



Dubbo City Urban Salinity Implementation Plan

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1.0 Introduction

The Salinity Management Strategy aims to minimise the current and future impacts of land degradation, inappropriate land use practices and climate change on production and the environmental and indigenous heritage values of land within the Dubbo urban area.

The Strategy will provide for the ongoing monitoring and management of salinity which will contribute to increasing the understanding of salinity within the urban area of Dubbo and allow for the proper management of salinity affected areas and landscapes at risk of impact by salinity.

The Strategy structures the factors of urban salinity into individual strategies and provides strategic outcomes as a template for salinity management. The individual strategies address:

1. Salt impact: The type and quantity of salt present within the landscape.
2. Groundwater Recharge: The amount of water mobilising and concentrating salts in particular areas of the landscape.
3. Land use: Use of the landscape and associated practises.
4. Infrastructure: Construction material and method used and maintenance of infrastructure.
5. Monitoring: Further investigation and management.

The Strategy will act as the main planning tool for salinity management, guiding salinity management actions. Salinity management actions are applied to the priority Hydro-geological Landscapes (HGLs), identified as the landscapes that contribute significantly to rising salinity, locations that are important in the functioning and our understanding of salinity processes in the LGA and those areas that are significant in order to protect local assets and values.

The HGLs identified in this context are detailed in Table 1 and include the Macquarie Alluvium, Central Business District, Orana Heights, West Dubbo, Dubbo Basalt, Troy Creek Constriction, Dunedoo Road, Fitzroy Upland Alluvium, Richmond Estate, Brocklehurst, South Dubbo, Eulomogo Estate, Kintyre, and Firgrove HGLs.

The groundwater bore sites prioritised in this context

include those with extreme, high and medium concern salinity hazard trends (2009-2012) as detailed in Table 2 and those within the Central Business District HGL. The priority Hydro-geological Landscapes and Bore Sites are further detailed in Section 2.0 of this Plan.

The Implementation Plan provides the identified requirements and actions necessary for achieving the strategic outcomes of the Strategy. These requirements inform the development of Council Delivery and Operational Plans and act as a tool for developers and the community in determining the measures associated with salinity management within particular landscapes.



2.0 Priority Landscapes and Bore Sites

The Salinity Implementation Plan delivers actions specific to the Hydro-geological Landscapes with a focus on addressing the salinity hazard in the landscapes identified with an overall hazard of Very High, High or Medium. Further, the actions address bore sites determined as extreme, high and medium based on water quality and groundwater height over the period 2009 to 2012, as assessed by the Impax Group in February 2013 as part of the annual monitoring of the Urban Salinity Network.

The landscapes identified as a focus for the Strategy are detailed in the following tables. Table 1 identifies the assessed salinity data for each of the Hydro-geological

Landscapes determined in the Dubbo Urban Landscape Interpretation Project (2010). A detailed account of the landscapes prioritised for salinity management in this Plan is included in Table 3. Table 2 identifies the bore sites with extreme, high and medium concern. A map identifying the location of these bores is attached as Appendix A. The background data for the bore hazard assessment is provided as Appendix C.

Table 1. Dubbo Urban Areas Hydro-geological Landscapes (April 2010)

Hydro-geological Landscapes		Land Impact	Salt Load Export Impact	Impact on Water Quality	Overall Hazard
1	Macquarie Alluvium	Low	Moderate	Low	Medium
2	Central Business District	High	High	High	Very High
3	Orana Heights	High	Moderate	Moderate	High
4	West Dubbo	Moderate	Moderate	Moderate	Medium
5	Dubbo Basalt	Moderate	Moderate	Low	Medium
6	Troy Creek Constriction	High	High	High	Very High
7	Dunedoo Road	High	Moderate	High	High
8	Whylandra Creek	Low	Low	Low	Low
9	Fitzroy Upland Alluvium	High	High	Moderate	High
10	Cumboogle	Moderate	Low	Low	Low
11	Richmond Estate	Moderate	High	High	High
12	Brocklehurst	Moderate	Moderate	Moderate	Medium
13	South Dubbo	High	Moderate	Moderate	High
14	Eulomogo Estate	High	High	High	Very High
15	Old Dubbo Road	Low	Moderate	Low	Low
16	Wongarbon Basalt	Low	Low	Low	Very Low
17	Kintyre	Moderate	Moderate	Moderate	Medium
18	Peachville	Low	Moderate	Low	Low
19	Firgrove	Low	Moderate	Low	Medium
20	Talbgagar Alluvium	Low	Moderate	Moderate	Low

2.0 Priority Landscapes and Bore Sites

Table 2. Extreme, High, Medium Concern Bore Sites (2009-2012)

Hydro-geological Landscape		Bore ID	Bore Monitoring Assessment
3	Orana Heights	GW24	Medium
		GW59	Medium
		GW62	Medium
4	West Dubbo	GW34	Medium
		GW85	Medium
		GW98	Medium
		GW109	Medium
		GW110	Medium
5	Dubbo Basalt	GW73	Medium
6	Troy Creek Constriction	GW107	Medium
		GW T129	Medium
		GW T130	Medium
		GW T132	Medium
9	Fitzroy Upland Alluvium	GW72	High
		GW T103	Medium
		GW T104	Medium
11	Richmond Estate	GW8	High
		GW7	Medium
		GW106	Medium
13	South Dubbo	GW75	High
		GW78	High
14	Eulomogo Basalt	GW114	Extreme
		GW128	Extreme
18	Peachville	GWT302	High
		GW43	Medium
		GW T303	Medium
		GW T307	Medium
19	Firgrove	GW1	High
		GW5	Medium



2.0 Priority Landscapes and Bore Sites

Table 3. Priority Landscapes for Salinity Management

Hydro-geological Landscapes		Land Impact	Salt Load Export Impact	Impact on Water Quality	Overall Hazard
1	Macquarie Alluvium	Low	Moderate	Low	Medium
<p>The Macquarie Alluvium HGL is dominated by the Macquarie River and its floodplain, covering the area of land north to south through the western side of Dubbo. The HGL is characterised by flat to gently undulating alluvial systems including floodplains, alluvial plains, anabranches, alluvial fans, terraces, levees, swamps, channels and closed depressions.</p> <p>Soils in the landscape are loose dark brown, weakly structured sandy loam to loam stratified with loamy sandy (topsoil). The subsoil consists of silt loam interlayered with loamy sand and clayey sand. In this HGL water moves vertically through the alluvial soils to the water table and then laterally to the drainage lines. Seasonal flooding on the floodplain and water-logging in drainage depressions and back swamps is common.</p> <p>Salt flow in to this landscape is dependent on the areas adjacent to it; generally the HGL is relatively non-saline as water flows remove salts from the landscape. The landscape received and stores salt load through irrigation or surface flow and provides important base flow to local streams.</p>					
2	Central Business District	High	High	High	Very High
<p>The Central Business District HGL is located in the centre of the City precinct and has a high density of urban infrastructure. The landscape contains important land based assets which are being impacted by salinity processes. The landscape is characterised by wide-scale urban salinity and consists of low lying lightly undulating areas of levee banks, terraces, depressions, relict channels, closed depressions, former swamps and drainage lines running parallel to the modern channel of the Macquarie River.</p> <p>Significant salinity is identified in this HGL causing widespread damage to homes, infrastructure, public buildings and parks. Key land degradation issues include moderate erosion in areas of high water flow, slightly acidic topsoil, moderate shrink and swell potential in subsoils, flooding, large saline sites, high hydraulic head, groundwater discharge and overwater of gardens, parks and fields.</p> <p>The landscape generates salt loads which enter the streams and are redistributed in the catchment. Salt loads are received and stored through irrigation or surface flow. The landscape contains high hazard for generating sodic and saline sediment.</p>					
3	Orana Heights	High	Moderate	Moderate	High
<p>The Orana Heights HGL is located in the central area of Dubbo. The landscape is characterised by a plateau exhibiting a high salt store, high groundwater conditions and urban salinity. The landscape generates salt loads which enter the streams and are redistributed in the catchment. Salt load is stored and received through irrigation or surface flow. The landscape generates high salinity concentration water and contains important land based assets which are being impacted by salinity processes. A high number of localised sites have been identified with minor impacts to vegetation and infrastructure, generally occurring at the edges of the plateau landform.</p>					

2.0 Priority Landscapes and Bore Sites

Table 3. Priority Landscapes for Salinity Management

4	West Dubbo	Moderate	Moderate	Moderate	Medium
	<p>The West Dubbo HGL is located around the Dubbo Airport and West Dubbo area. The landscape consists of low flat broad valleys, undulating long sloping hills and low rises. Minor salinity is identified sloping easterly to the Macquarie River.</p> <p>The western and central soils have a moderate to high fertility and are moderately textured with a good water holding capacity. Soils in the southern and eastern parts of the HGL are lightly textured with a low infiltration rate and low water holding capacity. These are more susceptible to structural degradation.</p> <p>The HGL has a low level of observed salinity though localised sites are known. Salt storage in the landscape is moderate, though is identified at a depth which is currently not mobilised by land use. It is identified, however that the salt stores being redistributed throughout the catchment through streams. The landscape currently provides fresh water runoff as an important water source and as an important dilutions flow source.</p>				
5	Dubbo Basalt	Moderate	Moderate	Low	Medium
	<p>The Dubbo Basalt HGL incorporates narrow areas running parallel to the Macquarie River, east of the Dubbo City Centre and includes a broad area north of Troy Creek. The landscape contains a high density of moderate to high water use development types; predominantly dry land cropping, improved pastures to the north and urban development expanding to the south.</p> <p>Soils in the Dubbo Basalt HGL are moderately fertile, generally thin, friable and have a high water holding capacity with moderate shrink-swell potential. Surface flow from this HGL contributes saline flows to the Troy Creek Constriction HGL and throughout the catchment, increasing the significant salinity damage. The landscape provides fresh water runoff as an important dilutions flow source.</p>				
6	Troy Creek Constriction	High	High	High	Very High
	<p>The Troy Creek Constriction HGL is located to the north east of Dubbo City and incorporates the mid to lower reaches of the Troy Creek system. The landscape has been recognised as an area of urban salinity since the early 1990's. Significant research and investigation over time has provided a sound understanding of the landscape character and nature of the salinisation.</p> <p>The land consists predominantly of permeable clay soils which, combined with the large catchment area and intermediate groundwater system forces saline groundwater to the surface. This is further exacerbated with high local water use, the construction of roadways across the drainage line, catchment vegetation clearance and urban development.</p> <p>The landscape generates salt loads which enter the streams and are redistributed in the catchment. Salt loads are received and stored through irrigation or surface flow. The landscape generates high salinity concentration water and contains important land based assets which are being impacted by salinity processes. Large saline sites have been recently improved with the implantation of rehabilitation practises including extensive tree planting, drainage programs further enhanced by the recent dry climatic conditions.</p>				
7	Dunedoo Road	High	Moderate	High	High
	<p>The Dunedoo Road HGL is located parallel with the Talbragar River from its Junction with the Macquarie River to west of Beni. The HGL is characterised by undulating long slopes with high surface water runoff on upper slopes and high recharge zones around basalt areas.</p> <p>In the HGL, water moves quickly through the landscape in two ways: firstly as runoff over surface soils due to their hydrophobic nature and also vertically through the regolith with increased recharge over mid -slope basalts.</p> <p>The HGL has a shallow saline water table and a deeper saline water table in the lower catchment. Salinity problems are generally seasonal, mostly found lower down the slope below the highway. Basalt areas are high recharge zones and are located high in the landscape. The landscape generates salt loads which enter the streams and are redistributed in the catchment. Additional salt load is received through irrigation or surface flow.</p>				

2.0 Priority Landscapes and Bore Sites

Table 3. Priority Landscapes for Salinity Management

9	Fitzroy Upland Alluvium	High	High	Moderate	High
<p>The Fitzroy Upland Alluvium HGL is located around the Troy Creek junction area in the Dubbo City Precinct. It consists of broad alluvial floodplains, relict terraces, drainage channels, levees, depressions and river banks of recent alluvial deposits.</p> <p>The HGL contains a high density of urban infrastructure including the Senior High School Campus and Charles Sturt University (Dubbo) Campus. These developments combined with road and rail infrastructure influence water movement in the landscape forcing the water table to rise which is creating discharge sites on either side of the constrictions.</p> <p>The HGL is subject to extreme flooding, erosion, seasonal water logging and contains acidic soils and sites of major salinity. The landscape provides important base flow to local streams. It generates and stores salt loads which enter the streams and are redistributed in the catchment. Additional salt load is received through irrigation or surface flow.</p>					
11	Richmond Estate	Moderate	High	High	High
<p>The Richmond Estate HGL is located on the eastern side of Dubbo City and is characterised by rural residential development. The HGL experiences increasing salinity symptoms in lower elements of the drainage system as a result of development. Further, rural residential development in the area contributes to salinity through the loss of native woodland vegetation and the overwatering of lawns.</p> <p>The HGL features a bowl shaped landscape of gently undulating rises and low hills. This landform shape and increased clay in the lower drainage lines subjects the landscape to salinity in low areas and in drainage lines. Salinity in the HGL is subject to seasonal climatic changes and human intervention. The landscape generates and stores salt loads which enter the streams and are redistributed in the catchment. Additional salt load is received through irrigation or surface flow.</p>					
12	Brocklehurst	Moderate	Moderate	Moderate	Medium
<p>The Brocklehurst HGL is located to the north of the junction of Macquarie and Talbragar Rivers in the Brocklehurst area. The landscape consists of low undulating hills and rises formed on tertiary basalt with some stony hillocks.</p> <p>The soils are characteristically moderately fertile, typically deep, friable and have a high water holding capacity. In this HGL water moves vertically to the water table, as well as laterally to drainage lines or discharge sites.</p> <p>The landscape is extensively clear open woodland and grassland, dominated by white and yellow box and white cypress pine. Saline sites are highly seasonal and arise due to structural changes in the upper drainage line elements of the landscape. The landscape provides important base flow to streams. The landscape generates and stores salt loads which enter the streams and are redistributed in the catchment. Additional salt load is received through irrigation or surface flow.</p>					
13	South Dubbo	High	Moderate	Moderate	High
<p>The South Dubbo HGL incorporates a large part of South Dubbo to the east of the Macquarie River. The HGL is highly developed for residential use and is extensively cleared. The area has been revegetated and landscaped with exotic plants and vegetation.</p> <p>Numerous large sites of salinity are identified in the HGL, occurring mostly on the geologically controlled contours and have a significant impact on urban buildings and infrastructure. The soils have been highly disturbed through the process of urban development and are fragile, lightly textured and have a low infiltration rate. Pooling of water is common in the HGL due to the low infiltration rate.</p> <p>The landscape generates and stores salt loads which enter the streams and are redistributed in the catchment. The landscape provided fresh water runoff as an important dilutions flow source. Additional salt load is received through irrigation or surface flow.</p>					

2.0 Priority Landscapes and Bore Sites

Table 3. Priority Landscapes for Salinity Management

14	Eulomogo Estate	High	High	High	Very High
	<p>The Eulomogo Basalt HGL is located southwest of the Mitchell Highway between Butler's Falls and Eulomogo. The landscape consists of gently undulating rises, low hills and some stony hillocks. Soils in the HGL have a moderate to high fertility, a friable surface with a high water holding capacity and a moderate to high shrink-swell potential. In this HGL water infiltrates the soil at a slow to medium rate, moving vertically through the water table; The landscape generates high salinity concentration water.</p> <p>A large number of salt sites are identified within the HGL along drainage lines and depressions. Water from the upper catchment (Firgrove HGL) comes to the surface in this location. Further, the constriction at the north-eastern edge of the HGL influences the water table and seasonal flooding in the area. The landscape generates and stores salt loads which enter the streams and are redistributed in the catchment. Additional salt load is received through irrigation or surface flow.</p>				
17	Kintyre	Moderate	Moderate	Moderate	Medium
	<p>The Kintyre HGL is situated south west of Dubbo, north of the Newell Highway, running from the Macquarie River near the Zoo to the west of the upper catchment of Whylandra Creek in the central west of Dubbo.</p> <p>Soils are very sandy having formed on quartz sandstone with some clay rich soil found in depressions which usually have sodic sub-soils. Water in the HGL moves vertically through regolith until it reaches the water table or bedrock, it then moves laterally to drainage lines.</p> <p>Generally, the HGL is relatively non-saline in the upper areas and shows moderate urban salinity in the lower elements of the landscape.</p> <p>The upper elements of the landscape are vegetated with regrowth in some areas and the remaining has been cleared for grazing and is now experiencing increasing urbanisation.</p> <p>The landscape provides fresh water runoff as an important dilutions flow source. The landscape generates and stores salt loads which enter the streams and are redistributed in the catchment. Salt load is stored and received through irrigation or surface flow.</p>				
19	Firgrove	Low	Moderate	Low	Medium
	<p>The Firgrove HGL is partially located in the Beni State Forest area south east of Dubbo, although it predominantly covers the area to the north of the Mitchell Highway incorporating the upper catchment of Wongarbon Creek.</p> <p>The HGL is a flat-lying geological landscape characterised by its bowl shaped constrictions and large areas of native vegetation. The HGL contains areas of extensively cleared woodlands and grasslands with a moderate building density and level of existing rural residential development.</p> <p>The HGL experiences seasonal water logging in low lying areas and drainage depressions. Salinity in this HGL is identified as being a product of the landform characteristics and climatic conditions. Most saline sites are found where shallow groundwater is constricted and forced to discharge, at a change of slope or where the water table discharges to low lying areas, near creeks and streams. The landscape provides fresh water runoff as an important water source and as an important dilutions flow source. The landscape generates salt loads which enter the streams and are redistributed in the catchment.</p>				

3.0 Implementation Plan

STRATEGY ONE: SALT IMPACT

To ensure the salt impact on the landscape is minimised and managed.

STRATEGIC OUTCOME		REQUIREMENTS		APPLICABLE HGL
1.1	The discharge of saline water into the groundwater system, river and streams is minimised.	1.1.1	Rehabilitate discharge sites with the strategic planting of salt tolerant species matched to the site salt intensity.	<ul style="list-style-type: none"> • Eulogmogo Basalt • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • Kintyre • Macquarie Alluvium
		1.1.2	Vegetation management in riparian areas to minimise salt export to streams.	<ul style="list-style-type: none"> • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • South Dubbo • Peachville • Orana Heights • West Dubbo • Dubbo Basalt • Troy Creek • Kintyre • Macquarie Alluvium
1.2	Salt stores are buffered to limit their interaction with shallow groundwater.	1.2.1	Strategic planting of vegetation to buffer the salt stores in the upper colluvial areas of the HGL.	<ul style="list-style-type: none"> • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • Kintyre
		1.2.2	Installation of sub-surface drains where required to intercept saline water discharge into the groundwater system, rivers and streams.	<ul style="list-style-type: none"> • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • South Dubbo • Peachville • Orana Heights • West Dubbo • Dubbo Basalt • Troy Creek

3.0 Implementation Plan

STRATEGY TWO: GROUNDWATER RECHARGE

The volume of water with the potential to enter in to and contaminate the natural system is minimised.

STRATEGIC OUTCOME		REQUIREMENTS		APPLICABLE HGL
2.1	Lateral flow of shallow groundwater is intercepted and reduced.	2.1.1	Strategic planning of vegetation of native vegetation in intercept and lateral flow of saline water and reduce volume of flow.	<ul style="list-style-type: none"> • Eulomogo • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • Kintyre • Dunedoo Road
2.2	Excess soil moisture within the landscape is utilised.	2.2.1	Strategic planting of native vegetation within the landscape to reduce the volume of shallow groundwater and dry out the landscape.	<ul style="list-style-type: none"> • Eulomogo • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • Kintyre • Dunedoo Road
		2.2.2	Productive use of groundwater to dry out the landscape.	<ul style="list-style-type: none"> • Fitzroy Upland Alluvium
2.3	Ponding of water on discharge sites is minimised.	2.3.1	Identification of discharge sites and subsequent management of water input.	<ul style="list-style-type: none"> • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • South Dubbo • Peachville • Orana Heights • West Dubbo • Dubbo Basalt • Troy Creek • Kintyre • Dunedoo Road • Macquarie Alluvium

3.0 Implementation Plan

STRATEGY TWO: GROUNDWATER RECHARGE (CONTINUED)

		2.3.2	The size and location of future urban development is influenced by the location of discharge sites.	<ul style="list-style-type: none"> • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • South Dubbo • Peachville • Orana Heights • West Dubbo • Dubbo Basalt • Troy Creek • Brocklehurst • Dunedoo Road • Macquarie Alluvium
2.4	Discharge to the groundwater system is minimised.	2.4.1	Protect and manage native vegetation.	<ul style="list-style-type: none"> • All HGLs
		2.4.2	Strategic planting of native vegetation in public open space, sites with high groundwater recharge potential and where protecting salt affected land.	<ul style="list-style-type: none"> • All HGLs
		2.4.3	Elements of the landscape identified as recharge points are managed to eliminate discrete groundwater recharge.	<ul style="list-style-type: none"> • Central Business District • Richmond Estate • South Dubbo • Dubbo Basalt • Kintyre
2.5	Discharge of water into the landscape is minimised	2.5.1	Urban management of water use (lawns, gardens, sporting fields) encourages the establishment of spaces with low water requirements.	<ul style="list-style-type: none"> • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • South Dubbo • Peachville • Orana Heights • West Dubbo • Dubbo Basalt • Troy Creek • Kintyre • Brocklehurst • Dunedoo Road • Macquarie Alluvium

3.0 Implementation Plan

STRATEGY THREE: LAND USE

Water usage and land use activities are appropriate for the soil landscape in managing urban salinity and do not contribute to an increase in the assessed salinity hazard of the landscape.

STRATEGIC OUTCOME		REQUIREMENTS		APPLICABLE HGL
3.1	The use of salinity affected land is undertaken in accordance with best practice management principles.	3.1.1	Best practise management principals are applied on land affected by salinity.	<ul style="list-style-type: none"> • All HGLs
3.2	Salinity risk is considered in the land use planning process.	3.2.1	Salinity risk is considered in Structure Planning of Urban Release Areas.	<ul style="list-style-type: none"> • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • South Dubbo • Peachville • Orana Heights • West Dubbo • Dubbo Basalt • Troy Creek • Brocklehurst
		3.2.2	The impact of land use on salinity is address in strategic planning processes within the relevant Hydro-geological Landscapes.	<ul style="list-style-type: none"> • All HGLs
3.3	The extent to which land use activities and practises contribute to salinity hazard is understood.	3.3.2	Increase agricultural production to dry out the landscape and reduce recharge.	<ul style="list-style-type: none"> • West Dubbo

3.0 Implementation Plan

STRATEGY FOUR: INFRASTRUCTURE

Public and private infrastructure development and maintenance is consistent with the salinity hazard of the landscape.

STRATEGIC OUTCOME		REQUIREMENTS		APPLICABLE HGL
4.1	Construction techniques are responsive and appropriate for the salinity risk of the landscape.	4.1.1	Design, construction materials, method, depth of cut and fill and location of roads and infrastructure including underground utilities is suited to the landscape salinity hazard.	<ul style="list-style-type: none"> • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • South Dubbo • Peachville • Orana Heights • West Dubbo • Dubbo Basalt • Troy Creek • Kintyre • Brocklehurst • Dunedoo Road • Macquarie Alluvium
4.2	Urban development on at risk landscapes specifically addresses the impacts of salinity.	4.2.1	Site specific assessment and investigation is a part of the development assessment process.	<ul style="list-style-type: none"> • All HGLs
		4.2.2	Existing salt affected areas are remediated and monitored as a condition of consent where determined as necessary in the site specific assessment and investigation.	<ul style="list-style-type: none"> • All HGLs
4.3	Existing infrastructure is maintained to minimise salinity impacts on the landscape.	4.3.1	Stormwater infrastructure is evaluated for contribution to groundwater recharge.	<ul style="list-style-type: none"> • All HGLs
		4.3.2	A pipe replacement program is developed where necessary to reduce input of water into the landscape.	<ul style="list-style-type: none"> • All HGLs

3.0 Implementation Plan

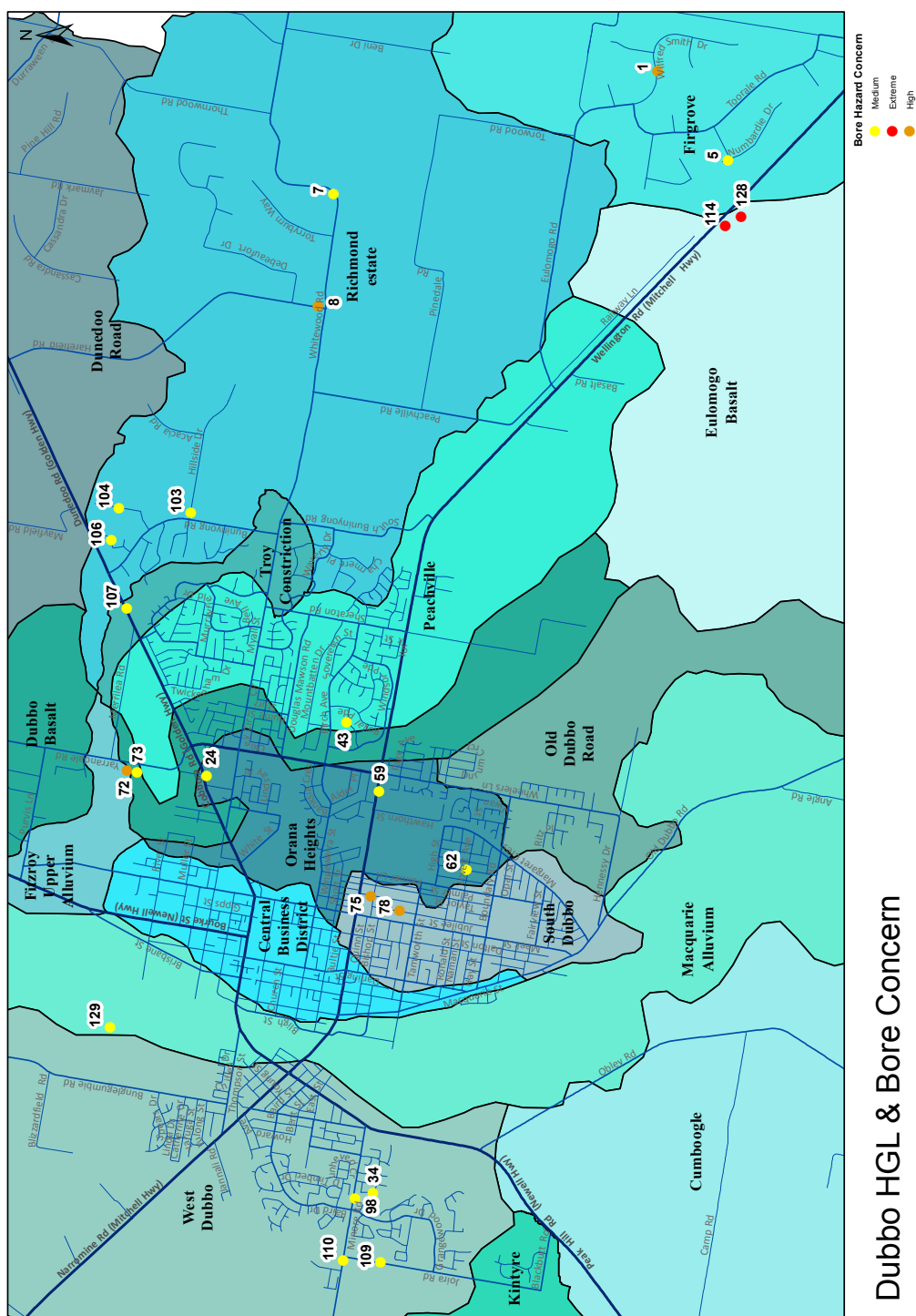
STRATEGY FIVE: MONITORING

The capacity to predict and monitor salinity impacts on land resources and biodiversity is maintained.

STRATEGIC OUTCOME		REQUIREMENTS		APPLICABLE HGL
5.1	The impacts of development on groundwater and salinity are recognised, measured and monitored.	5.1.1	Urban Investigation of areas with extreme salinity and areas that may impact on extreme areas.	<ul style="list-style-type: none"> • Firgrove • Richmond Estate • Fitzroy Upland Alluvium • South Dubbo • Peachville • Orana Heights • West Dubbo • Dubbo Basalt • Troy Creek
		5.1.2	Evaluation of the Urban Salinity Network; any groundwater bores which are identified to increase in salinity concern are further investigated.	<ul style="list-style-type: none"> • All HGLs
		5.1.3	Installation of additional groundwater bores suitable for incorporation in to the Urban Salinity Network are considered during new developments.	<ul style="list-style-type: none"> • Richmond Estate • West Dubbo • Peachville • South Dubbo • Troy Creek Constriction • Eulomogo Basalt • Fitzroy Upland Alluvium
5.2	The overall situation of salinity in Dubbo is understood.	5.2.1	Groundwater bore sites identified in Table 3 of the Salinity Management Strategy are further evaluated.	<ul style="list-style-type: none"> • Richmond Estate (GW 25) • West Dubbo (GW 34) • Peachville (GW 43) • South Dubbo (GW 78) • Troy Creek (GW107) • Eulomogo Basalt (GW 128 & GW114) • Fitzroy Upland Alluvium (GW 72)
		5.2.2	Salinity trends are monitored annually.	<ul style="list-style-type: none"> • All HGLs.
5.3	Groundwater modelling is provided in a spatial capacity	5.3.1	The groundwater modelling map is updated using the average SWL data calculated for each groundwater bore for the period 2009-2012.	<ul style="list-style-type: none"> • All HGLs.

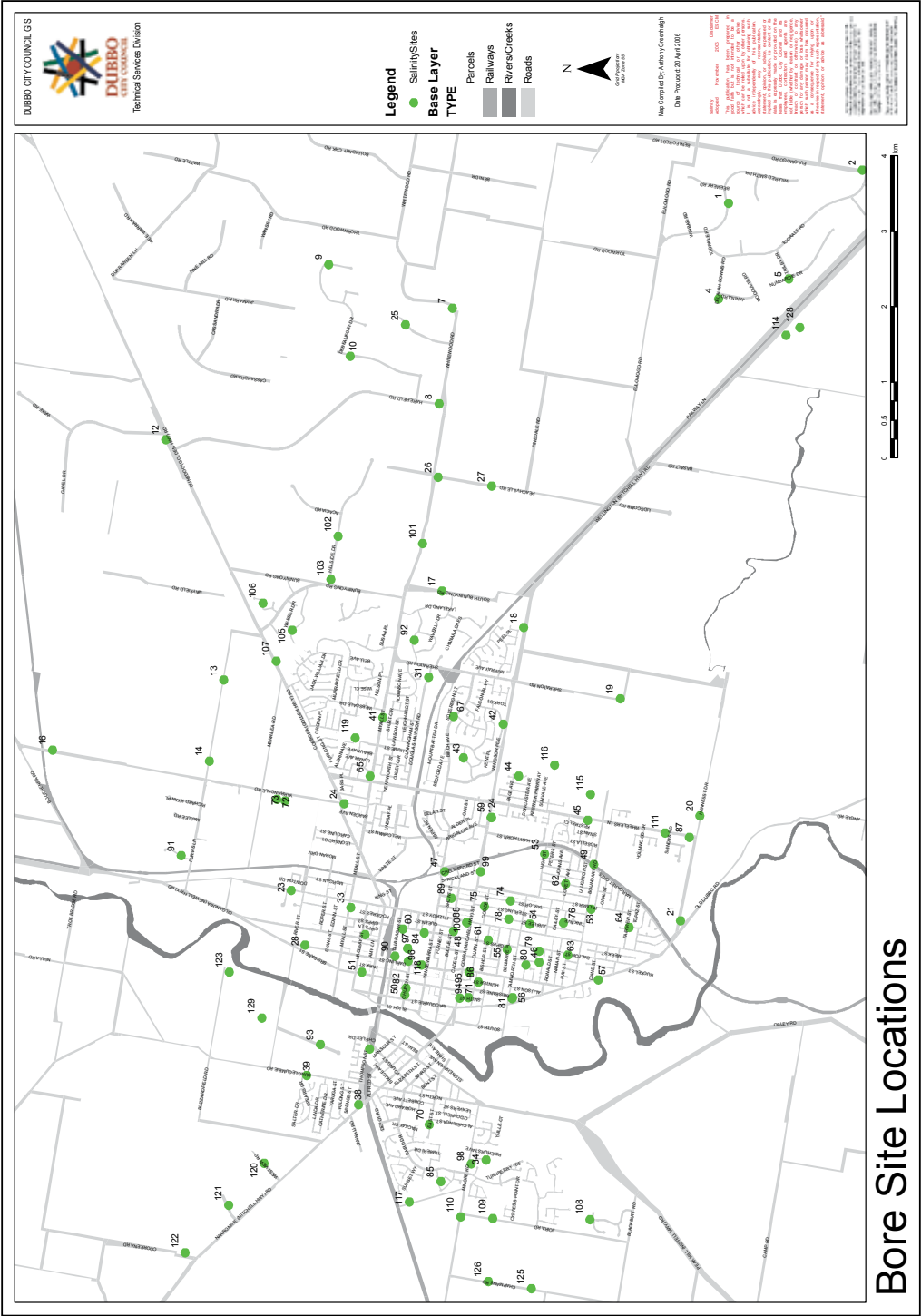
4.0 Appendix

APPENDIX A. GROUNDWATER MONITORING BORES (EXTREME, HIGH AND MEDIUM BORE HAZARD CONCERN 2009 – 2012)



4.0 Appendix

APPENDIX B. GROUNDWATER MONITORING BORES DUBBO LOCAL GOVERNMENT AREA.



4.0 Appendix

APPENDIX C. USING TRENDS IN SALINITY RISK AND SALINITY CLASS TO EVALUATE SALINITY POTENTIAL AT BORE SITES

Salinity Risk and Salinity Class are used to evaluate the Salinity potential of each monitoring bore, as detailed in the following tables.

Table 1. Guidelines on Salinity Risk Determination

Standing Water Level	Salinity Risk
0.00m-2.00m	High Risk
2.01m – 5.00 m	Moderate Risk
5.01m – 10.00m	Low Risk
>10.00	Minimal Risk

Table 2. Guidelines on Salinity Class Determination

Electrical Conductivity (dS/m)	Salinity Class
>15.00 dS/m	Extreme Salinity
6.01-15.00 dS/m	High Salinity
2.01-6.00 dS/m	Moderate Salinity
0.00-2.00 dS/m	Low Salinity

Table 3. Salinity Hazard

Salinity Risk	Salinity Class	Salinity Hazard
High	Extreme	Extreme Concern
High	High	
Moderate	Extreme	
High	Moderate	High Concern
Moderate	High	
Low	Extreme	
High	Low	Medium Concern
Moderate	Moderate	
Low	High	
Minimal	Extreme	Least Concern
Minimal	High	
Moderate	Low	
Low	Moderate	Least Concern
Low	Low	
Minimal	Moderate	
Minimal	Low	Least Concern

Note: The salinity class definition is for a texture compensated soil AC reading.