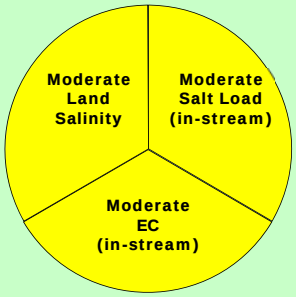
21. Royalla Hydrogeological Landscape

LOCALITIES	**Guises Creek, Royalla, Bellview**	
MAP SHEET	**Canberra 1:100 000** **Michelago 1:100 000**	
CONFIDENCE LEVEL	**Moderate**	

OVERVIEW

The Royalla Hydrogeological Landscape (HGL) extends to the west of the Monaro Highway from Royalla to Williamsdale (Figure 1). The HGL covers an area of 44 km^2 and receives 650 to 850 mm of rain per annum.

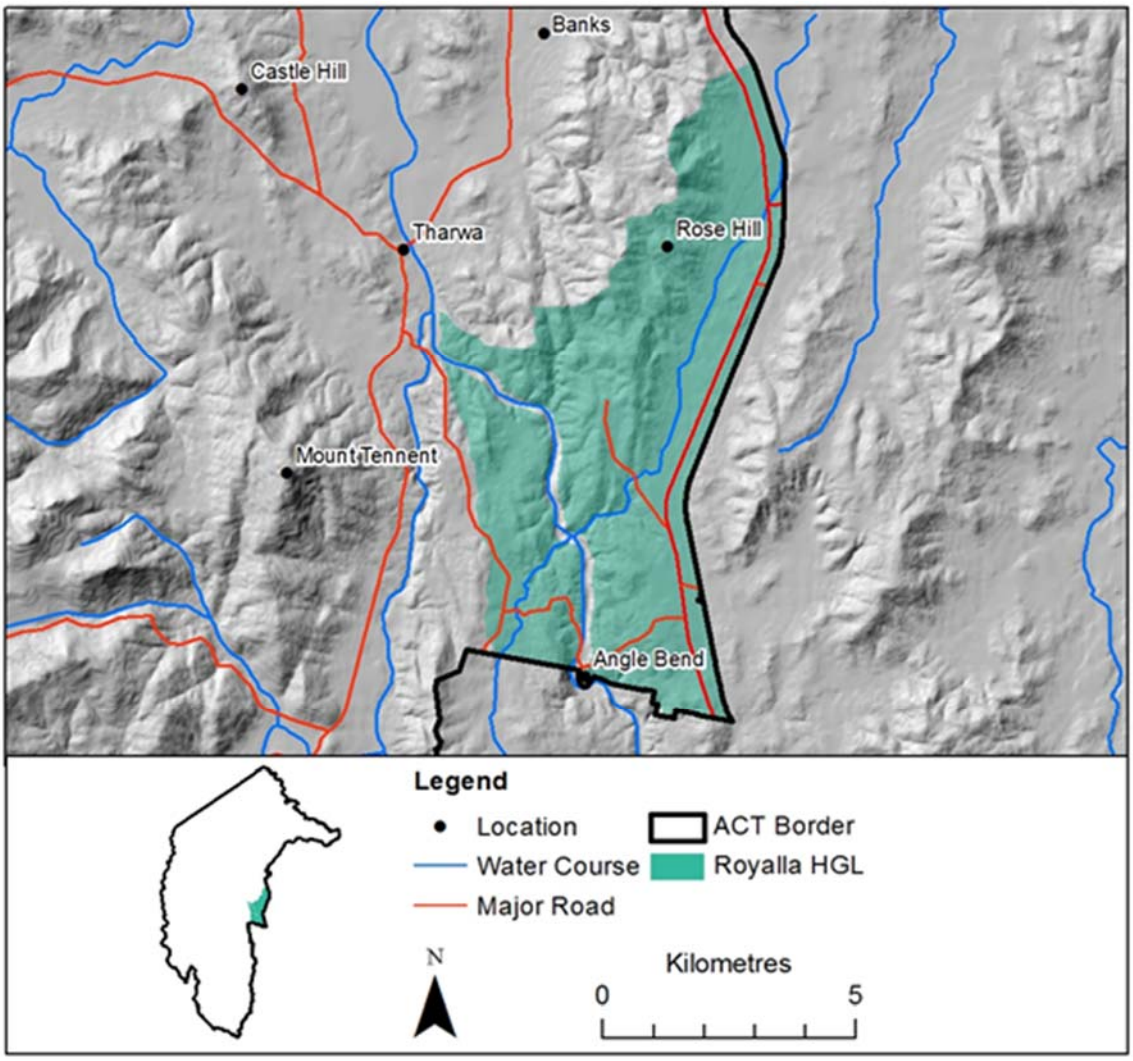


Figure 1: Royalla HGL distribution map.

The Royalla HGL boundary is derived from the geological boundaries of the Silurian volcanics (Figure 2). The Murrumbidgee Gorge runs through, and it has rolling grazing land to the east and steeper grazing country to the west. Land use is principally grazing and the area also includes a solar farm.

The HGL is sodic and is subject to significant erosion. It has waterlogged discharge areas and salinity indicators found in the drainage lines. Streams have some salt load and elevated EC occurs during spike events. Salt land is very visible on similar landscape units across the border in NSW, particularly to the south.

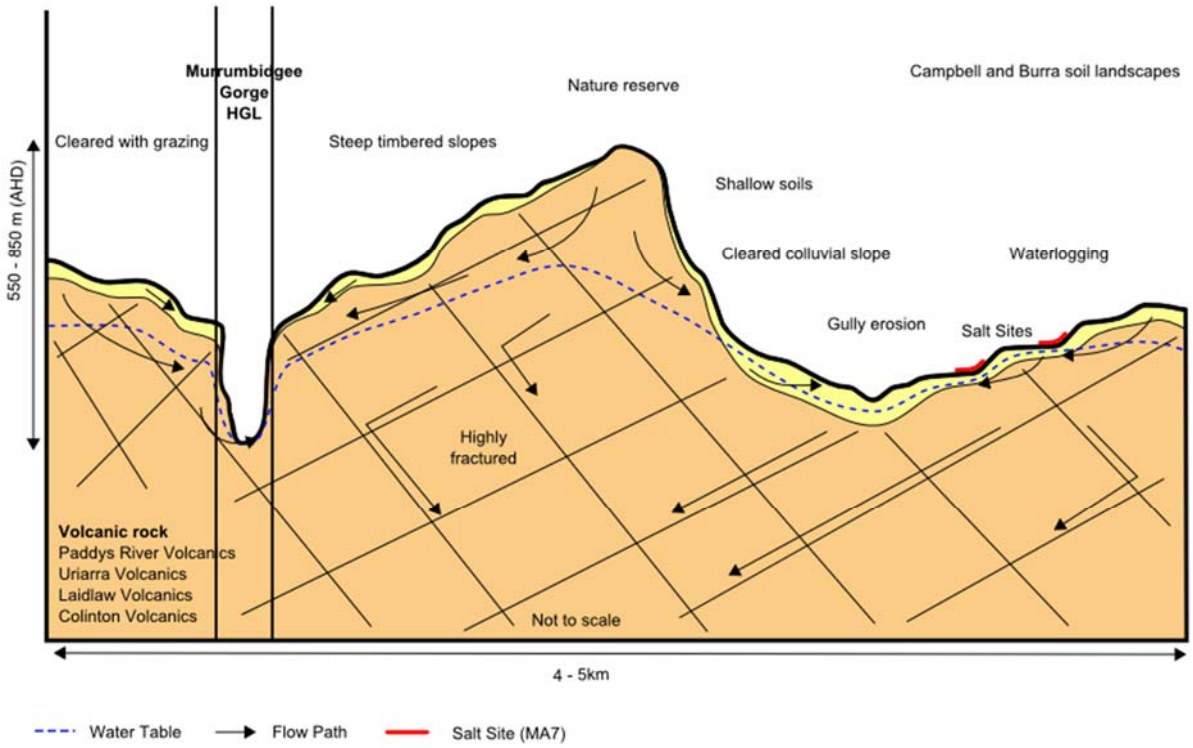


Figure 2: Conceptual cross-section for Royalla HGL showing the distribution of regolith and landforms, salt sites if present, and flow paths of water infiltrating the system.

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

Table 1: Royalla HGL salinity expression.

SALINITY EXPRESSION	
Land Salinity (Occurrence)	Moderate – known occurrence of salt land in similar landscapes nearby in NSW.
Salt Load (Export)	Moderate
EC (Water Quality)	Moderate

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 Royalla HGL has moderate mobility. There is a moderate salt store that has moderate availability (Table 2).

Table 2: Royalla HGL salt store and availability.

SALT MOBILITY			
	Low availability	**Moderate** availability	**High** availability
High salt store			
Moderate salt store		**Royalla**	
Low salt store			

Overall salinity hazard is based on the likelihood of salinity occurring and how much impact it will have. The overall salinity hazard in Royalla HGL is moderate. This is due to the moderate 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 Royalla HGL.

OVERALL SALINITY HAZARD			
	Limited potential impact	**Significant** potential impact	**Severe** potential impact
High likelihood of occurrence			
Moderate likelihood of occurrence		**Royalla**	
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: Looking east from Smiths Road towards the incised Murrumbidgee Gorge HGL (Photo: OEH / R Muller).

Photo 2: View looking east from Smiths Road across partially cleared upper slope elements of Royalla HGL. St Johns Wort is a common weed in this landscape (Photo: OEH / R Muller).

Photo 3: View looking southwest across the lower slope and plain elements of Guises Creek in Royalla HGL (Photo: OEH / R Muller).

Photo 4: Royalla HGL in the vicinity of the 'solar farm' to the west of the Monaro Highway (Photo: DPI / A Nicholson).

Photo 5: Landscape view of long colluvial slope element in foreground and steep hills of Royalla HGL in the background; taken from the Monaro Highway (Photo: DPI / A Nicholson).

Photo 6: Small area of Williamsdale Soil Landscape adjacent to Angle Crossing Road at Williamsdale (Photo: DPI / A Nicholson).

Table 4: Summary of information used to define Royalla HGL.

Lithology *(Raymond et al. 2007; Geoscience Australia 2015)*	This HGL comprises Silurian volcanic rocks. Key lithologies include: • Colinton Volcanics • Laidlaw Volcanics • Deakin Volcanics
Annual Rainfall	650–850 mm
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 in the lower landscape provide moderate potential for salt store. Slopes generally 10–32%; 0–10% in valley bottoms. Elevation Range is 560–1000 m.
Soil Landscapes *(Jenkins 1993; Jenkins 2000; Cook & Jenkins in prep)*	The following soil landscapes are dominant in this HGL: • Campbell • Burra • Burra (variant A) • Murrumbidgee Gorge Clastic Rudosols or Leptic Tenosols (Lithosols) on crests and associated with outcrops and subcrops. Well drained Red and Yellow Chromosols (Red and Yellow Podzolic Soils) occur in many mid to lower slope positions. A number of areas of impeded drainage are found in the lower slope-rolling terrain to the east of the Murrumbidgee Gorge. Typically these areas will have poorly drained Sodosols (Solodized Solonetz and Solodic Soils) or Gleyed Chromosols and Hydrosols (Gleyed Podzolic Soils). The Sodosols are sodic and have a high erosion hazard. They readily gully and are often associated with dryland salinity. The Murrumbidgee Gorge is incised within this landscape. Slopes are usually steeper within the gorge than elsewhere in the HGL. Soils tend to be shallow with Clastic Rudosols or Leptic Tenosols (Lithosols) on crests and slopes. Minor deeper soils on the lower slopes with Red Kandosols (Red Earths). Minimal floodplain deposits with Stratic Rudosols (Alluvial soils and unconsolidated sediments).
Land and Soil Capability	Class 5
Land Use	• grazing • native forest (scrub) • Royalla solar farm
Key Land Degradation Issues	• water erosion • mass movement • shallow rock • 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 Grassy Woodland, with areas of Wet and Dry Sclerophyll Forest, Grasslands 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 Royalla HGL.

Aquifer Type	Unconfined to semi-confined in fractured rock and saprolite Lateral flow through unconsolidated colluvial and alluvial sediments on lower slopes and in flow lines
Hydraulic Conductivity	Moderate Range: 10^{-2}–10 m/day
Aquifer Transmissivity	Low Range: <2 m^2/day
Specific Yield	Moderate Range: 5–15%
Hydraulic Gradient	Gentle to moderate Range: <10–30%
Groundwater Salinity	Fresh to marginal Range: <800–1600 µS/cm
Depth to Watertable	Shallow to intermediate Range: <2–8 m
Typical Sub-Catchment Size	Small (<100 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 – Royalla HGL

Functions this landscape provides within a catchment scale salinity context:

- **A.** The landscape provides fresh water runoff as an **important water source**.
- **D.** The landscape generates salt loads which enter streams and are redistributed in the catchment.
- **H.** The landscape contains high hazard for generating sodic and saline sediments.

Landscape Management Strategies – Royalla 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 vegetation can buffer, 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 in the landscape 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 to use excess soil moisture and shallow groundwater. Healthy, actively growing vegetation will also buffer groundwater accessions in wet seasonal conditions.

Key Management Focus – Royalla HGL

This landscape impacts on offsite water quality and the key management focus should be to introduce perennial components into the landscape and farming systems.

Specific Land Management Opportunities

Specific opportunities for this HGL:

- grazing land has good native pasture base

Specific Land Management Constraints

Constraints on land management in this HGL include:

- soil limitations – acid, low fertility
- erosion and gullying
- total grazing pressure

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.

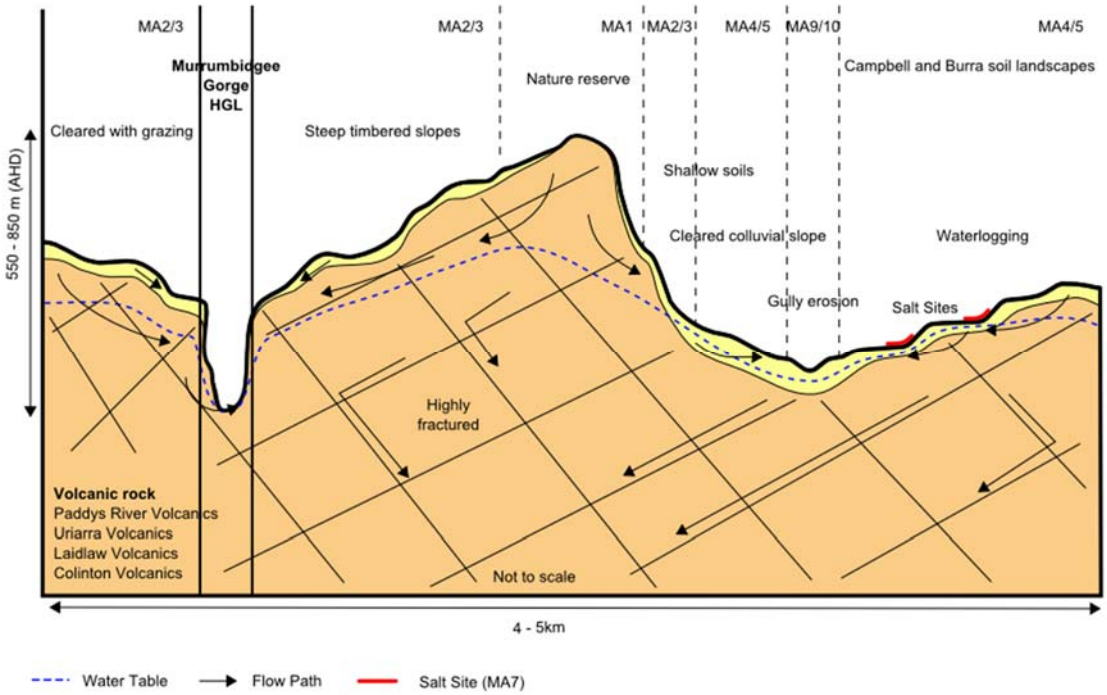


Figure 3: Management cross-section for Royalla HGL showing defined management areas.

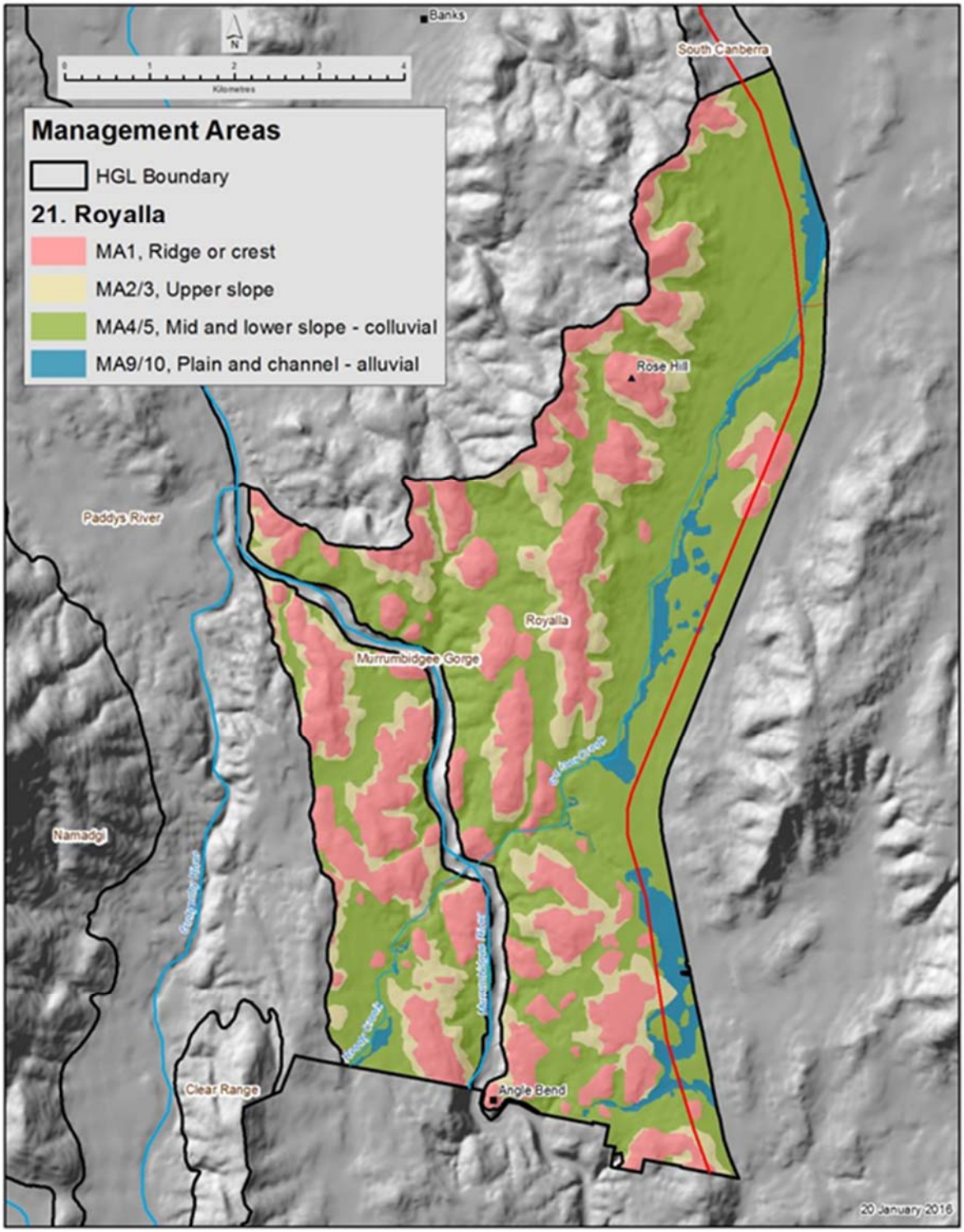


Figure 4: Spatial distribution of management areas for Royalla HGL.

Table 6: Specific management actions for management areas within Royalla HGL.

Management Area (MA)	Action
MA1 (RIDGES)	**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)**
MA 2/3 (UPPER SLOPE – COLLUVIAL EROSIONAL)	**Vegetation for ecosystem function** Interception planting of native woody species to target shallow groundwater **(VE2)** 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)** Improve grazing management to improve or maintain native pastures to manage recharge **(VP5)**
MA 4/5 (MID SLOPES & LOWER SLOPES – COLLUVIAL) NB: INCLUDES MA7 – SALTLAND	**Vegetation for production** Improve grazing management of existing perennial pastures to manage recharge **(VP1)** Establish and manage perennial pastures to manage recharge **(VP2)** Establish and manage perennial pastures to intercept shallow lateral groundwater flow **(VP3)** Improve grazing management to improve or maintain native pastures to manage recharge **(VP5)** **Farming Systems** Rotational cropping with perennial pasture component **(FS3)** Pasture cropping **(FS1)** **Salt land rehabilitation** Fence and isolate salt land and discharge areas to promote revegetation **(SR1)** Establish and manage salt land pasture systems to improve productivity **(SR2)** Undertake rehabilitation to ameliorate land salinity processes and reduce land degradation **(SR4)** Mulch sites to reduce evaporation and promote pasture growth **(SR8)**

Management Area (MA)	Action
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 Royalla HGL.

At Risk Management Areas	Action
MA 1, 2, 3, 4 & 5	Poor management of grazing pastures **(DLU2)** Clearing and poor management of native vegetation **(DLU4)** Annual cropping with annual plants **(DLU3)**
MA 7	Deep ripping of soils to maximise water infiltration to subsoil **(DLU11)** Poor management of grazing pastures **(DLU2)** Clearing and poor management of native vegetation **(DLU4)**
MA 9/10	Clearing and poor management of native vegetation **(DLU4)**

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