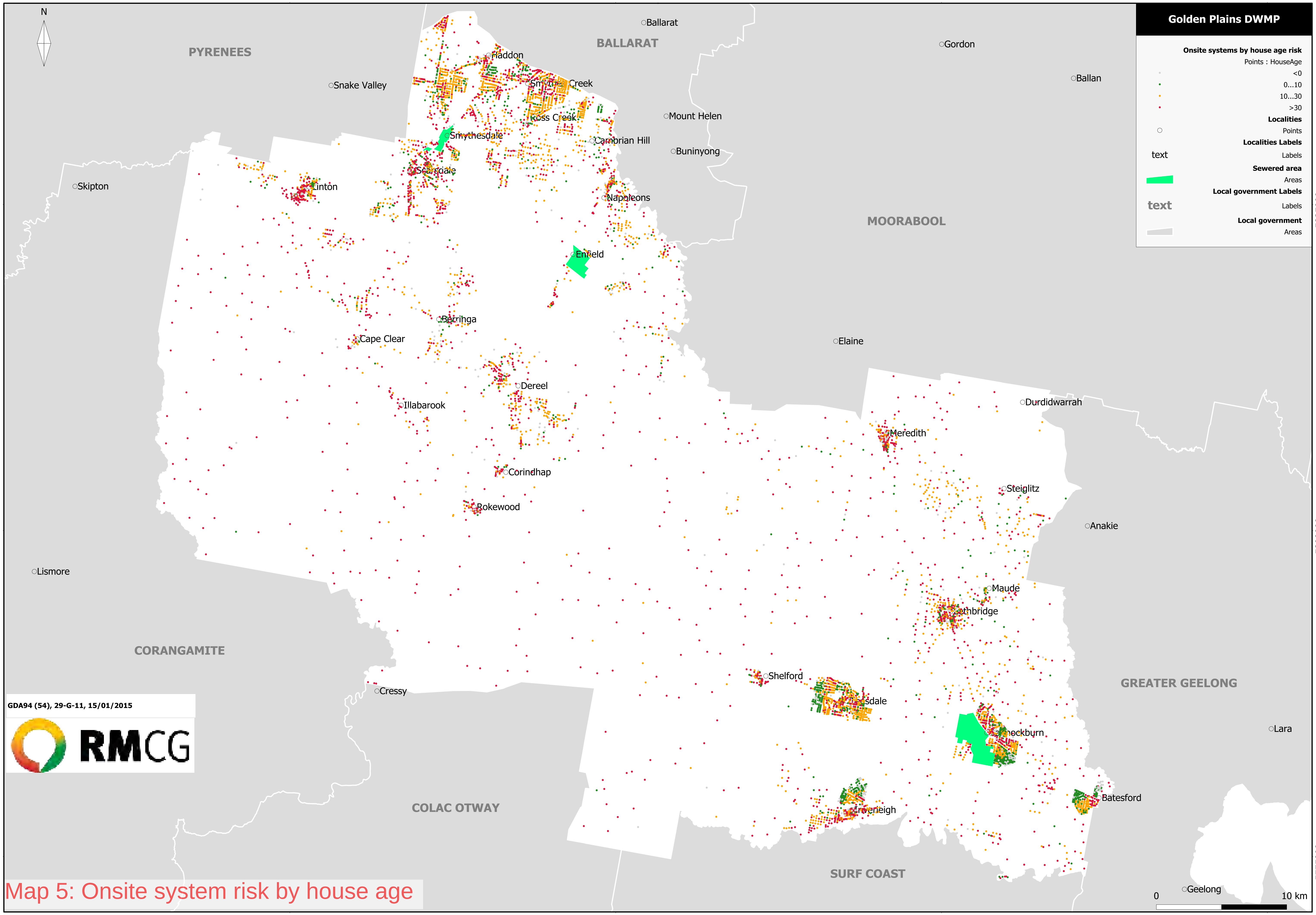
725000 m
750000 m
775000 m
800000 m
5825000 m
5800000 m
5775000 m
N
Golden Plains DWMP
Localities
Points
Localities Labels
text
Labels
Local government Labels
text
Labels
Local government
Areas
Air_2013feb06_25cm_mga54
PYRENEES
BALLARAT
MOORABOOL
CORANGAMITE
COLAC OTWAY
SURF COAST
GREATER GEELONG
Ballarat
Gordon
Ballan
Haddon
Smythes Creek
Snake Valley
Ross Creek
Mount Helen
Smythesdale
Cambrian Hill
Buninyong
Scarsdale
Skipton
Linton
Napoleons
Enfield
Berringa
Cape Clear
Elaine
Dereel
Illabarook
Durdidwarrah
Meredith
Corindhap
Steiglitz
Rokewood
Anakie
Lismore
Maude
Lethbridge
Shelford
Cressy
Teesdale
Bannockburn
Lara
Batesford
Inverleigh
Geelong
0
10 km
GDA94 (54), 29-G-11, 15/01/2015
RMCG
Map 2: Aerial



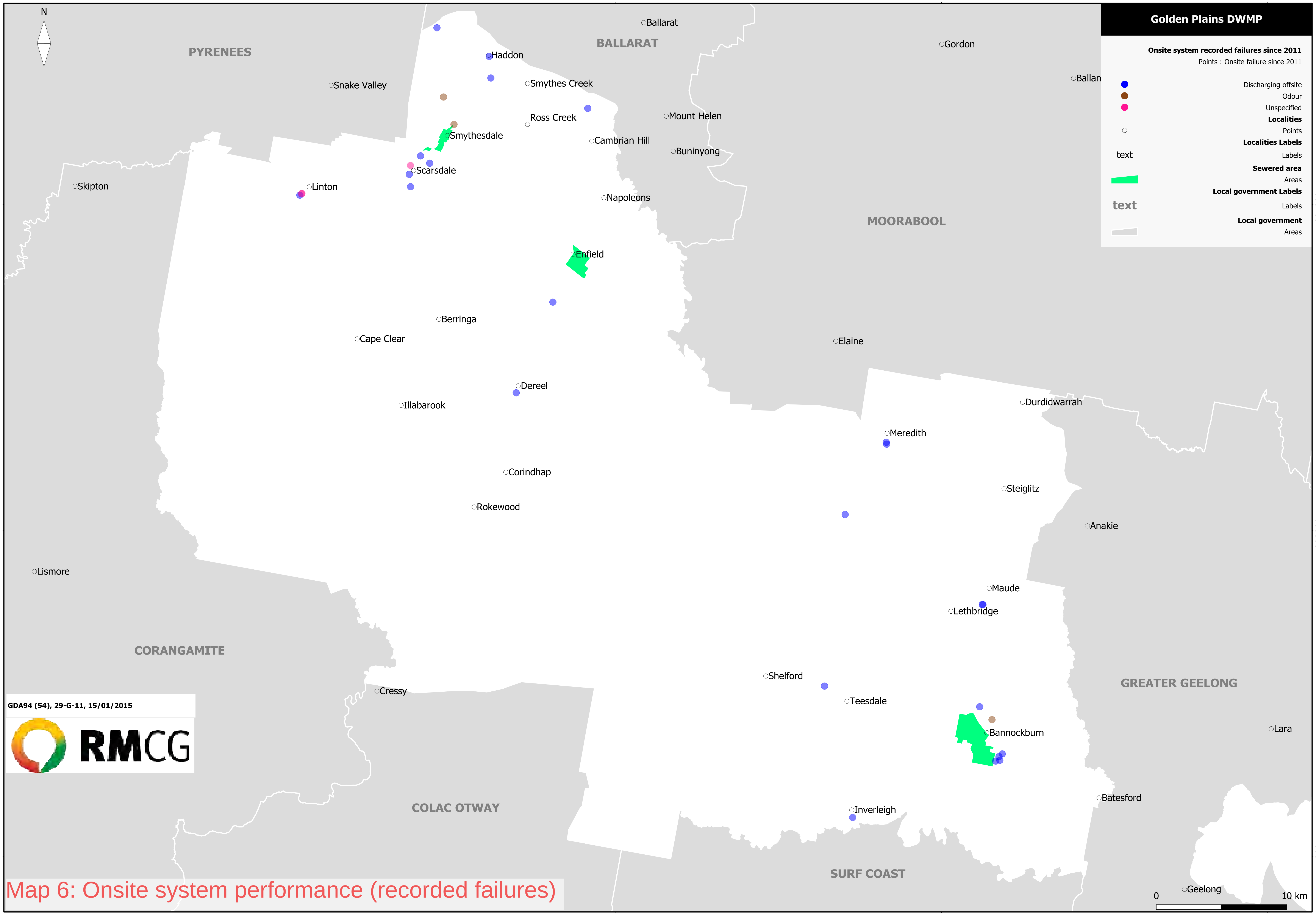
Map 3: Planning zones and designated catchment area



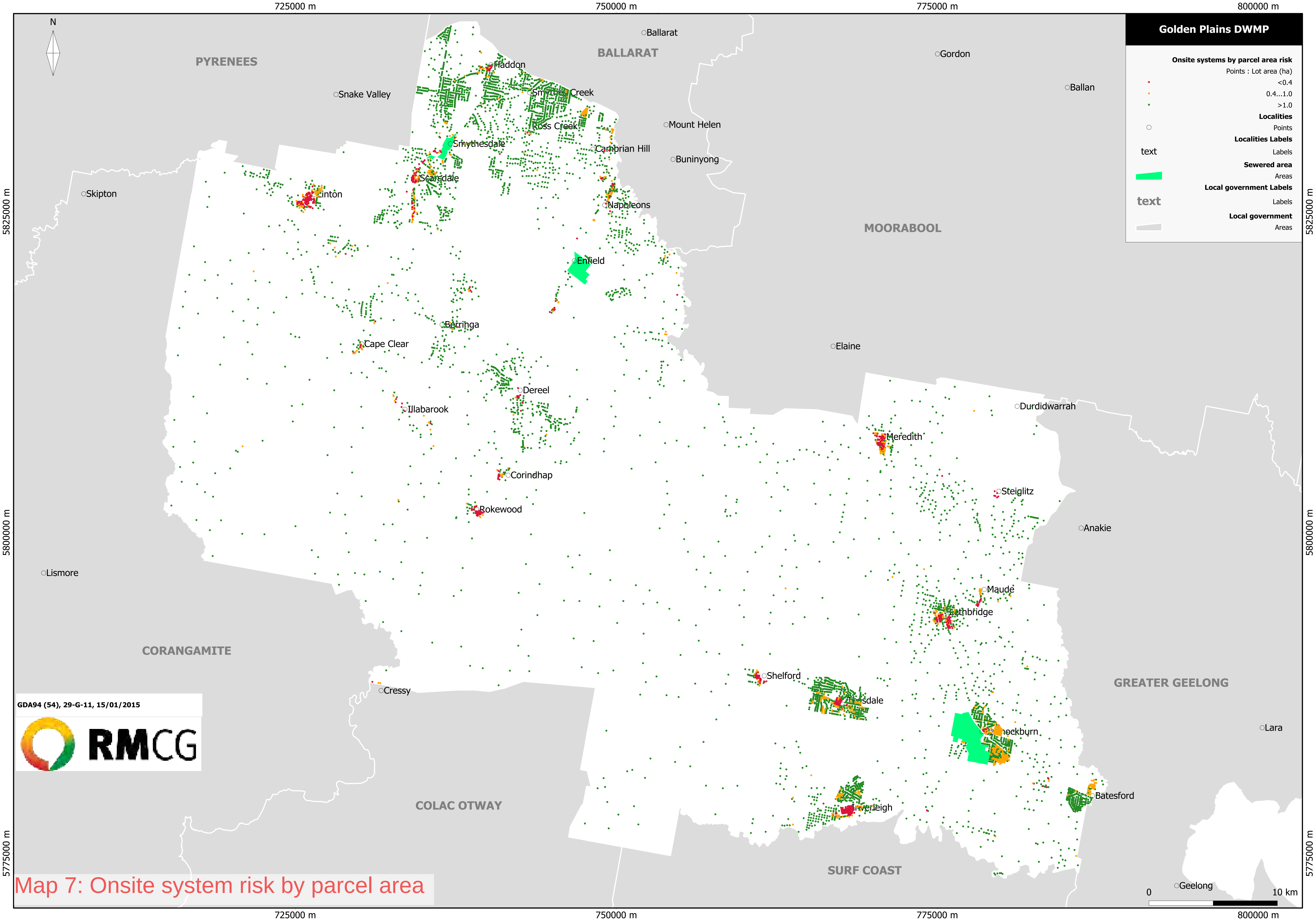
Map 4: Onsite systems by treatment type and sewered areas



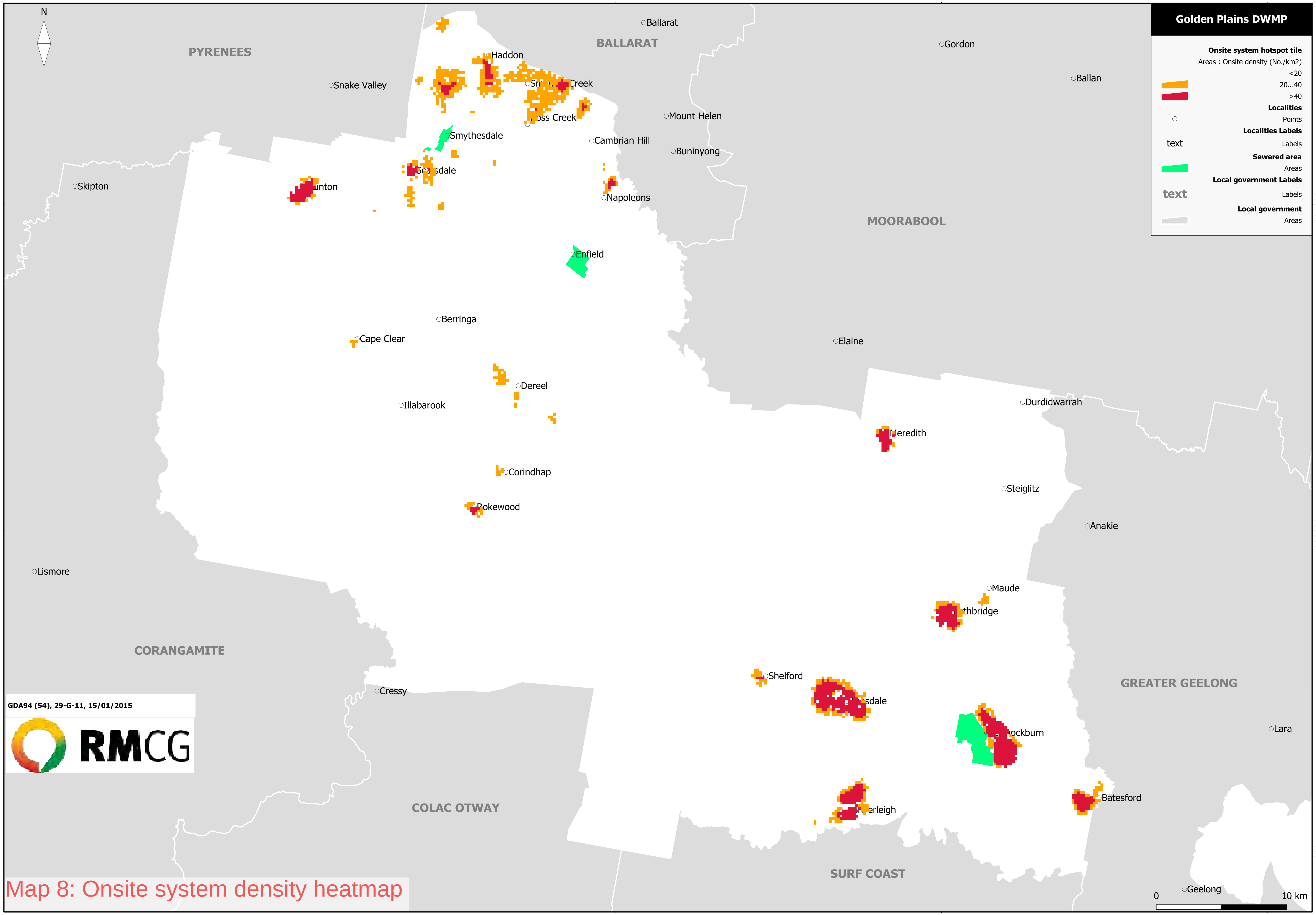
Map 5: Onsite system risk by house age



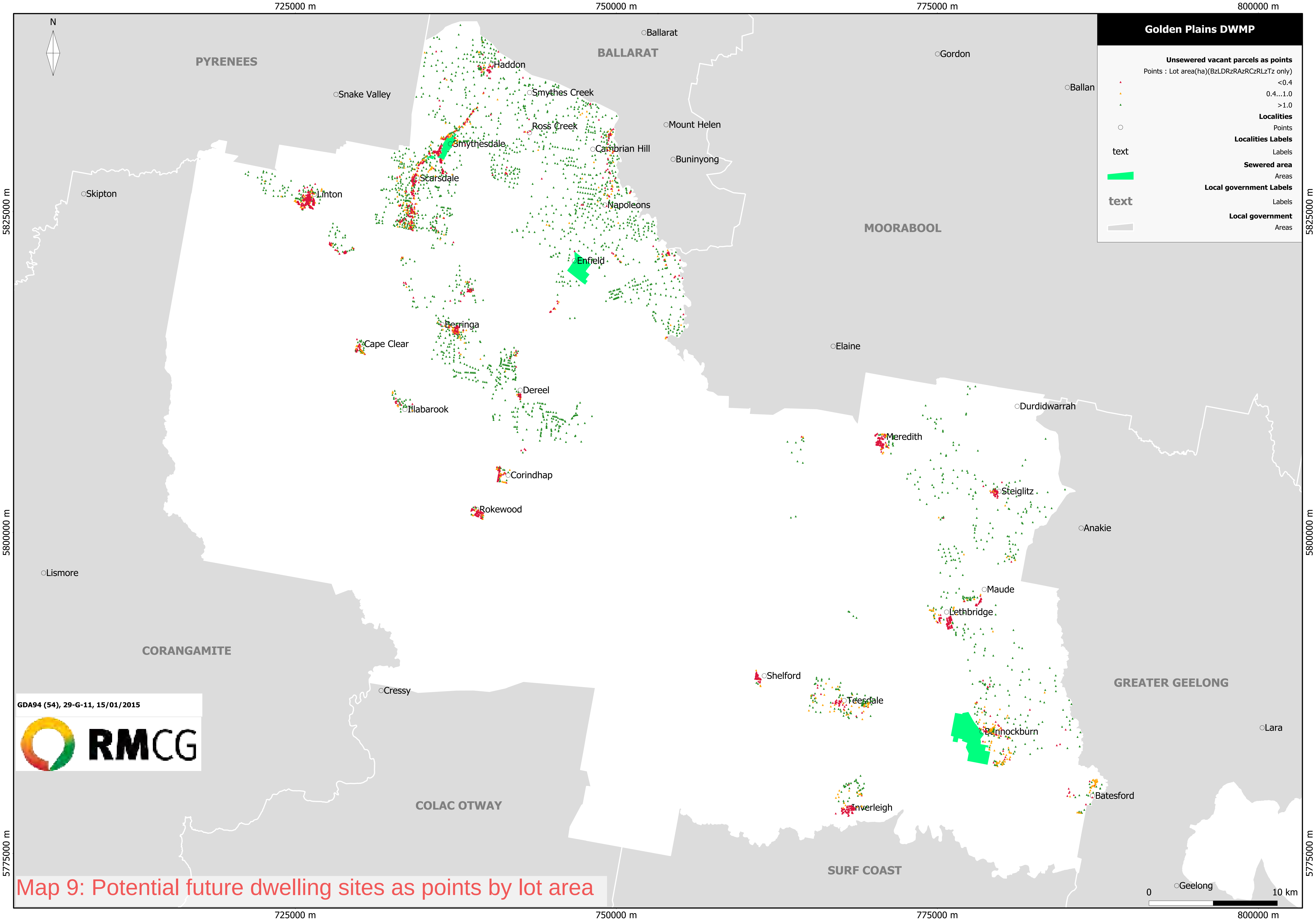
Map 6: Onsite system performance (recorded failures)



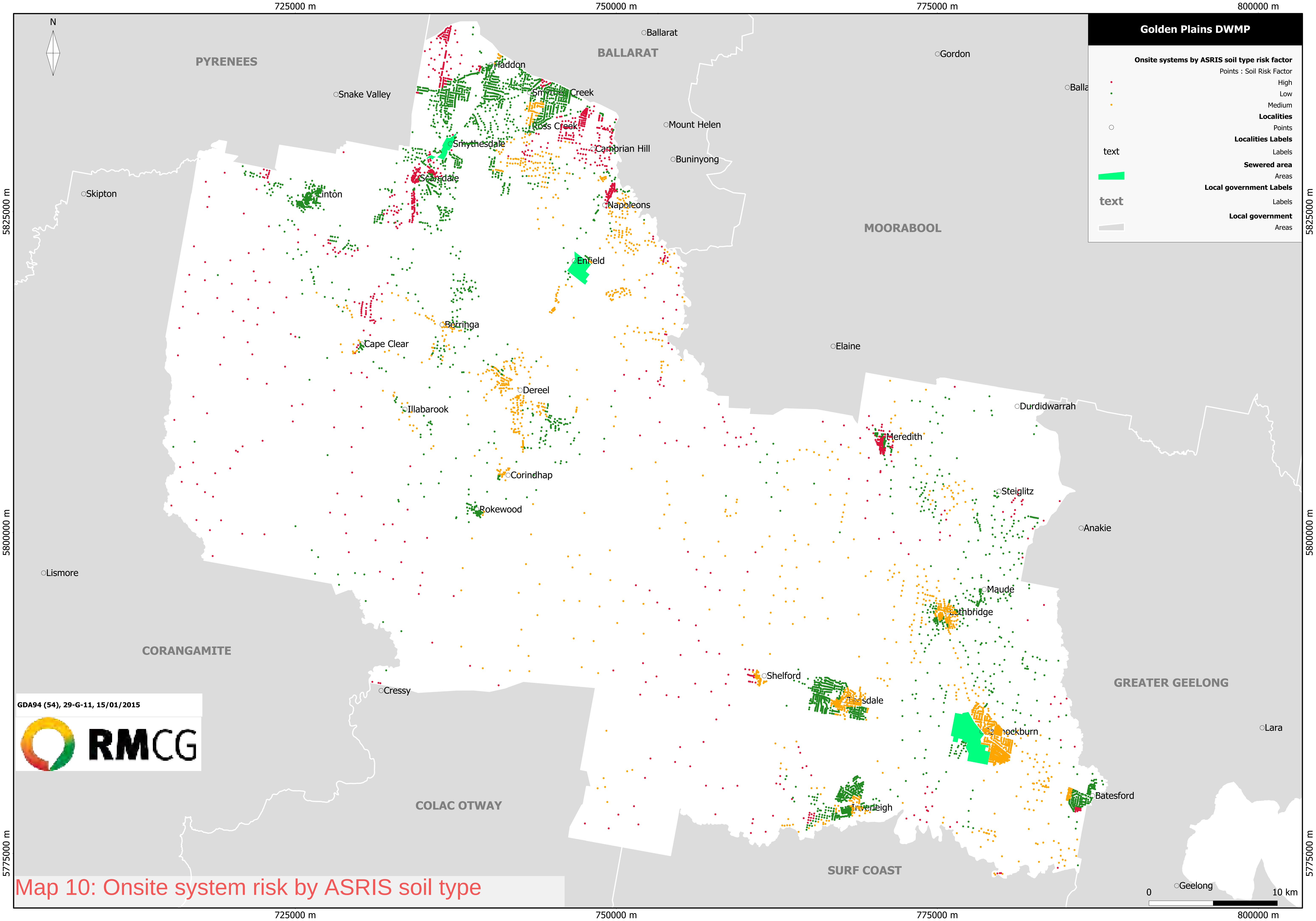
Map 7: Onsite system risk by parcel area



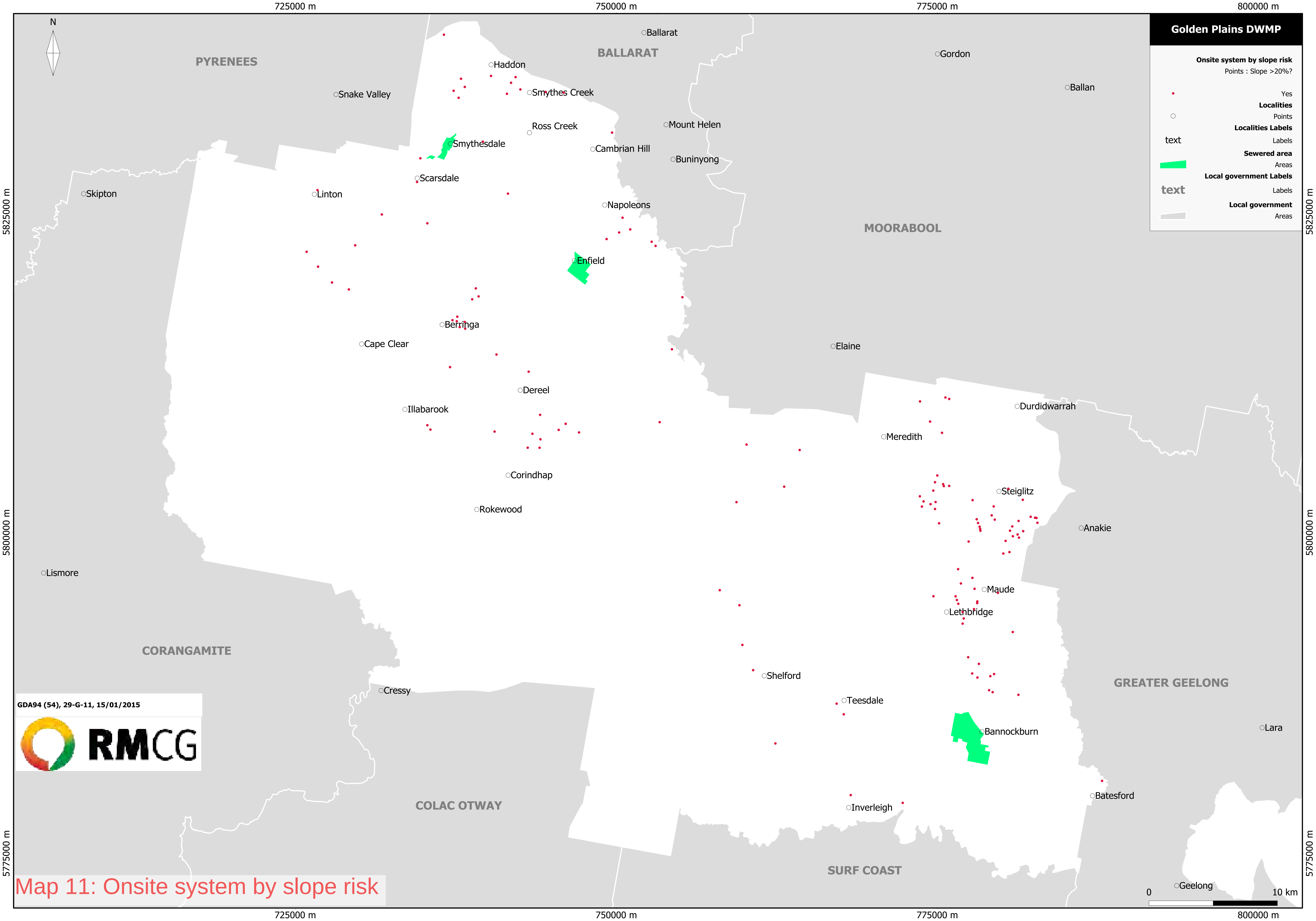
Map 8: Onsite system density heatmap



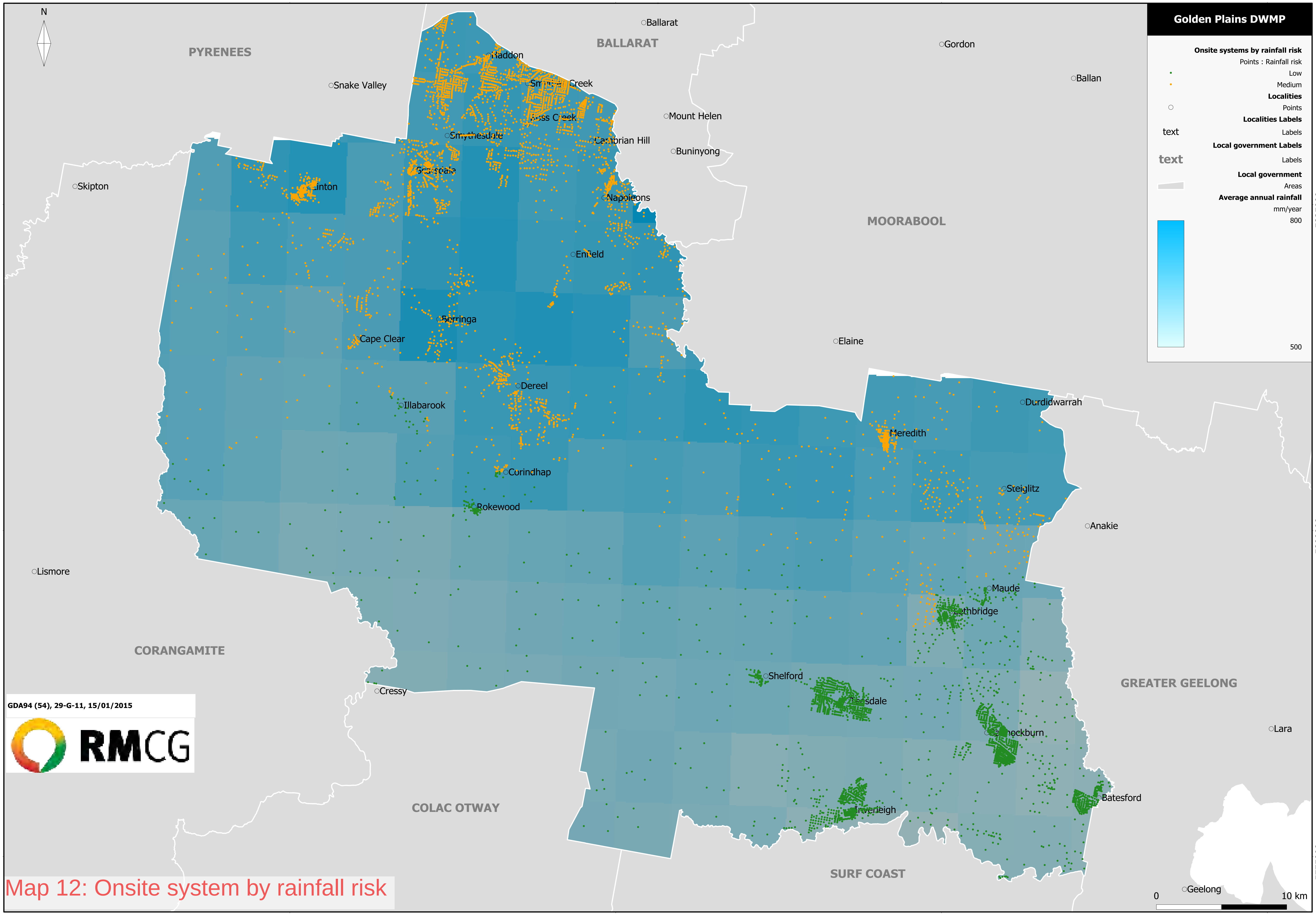
Map 9: Potential future dwelling sites as points by lot area



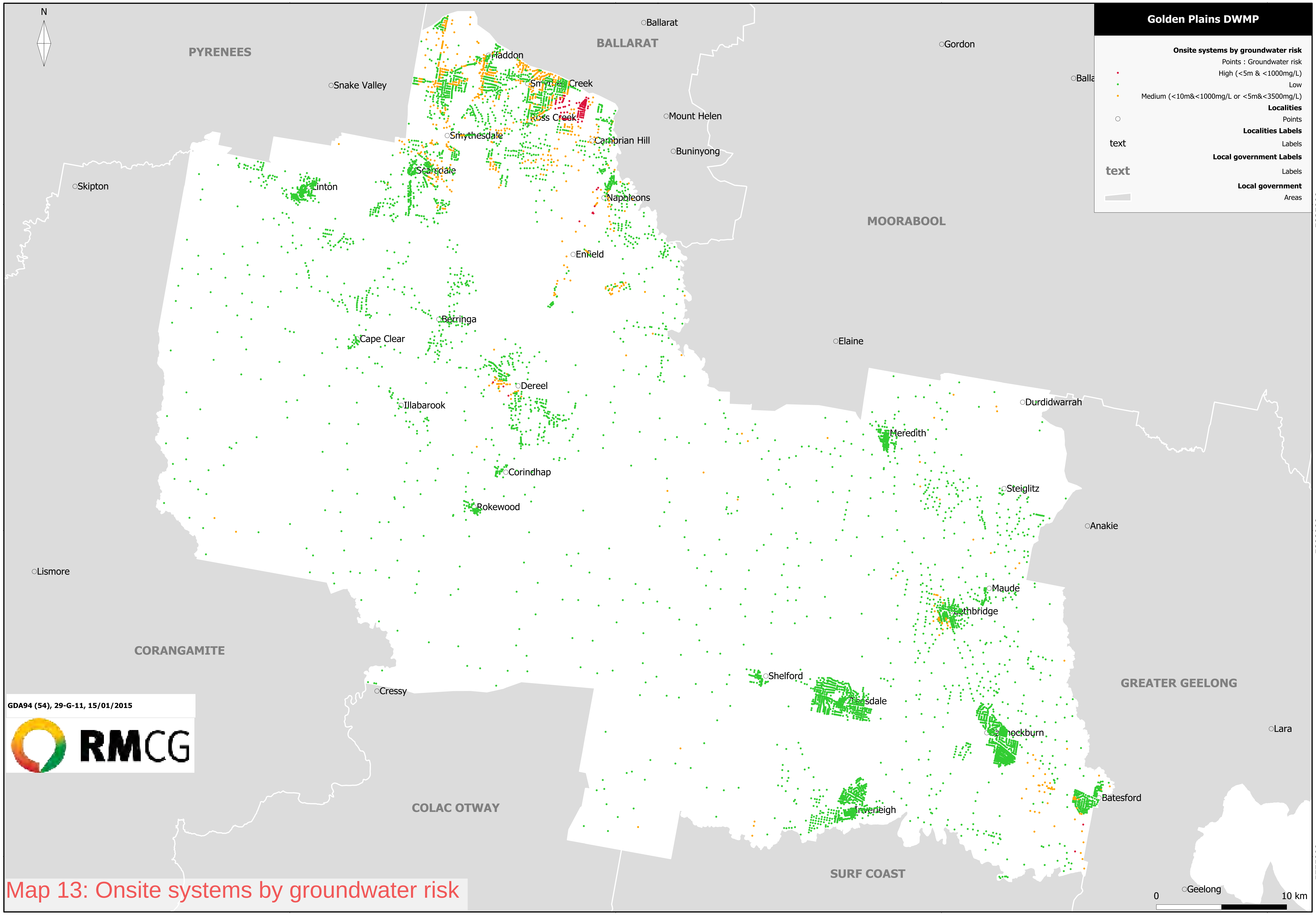
Map 10: Onsite system risk by ASRIS soil type



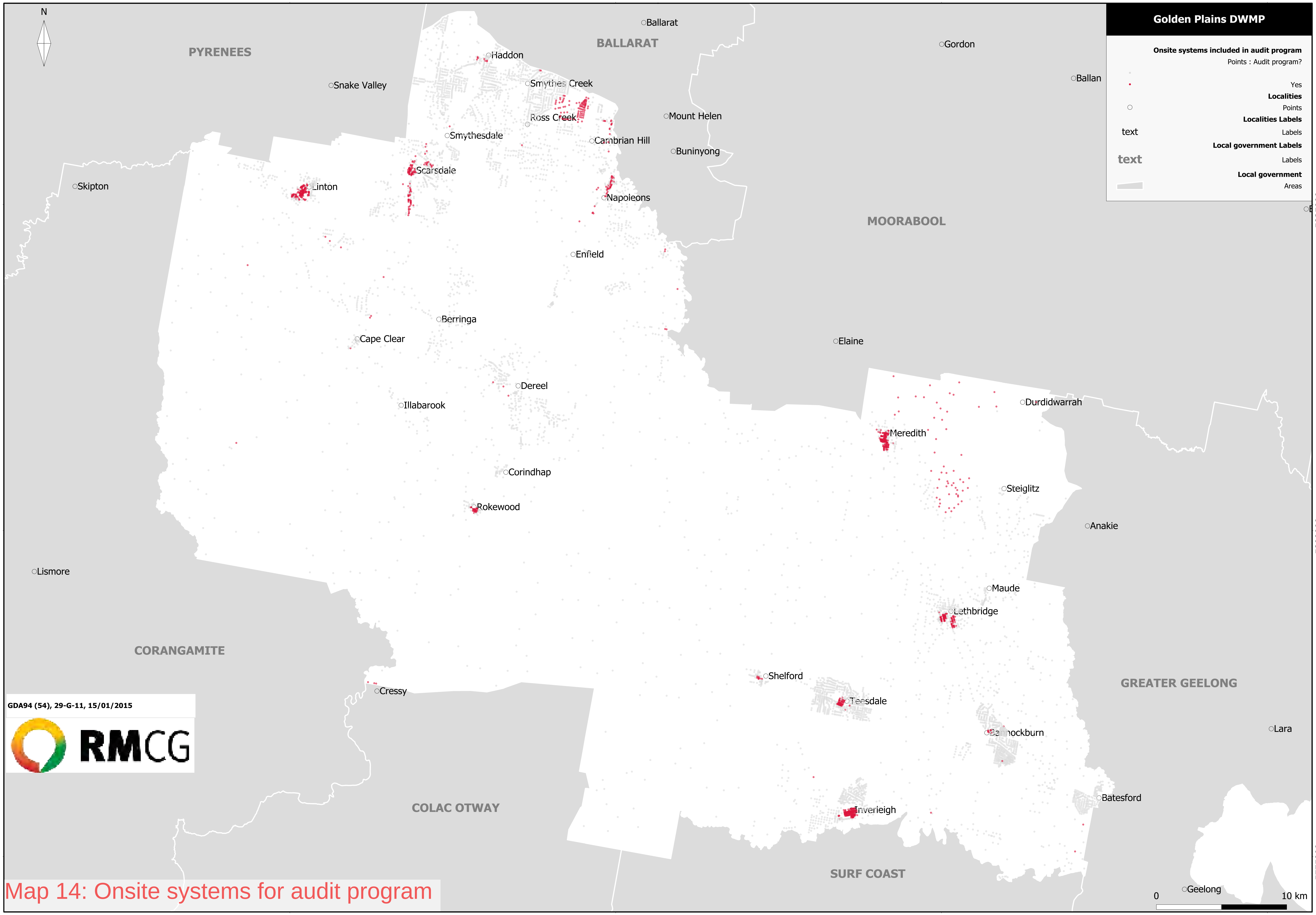
Map 11: Onsite system by slope risk



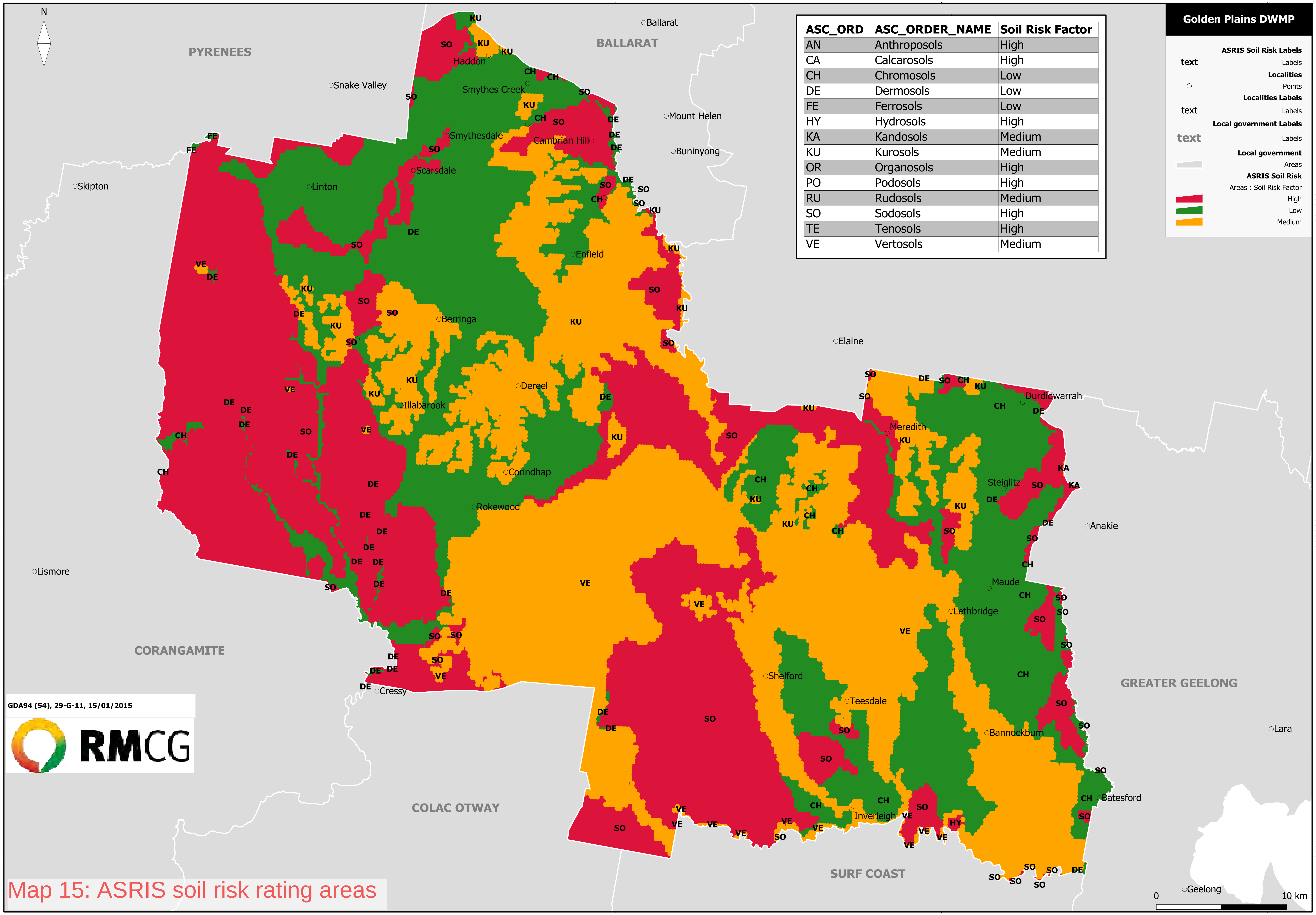
Map 12: Onsite system by rainfall risk



Map 13: Onsite systems by groundwater risk

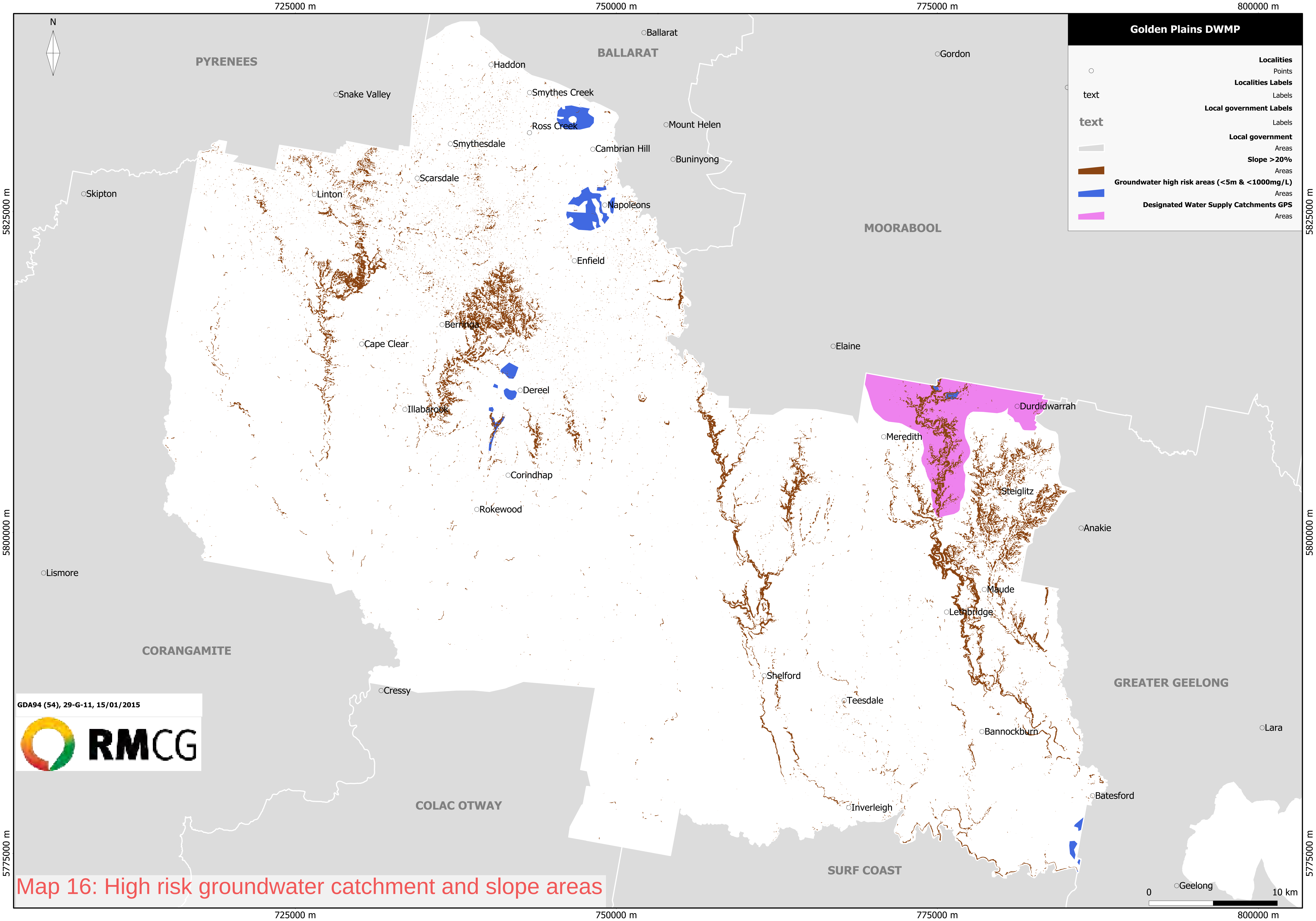


Map 14: Onsite systems for audit program



ASC_ORD	ASC_ORDER_NAME	Soil Risk Factor
AN	Anthroposols	High
CA	Calcarosols	High
CH	Chromosols	Low
DE	Dermosols	Low
FE	Ferrosols	Low
HY	Hydrosols	High
KA	Kandosols	Medium
KU	Kurosols	Medium
OR	Organosols	High
PO	Podosols	High
RU	Rudosols	Medium
SO	Sodosols	High
TE	Tenosols	High
VE	Vertosols	Medium

Map 15: ASRIS soil risk rating areas



Map 16: High risk groundwater catchment and slope areas

This report has been prepared by:

RMCG
135 Mollison Street, BENDIGO VIC 3550
PO Box 2410, BENDIGO DC VIC 3554

P: (03) 5441 4821
E: rm@rmcg.com.au
W: www.rmcg.com.au

ABN: 35 154 629 943

Offices in Bendigo, Melbourne, Torquay, Warragul and Penguin (Tasmania)

Key Project Contact

Duncan Wallis
M: 0429 145 169
E: duncanw@rmcg.com.au]

ISO 9001
International Standards
Certifications

Document review and authorisation

Job Number: **29-G-11**

Doc. Version	Final/Draft	Date	Author	Reviewed by	Quality check	Release approved by	Issued to	Copies
1.0	Draft	9/10/2014	D Wallis	-	P Mawson	-	A Kelliher	Internal review
2.0	Draft	10/10/2014	D Wallis	A. Kelliher	P Mawson	D. Wallis	S. McLay	1(e)
3.0	Final	19/01/2015	D Wallis	A. Kelliher	P. Mawson	D Wallis	S McLay	1(e)
4.0	Final	7/5/2015	D Wallis	S McLay	P Mawson	D Wallis	S McLay	1(e)

Note: (e) after number of copies indicates electronic distribution

RMCG Bendigo:RMCG Client Files:DUNCAN - 29:A-K:29-G-11 Golden Plains Shire DWMP:REPORTS:Volume 2:Spatial risk assessment:Revised draft:GPS DWMP Spatial Risk Assessment V4.docx