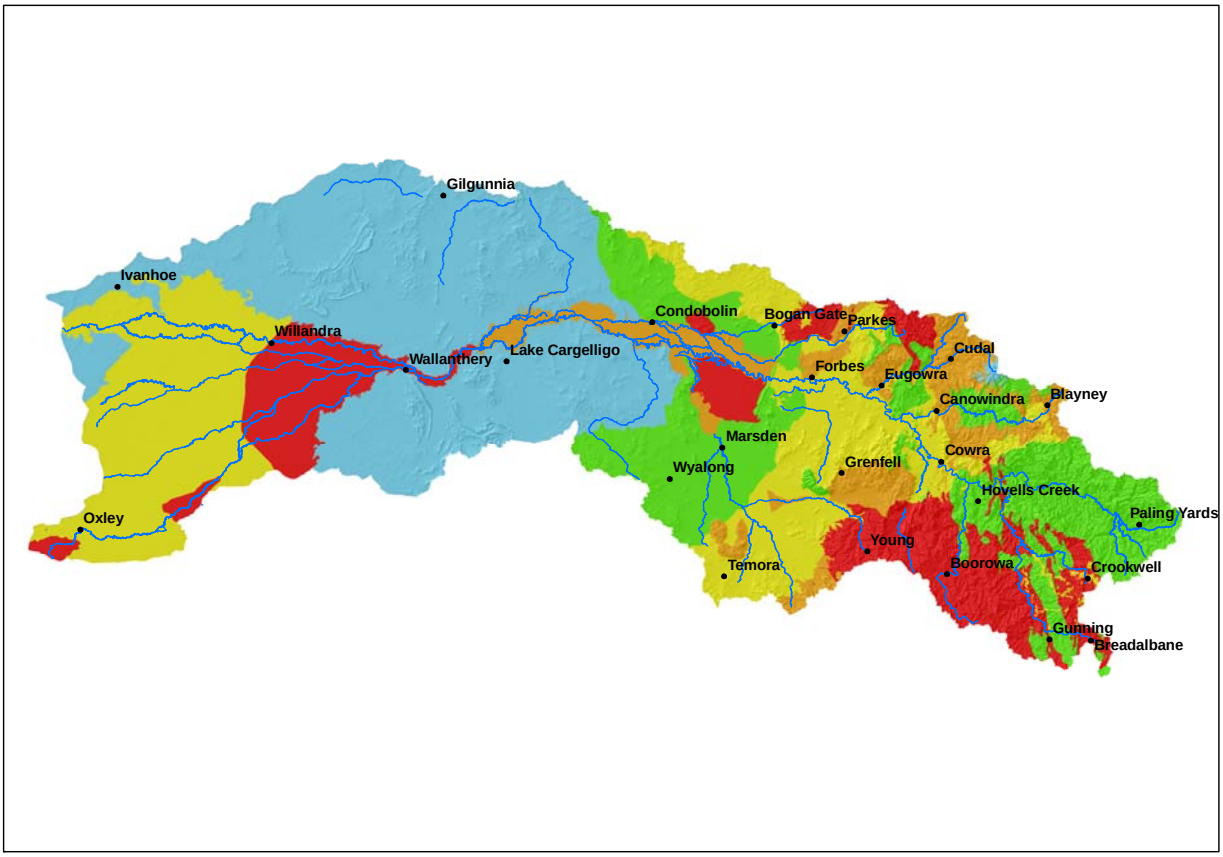
Department of Primary Industries

Salinity hazard report for Catchment Action Plan upgrade – Lachlan CMA



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More information

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Cover image: Salinity hazard map of Lachlan CMA catchment management area.

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Contents

1 Introduction

1.1 Background

The eleven NSW Catchment Management Authorities (CMAs) are required to update their Catchment Action Plans (CAPs) in a process to be completed by early 2013. The CAPs are required to be "Whole of Government" in order to provide greater coherence between policies and plans as they develop strategic direction at regional levels. CAPs must align with or take into account common elements of agency activity, and require a high level of co-ordination.

A cross-agency team was engaged in December 2011 to produce a salinity tool for the 2012-13 CAP update process. The Salinity Hazard for CAP Updates project has been funded by Catchment Action NSW and delivers state-wide information.

The project work associated with this report was carried out prior to the formation of the new Local Land Services (LLS) areas. The boundaries used for hazard identification in this report relate to the CMA boundaries as they were prior to October 2012.

The primary output of the Salinity Hazard for CAP Updates project is a broad scale salinity hazard spatial coverage and report for each CMA. This report is produced for the Lachlan Catchment Management Authority (LCMA) for use in upgrading its Catchment Action Plan. The Lachlan CAP is a cabinet approved document which outlines the investment priorities and delivery targets for natural resource management (NRM) across the LCMA area. The LCMA is currently reviewing and upgrading the CAP which was developed in 2004-05.

Salinity information is required to guide the ten year strategic plan (CAP), to prioritise actions, and to target specific landscapes with spatially explicit management actions on ground. The CAPs must

- comply with the NRC Standards for Quality Natural Resource Management (the Standard)
- demonstrate "Adaptive Management"
- deal with emerging issues such as the MDBA Basin Plan / Strategic Land Use Plans etc
- consider the resilience of landscapes and systems

This project will utilise state-wide data sets and collect and integrate Hydrogeological Landscape (HGL) information where it exists. The project has the potential to be expanded to a detailed HGL project targeted at the areas identified in the state-wide approach.

This document describes the hazard posed by salinity for different parts of the LCMA catchment. The associated Salinity Hazard for CAP Update map is a specific product for CAP planning. It is appropriate at the catchment scale. More detailed investigations are required for sub-regional works.

1.2 Resilience

The Natural Resource Commission (NRC) has released The Framework for Assessing and Recommending CAPs (2011). A key component of this document is a shift towards resilience thinking. This approach influences CAP targets, partnerships and the type of knowledge that the LCMA should draw on to analyse, understand and communicate how the landscape functions.

"Resilience thinking aims to identify a small number of important variables that control the way a complex landscape system is functioning, and the thresholds within which the system can continue to function in a desired way" (NRC 2011).

Salinity is one of the 'small set of important variables' that control the function, thresholds and resilience of landscapes. The 5 salinity hazard classes (see Section 2.1 – Hazard Ranking) used as part of this Salinity Hazard for CAP Updates project, provide a simple system for understanding how salinity influences landscape resilience.

The following is the Resilience definition of the Stockholm Resilience Centre (Walker et al., 2004; Folke et al. 2010). It is the definition adopted for the Salinity Hazard for CAP Updates project.

"The capacity of a system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function and feedbacks and therefore identify, that is, the capacity to change in order to maintain the same identity."

Salinity is an important variable in landscape systems and is often a determining factor in the capacity of the landscape to absorb change. It has a three-pronged impact on landscapes, namely land salinisation, in-stream salt load and in-stream salt concentration. Any of these can of themselves or in concert impact on landscape resilience.

"Management can then be designed to maintain a functioning system either by remaining within thresholds or transforming to a desirable (or least undesirable) alternative stable state." (NRC 2011)

Salinity as a major landscape degradation issue can determine the nature of thresholds and tipping points. If thresholds within landscapes are to be understood and managed then salinity must be understood and managed in a landscape context.

The drivers, variables, thresholds, priority actions and gap analysis for salinity in the LCMA are provided in Appendix 1.

2 Methodology

2.1 Overview of the descriptors

Each hazard area has a descriptor which includes a hazard ranking; a location diagram and description; a statement on the significance of the salinity hazard in that unit; a resilience statement; a confidence statement; and the decision rules used to derive the hazard ranking.

Hazard ranking

Areas are given a salinity hazard ranking – Very High, High, Moderate, Low or Very Low. Rankings are determined from a number of variables including salt stores, salinity outbreaks, water quality, salt loads, onsite and offsite impacts, presence of acid sulfate soils, presence of highly sodic soils, aquifer systems, ground water salinity and ground water depth.

Location diagram

A simple overview of where the hazard areas occur within the CMA catchment. Hazard areas are coloured using the following colour scheme.

Table 1 Salinity hazard colour scheme

Attribute	Range	Colour	RGB Colour Scheme
Salinity Hazard	Very High	Red	255, 50, 0
	High	Orange	255, 150, 0
	Moderate	Yellow	230, 230, 0
	Low	Green	150, 230, 0
	Very Low	Blue	0, 200, 255

This colour scheme is also used in the hazard descriptor headers and in the overall salinity hazard map (Figure 1).

Overview / location

General statements on the terrain and geological characteristics of the hazard area, and where it is located.

Significance

Salinity characterises such as salt stores, salinity outbreaks, water quality, onsite and offsite impacts, and other land degradation issues that may be relevant to salinity processes.

Resilience statement

Factors that drive salinity development and the salinity related variables which control, impact or influence the resilience of landscapes.

Confidence

High, moderate or poor. A qualifier is provided where relevant (e.g. poor, due to lack of field investigation).

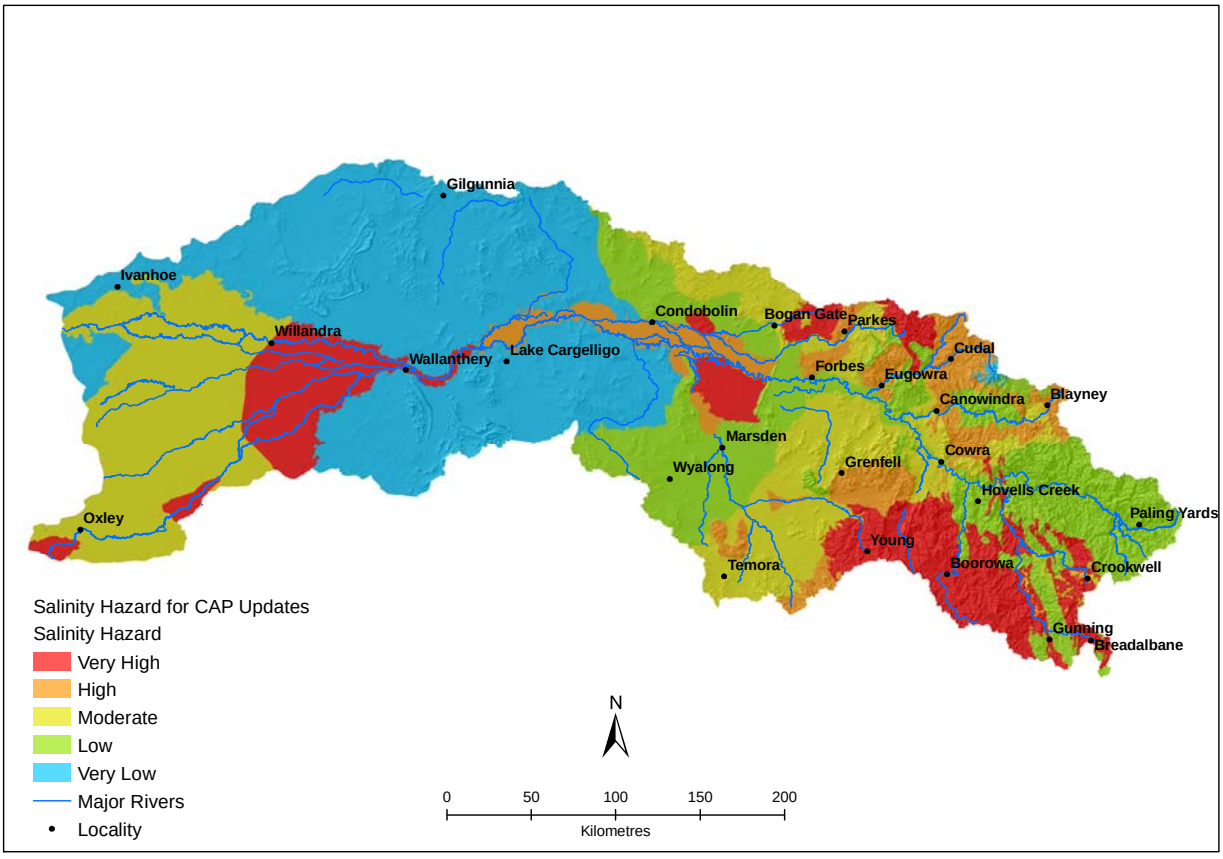
Decision rules

Decision rules for why a particular hazard rating was assigned (e.g. moderate hazard rating is based on HGL assessment which recognised significant areas of moderate levels of land salinity, moderate in-stream salt loads and moderate water EC).

2.2 Overview of the salinity hazard for CAP update map

The Salinity Hazard for CAP Update map (Figure 1) shows the broad salinity hazard distribution across the Lachlan CMA. It is appropriate for planning at a CMA catchment scale. More detailed investigations are required to target sub-regional works.

Figure 1 Salinity Hazard for CAP Update map for the Lachlan CMA area



Boundaries for the salinity hazard for CAP updates project in the Lachlan and subsequent hazard rankings were derived from several existing data sources:

- Geology of Australia (Raymond & Retter 2010) formed the basis for the linework. Geology polygons were grouped by lithology. Where necessary these were subdivided based on information from the datasets listed below and on knowledge of salinity processes and occurrences in the area.

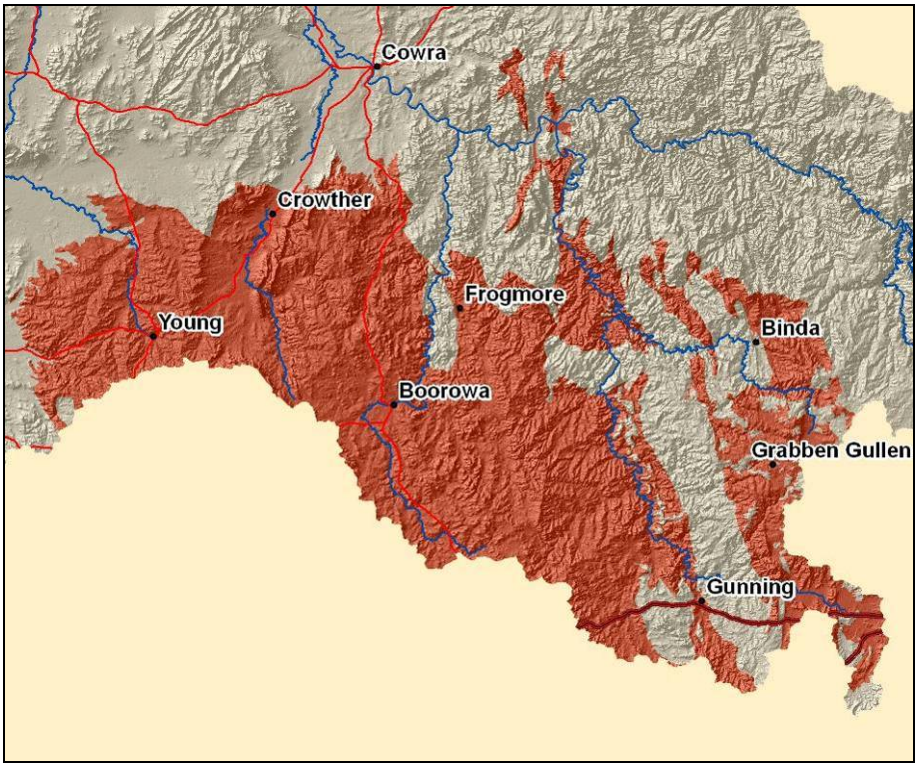
- National Geochemical Survey of Australia (de Caritat & Cooper 2011)
- GADDS (Geophysical Archive Data Delivery System) – "Radmap10" uranium, thorium and potassium radiometric data were extracted then converted to a Ternary image using ARCGIS software.
- BIOCLIM Annual Rainfall Layer (DECCW 2009) – climate layers for NSW at 250m based on the Geoscience Australia 9 second DEM.
- Dryland salinity outbreak mapping (DECCW 2012) was used in conjunction with existing knowledge of salinity processes and occurrences to assist in assigning hazard rankings

3 Descriptors

3.1 Very high hazard – Area 1

VH1	Upper Lachlan	Hazard:	Very High

Figure 2 Location diagram of very high hazard area 1



Overview / location

This category comprises landscapes underlain by mixed metasediments, sediments, volcanic and granitic rocks in the Upper Lachlan. It also includes the towns of Boorowa, Gunning, Rye Park and Young. This category coincides with portions of the Lachlan Tablelands and Mixed Farming Slopes SES zones.

Significance

Very high salinity hazard is due to the geological processes and landscape setting.

Land salinity is high. Land salinity is common across the entire unit. Land salinity occurs at a variety of locations in landscape. Land salinity symptoms cover a wide range from impacts on native vegetation through to scalding and erosion. Many salt land sites are actively eroding and provide salt and sediment to local streams and rivers.

Geological structural features have a large impact on the size, type and location of many saline areas.

Salt load export is high. Large loads of salt are exported by these landscapes and redistributed in the Lachlan catchment and the Bland catchment. Significant high salt loads are observed in the Upper Lachlan and Boorowa River. A high proportion of the total salt load measured at Forbes can be traced to this landscape.

Salinity concentration in surface water is high. High stream EC common in streams and rivers within this landscape. The Boorowa River, Upper Lachlan, Back Creek and Burrangong Creek all show higher concentrations than the main channel of the Lachlan at Forbes.

There is a long history of the landscape being significantly altered though clearing, grazing and cropping.

Cropping of winter cereals is a significant land use in some areas near Young and Boorowa and is a high hazard for salinity development.

There are many examples of salt land being rehabilitated and returned to productive grazing areas by on farm management in this area.

There are many examples of salt land rehabilitation practices being implemented with limited success in parts of this area.

Saline sites are slowly expanding in size. Long dry periods slow the rate of spread but most sites do not revegetate without management changes. Many saline sites are very expensive to rehabilitate with little on-farm benefit.

There is a long history of agency salinity extension, research, demonstration and on-ground works – based out of Yass, Young, Cowra and Crookwell.

There is a long history of salinity being an important issue within community NRM activities - Boorowa Landcare, Former Boorowa River Catchment Committee, Upper Lachlan Landcare, Yass Area Landcare Network and Young District Landcare.

Resilience statement

The main drivers for salinity development are:

- inappropriate grazing management
- inappropriate cropping practices (around Boorowa, Young and Murringo)
- inappropriate irrigation practices (around Young only)
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation (legacy of history)
- loss of perenniality
- loss of soil via erosion and exposure of saline/sodic subsoils
- loss of soil health (physical, biological, chemical)
- concentration of salt in surface soils (particularly in summer and autumn)

The variables that impact on resilience:

- water table depth
- soil stability (erosion, gullying, sodic soil)
- degree of soil degradation
- extent of land salinity
- soil salt store
- regolith salt availability
- soil recharge characteristics
- soil and landscape permeability lateral and vertical

Confidence

High. Saline sites have been observed and mapped. Water quality data showing high salinity concentration and salt load (Waterinfo data base).There has been significant widespread agency activity.There has been significant widespread community activity.

Decision rules

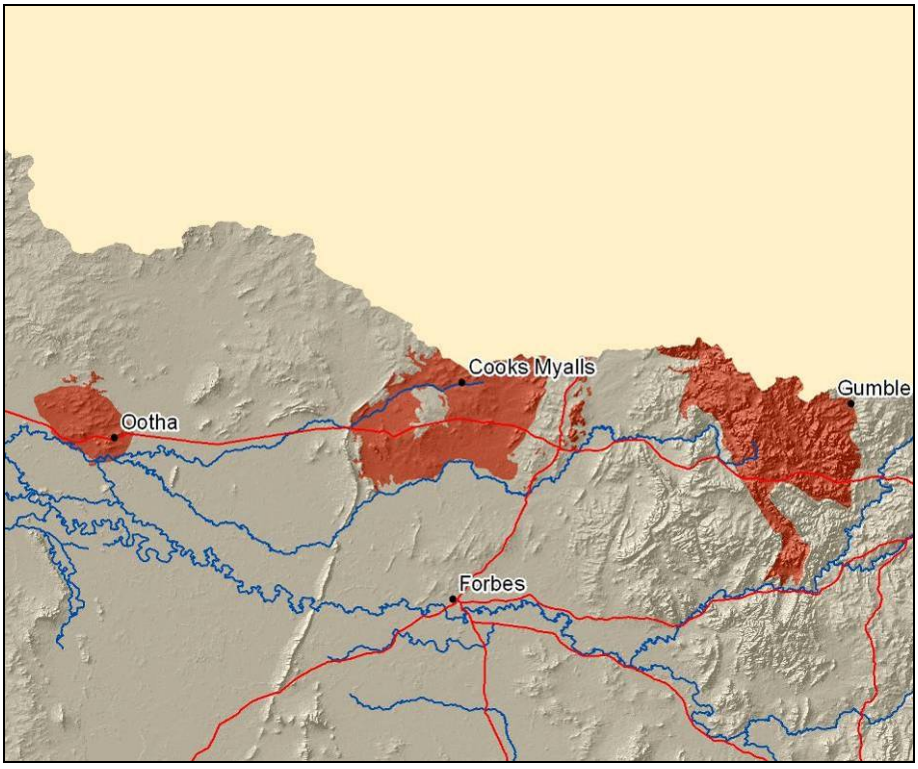
The hazard is Very High. Large areas of land are salt affected and are common and widespread. Streams are usually more saline (higher concentration) then the main channel of the Lachlan at Forbes. A high percentage of the salt load which reaches Forbes in the Lachlan River comes from this landscape.

This category comprises landscapes underlain by mixed metasediments, sediments, volcanic and granitic rocks in the Upper Lachlan. These types of geologies are known to have a high hazard for salinity development. These geologies include Ordovician metasediments, Ordovician volcanic sediments, Devonian sediments, Silurian units and Silurian Young Granite.

3.2 Very high hazard – Area 2

VH2	Rolling Northern Slopes	Hazard:	Very High

Figure 3 Location diagram of very high hazard area 2



Overview / location

This category comprises landscapes underlain by metasediments and felsic volcanic geologies. This occurs in several locations in the northern part of the Lachlan catchment. Rainfall is 450-550 mm and is an important area for salinity. It includes the localities of Ootha, Gumble and Cooks Myalls. This category coincides with portions of the Mixed Farming Slopes and Cropping Plains SES zones.

Significance

Very high salinity hazard is due to the geological and geomorphology process, very high salt stores in some landscapes and soils with a rainfall patterns which facilitates salt movement.

Land salinity is High. Land salinisation is locally severe, but not extensive or common.

Salinity concentration in surface water is moderate. High stream EC occurs in sections within this landscape. Many portions of this landscape have low connection between land salinity processes and surface water impacts, High salinity concentration is observed consistently in Manildra Creek and Gumble Creek.

Salt load export is moderate. Large loads of salt are exported by portions of this landscape and redistributed in the Lachlan catchment. The high export is consistently observed in Manildra Creek and Gumble Creek.

Landscape salt store is locally very high with local impacts.

Geological structural features have a large impact on the size, type and location of many saline areas in the Gumble and Cooks Myalls districts.

Geomorphology features have a large impact on the size, type and location of saline areas in the Cooks Myalls and Ootha districts.

There has been a long history of agency salinity extension, research, demonstration and on-ground works – based out of Wellington, Parkes, Condobolin, Cowra and Orange.

There is a long history of salinity being an important issue within community NRM activities – Parkes and District Landcare, Condobolin Landcare, Terrara Landcare and Gumble Landcare.

Cropping is a significant land use in this area.

Resilience statement

Drivers for salinity development are:

- inappropriate grazing management
- inappropriate cropping practices
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation (legacy of history)
- loss of perenniality
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience are:

- water table depth
- type of salt (salt chemistry)
- extent of land salinity
- stream EC
- salt load in streams
- soil salt store
- regolith salt availability
- soil recharge characteristics
- soil and landscape permeability, both lateral and vertical

Confidence

High. Saline sites have been observed and mapped. Water quality data shows high salinity concentration and salt load in Manildra Creek and Mandagery Creek systems (Waterinfo data base). There has been significant agency and community activity.

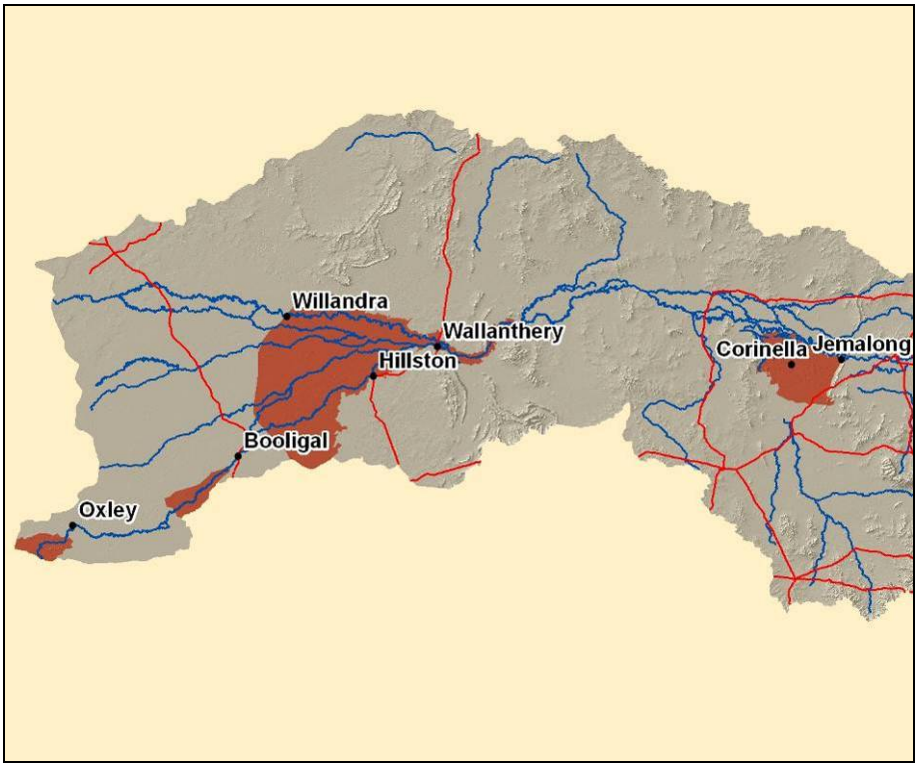
Decision rules

The hazard is very high. Significant areas of land are severely salt affected. Streams within this landscape are usually more saline (higher concentration) then the main channel of the Lachlan at Forbes or Condobolin. A significant portion of the total salt load which reaches Forbes comes from portions of this landscape - Manildra Creek / Mandagery system.

3.3 Very high hazard – Area 3

VH3	Irrigation and Terminal Swamps	Hazard:	Very High

Figure 4 Location diagram of very high hazard area 3



Overview / location

This category comprises alluvial sediments. It includes the Jemalong and Wyldes Plains Irrigation areas, and areas that are irrigated between Lake Cargelligo and west of Hillston. It includes the localities of Hillston and Corinella. This category coincides with portions of the Wet Rangelands and Cropping Plains SES zones.

Significance

Very high salinity hazard is due to the geological and geomorphology process resulting in high landscape salt store and irrigation being a high hazard land use for salinity.

Land salinity is High. Land salinisation is locally severe, but not extensive or common. Salt land is caused by a range of processes including on farm irrigation, water delivery systems, climatic cycles, flooding, dryland salinity and river flow regime. Some of this landscape has low connection between land salinity processes and surface water impacts.

Salinity concentration in surface water is moderate. Moderate and high stream EC is present in localised areas within this landscape. The main channel of the Lachlan usually shows low concentration in current flow regime management. High salinity concentration is commonly observed in the Bogondillon Creek system.

Salt load export is moderate. Large loads of salt are exported by portions of these landscapes and redistributed in the Lachlan catchment.

Salt load import is high. Salt loads are distributed into this landscape by irrigation and flooding. This landscape is a net salt importer /taker.

Landscape salt store is variable with some soil types having very high salt stores.

Geomorphology, soils and landscape shape has an impact on salt land expression. There are a variety of soil drainage characteristics. Sodic soils have an impact. There are highly sodic clays in many areas. Perched water tables occur.

Geological and geomorphology features have a large impact on the size, type and location of many saline areas.

There is a long history of agency salinity extension, research, demonstration and on-ground works – based out of Wellington, Forbes, Griffith, Condobolin and Cowra.

There is a long history of salinity being an important issue within community NRM activities – Parkes and District Landcare and Condobolin Landcare.

Salinity issues are a major part of Jemalong Wyldes Plains Land and Water Management Plan. These issues include:

- intensive areas of irrigation leading to potential irrigation salinity processes
- channel leakage – leaking delivery systems and infrastructure are an issue in this landscape
- old landscape channel features and shoestring sands act as barriers and pathways for groundwater movement in some areas.

Dryland cropping is a significant land use in this landscape area. This is a significant salinity hazard on some soil types under dryland cropping programs.

Evidence of successful salinity management through changes in irrigation management occurs in this landscape.

Resilience statement

Drivers for salinity development are:

- inappropriate cropping practices
- inappropriate irrigation practices
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation (legacy of history)
- loss of perenniality
- loss of soil via erosion and exposure of saline/sodic subsoils
- loss of soil health (physical, biological, chemical)
- concentration of salt in surface soils

Variables that impact on resilience are:

- water table depth
- type of salt (salt chemistry)
- extent of land salinity
- groundwater quality
- soil salt store
- regolith salt availability
- soil recharge characteristics
- soil and landscape permeability lateral and vertical

Confidence

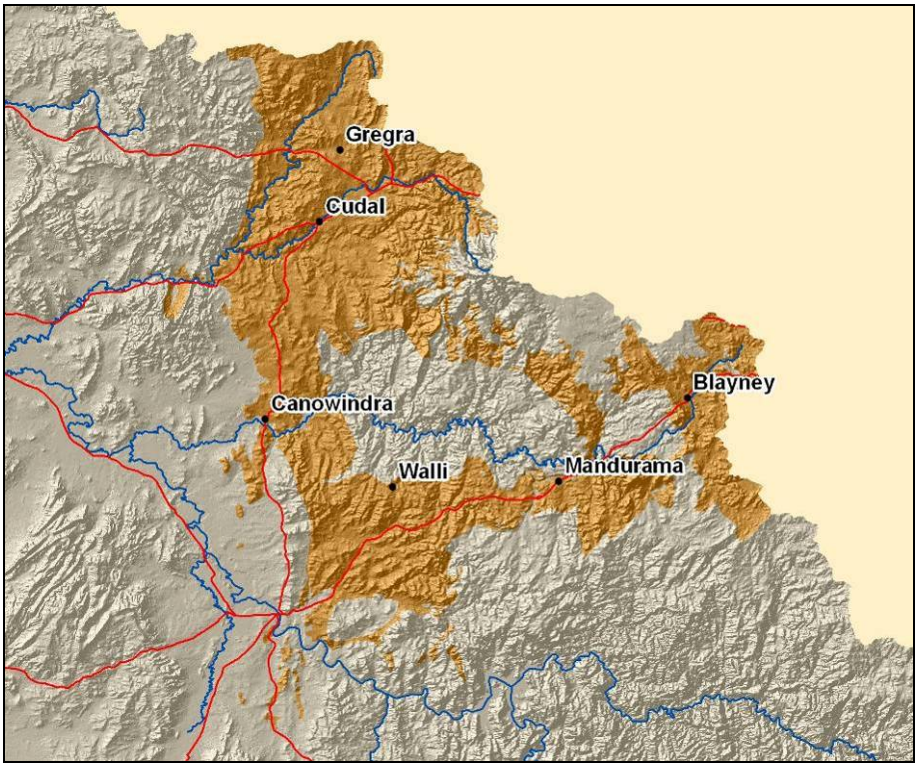
High - confidence is high due to historical monitoring and landscape assessment particularly within the designated Land and Water Management Plan area (Jemalong).

Decision rules

The hazard is very high. Irrigated agriculture is a high hazard for the development of salinity within this hazard area. Irrigated agriculture is a high hazard by the receiving salt load through irrigation water within this hazard area. Salt land and high salinity concentration surface water have been observed in this unit.

3.4 High hazard – Area 1

H1	North East Fractured Rock	Hazard:	High



Overview / location

This category includes important parts of the Waugoola, Belubula and Mandagery catchments. This category comprises metasediments, volcanic and granitic rocks. It includes the localities of Canowindra, Walli, Cudal, Mandurama and Gregra. This category coincides with portions of the Mixed Farming Slopes SES zone.

Significance

High salinity hazard is due to landscape salt store being available and mobile through land use and rainfall.

Land salinity is high. Land salinity is common across the entire unit and is a driver for erosion and offsite water quality issues. Land salinity symptoms range from subtle water-logging symptoms to obvious scalding and salt effervescence. Land salinity occurs at a variety of locations in the landscape. Groundwater flow paths are mainly through multiple local systems.

Salt load export is high. Large loads of salt are exported by this landscape and redistributed in the Lachlan catchment. These landscapes contribute a significant proportion of the total salt load seen in the Lachlan River at Forbes. High loads are consistently observed in the Belubula River and vary due to rainfall in the Mandagery catchment.

Salinity concentration in surface water is high. High stream EC is common in streams and creeks within this landscape. Waugoola Creek (below Reg Hailstone Way), Binni Creek, Jacks Creek, Tenandra Creek, Limestone Creek, Belubula River (between Mandurama and Canowindra), Mandagery Creek (above Toogong), Boorimbla Creek and Boree Creek all show high salinity concentration.

Moderate to high landscape salt stores are present, particularly in deeper soils and deeper regolith areas.

Geological structural features and landscape geomorphology have a large impact on the size, type and location of many saline areas.

There is a long history of the landscape being significantly altered though clearing, grazing and cropping.

Many examples of demonstrated history of salinity management through farm-scale management change exist in this unit.

Cropping is a significant land use in this landscape.

There is a long history of agency salinity extension, research, demonstration and on-ground works – based out of Wellington, Cowra and Orange.

There is a long history of salinity being important issue within community NRM activities – Cowra District/Mid Lachlan Landcare, Central Tablelands Landcare, Parkes and District Landcare.

Resilience statement

Drivers for salinity development are:

- inappropriate grazing management
- inappropriate cropping practices
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation (legacy of history)
- loss of perenniality
- loss of soil via erosion
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience are:

- water table depth
- soil stability (erosion, gullying, sodic soil)
- degree of soil degradation
- type of salt (salt chemistry)
- extent of land salinity
- stream EC
- salt load in streams

Confidence

High. Known salt land mapping is available. Many site, farms scale and landcare group scale investigations have been conducted.

Decision rules

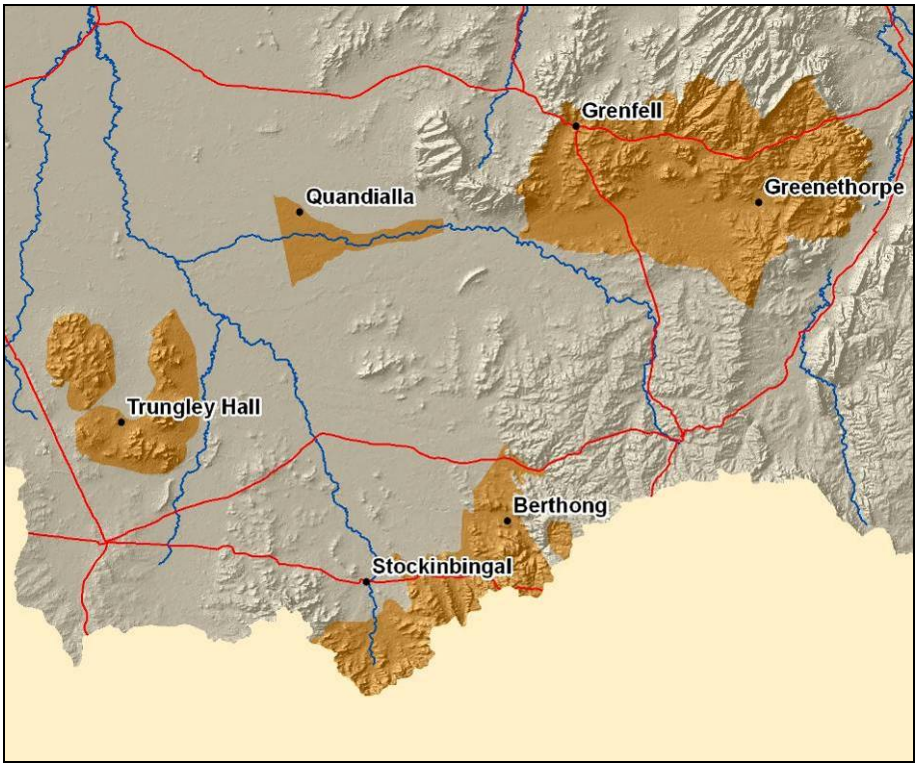
The hazard is high. The extent of land salinity is known and mapped.

The impacts on water quality stream salinity concentration and salt load in Belubula, Mandagery and Waugoola and impacts on Lachlan River are known (Waterinfo data base).

3.5 High hazard – Area 2

H2	Upper Bland	Hazard:	High

Figure 5 Location diagram of high hazard area 2



Overview / location

This category comprises mixed metasediments, volcanic and granitic rocks and some alluvial and depositional in parts of the Upper Bland catchment. It includes the localities of Greenethorpe, Quandialla, Trungley Hall and the area south of Stockinbingal. This category coincides with portions of the Mixed Farming Slopes and Cropping Plains SES zones.

Significance

High hazard due to recharge occurring through land use, landscape salt store being available and mobile through rainfall and slope changes.

Land salinity is moderate to high. Land salinisation is locally severe, but not extensive or common. Land salinity is most common around Greenethorpe, Brundah and east and south of Stockinbingal.

Salinity concentration in surface water is moderate. High stream EC is present in localised areas within this landscape. Most of this landscape has low connection between land salinity processes and surface water impacts. High salinity concentration is consistently observed in the Upper Tyagong creek and in flow lines east and south of Stockinbingal.

Salt load export is moderate. Large loads of salt are exported by portions of this landscape and redistributed in the Bland catchment to Lake Cowal and occasionally to the Lachlan catchment.

Landscape salt store is locally very high with local impacts.

Geological structural features have a large impact on the size, type and location of many saline areas in the upper catchment.

Geomorphology, soils and landscape shape has an impact on salt land expression in depositional and colluvial areas.

There are examples of on-farm salinity management in this landscape.

There has been a long history of agency salinity extension, research, demonstration and on-ground works – based out of Wagga Wagga, Condobolin,Temora, Grenfell, Cowra and Young.

There has been a long history of salinity being an important issue within community NRM activities – Weddin Landcare, Mid Lachlan Landcare, Blandcare and Young District Landcare.

Cropping is a significant land use in this landscape area.

Resilience statement

Drivers for salinity development are:

- inappropriate grazing management
- inappropriate cropping practices
- decreasing depth to water table and/or rising groundwater pressures
- loss of perenniality
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience:

- water table depth
- type of salt (salt chemistry)

Confidence

High in Upper Tyagong and Memmagong/Tumbleton Creek areas due to large scale EMI surveys, observed and mapped saline sites and ongoing water quality monitoring. Confidence is moderate in other areas.

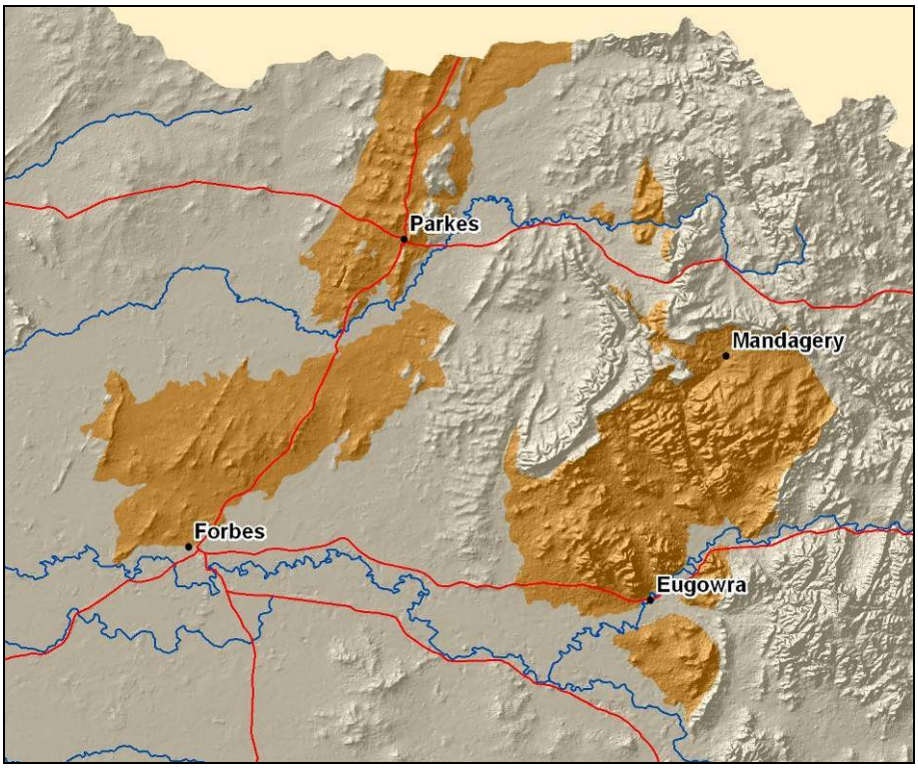
Decision rules

The hazard is high. There are known salinity processes. There are observed surface water quality impacts. Salt land has been observed and investigated. There are known high salt stores in some soils. Land use practices (winter cereal cropping) is a high hazard for salinity.

3.6 High hazard – Area 3

H3	Mid Lachlan Rises	Hazard:	High

Figure 6 Location diagram of high hazard area 3



Overview / location

This category comprises mixed metasediments, volcanic and granitic rocks. It includes the localities Parkes, Forbes, Eugowra and Mandagery. This category coincides with portions of the Mixed Farming Slopes and Cropping Plains SES zones.

Significance

High hazard due to recharge occurring through land use, landscape salt store being available and mobile through rainfall and slope changes.

Land salinity is moderate to high. Land salinisation is locally severe, but not extensive or common. Salt land includes localised sites on granites at the edge of the colluvial slope, break of slope salinity and urban salinity.

Urban salinity is an important issue in the town of Forbes.

Salinity concentration in surface water is moderate. High stream EC is present in localised areas within this landscape. Most of this landscape has low connection between land salinity processes and surface water impacts.

Salt load export is moderate. Moderate loads of salt are exported by portions of this landscape and redistributed locally or in the Lachlan catchment.

Landscape salt store is locally very high with local impacts.

Geological structural features have a large impact on the size, type and location of many saline areas in the upper catchment.

Geomorphology, soils and landscape shape has an impact on salt land expression in depositional and colluvial areas.

There has been a long history of agency salinity extension, research, demonstration and on-ground works – based out of Parkes, Wellington, Forbes, Condobolin and Cowra.

There has been a long history of salinity being an important issue within community NRM activities – Forbes Urban Landcare, Mid Lachlan Landcare, and Parkes & District Landcare.

Evidence of successful salinity management through grazing management changes on land near Four Ways.

Cropping is a significant land use in this landscape area.

Resilience statement

Drivers for salinity development are:

- inappropriate planning and construction methods for salinity (urban areas)
- inappropriate grazing management
- inappropriate cropping practices
- inappropriate irrigation practices
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation (legacy of history)
- loss of perenniality
- loss of soil via erosion
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience are:

- water table depth
- perenniality
- soil stability (erosion, gullying, sodic soil)
- degree of soil degradation
- type of salt (salt chemistry)
- extent of land salinity

Confidence

Moderate. Saline areas have been observed and sites mapped. Site investigations have been done including some EMI surveys and soil testing. There is a high level of existing information on urban salinity issues in Forbes through agency salinity investigation and community monitoring.

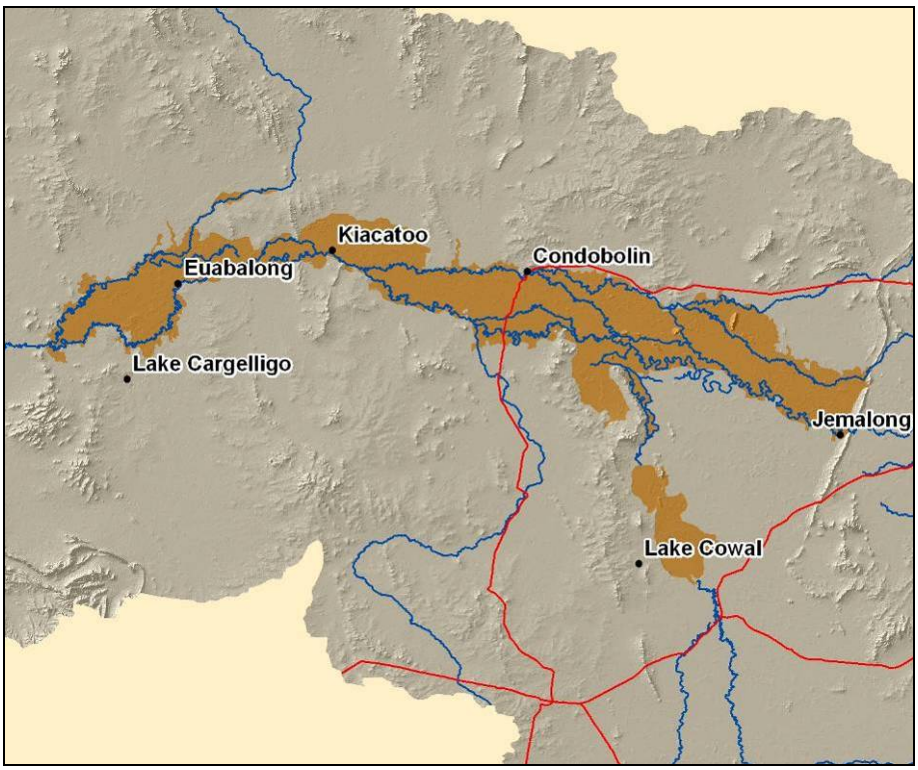
Decision rules

The hazard is high. There are known high salt stores in some soils Land use practices (winter cereal cropping and urban water use) are a high hazard for salinity occurrence. There are known salinity processes. There are observed surface water quality impacts. Salt land has been observed and investigated.

3.7 High hazard – Area 4

H4	Riverine Irrigation and Lake Cowal	Hazard:	High

Figure 7 Location diagram of high hazard area 4



Overview / location

This category comprises alluvial sediments of the current Lachlan floodplain between Jemalong Gap and Lake Cargelligo. It also includes Lake Cowal and Bogandillon Swamp. It includes the localities of Condobolin, Kiacatoo and Euabalong. This category coincides with portions of the Cropping Plains SES zone.

Significance

Land salinity is moderate to high. Land salinisation is locally severe, but not extensive or common.

Salt land is caused by a range of processes including on-farm irrigation, water delivery systems, climatic cycles, flooding, dryland salinity and river flow regime.

Salinity concentration in surface water is an issue. High stream EC is present in localised areas within this landscape. High concentration surface water has been observed in the Bogandillon

Creek. The main channel of the Lachlan River usually shows low concentration in current flow regime management.

Some of this landscape has low connection between land salinity processes and surface water impacts.

Salt load export is low.

Salt load import is high. Salt loads are distributed into this landscape by irrigation and flooding. This landscape is a net salt importer /taker.

Landscape salt store is variable with some soil types having very high salt stores.

Geomorphology, soils and landscape shape have an impact on salt land expression. Soils exhibit a variety of drainage characteristics. Sodic soils have an impact.

There has been a long history of agency salinity extension, research, demonstration and on-ground works – based out of Forbes, Condobolin, Cowra, and Griffith.

There has been a long history of salinity being important issue within community NRM activities – Condobolin & District Landcare and Parkes & District Landcare.

There is evidence of successful salinity management through changes in irrigation management in this landscape.

Irrigation is a significant land use in this landscape area – this increases the hazard for salinity to occur.

Cropping is a significant land use in this landscape area.

Mining activity is an important consideration in salinity processes in Lake Cowal.

Resilience statement

Drivers for salinity development are:

- inappropriate planning and construction methods for salinity (irrigation infrastructure)
- inappropriate cropping practices
- inappropriate irrigation practices
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation (legacy of history)
- loss of perenniality
- loss of soil via erosion
- mining
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience:

- water table depth
- perenniality
- type of salt (salt species)
- extent of land salinity
- salt load in streams

Confidence

Low - due to lack of recent monitoring data in irrigation areas.

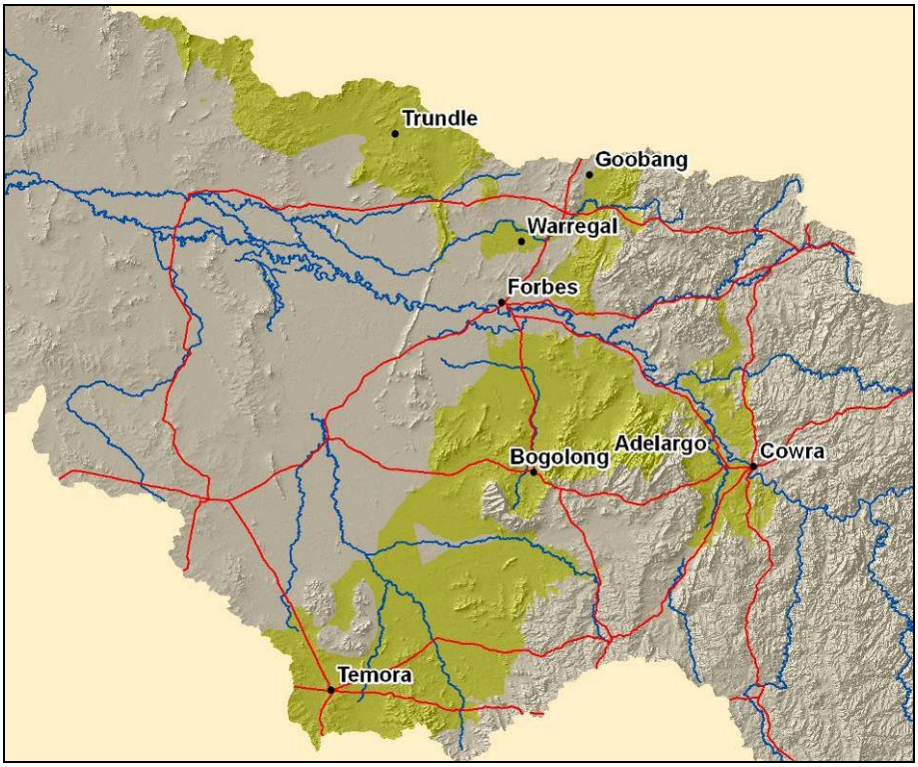
Decision rules

The hazard is high. Irrigated agriculture is a high hazard land use for salinity development. Large salt stores exist in this landscape. Large salt stores are being added to this landscape.

3.8 Moderate hazard – Area 1

M1	Lachlan Slopes	Hazard:	Moderate

Figure 8 location diagram of moderate hazard area 1



Overview / location

This category comprises mixed metasediments, volcanic and granitic rocks, depositional and colluvial areas of the Lachlan slopes in the 550–650mm rainfall band. It includes the localities of Bribbaree, Ooma, Billimari and Cookamidgera. This landscape covers a large area of cropping land. This category coincides with portions of the Mixed Farming Slopes and Cropping Plains SES zones.

Significance

Hazard is moderate due to rainfall pattern which allows accumulation of cyclic salt.

Salt land is moderate. Salt land occurs infrequently and shows symptoms including water-logging, bare areas and subsoil salinity as a constraint to plant growth. Salt land in this landscape ranges from moderate to severe symptoms.

Soil sodicity issues are frequently seen in association with salt land.

Salinity concentration in surface water is low. Most of this landscape has low connection between land salinity processes and surface water impacts.

Salt load export is low. Moderate loads of salt are exported by small portions of this landscape and redistributed locally or in the Lachlan catchment.

Landscape salt store is variable with some soil types having very high salt stores.

Geomorphology, soils and landscape shape have an impact on salt land expression. Soils exhibit a variety of soil drainage characteristics. Sodic soils have an impact.

Agencies have worked around this landscape and have had a high level of activity within it.

There is a long history of salinity being important issue within community NRM activities – Condobolin & District Landcare and Parkes & District Landcare.

Irrigation is a significant land use in portions of this landscape area – this increases the hazard for salinity to occur.

Cropping is a significant land use in this landscape area.

Resilience statement

Drivers for salinity development are:

- inappropriate grazing management
- inappropriate cropping practices
- inappropriate irrigation practices
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation (legacy of history)
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience are:

- water table depth
- groundcover percentage
- degree of soil degradation
- type of salt (salt chemistry)

Confidence

Moderate to low due to lack of data and field investigation.

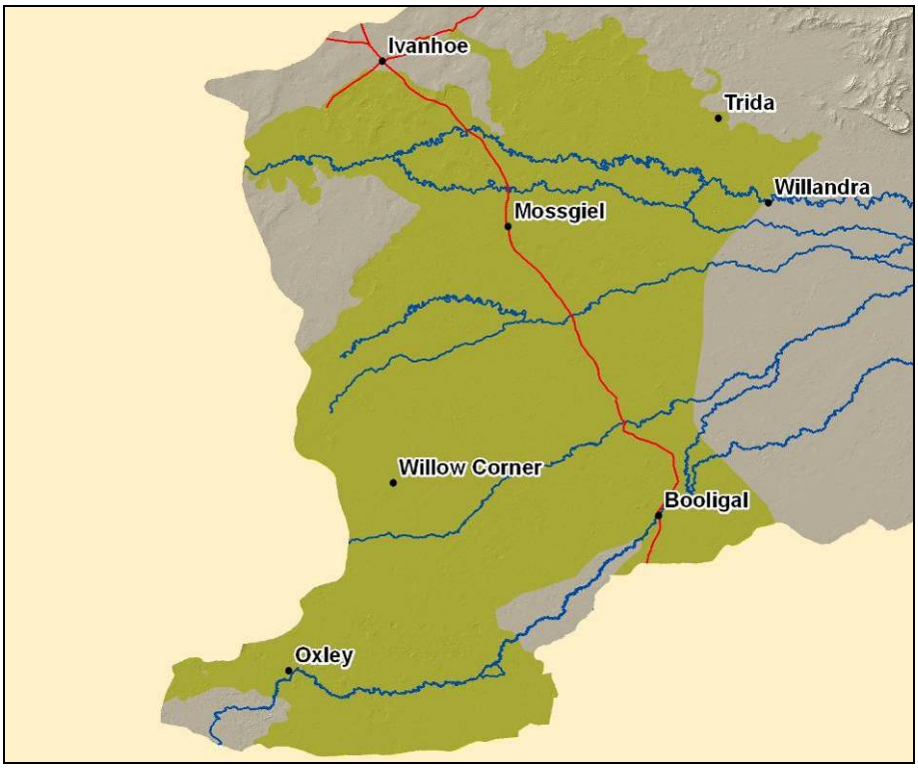
Decision rules

The hazard is moderate. There are high salt stores in some soils. Isolated areas of saline land exist with low level of observed offsite impact.

3.9 Moderate hazard – Area 2

M2	Lower Lachlan	Hazard:	Moderate

Figure 9 location diagram of moderate hazard area 2



Overview / location

This category comprises alluvial, dune and lake sediments. It includes the localities of Booligal, Mossgiel and Oxley. This category coincides with portions of the Wet Rangelands SES zone.

Significance

Hazard is moderate due to rainfall pattern and geomorphology which allows accumulation of cyclic salt.

Salt land is moderate. Salt land occurs infrequently and shows symptoms including water-logging, bare areas, dry scalds and subsoil salinity as a constraint to plant growth. Salt land in this landscape ranges from moderate to severe symptoms.

Soil sodicity issues are frequently seen in association with salt land.

Salinity concentration in surface water is low. Most of this landscape has low connection between land salinity processes and surface water impacts.

Salt load export is low. Moderate loads of salt are exported by small portions of these landscapes and redistributed locally or in the Lachlan catchment.

Salt load import is high. Salt loads are added to this landscape through flooding events.

Landscape salt store is variable with many soil types having very high salt stores.

Large areas are covered by halophyte (salt loving) vegetation.

Geomorphology, soils and landscape shape has an impact on salt land expression. Soils exhibit a variety of soil drainage characteristics. Sodic soils have an impact.

There is a long history of surface scalding being an important issue within agency NRM activities – Western Lands staff, Condobolin and Hay.

Resilience statement

Drivers for salinity development are:

- inappropriate grazing management
- inappropriate vegetation management
- inappropriate cropping practices
- loss of perenniality
- loss of soil via erosion
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience:

- total grazing pressure
- perenniality
- soil stability (erosion, gullying, sodic soil)
- type of salt (salt species)
- extent of land salinity

Confidence

Moderate due to lack of data and field investigation.

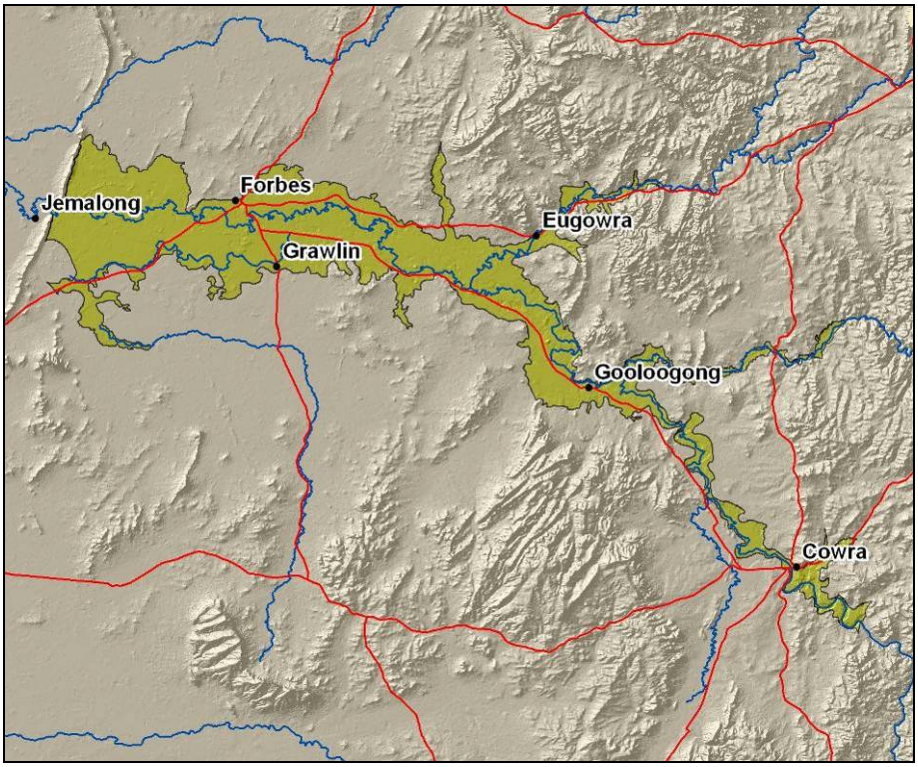
Decision rules

The hazard is moderate due to very high salt stores being present in the landscape.

3.10 Moderate hazard – Area 3

M3	Lachlan Alluvial – Jemalong to Cowra	Hazard:	Moderate

Figure 10 location diagram of moderate hazard area 3



Overview / location

This category comprises alluvial, sediments along the Lachlan River between Cowra and Jemalong Gap. It also includes alluvial areas along the lower parts of the Belubula River and Mandagery Creek. The area includes the localities of Cowra, Gooloogong, Forbes, Canowindra and Eugowra. This category coincides with portions of the Mixed Farming Slopes and Cropping Plains SES zones.

Significance

This landscape has moderate hazard due to recharge occurring through land use (irrigated and dryland cropping).

Land salinity is moderate to low. Land salinisation is occasionally present but not extensive or common. Salt land varies with climate cycles and commonly appears as water-logging.

Salt land is caused by a range of processes including on-farm irrigation, water delivery systems, climatic cycles, flooding, dryland salinity and river flow regime.

Salinity concentration in surface water is moderate. This landscape transmits salt concentration rather than adding to it.

The Lachlan River usually shows low to moderate salinity concentration in current flow regime. Belubula and Mandagery are consistently saltier than the Lachlan.

Salt load export is low.

Salt load import is high. Salt loads are distributed into this landscape by irrigation and flooding. This landscape is a net salt importer /taker.

Landscape salt store is variable with some soil types having very high salt stores.

Geomorphology, soils and landscape shape have an impact on salt land expression. A variety of soil drainage characteristics exist and many areas show strong connection to the river which means they drain to the river. Sodic soils have an impact.

There is a long history of agency salinity irrigation extension, research, demonstration and on-ground works – based out of Forbes, Condobolin, Cowra, and Orange.

There is a long history of salinity being important issue within community NRM activities – Cowra/Mid Lachlan Landcare and Parkes & District Landcare.

There is evidence of successful salinity management through changes in irrigation management occurring in this landscape.

Irrigation is a significant land use in this landscape areas – this increases the hazard for salinity to occur.

Soil characteristics are being changed – irrigation is resulting in many soils becoming more sodic, acid or saline over time.

Cropping is a significant land use in this landscape area.

Resilience statement

Drivers for salinity development are:

- inappropriate planning and construction methods for salinity (irrigation delivery systems)
- inappropriate grazing management
- inappropriate cropping practices
- inappropriate irrigation practices
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation (legacy of history)
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience are:

- water table depth
- perenniality
- soil stability (erosion, gullying, sodic soil)
- degree of soil degradation
- type of salt (salt species)

Confidence

Low due to lack of data and field investigation. Irrigation water usage data not readily available and water quality data only available for the main Lachlan channel.

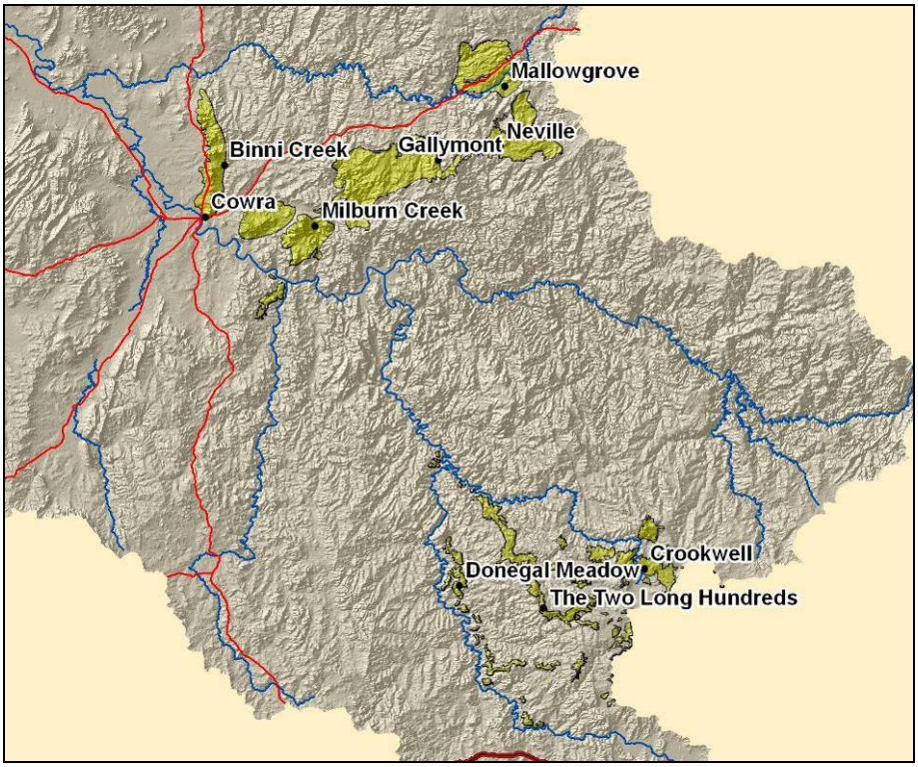
Decision rules

The hazard is moderate. Irrigated agriculture is a high hazard land use for salinity development. Salt stores are significant in some soil types. Dryland cropping is a high hazard land use for salinity development. Flow regimes limit flooding of the floodplain.

3.11 Moderate hazard – Area 4

M4	Upper Lachlan Igneous	Hazard:	Moderate

Figure 11 location diagram of moderate hazard area 4



Overview / location

This category comprises a mix of granitic landscapes east and north east of Cowra and basalt cap landscapes in the Upper Lachlan. It includes the localities of Gallymont, Binni Creek and Crookwell. This landscape has a higher hazard than other granites and basaltic landforms (L2). Salinity symptoms have been observed in this landscape. This category coincides with portions of the Mixed Farming Slopes and Lachlan Tablelands SES zones.

Significance

Moderate hazard due to landscape salt store being available and mobile through land use and rainfall. Salt symptoms occur in this landscape

Land salinity is moderate. Usually water-logging with some salt concentration at permeability contrasts. This usually occurs at the edge of basalt caps or edge of granite colluvial slopes. Low level land salinity is common across the entire unit. Land salinity is an important driver for erosion issues.

Land salinity symptoms range from subtle water-logging symptoms to obvious small scalds and salt effervescence.

Land salinity occurs at a variety of locations in the landscape.

Salt load export is moderate. Moderate loads of salt are exported by this landscape and redistributed in the Lachlan catchment. This landscape contributes a small proportion of the total salt load seen in the Lachlan River at Forbes. These loads are seen as small creeks consistently adding water at moderate salinity concentration.

Salinity concentration in surface water is moderate. Many streams in this landscape show moderate salinity concentration. Many of these streams provide dilution flows for more salty parts of the landscape.

Moderate landscape salt store particularly in deeper soils and deeper regolith areas.

Geological structural features particularly barriers to groundwater flow and landscape geomorphology, have a large impact on the size, type and location of many saline areas.

There is a long history of the landscape being significantly altered though clearing, grazing and cropping.

There is a demonstrated history of salinity management through on-farm site management in this landscape.

Cropping is a significant land use in this landscape.

There is a long history of agency salinity extension, research, demonstration and on-ground works – based out of Crookwell, Yass, Wellington, Cowra and Orange.

There is a long history of salinity being important issue within community NRM activities – Cowra District - Mid Lachlan Landcare, Central Tablelands Landcare, Upper Lachlan Catchment Coordinating Committee - Landcare.

Resilience Statement

Drivers for salinity development are:

- inappropriate grazing management
- inappropriate cropping practices
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation (legacy of history)
- loss of perenniality
- loss of soil via erosion
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience:

- water table depth
- degree of soil degradation
- type of salt (salt species)
- extent of land salinity

Confidence

Moderate. Information on salt land exists due to structured salt land mapping. There have been several salinity investigations with individual landholders and landcare groups. Agency based and community water sampling has occurred in this landscape

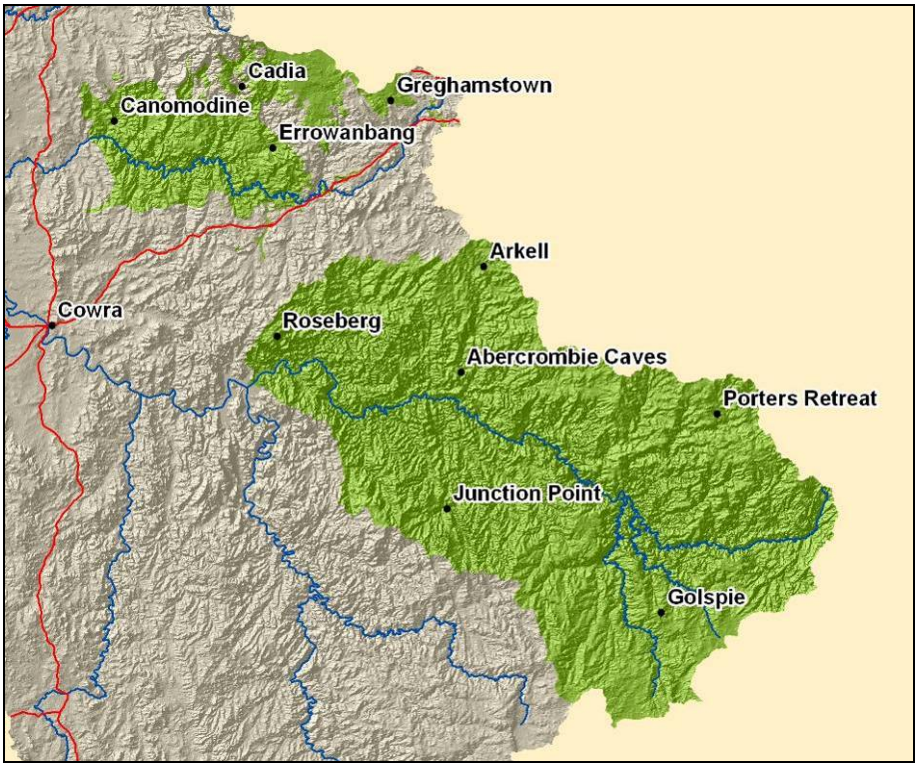
Decision Rules

The hazard is moderate. Salt land exists but has limited offsite impact.

3.12 Low Hazard – Area 1

L1	Abercrombie and Belubula Steep	Hazard:	Low

Figure 12 location diagram of low hazard area 1



Overview / location

This category comprises steep mixed metasediments, volcanic and granitic rocks in the Abercrombie catchment and steep landscapes within the Belubula Catchment. It includes the localities of Abercrombie, Golspie, The Needles, Cadia and Errowanbang. These landscapes are important for water supply through surface water runoff. This category coincides with portions of the Mixed Farming Slopes and Lachlan Tablelands SES zones.

Significance

Low hazard due to low level landscape salt store and high rainfall.

Land salinity is low. Land salinity usually shows water-logging symptoms which do not develop into scalding.

Salt load export is moderate. Moderate loads of salt are exported by these landscapes and redistributed in the Lachlan catchment. These landscapes contribute a small proportion of the total salt load seen in the Lachlan River at Forbes. These loads are seen as small creeks consistently adding water at moderate salinity concentration.

Salinity concentration in surface water is low. Many streams in this landscape show occasional spikes of moderate salinity concentration. Many of these streams provide dilution flows for more salty parts of the landscape. Many streams transmit high concentration water rather than generating it.

This landscape is a net dilution landscape close to other salt generating landscapes. Abercrombie River is a net dilution catchment for Wyangala Dam. This landscape is a net dilution area within the Belubula catchment.

This landscape is steep and deeply dissected and has low salt store. A small proportion of this landscape is high rainfall plateaux.

Many areas of this landscape are not as altered through clearing, grazing and cropping as other parts of the Lachlan catchment. There are many areas of remnant woody vegetation.

There is a demonstrated history of salinity and water-logging management through on-farm management – particularly revegetation and grazing management.

There has been a long history of agency salinity extension, research, demonstration and on-ground works – based out of Crookwell, Bathurst, Wellington, Cowra and Orange.

There has been a long history of salinity being important issue within community NRM activities – Cowra District - Mid Lachlan Landcare, Central Tablelands Landcare, Upper Lachlan Catchment Coordinating Committee - Landcare.

Resilience statement

Drivers for salinity development are

- inappropriate grazing management
- inappropriate vegetation management
- decreasing depth to water table and/or rising groundwater pressures
- clearing of native vegetation

Variables that impact on resilience

- water table depth
- perenniality
- soil stability (erosion, gullying, sodic soil)

Confidence

Moderate due to presence of long term gauging stations in Abercrombie River and Belubula River and salt land mapping.

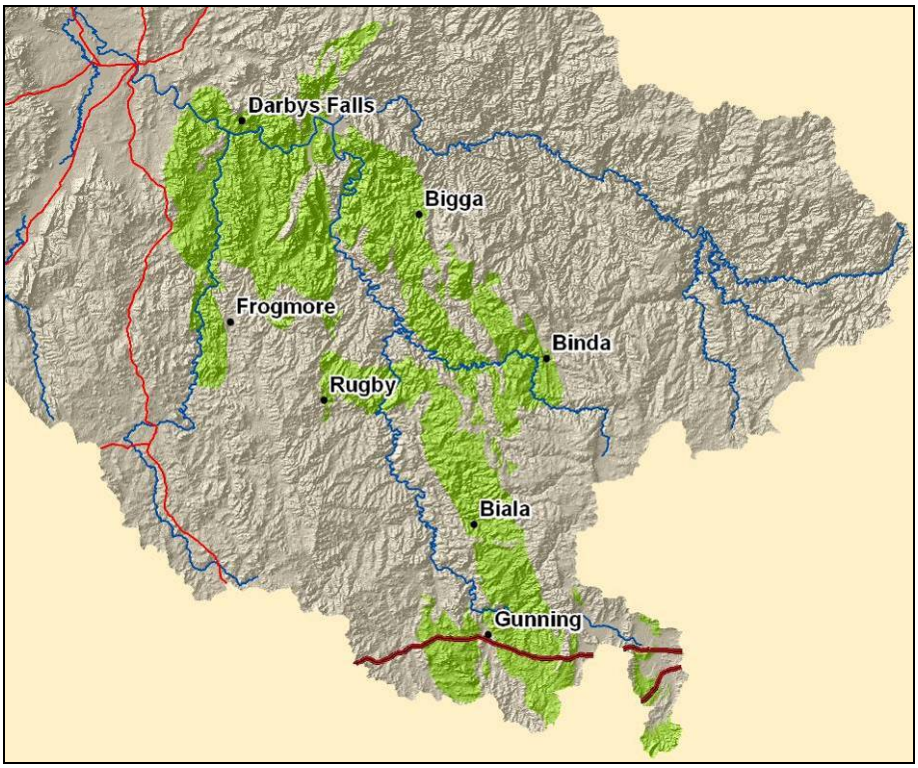
Decision rules

The hazard is Low. This landscape is an important net dilution catchment and an important water supply area for the Lachlan catchment.

3.13 Low hazard – Area 2

L2	Upper Lachlan Granites	Hazard:	Low

Figure 13 location diagram of low hazard area 2



Overview / location

This category comprises granitic rocks of the Wyangala Batholith and some older granitic bodies. It includes the localities of Bigga, Biala, Gunning, Darbys Falls and Wyangala. These landscapes are important for water supply through surface water runoff. This category coincides with portions of the Mixed Farming Slopes and Lachlan Tablelands SES zones.

Significance

Low hazard due to low level landscape salt store and high rainfall.

Land salinity is low. Land salinity usually occurs in small areas (less than 1 hectare) and shows waterlogging symptoms, scalding and erosion.

Salt load export is moderate. Moderate loads of salt are exported by this landscape and redistributed in the Lachlan catchment. These landscapes contribute a small proportion of the total salt load seen in the Lachlan River at Forbes. These loads are seen as small creeks consistently adding water at moderate salinity concentration.

Salinity concentration in surface water is low. Many streams in this landscape show occasional spikes of moderate salinity concentration. Many of these streams provide dilution flows for more salty parts of the landscape.

This landscape is a net dilution area close to other salt generating areas. Upper Lachlan Granite landscapes act as a net dilution catchment for Wyangala Dam.

Landscape is steep has a low salt store overall. Lower colluvial slopes are a small proportion of this landscape and show higher salt stores.

Many areas of this landscape are not as altered through clearing, grazing and cropping as other parts of the Lachlan catchment. There are many areas of remnant woody revegetation.

There is a demonstrated history of salinity and water-logging management through on-farm management – particularly revegetation and grazing management.

There has been a long history of agency salinity extension, research, demonstration and on-ground works – based out of Crookwell, Wellington, Yass and Cowra.

There is a long history of salinity being an important issue within community NRM activities – Cowra District - Mid Lachlan Landcare, Central Tablelands Landcare, Upper Lachlan Catchment Coordinating Committee - Landcare.

Resilience Statement

Drivers for salinity development are:

- inappropriate grazing management
- clearing of native vegetation (legacy of history)
- loss of perenniality
- loss of soil via erosion

Variables that impact on resilience:

- water table depth
- perenniality
- soil stability (erosion, gullying, sodic soil)
- degree of soil degradation

Confidence

High. There is existing salt land mapping and measurement of streams. Landcare group scale salinity investigations have been conducted at Narrawa, Rugby and Gunning.

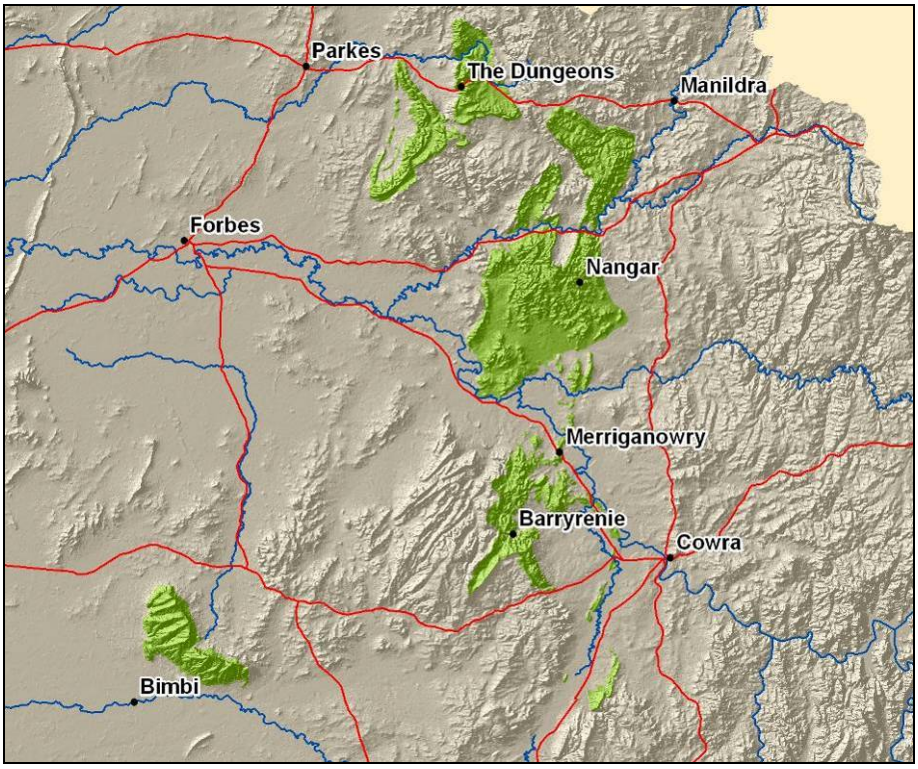
Decision Rules

Low hazard due to low level landscape salt store and high rainfall.

3.14 Low hazard – Area 3

L3	Hervey Group	Hazard:	Low

Figure 14 location diagram of low hazard area 3



Overview / location

This category comprises mixed sedimentary rocks of Devonian age which occur in several localities in the Lachlan catchment. They are usually important fresh water sources. This category coincides with portions of the Mixed Farming Slopes SES zone.

Significance

Low hazard due to low level landscape salt store and high rainfall.

Land salinity is low. Land salinity is not common and usually occurs in small areas (less than one hectare) and frequently shows related erosion issues.

Salt load export is moderate. Moderate loads of salt are exported by these landscapes and redistributed in the Lachlan catchment. These landscapes contribute a small proportion of the total salt load seen in the Lachlan River at Forbes. These loads are seen as small creeks occasionally adding water at moderate salinity concentration.

Salinity concentration in surface water is low. Many streams in this landscape show occasional spikes of moderate salinity concentration. Many of these streams provide dilution flows for more salty parts of the landscape.

This landscape acts as a net dilution landscape close to other salt generating landscapes.

Landscape is steep and has a low overall salt store. Steep slopes and cliffs are common. Lower colluvial slopes are a small proportion of this landscape and show higher salt stores.

This landscape is mainly timbered. National Parks and State Forests are a common land use.

There is a demonstrated history of erosion, salinity and water-logging management through on-farm management – particularly agricultural earthworks, revegetation and grazing management.

There is a long history of agency salinity extension, research, demonstration and on-ground works – based out of Wellington, Young, Parkes and Cowra.

There is a long history of salinity being important issue within community NRM activities – Cowra District - Mid Lachlan Landcare, Central Tablelands Landcare, Upper Young District Landcare, Parkes and District Landcare, Weddin Landcare.

Resilience statement

Drivers for salinity development are:

- inappropriate grazing management
- clearing of native vegetation
- loss of perenniality
- loss of soil via erosion

Variables that impact on resilience:

- water table depth
- perenniality
- soil stability (erosion, gullying, sodic soil)
- degree of soil degradation

Confidence

High. Existing salt land mapping is available and streams have been measured in the past. Landcare group scale salinity investigations have been conducted in these landscapes (Warrengong, Murringo).

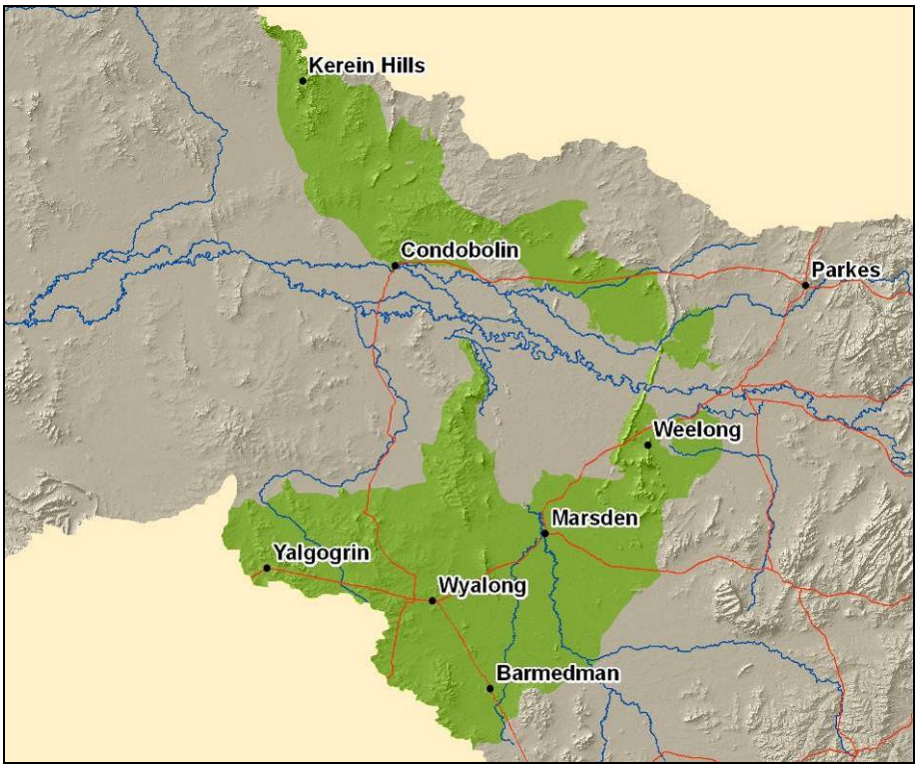
Decision rules

Low hazard due to low level landscape salt store and landscape being uncleared.

3.15 Low hazard – Area 4

L4	Lachlan Plains	Hazard:	Low

Figure 15 location diagram of low hazard area 4



Overview / location

This category comprises colluvial sediments. It includes the localities of West Wyalong, Burcher, Ungarie and Derriwong. This category coincides with portions of the Mixed Farming Slopes and Cropping Plains SES zones.

Significance

Low hazard due to low rainfall. This landscape has ability to adsorb and utilise most rainfall events.

Land salinity is low and is not common. Surface dry scalds exist and many have salinity and sodicity as drivers. Water-logging is frequently seen in wetter years. Sub soil salinity can be a constraint to plant growth.

Salt load export is low. Streams are ephemeral and have low level connection to groundwater systems.

Salinity concentration in surface water is low. Streams are ephemeral and have low level connection to groundwater systems.

Landscape has a high salt store overall. Very high salt stores exist in some soils.

There is a demonstrated history of erosion, scalding, salinity and water-logging management through on-farm management – particularly agricultural earthworks, revegetation and grazing management.

There has been a long history of agency salinity extension, research, demonstration and on-ground works – based out of Temora, West Wyalong, Young, Grenfell, Condobolin, Parkes and Cowra.

Resilience statement

Drivers for salinity development are:

- inappropriate grazing management
- inappropriate cropping practices
- loss of perenniality
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience are:

- perenniality
- soil stability (erosion, gullying, sodic soil)
- degree of soil degradation
- type of salt (salt species)

Confidence

Low confidence in the hazard classification for this landscape. Lack of awareness in landholders. Low level activity by agency staff. There is a lack of surface water and groundwater quality data.

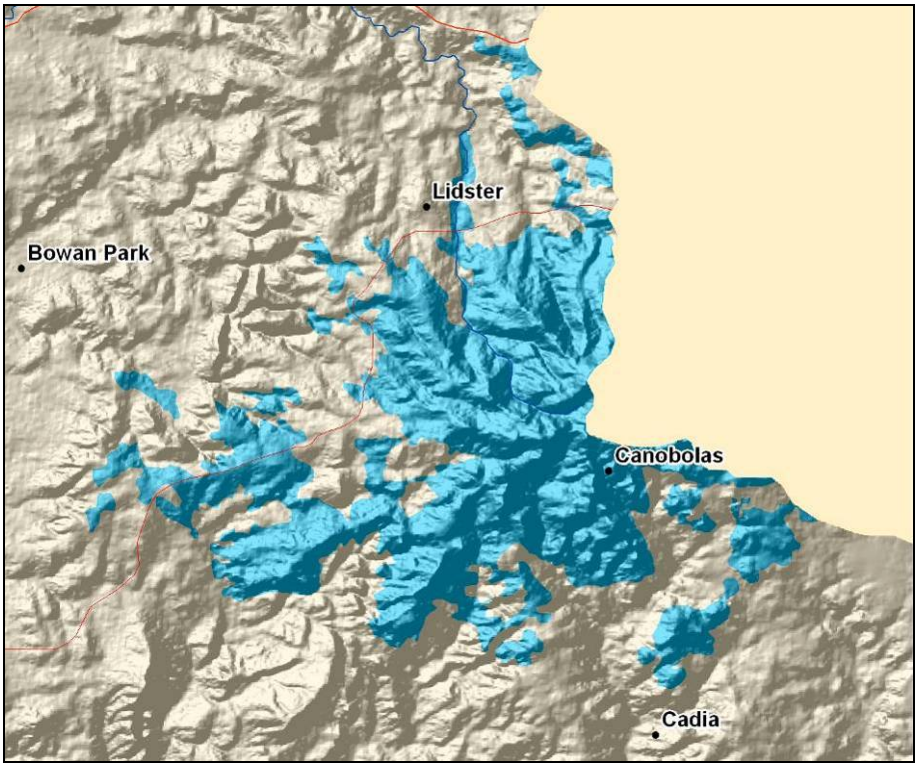
Decision Rules

The hazard is low for this landscape. It is a low rainfall area and has ability to adsorb and utilise most rainfall events.

3.16 Very low hazard – Area 1

VL1	Canobolas	Hazard:	Very Low

Figure 16 location diagram of very low hazard area 1



Overview / location

This category comprises volcanic rocks between Orange, Cargo and Cadia. It includes the localities of Nashdale and Lidster. This category coincides with portions of the Mixed Farming Slopes SES zone.

Significance

Low hazard due to high rainfall and low landscape salt store.

Land salinity is low and is not common. Water-logging is frequently seen in wetter years.

Salt load export is low. Streams are perennial and fresh.

Salinity concentration in surface water is low. Streams are perennial and fresh.

The landscape is steep has high relief and is highly dissect. This results in the landscape having a low salt store overall.

Many areas of this landscape are not as altered through clearing, grazing and cropping as other parts of the Lachlan catchment. There are many areas of remnant woody revegetation. Forestry is a significant land use.

This landscape is an important source of large quantities of fresh water. Water quantity and water quality in the Belubula River and Boorimbla Creek will be impacted by forestry and mining actions within this landscape.

Resilience statement

Drivers for salinity development are:

- clearing of native vegetation (potential)
- inappropriate vegetation management

Variables that impact on resilience:

- perenniality

Confidence

High due to presence of field observations, investigation and gauging stations.

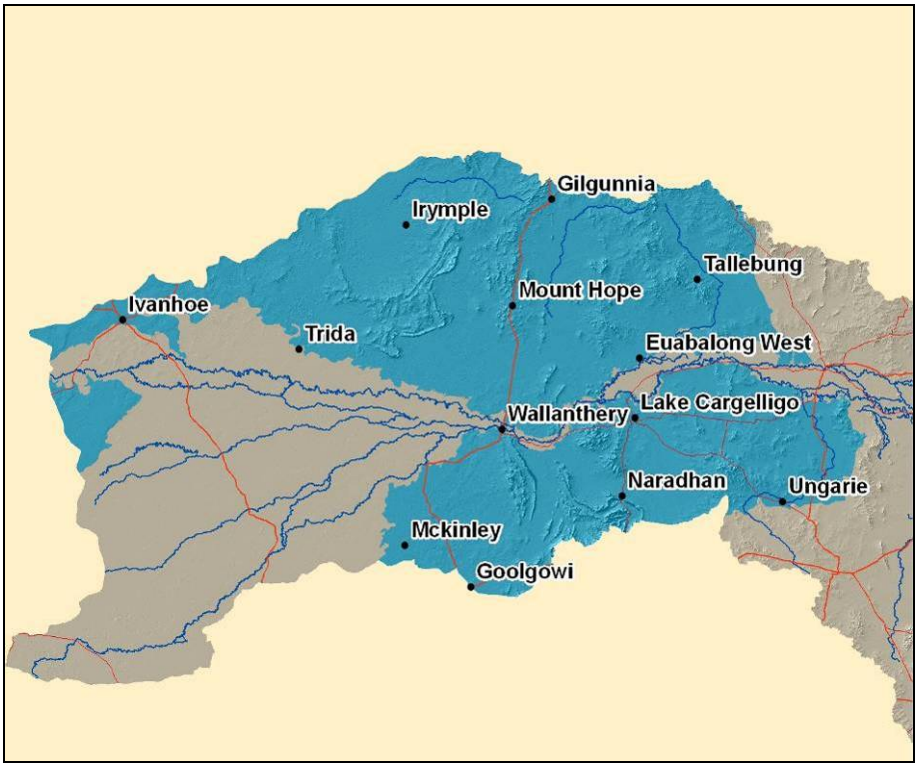
Decision rules

The hazard is low due to low salt store and high rainfall.

3.17 Very low hazard – Area 2

VL2	Lachlan Low Rainfall Colluvium	Hazard:	Very Low

Figure 17 location diagram of very low hazard area 2



Overview / location

This category comprises colluvial sediments and residual mixed metasedimentary, volcanic and granitic rocks. It includes the localities of Mount Hope, Yathong, Ivanhoe, Naradhan and Euabalong West. This category coincides with portions of the Dry Rangelands and Cropping Plains SES zones.

Significance

This landscape has low hazard due to low rainfall. The landscape has ability to adsorb and utilise most rainfall events.

Land salinity is low and is not common. Surface dry scalds exist and many have salinity and sodicity as drivers. Water-logging is frequently seen in wetter years.

Sub soil salinity can be a constraint to plant growth.

Salt load export is low. Streams are ephemeral and have low level connection to groundwater systems.

Salinity concentration in surface water is low. Streams are ephemeral and have low level connection to groundwater systems.

Landscape has a high salt store overall. Very high salt stores exist in some soils. Many soils have a high Aeolian component and added salt risk. The very high salt store is not very mobile.

There is a demonstrated history of erosion, scalding, salinity and water-logging management through on-farm management – particularly agricultural earthworks, revegetation and grazing management.

Some areas of this landscape are mainly pastoral and vegetation is based on perennial plants.

Agencies have been active in soil extension, research, demonstration and on-ground works – based out of Cobar, Hay, Condobolin and Cowra.

Resilience statement

Drivers for salinity development are:

- inappropriate grazing management
- inappropriate vegetation management
- inappropriate cropping practices
- loss of perenniality
- clearing of native vegetation
- loss of soil health (physical, biological, chemical)

Variables that impact on resilience are:

- perenniality
- soil stability (erosion, gullying, sodic soil)
- degree of soil degradation
- type of salt (salt species)

Confidence

Low due to limited data on groundwater and soil characteristics.

Decision rules

The hazard is low due to low rainfall.

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Appendix 1: Factors influencing resilience in Lachlan CMA

Table 2 Factors influencing resilience in Lachlan CMA

Drivers	Main Variables	Thresholds	Priority Actions	Evidence gaps/needs
• Increasing urbanisation • Inappropriate planning and construction methods for salinity • Inappropriate grazing management • Inappropriate vegetation management • Inappropriate cropping practices • Inappropriate irrigation practices • Decreasing depth to water table and/or rising groundwater pressures • Clearing of native vegetation • Loss of perenniality • Loss of soil via erosion • Loss of soil health (physical, biological, chemical)	• Water table depth • Groundcover percentage • Total grazing pressure • Perenniality • Soil stability (erosion, gullying, sodic soil) • Degree of soil degradation • Type of salt (salt species) • Extent of land salinity • Stream EC • Salt load in streams • Extent of potential acid sulfate soils • Climatic variability • Planning control and policy related to salinity hazard • Groundwater quality	• Land salinity develops when groundwater is within 2 m of surface • Threshold for soil salinity impacts: 2 dS/m ECe • Threshold for soil stability ESI = EC/ESP <0.02 instantaneous dispersion on wetting; <0.05 unstable (Murphy & McKenzie 2012) • Groundcover 70% • Riparian vegetation can buffer saline discharge into streams • Point where increasing recharge exceeds plant water uptake (water balance) • Loss of soil A horizon (topsoil) • Exposure and wetting of sodic soils • Exposure of acid sulfate soil (anaerobic to aerobic) • Stream salinity thresholds: human consumption (preferred) = 500 mg/L (800 EC); ecological system function threshold will depend on asset to be protected • Land management within capability / land management not within capability threshold • Building of infrastructure (irreversible)	• Water management (irrigation and flow regime) • Appropriate grazing management • Discharge management • Soil health management • Vegetation management for production • Vegetation management for ecosystem services • Soil amelioration • Urban design catering for salinity • Riparian management • Planning related to salinity hazard • Policy related to salinity hazard	• Salinity investigations in a landscape context not complete across entire CMA area • Salinity landscape management system to a landscape facet scale required for appropriate, targeted management • MERI • Time series groundwater data • Time series stream EC data • Time series load data (including flow data) • Water use of systems used in agricultural practices • Surface-groundwater connectivity information • Salinity-sedimentation relationship information • Land use change data • Salinity outbreak data (out of date and incomplete) • Continuous spatial soil coverage (unpublished or incomplete) • Spatial Land management within Capability (LMwC) (only partial coverage)