Warrego Alluvium

Groundwater Background Paper

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Queensland Government

This publication has been compiled by Water Policy (South Region), Department of Natural Resources and Mines.

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1 Warrego Alluvium area

1.1 Background

This report provides background information on the Warrego Alluvium regarding local climate, hydrogeology, resource condition and current use and management practices.

1.2 State water planning

The Warrego Alluvium falls within the area managed under a single State water resource plan (implemented by a resource operations plan) which houses the managements arrangements for the Warrego along with the Paroo, Bulloo and Nebine catchment areas (table 1):

Table 1: State water resource planning instruments

State planning instrument	*Surface water catchment areas*
Water Resource (Warrego, Paroo, Bulloo and Nebine) Plan 2003	Bulloo Nebine Paroo Warrego
Warrego, Paroo, Bulloo and Nebine Resource Operations Plan 2006	

These plans provide for the management of surface and groundwater resources within the plan area. The Warrego Alluvium is identified in the Murray Darling Basin Plan (the Basin Plan) as a groundwater sustainable diversion limit resource unit (SDL unit). See table 2:

Table 2: Warrego Alluvium—Water Plan areas and Basin Plan SDL units

Water Plan Area	*Basin Plan SDL unit*	*SDL unit code*
Warrego, Paroo, Bulloo and Nebine	Warrego Alluvium	GS66

1.3 Location

The Warrego Alluvium is located within the Warrego catchment in South Western Qld (see figure 2). The alluvium largely underlies the Warrego River and its tributaries, beginning north of Augathella and Langlo Crossing and running southward along the Langlo, Ward and Nive Rivers towards Charleville. It continues south, following the Warrego River across the New South Wales border.

The alluvium covers the extent of the quaternary alluvial sediments associated with the Warrego River and has an area of approximately 1 131 900 hectares (DERM 2012) (see figure 3). It falls within the local government areas of Murweh and Paroo, and underlies the towns of Augathella, Charleville and Cunnamulla (DERM 2012).

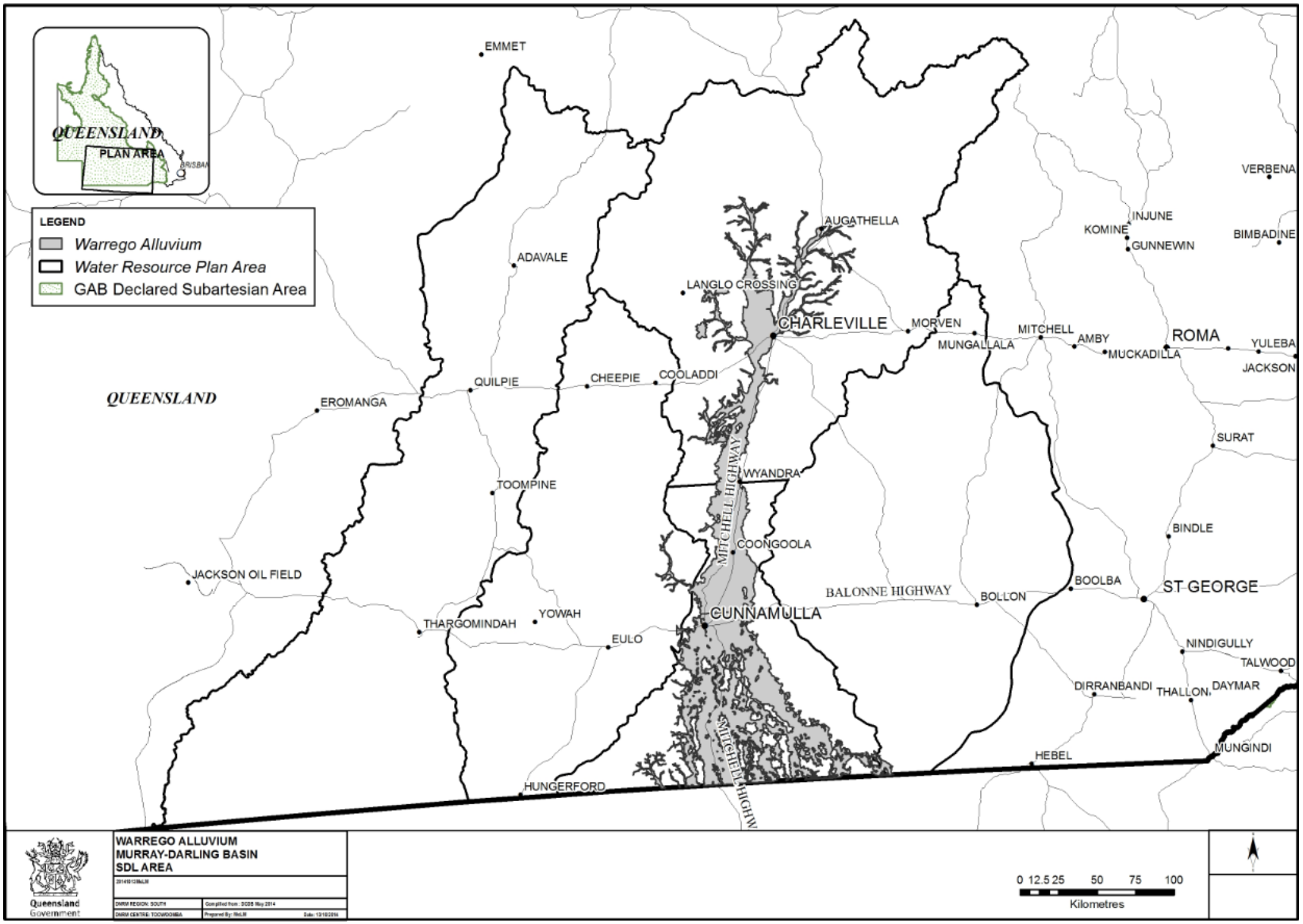

Figure 1: Warrego Alluvium location

1.4 Climate and annual rainfall

The climate of the Warrego catchment is classified as grassland, and characterised by persistent, hot and dry periods with highly variable rainfall (see to figure 4) (SWNRM 2010). Winters are cold and summers tend to be hot and dry with moderate rainfall. A small area in the north eastern part of the catchment is subtropical, with moderately dry winters and hot summers (BOM 2011).

Annual rainfall is variable across the catchment. Mean annual rainfall within the catchment ranges from approximately 650mm in the north to 250mm in the south. Table 3 details the median rainfall statistics for Augathella, Charleville and Cunnamulla. While extended dry periods are common, high rainfall and flooding occurs periodically.

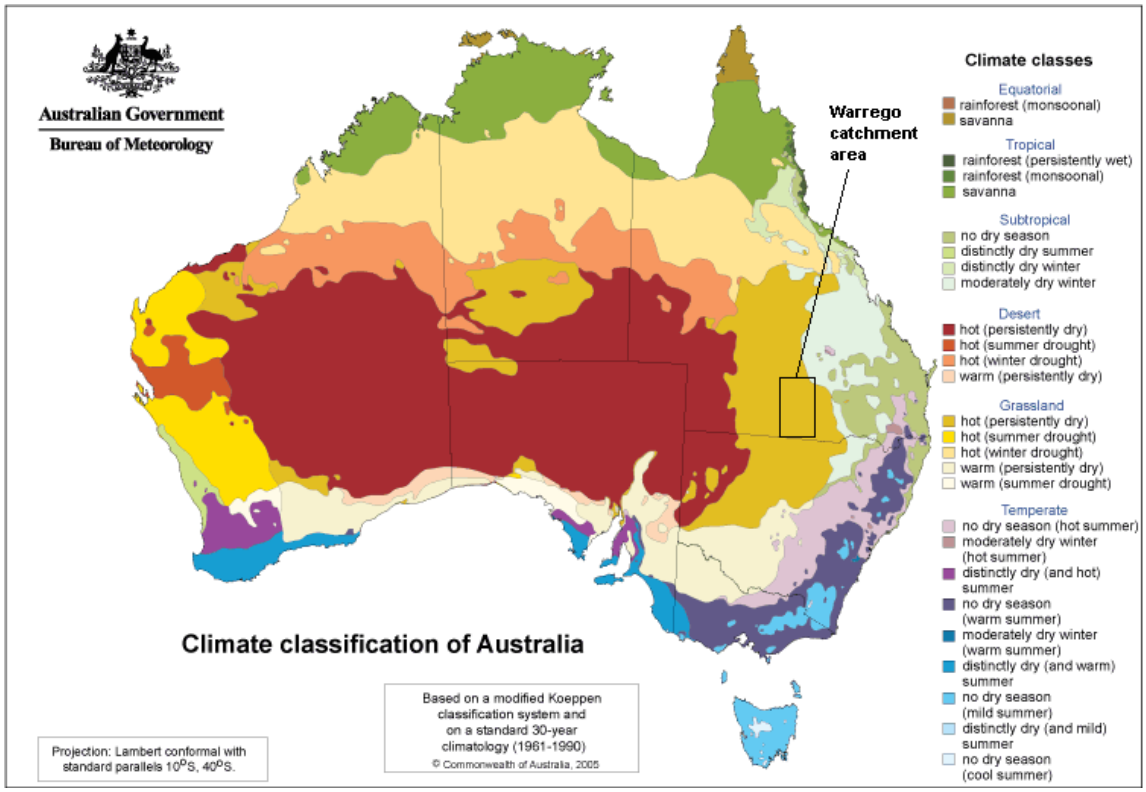

Figure 2: Climate Classes (BOM 2011)

Table 3: Rainfall data at Augathella post office, Charleville Aero and Cunnamulla post office (BOM 2011)

Rain Gauging Station	*Period Collected*	*Elevation (m)*	*Mean annual rainfall (mm)*	*Median annual rainfall (mm)*
Augathella post office	1889 - present	362	531.6	483.4
Charleville Aero (044021)	1942 - current	302	497.4	482.7
Cunnamulla post office (044026)	1879 - current	189	377.1	362.2

2 Geology and hydrogeology

2.1 Geological setting

The Warrego catchment predominantly overlies the Eromanga Basin, and partly overlies the Surat Basin (DNRW 2007). The Eromanga Basin is part of the Great Artesian Basin and is dominated by sub-horizontal Jurassic to Cretaceous sediments of marine and freshwater origin. To the west of the catchment lies the Nebine Ridge; separating it from the Paroo catchment. In the north, the Permian-Triassic Galilee Basin underlies the Eromanga Basin (DNRW 2007).

The sedimentary rocks of the Eromanga Basin vary in lithology, degree of post-depositional weathering and depositional environment, giving rise to a range of landscapes and soil types (see appendix B). Extensive alluvial deposits are associated with the Warrego, Nive, Langlo and Ward Rivers' (DNRW 2007).

The headwaters and tributaries of the Warrego River lie in the north-east of the Warrego catchment. In this area the Warrego Alluvium is separated by hills of Jurassic quartzose sandstones such as Hooray sandstone and the Injune Creek Group. In the Ward River area the geology is dominated by Allaru Mudstone, with Wallumbilla Formations and Winton Formations to the east and west. South of Charleville rock outcrops become uncommon, except for the Winton Formation which flanks the western side of the catchment (DNRW 2007).

2.2 Hydrogeology

The Warrego catchment is generally flat with a gentle southward gradient (CSIRO 2007). It possesses shallow alluvial aquifers, associated with the Warrego River and a deeper aquifer system associated with the Charleville Basin and Mangalore Basin. Below these, the Great Artesian Basin is separated from the Warrego Alluvium by thick confining beds. There is little interaction between the Warrego Alluvium and the underlying aquifers, which include the Great Artesian Basin and the sediments above the Great Artesian Basin Warrego, Paroo and Nebine (CSIRO 2007). The Warrego Alluvium consists of shallow sedimentary local and intermediate groundwater flow systems of Quaternary and Tertiary Age (DNRW 2007). The aquifer is unconfined and is contained mainly in the vicinity of the Warrego River and its tributaries (McNeil 1973; DNRW 2007). The transverse width varies from 0.5 to 10 km, with the widest section downstream of Wyandra (see figure 3).

In the area around Augathella, groundwater is sourced from sandy aquifers between 10 and 25 m deep. The alluvium associated with the Warrego River and its tributaries is of fluvial origin and is of Quaternary Age. This unconfined alluvium begins at Augathella and continues to just north of Charleville. It comprises of gravel, sand, silt and clay (DNRW 2007). Underlying this aquifer is an older Cainozoic Age alluvium, up to 100 m deep, comprising of the Charleville Basin (which is in the area of Charleville) and the Mangalore Basin (extending from south of Charleville into northern New South Wales). These basins are semi-confined, are of fluvial and lacustrine sequence and comprise of sands, gravel and silts (DNRW 2007).

3 Groundwater condition

3.1 Recharge and baseflow

Recharge to the Warrego Alluvium is thought to come primarily from rainfall infiltration and from stream losses from the Warrego River and upstream, from the Langlo, Ward and Nive Rivers (McNeil 1973). The connectivity between the stream and the alluvium declines south from Charleville to the New South Wales border. Slow stream velocity, low stream gradient and sandy beds along the river encourage aquifer recharge (DNRW 2007). At the Augathella Line, the most upstream area of the Warrego Alluvium, short term fluctuations in the groundwater level of up to 2 meters indicate that recharge in this area may be effected by local rainfall (McNeil 1973). Declines of up to 2 meters in the period between 1969 and 1973 were recorded, with many bores being dry for most or all of this period. Due to these findings it was concluded that groundwater levels in the Warrego Alluvium could fall significantly during prolonged dry periods and were highly variable depending on the season (McNeil 1973).

3.2 Groundwater chemistry

Water quality in the Warrego Alluvium is highly variable, depending on what part of the alluvium it is sourced from. In the shallow aquifer around Charleville (which reaches depths of approximately 30 m) salinity ranges from 530 to 1500 µS/cm. In the Quaternary alluvium north of Charleville the water quality is moderately good (less than 1000 mg/L total soluble salts) and is suitable for stock and domestic and irrigation purposes (DNRW 2007). The Charleville Basin contains low salinity water for up-to 4 km on the eastern side of the Warrego River, however water quality deteriorates significantly on the western bank. Total salinity in the Mangalore Basin is sufficiently low for irrigation purposes, but further downstream it becomes too saline for even stock purposes (McNeil 1973). Groundwater in the Charleville Line contains high levels of fluoride and is unsuitable for drinking (McNeil 1973).

3.3 Transmissivity and specific yield estimates

There is limited information regarding the transmissivity and specific yield estimates for the Warrego Alluvium. All of the existing information comes for McNeil's (1973) report. North of Charleville, the shallow unconfined aquifer has a transmissivity of approximately 4900 m^2/second and a specific yield of 7%. The maximum supply obtained is 2000 gallons per hour, but the water supply is prone to fail during long dry periods (McNeil 1973). In the Charleville Basin transmissivity reaches maximums of 17 300 gallons per hour, however decreases north and south of the Charleville Line. Supplies in the Mangalore Basin can reach up to 60 000 gallons per hour, though water quality deteriorates downstream away from the river (McNeil 1973).

3.4 Resource condition of the groundwater area

3.4.1 History of groundwater monitoring

There is minimal bore monitoring information for the Warrego Alluvium. An extensive search of the Department's Groundwater Database, the software program that contains information relating to all Departmental, private and abandoned bores in Queensland, revealed that most bores in the Warrego Alluvium were drilled between 1967 and 1972 as part of McNeil's (1973) study. Many of these bores were monitored on a regular basis, up-to four times per

year, throughout the 1970's. After 1980 many of the bores ceased to be monitored possibly owing to the fact that they failed or the water quality was unsuitable for use. From 1980 to the present some bores, most of which are situated around the towns of Augathella and Charleville, have been sporadically monitored.

3.4.2 Current groundwater monitoring

There are two monitoring bores in the Warrego Alluvium that are on the Department's Groundwater Level monitoring network. These bores, 42320071 and 42320073, are located near Charleville and are required to be monitored twice per year. Figures 5 and 6 show hydrographs for these monitoring bores. Both hydrographs show several dry readings (D). This may be due to the bores failing or the pipes being blocked.

Figure 3: Hydrograph—monitoring bore 42320071

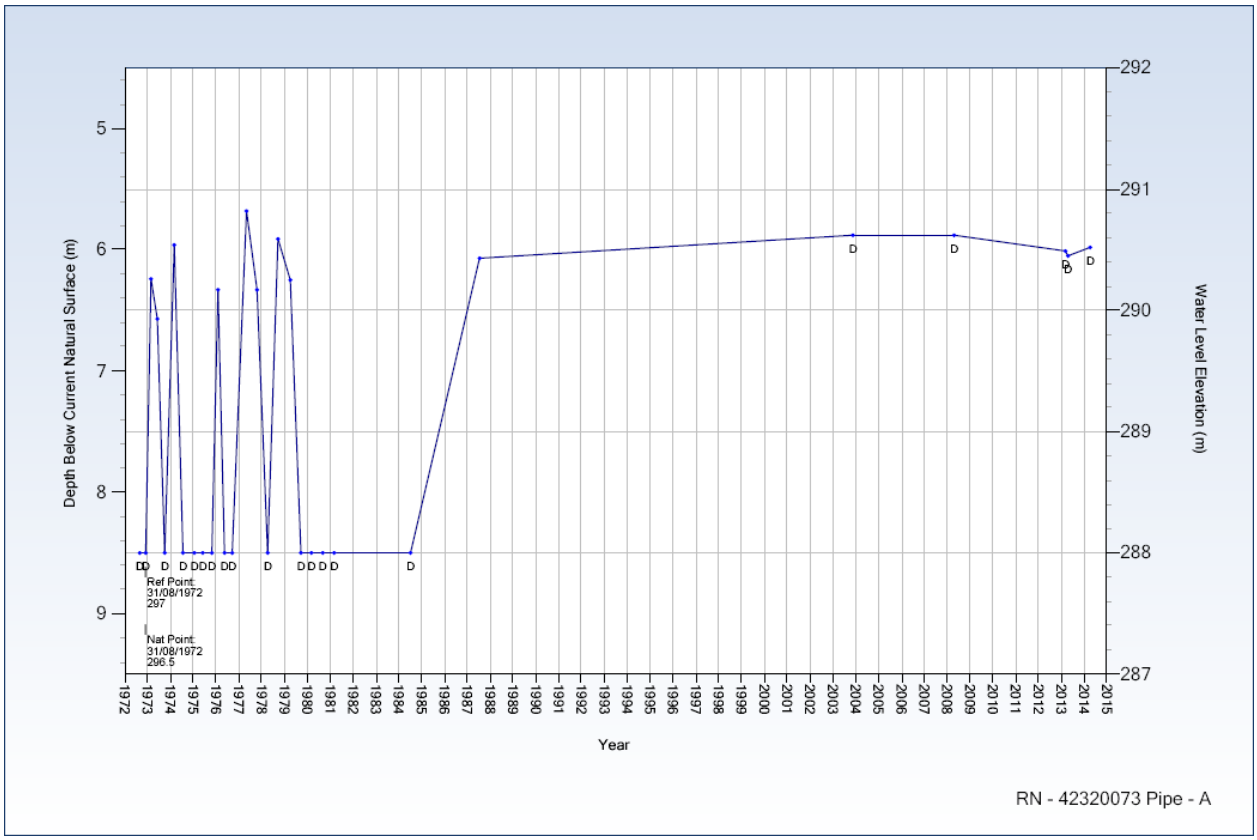

Figure 4: Hydrograph—monitoring bore 42320073

3.5 Groundwater dependent ecological assets

There is no current evidence of groundwater dependant ecosystems that rely on the Warrego Alluvium. The Bureau of Metrology's Groundwater Dependant Ecosystems Atlas (2012) does not list any groundwater dependent ecosystems as having significant reliance on the Warrego Alluvium.

4 Entitlement and use

4.1 Specification of entitlements

Groundwater located within the Warrego Alluvium resides in the Great Artesian Basin declared subartesian area, declared under section 102 of the Water Regulation 2002 (Water Regulation). The Water Regulation requires anyone accessing groundwater from the alluvial deposits within the Great Artesian Basin declared subartesian area for purposes other than stock and domestic to obtain a water licence. Water licences within the Warrego Alluvium area must specify:

- an authorisation number, licensee name and expiry date
- authorised activity and purpose
- description of land (e.g. Lot and Plan No.)
- nominal entitlement (in ML)
- conditions (if required) (i.e. water year).

4.2 Water licences for irrigation and other purposes

The majority of groundwater take in the Warrego catchment is sourced from the deeper Great Artesian Basin aquifers, where more reliable supplies can be achieved. The aquifers of the Great Artesian Basin and Sediments above the Great Artesian Basin are separated from the Warrego Alluvium by thick confining beds. The main use of the groundwater from the Warrego Alluvium is for irrigation and stock and domestic purposes.

A relatively small number of groundwater licences for the Warrego Alluvium exist, mainly in the vicinity of Charleville. High priority groundwater, such as town water supply, is accessed from the Great Artesian Basin due to quality and supply limitations associated with the Warrego Alluvium. Table 4 presents an overview of licences issued to take water from the Warrego Alluvium.

Table 4: Summary of licensing details for the Warrego Alluvium

Resource	*Number of licences*	*Total nominal entitlement volume (ML/annum)*
Warrego Alluvium	9	232

5 Management arrangements

5.1 Assessment

Groundwater in the Warrego Alluvium began to be developed during the late 1960's, primarily for irrigation and stock and domestic purposes. Between 1967 and 1972 test drilling was conducted in the alluvium between Augathella and the New South Wales border. A total of 208 bores were drilled in order to determine water quality, yield and methods of bore construction (McNeil 1973). Overall the report found that water supply from the Warrego Alluvium was unreliable and that water quality ranged between poor and moderately good.

5.2 Current arrangements

Table 5 summarises the current management arrangements for groundwater in the Warrego Alluvium. The alluvium area is not subject to a moratorium on take. Take of groundwater is not metered and there is no seasonal water assignment. As mentioned above, the alluvium falls within a declared subartesian area under section 102 of the Water Regulation requiring water licences for all purposes, other than stock and domestic. Currently the Warrego Alluvium is not managed under the WPBN WRP. However, the WRP is currently under review and a groundwater amendment to the plan is being developed.

Table 5: Current management arrangements in the Warrego Alluvium

Management Arrangement	*Comment*
Moratorium	No
Declared Subartesian Area	Great Artesian Basin Subartesian Area
Water licences	Required for all purposes other than stock and domestic
Development permit for works	Required for all purposes excluding domestic
Water resource plan	No
Declared Groundwater Management Area	No
Metered	No
Sub-areas	No
Announced entitlements (range last 3 years)	No
Carry over	No
Forward draw	No
Seasonal water assignment	No
Consultation Committee	No
Section 25 Water Act 2000	No
Limitations on take (range last 3 years)	No
Pumping hours restrictions	No
Monitoring	2 bores are monitored as per requirements of the Groundwater Level Network (DNRM 2014)
Groundwater dependent ecosystems	No

5.3 Limitations

There are no historical or existing limitations on taking water in the Warrego Alluvium. Similarly, there have not been any restrictions on pumping hours.

5.4 Metering

There is no standardised metering in the Warrego Alluvium. Metering in this groundwater area has been identified as a low priority for the proposed metering roll out program.

5.5 Monitoring

Two monitoring bores hydrographs shown in figures 5 and 6 are included on the Department's Groundwater Level Network. Their monitoring, as per requirements in the Groundwater Level Network, provides information for management and investigation purposes (DNRM 2014).

6 Overall status

The Warrego Alluvium is made up of shallow sedimentary local and intermediate groundwater flow systems of Quaternary and Tertiary Age (DNRW 2007). Water quality from the alluvium is highly variable and ranges from low to moderately good depending on where it is sourced from. It is predominately used for stock and domestic purposes, and irrigation where quality and access is better. Hydrographs from the alluvium situated between Augathella and Charleville (see figures 5 and 6) indicate that the groundwater level responds to seasonal conditions, but is broadly stable.

A relatively small number of licences exist, which source groundwater from the Warrego Alluvium. These licences have a total nominal entitlement of 232 ML. Most demand for groundwater in the area is met by bores tapping the aquifers of the Great Artesian Basin, where supply is more reliable.

7 Bibliography

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Appendix A Summary of details for the Warrego Alluvium SDL area

Table 6: Details for the Warrego Alluvium SDL area

Existing management arrangements	***Y (✓)/N (×)***	**Comments**
WRP	×	
Declared Subartesian Area	✓	Great Artesian Basin Subartesian Area
Moratorium	×	
Groundwater Management Area	×	
Section 25 Limitations[1]	×	
Metering (Schedule 11 Water Regulation)	×	
Existing authorised water use:	***Volume (ML)***	**Number of entitlements**
Water licences	232	9
Estimated stock and domestic use[2]	468	N/A
Anticipated Growth	***Volume (ML)***	**Number**
Stock and domestic (total)	9[3]	
Basin Plan implications	***Volume (ML)***	**Comments**
BDL	700	
SDL	10 200	
Unassigned Water	9 500	

[1] Water Act 2000 section 25 provides power to impose restrictions on the take of water by public notification.
[2] Estimates determined by PB. Refer to report: Methodology for estimating the take of groundwater for stock and domestic purposes in the Queensland Murray Darling Basin.
[3] Assessed as the average number of bores drilled in a year based on the bores drilled between 2001 and 2010, this figure has been converted to ML (PB 2011)

Appendix B

Lithology and depositional environment of outcropping sedimentary rocks and unit lithology environment of the Warrego catchment

The sedimentary rocks of the Eromanga Basin vary in their lithology, depositional environment and their degree of post-depositional weathering, giving rise to a variety of landscapes and soil types. Surface geology is dominated by extensive erosion and re-deposition of both weathered and unweathered materials.

Table 7: Warrego catchment lithology and depositional environment of outcropping sedimentary rocks and unit lithology environment

Unit	Lithology	Environment
Quaternary alluvia	Sand, silt, clay	Fluvial
Glendower formation	Silcrete, quartzose sandstone, sandy conglomerate	Fluvial
Winton formation	Very labile sandstone, siltstone calcareous in part; minor conglomerate, coal	Fluvial and lacustrine
Mackunda formation	Very labile sandstone, calcareous in part, siltstone, mudstone, coquinite	Paralic
Allaru mudstone	Mudstone, siltstone; minor limestone	Shallow marine
Toolebuc formation	Limestone, calcareous siltstone, coquinite	Shallow marine
Wallumbilla formation (Coreena Member)	Very labile sandstone, siltstone, mudstone	Fluvial and paralic
Wallumbilla formation (Doncaster Member)	Mudstone, minor glauconitic sublabile sandstone and siltstone, minor limestone	Shallow marine
Hooray sandstone	Clayey quartzose to sublabile sandstone, conglomerate; siltstone and mudstone	Fluvial
Injune Creek group	Sublabile to labile sandstone, calcareous in part, siltstone, mudstone, quartzose sandstone, minor coal	Fluvial-deltaic with possible minor marine incursions