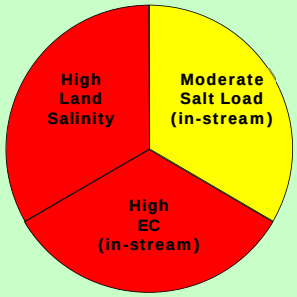
20. Reedy Creek Hydrogeological Landscape

LOCALITIES	**Reedy Creek, Sutton Road**	
MAP SHEET	**Canberra 1:100 000**	
CONFIDENCE LEVEL	**Low**	

OVERVIEW

The Reedy Creek Hydrogeological Landscape (HGL) extends either side of Sutton Road from near Queanbeyan to the northern boundary of the ACT (Figure 1). The HGL covers an area of 50 km^2 and receives 550 to 750 mm of rain per annum.

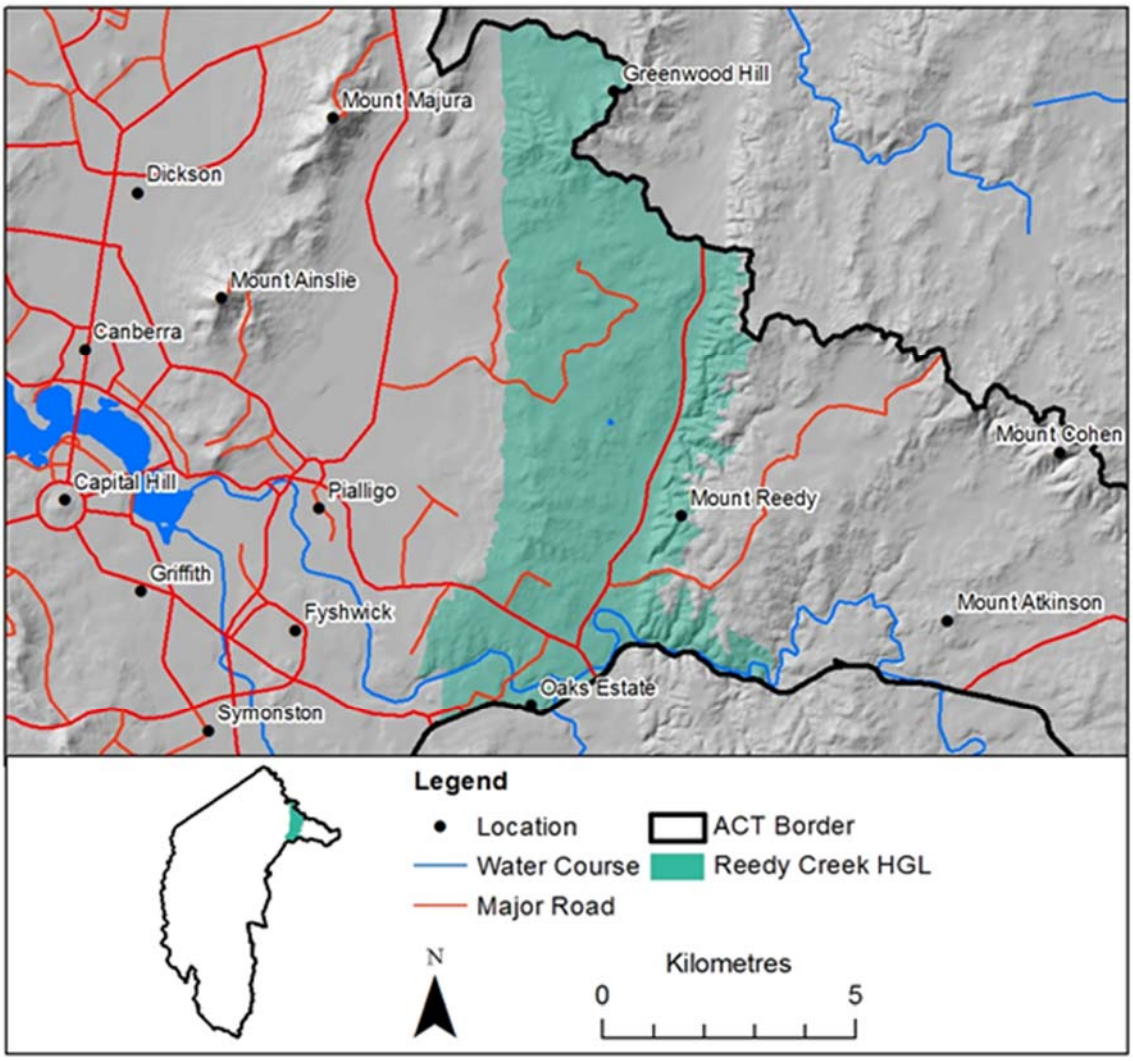


Figure 1: Reedy Creek HGL distribution map.

Reedy Creek HGL is a moderately steep, catchment based landscape bounded by steep hills (Silurian Mt Ainslie Volcanics to the west, and Ordovician Adaminaby Group to the east) (Figure 2). The valley has a deeply incised creek line (channel) that is currently relatively stable.

The area shows salinity on lower landscape areas, particularly the western slopes. The sites are also seasonal and 'bare out' in wet times. Waterlogged patches also occur with foliage damage to *in situ* trees in lower landscape positions. Stream EC recordings are high with brackish quality (1600–2400 µS/cm) in Reedy Creek.

The area has had significant gully stabilisation works conducted under former Soil Conservation Service project works. There has been large investment in riparian tree planting and fencing.

Diverse land use includes grazing and cropping in the lower landform units. Defence lands occupy the western ridges with pine plantations on the eastern ridge lines (start of the Kowen Pine Plantation). Sutton Road forms a major road link to new peri-urban development to the north and to Sutton, Gunning, Gundaroo, and access to the Federal Highway.

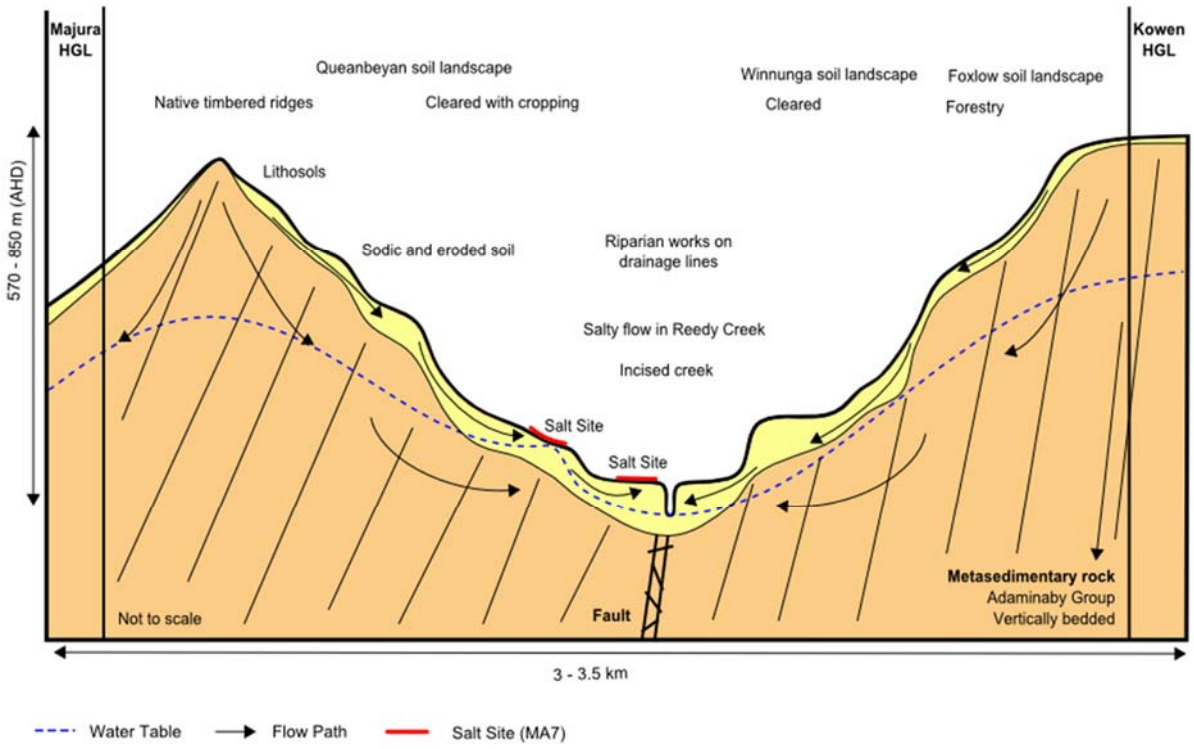


Figure 2: Conceptual cross-section for Reedy Creek HGL showing the distribution of regolith and landforms, salt sites if present, and flow paths of water infiltrating the system.

Salinity expression in this HGL is in the form of salt land and stream salt load and EC (Table 1).

Table 1: Reedy Creek HGL salinity expression.

SALINITY EXPRESSION	
Land Salinity (Occurrence)	High – salt land has been observed in this HGL, along with tree damage and waterlogged sites
Salt Load (Export)	Moderate – intermittent flow in creek. Available bore data suggest that base flow is brackish (1600–2400 µS/cm)
EC (Water Quality)	High – spikes within Reedy Creek have been observed

Salt store refers to the amount of salt stored in soil and geology materials. Salt availability refers to how easily this salt can be moved by water. Salt stored within Reedy Creek HGL has high mobility. There is a moderate salt store that has high availability (Table 2).

Table 2: Reedy Creek HGL salt store and availability.

SALT MOBILITY			
	Low availability	**Moderate** availability	**High** availability
High salt store			
Moderate salt store			**Reedy Creek**
Low salt store			

Overall salinity hazard is based on the likelihood of salinity occurring and how much impact it would have. The overall salinity hazard in Reedy Creek HGL is high. This is due to the high likelihood that salinity issues will occur that would have potentially significant impacts (Table 3).

Table 3: Likelihood of salinity occurrence, potential impact and overall hazard of salinity for Reedy Creek HGL.

OVERALL SALINITY HAZARD			
	Limited potential impact	**Significant** potential impact	**Severe** potential impact
High likelihood of occurrence		**Reedy Creek**	
Moderate likelihood of occurrence			
Low likelihood of occurrence			

LANDSCAPE FEATURES

The following photographs illustrate landscapes and specific features observed in this HGL. Information used to define the HGL is summarised in Table 4.

Photo 1: View from upper landscape elements of the eastern slope across to Defence lands on the western slope in the southern area of Reedy Creek HGL (Photo: DPI / A Nicholson).

Photo 2: Foxlow soil landscape with steep angular hills of the Pittman Formation of the Adaminaby Ordovician Group. This soil landscape forms the steep ridge/escarpment on the eastern margin of Reedy Creek HGL (Photo: DPI / A Nicholson).

Photo 3: Lower landscape elements viewed from Sutton Road in a north–east direction, indicating flatter landform units and steep ridges (Photo: DPI / A Nicholson).

Photo 4: Lower landscape units in the central area of Reedy Creek HGL (Photo: DPI / A Nicholson).

Photo 5: Reedy Creek, showing its incised nature and large scale riparian plantings (Photo: DPI / A Nicholson).

Table 4: Summary of information used to define Reedy Creek HGL.

Lithology *(Raymond et al. 2007; Geoscience Australia 2015)*	This HGL comprises Ordovician metasediments. The key lithology is: • Adaminaby Group
Annual Rainfall	550–750mm
Regolith and Landforms	Soil generally <1 m deep higher in the landscape and >1 m on lower slopes and in drainage lines. Deeper soil and imperfect drainage provide moderate potential for salt store. Slopes generally 10–32%; 0–10% in valley bottoms Elevation range is 570–850 m
Soil Landscapes *(Jenkins 1993; Jenkins 2000; Cook & Jenkins in prep)*	The following soil landscapes are dominant in this HGL: • Queanbeyan • Foxlow • Winnunga Shallow well drained Rudosols (Lithosols) on crests and upper slopes. Moderately deep Red Kurosols (Red Podzolic Soils) on sideslopes. Deep imperfectly drained Magnesic Brown Kurosols (Yellow Podzolic Soils) and Mottled Magnesic Sodosols (Solodic Soils) on some lower slopes and in drainage depressions. Due to run on, sodicity, catchment shape and imperfect drainage the Sodosols within this HGL have high potential for land degradation and dryland salinity. The Magnesic Brown Kurosols (Yellow Podzolic Soils) also readily degrade and are found with dryland salinity.
Land and Soil Capability	Class 6

Land Use	• cropping • grazing • defence lands • forestry (pines) • driver training facility
Key Land Degradation Issues	• water erosion (gully and streambank) • soil acidity
Native Vegetation *(Keith 2004; Gellie 2005; Dept. of Environment 2012)*	This HGL is situated within the IBRA7 South Eastern Highlands (Murrumbateman subregion). The HGL is extensively cleared with remaining vegetation formations comprising Dry Sclerophyll Forest, with areas of Grassy Woodland and Forested Wetlands. Local vegetation is described by Gellie (2005).

HYDROGEOLOGY

Typical values for the hydrogeological parameters of this HGL are summarised in Table 5.

Table 5: Summary of values for typical hydrogeological parameters of Reedy Creek HGL.

Aquifer Type	Unconfined to semi-confined in fractured rock and saprolite Lateral flow through unconsolidated colluvial and alluvial sediments on slopes and in flow lines
Hydraulic Conductivity	Moderate Range: 10^{-2}–10 m/day
Aquifer Transmissivity	Low Range: 2–100 m^2/day
Specific Yield	Moderate Range: 5–15%
Hydraulic Gradient	Gentle to moderate Range: <10–30%
Groundwater Salinity	Brackish Range: 1600–4800 µS/cm
Depth to Watertable	Shallow to intermediate Range: <2–8 m
Typical Sub-Catchment Size	Medium (100–1000 ha)
Scale (Flow Length)	Local Flow length: <5 km (short)
Recharge Estimate	Moderate
Residence Time	Medium (years)

Responsiveness to Change	Medium (years)

MANAGEMENT OPTIONS

Overarching salinity management strategies have specific biophysical outcomes. These are achieved by implementing a series of targeted land management actions that take into account the opportunities and constraints of the particular HGL. The actions recognise the need for diffuse and specific activities within the landscape to impact on salinity. Further explanation of land management functions, strategies and actions can be found in Wooldridge *et al.* (2015).

Salinity is driven by interactions between water-use capacity of vegetation, physical soil properties and hydrogeological processes within the HGL.

Actions that influence the way water is used by vegetation or stored in the soil profile will have impacts on recharge. The influence of both continual and episodic recharge and the impacts of extreme weather events should be considered when deciding on appropriate management actions. Short and long-term climate cycles also should be considered as they have a bearing on salinity processes, particularly salt load and land salinity.

Landscape Functions – Reedy Creek HGL

Functions this landscape provides within a catchment scale salinity context:

- **D.** The landscape generates salt loads which enter streams and are redistributed in the catchment.
- **E.** The landscape receives and stores salt load through irrigation or surface flow.
- **F.** The landscape generates high salinity concentration water.
- **G.** The landscape contains important land assets (including infrastructure and high value agricultural land) on which salinity processes impact.

Landscape Management Strategies – Reedy Creek HGL

Appropriate strategies pertinent to this landscape:

- **Buffer the salt store – keep it dry and immobile (1)**: There are stores of salt in particular parts of the landscape that can be buffered by vegetation, limiting the salinity impact. They are generally in the depositional elements of the middle to lower landscape. They comprise a significant percentage of this HGL.
- **Discharge rehabilitation and management (4)**: Discharge sites appear during wet climate cycles. Improved management of these saline areas can reduce the impact of salinisation and prevent large negative impacts during wet cycles. Discharge management will also limit on-site land degradation.
- **Dry out the landscape with diffuse actions over most of the landscape (6)**: Encourage plant growth and increase plant water use in order to use excess soil moisture and shallow groundwater. Healthy, actively growing vegetation will also buffer groundwater accessions in wet seasonal conditions.

Key Management Focus – Reedy Creek HGL

The key management focus is to introduce perennial components and change farming systems to use more water and buffer salt load delivery to streams. This is a preventative action to minimise offsite impacts from this HGL. Grazing management is a major factor in landscape stability, as the soils are very sodic and are easily eroded. Past earthworks in defence lands have failed due to total grazing pressure applied by overpopulation of kangaroos.

The area has a number of larger holdings where soils management programs potentially increase both soil health and runoff. Gully stabilisation works are a feature of the landscape and long-term maintenance of structures should take place.

Specific Land Management Opportunities

Specific opportunities for this HGL:

- forestry exists in this landscape and could be expanded
- saline land areas are small and discrete, and easily managed.

Specific Land Management Constraints

Constraints on land management in this HGL include:

- soil factors such as acidity, infertility and shallow profiles will constrain actions
- gullying will remain a long-term risk in the landscape
- grazing pressure from kangaroos limits rehabilitation programs.

Specific Targeted Actions

Management areas for this HGL are illustrated in Figures 3 and 4. The specific management actions for these areas are described in Table 6.

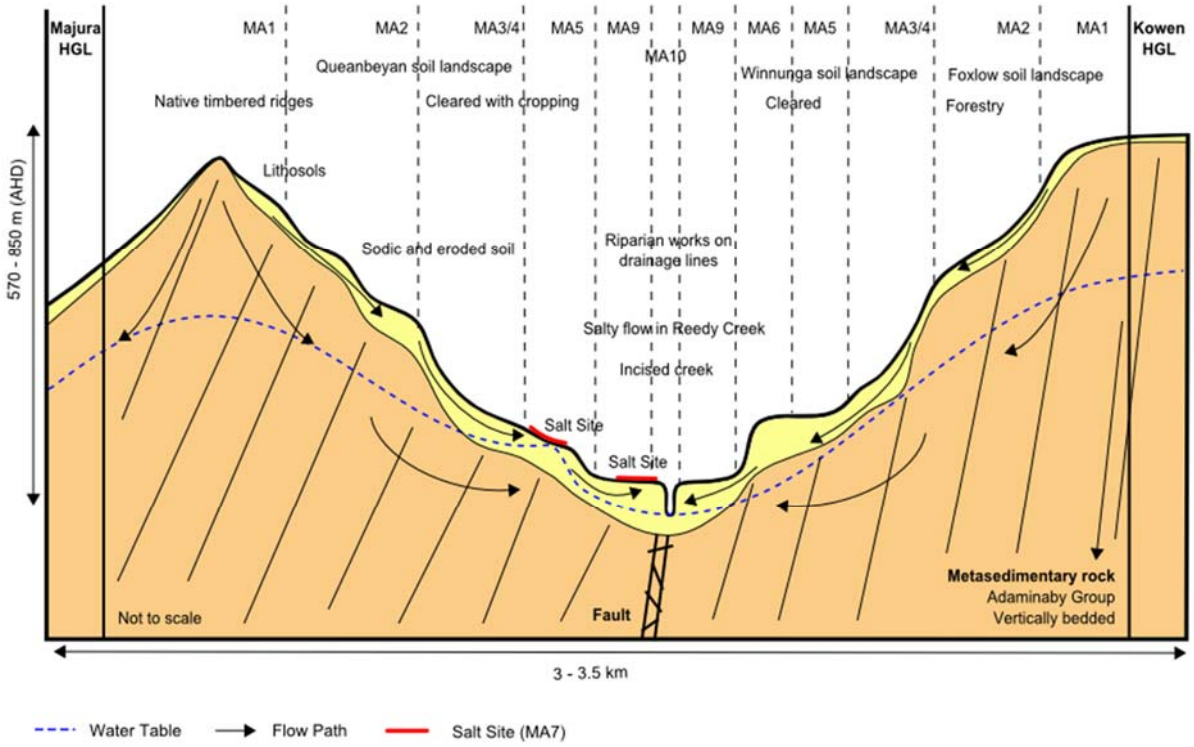


Figure 3: Management cross-section for Reedy Creek HGL showing defined management areas.

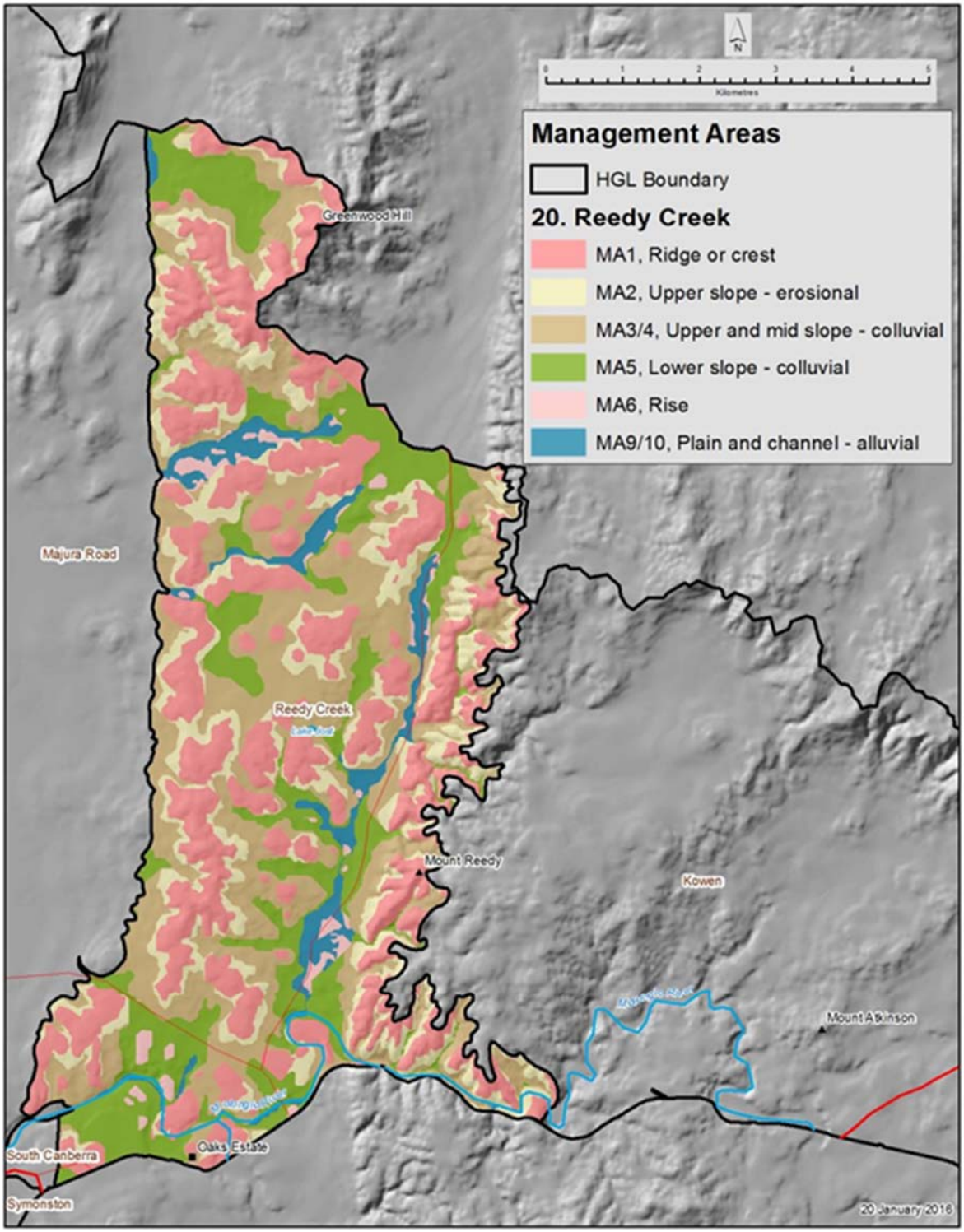


Figure 4: Spatial distribution of management areas for Reedy Creek HGL.

Table 6: Specific management actions for management areas within Reedy Creek HGL.

Management Area (MA)	Action
MA 1 (RIDGES)	**Vegetation for ecosystem function** Maintain and improve existing native woody vegetation to reduce discharge **(VE3)** Manage total grazing pressure to maintain and improve native vegetation for hydrology outcomes **(VE9)** **Vegetation for production** Improve grazing management of existing perennial pastures to manage recharge **(VP1)** Establish and manage perennial pastures to manage recharge **(VP2)** Improve grazing management to improve or maintain native pastures to manage recharge **(VP5)** Commercial plantation forestry to manage recharge **(VP7)** Revegetation of non-agricultural land with native species to manage recharge **(VP8)**
MA 2 (UPPER SLOPE – EROSIONAL)	**Vegetation for ecosystem function** Maintain and improve existing native woody vegetation to reduce discharge **(VE3)** Manage total grazing pressure to maintain and improve native vegetation for hydrology outcomes **(VE9)** **Vegetation for production** Improve grazing management of existing perennial pastures to manage recharge **(VP1)** Establish and manage perennial pastures to manage recharge **(VP2)** Improve grazing management to improve or maintain native pastures to manage recharge **(VP5)** Revegetation of non-agricultural land with native species to manage recharge **(VP8)**

Management Area (MA)	Action
MA 3/4 (UPPER SLOPE – COLLUVIAL & MID SLOPES)	**Vegetation for ecosystem function** Maintain and improve existing native woody vegetation to reduce discharge **(VE3)** **Vegetation for production** Improve grazing management of existing perennial pastures to manage recharge **(VP1)** Establish and manage perennial pastures to manage recharge **(VP2)** Improve grazing management to improve or maintain native pastures to manage recharge **(VP5)** Revegetation of non-agricultural land with native species to manage recharge (**VP8)** **Farming Systems** Rotational cropping with perennial pasture component **(FS3)** **Salt Land Rehabilitation** Rehabilitation of salt land to minimise onsite and offsite degradation **(SR4)**
MA 5 (LOWER SLOPE – COLLUVIAL) NB: INCLUDES MA7 – SALTLAND	**Vegetation for ecosystem function** Maintain and improve existing native woody vegetation to reduce discharge **(VE3)** **Vegetation for production** Improve grazing management of existing perennial pastures to manage recharge **(VP1)** Establish and manage perennial pastures to manage recharge **(VP2)** Improve grazing management to improve or maintain native pastures to manage recharge **(VP5)** Revegetation of non-agricultural land with native species to manage recharge **(VP8)** **Farming Systems** Rotational cropping with perennial pasture component **(FS3)** Pasture cropping **(FS1)** **Salt Land Rehabilitation** Fence and isolate salt land and discharge areas for saline site rehabilitation **(SR1)** Rehabilitation of salt land to minimise onsite and offsite degradation **(SR4)**

Management Area (MA)	Action
MA6 (RISES)	**Vegetation for ecosystem function** Maintain and improve existing native woody vegetation to reduce discharge **(VE3)** **Vegetation for production** Improve grazing management of existing perennial pastures to manage recharge **(VP1)** Improve grazing management to improve or maintain native pastures to manage recharge **(VP5)** Revegetation of non-agricultural land with native species to manage recharge **(VP8)**
MA 9 (ALLUVIAL) NB: INCLUDES MA7 – SALTLAND	**Vegetation for ecosystem function** Maintain and improve existing native woody vegetation to reduce discharge **(VE3)** **Vegetation for production** Improve grazing management to improve or maintain native pastures to manage recharge **(VP5)** **Salt Land Rehabilitation** Rehabilitation of salt land to minimise onsite and offsite degradation **(SR4)**
MA 9/10	**Vegetation for ecosystem function** Maintain and improve riparian native vegetation to reduce discharge to streams **(VE4)**

High Hazard Land Use

There are some management actions that should be discouraged in this HGL as they will have negative impacts on salinity (Table 7).

Table 7: Management actions having negative salinity impacts in Reedy Creek HGL.

At Risk Management Areas	Action
MA 1 & 2	Poor management of grazing pastures **(DLU2)** Clearing and poor management of native vegetation **(DLU4)** Deep ripping of soils to maximise water infiltration to subsoil **(DLU11)**
MA 3/4	Poor management of grazing pastures **(DLU2)** Annual cropping with annual plants **(DLU3)** Locating infrastructure on discharge areas **(DLU7)**
MA 5	Poor soil management – tillage causing poor structure **(DLU8)** Poor management of grazing pastures **(DLU2)**

At Risk Management Areas	Action
MA 9	Poor management of grazing pastures **(DLU2)** Annual cropping with annual plants **(DLU3)** Locating infrastructure on discharge areas **(DLU7)**
MA 9/10	Clearing and poor management of native vegetation **(DLU4)**

REFERENCES

Department of the Environment 2012, *Interim Biogeographic Regionalisation for Australia (IBRA), Version 7 (Regions),* Australian Government, Department of the Environment, Canberra, ACT

Gellie, N.J.H. 2005, Native vegetation of the Southern Forests: South-east Highlands, Australian Alps, South-west Slopes and South-east Corner bioregions, *Cunninghamia 9(2)*, pp 219–253

Geoscience Australia, 2015, *Australian stratigraphic units database*, Canberra, ACT, [Accessed: 20 June 2015] http://dbforms.ga.gov.au/www/geodx.strat_units.int

Jenkins B.R. 1993, *Soil Landscapes of the Michelago 1:100 000 Sheet map and report*, Department of Conservation and Land Management, Sydney, NSW

Jenkins B.R. 2000, *Soil Landscapes of the Canberra 1:100 000 Sheet map and report*, Department of Land and Water Conservation, Sydney, NSW

Keith, D. A. 2004, *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT*, NSW Department of Environment and Conservation, Hurstville, NSW

Raymond, O.L., Lui, S., Kilgour, P., Retter, A.J., Stewart, A.J. and Stewart, G. 2007, *Surface geology of Australia 1:1,000,000 scale, New South Wales – 2nd edition*, Geoscience Australia, Canberra, ACT

Wooldridge, A., Nicholson, A., Muller R., Jenkins, B. R., Wilford, J. and Winkler, M. 2015, *Guidelines for managing salinity in rural areas*, NSW OEH, Sydney, NSW [Accessed: 20 June 2015] http://www.environment.nsw.gov.au/resources/salinity/150241-HGL-salinity-rural.pdf