Environmental Protection (Water) Policy 2009

Regional groundwater chemistry zones:

Fitzroy-Capricorn-Curtis coast and Burdekin-Haughton-Don regions

Summary and results

DRAFT FOR CONSULTATION – NOT GOVERNMENT POLICY

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Front cover: Raglan Creek near the mouth of the Fitzroy River. Image source is from the Departmental archives of DES.

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Executive summary

This report and accompanying mapping identify draft environmental values and water quality chemistry ranges for groundwaters in the Fitzroy and Burdekin regions. The project extent includes groundwaters in the Fitzroy Basin and adjacent Styx, Shoalwater, Waterpark, Calliope, Boyne and Curtis Island basins, and the Burdekin Basin and adjacent Haughton (including Barratta Creek) and Don river basins (Figure 1). More detailed maps accompanying this report are available from the department's website. This report and mapping update the draft groundwater reports for Fitzroy, and Burdekin regions publicly released in 2017, and include additional data, revisions in mapping and other specified updates.

This work forms a basis for the development of groundwater environmental values (EVs), water quality objectives (WQOs), and mapping pursuant to the *Environmental Protection (Water) Policy 2009* – the EPP (Water)[1]. At the completion of consultation and after consideration of all submissions, EVs, WQOs and mapping will be recommended for inclusion under Schedule 1 of the EPP Water, where they inform statutory and non-statutory water quality management planning and decision-making. Amendments to the *Environmental Protection Act 1994* in regard to resource projects and resource activities place a key focus on the impact of the exercise of underground water rights on water quality and environmental values, including requirements under section 126A(2) that an application must also state the following—

> *'(d) the environmental values that will, or may, be affected by the exercise of underground water rights and the nature and extent of the impacts on the environmental values;*
>
> *(e) any impacts on the quality of groundwater that will, or may, happen because of the exercise of underground water rights during or after the period in which resource activities are carried out;'*

This work also complements initiatives to manage and improve water quality in Great Barrier Reef catchments, including the Reef 2050 Long-term Sustainability Plan, and the Reef 2050 Water Quality Improvement Plan 2017-2022.

The report identifies seven major **aquifer classes**: 'Alluvium', 'Fractured rock', 'Cainozoic deposits', 'Mid Great Artesian Basin (GAB) aquifers', 'Lower GAB aquifers and aquitards', 'Basal GAB formations', and 'Earlier sedimentary basins partially underlying the GAB'. Each aquifer class is divided into multiple **groundwater chemistry zones** with reasonably consistent baseline water chemistry. Zone boundaries are shown on mapping in this report, and in larger scale maps on the Department's website, which also show draft EVs by each chemistry zone. A chemistry zone may contain more than one **aquifer**, as well as other geological formations (e.g. aquitards) from the same aquifer class, but the aquifers will generally be closely related. Chemistry zones may extend across (under) surface water basin boundaries. A total of 27 alluvial zones are defined, 14 in the Fitzroy and 13 in the Burdekin. There are 12 fractured rock zones covering mainly basalts, granites and trap rocks, 8 zones to cover the mostly scattered remnants of Cainozoic weathered alluvium and Tertiary sediments, and 16 GAB zones (excluding upper GAB layers which do not extend into the project area). GAB zones are mostly in the southern Dawson headwaters, and some have been merged with corresponding zones in the QMDB. There are also 14 pre-GAB zones covering the Bowen and Galilee Basin sediments which mostly outcrop or underlie the Suttor sub-basin and inland Fitzroy Basin. These sediments account for most of the coal measures, as well as some artesian aquifers.

Water quality percentiles (e.g. 20th, 40th, 50th and 80th percentiles) are provided by chemistry zone in tables 5 (Fitzroy) and 6 (Burdekin) for different indicators (e.g. salinity expressed as electrical conductivity, major ions). For some groundwater zones found closer to stream channels (e.g. alluvial 'near stream'), separate percentile ranges have been provided, given that potential for recent interaction with surface waters can significantly vary water chemistry. The work is based on data collected mostly between the 1960s and the present, and represents a comprehensive dataset, although there are spatial and temporal variations in coverage. Groundwater chemistry data was extracted from the Queensland Department of Natural Resources, Mines and Energy (DNRME) database, and comprises about 29,700 lab-analysed sub-artesian samples, about 1,000 artesian lab-analysed samples, and 1,300 samples for pre-GAB basins. This was supplemented by data from the Office of Groundwater Impact Assessment (OGIA), particularly in the upper Dawson River headwaters (over 100 samples from 18 bores).

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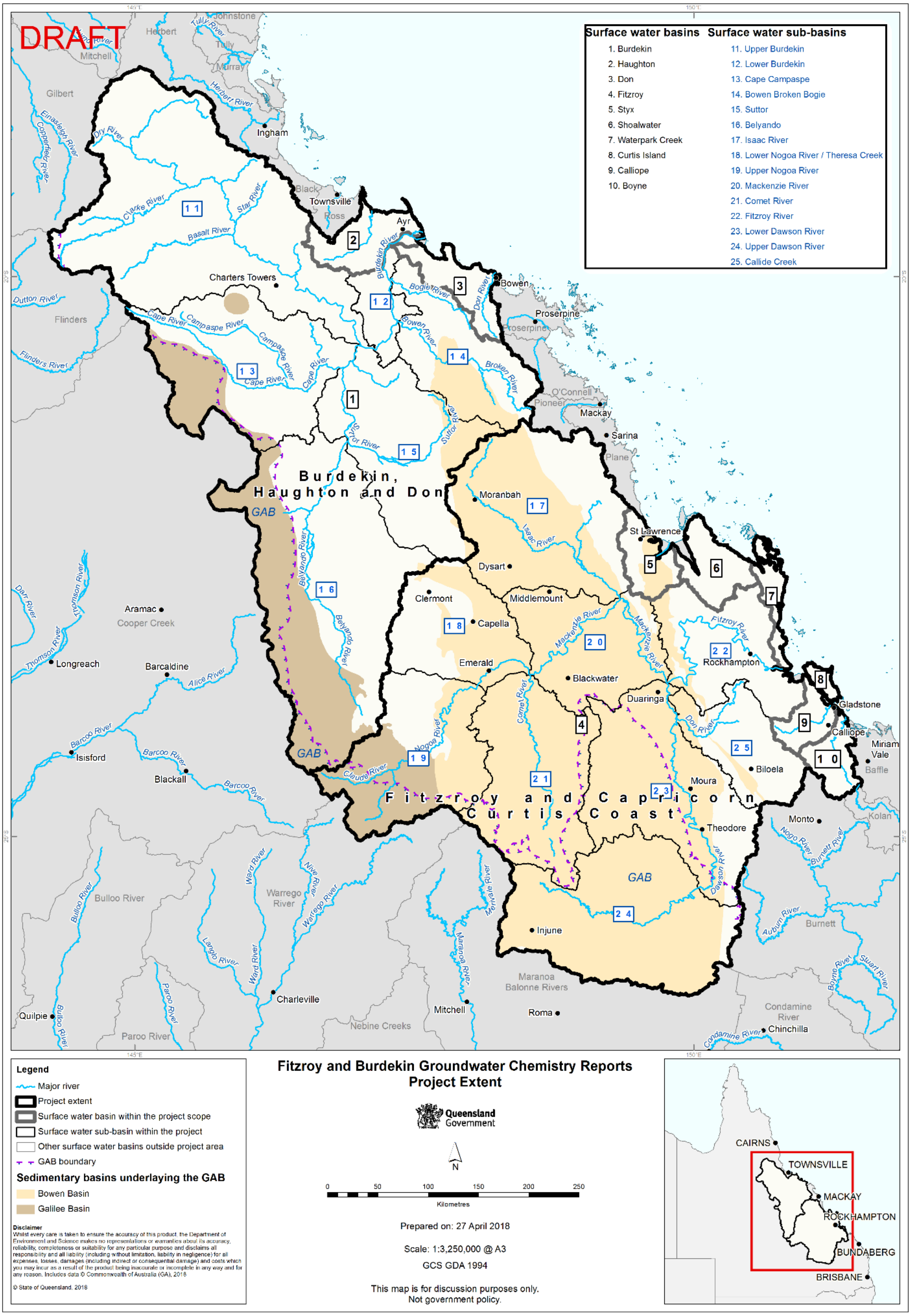
[1] EVs are the qualities of water that make water suitable for supporting aquatic ecosystems and human uses and values (e.g. irrigation, stock watering). WQOs are long-term goals for water quality management that protect environmental values.



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27/04/2018

Figure 1: Project extent

1 Introduction

1.1 The issue

Groundwater quality issues, including salinity and the composition of individual salts, can seriously affect agricultural production, the viability of infrastructure, the health of aquatic and terrestrial ecosystems, and the welfare of regional communities. Within Queensland, groundwater is a major and increasingly significant resource, particularly in rural areas, and supports a range of groundwater dependent ecosystems. Despite its importance, there is limited knowledge and understanding of the groundwater systems over wide areas of Queensland, both because of the size of the state, and because of its low but increasing population density.

Comparatively homogeneous water chemistry zones have previously been defined for Queensland's surface waters, so that baseline ranges could be determined for surface water salinity and water quality parameters. However, the chemical zonation of groundwater is a more complex task, because the sources and flow paths are less clear, spatial variation is three dimensional, and the chemistry is influenced by many factors. Some natural factors include recharge composition, soils, geology and rainfall. Other, more localised influences are related to human activities and the interaction between water bodies. The resulting high natural variability of groundwater chemistry may breach guidelines for environmental values pertaining to surface water, even in the absence of human impacts. This project employed both statistical and conceptual methods to define zones of similar groundwater chemistry within the region (after Raymond & McNeil 2013, 2011).

1.2 Project aim

The aim of this project is to define and characterise groundwater chemistry zones for the Fitzroy and Burdekin regions (Appendix 1), and to calculate background ranges of water quality constituents within them, as an aid to establishing appropriate groundwater quality guidelines for the region (an input to water quality objectives – see below). The calculated ranges exclude outliers caused by either local contamination or small, uncharacteristic aquifers.

The report presents the regional groundwater chemistry zones for the Fitzroy and Burdekin regions of central Queensland, including adjoining coastal areas with hydrological interactions. These areas include the Haughton and Barratta immediately to the north of the Burdekin, and the Don immediately to the south, as well as the Styx, Shoalwater and Waterpark catchments to the north of the mouth of the Fitzroy, the Calliope and Boyne catchments to the south, and Curtis Island.

This study acknowledges that the groundwater chemistry zones and their baseline ranges represent current conditions with varying levels of accuracy, chiefly because data is limited particularly for the pre-European period; however, it is emphasised that these draft values are in line with the precautionary principle (Cousins et al. 2016; Eberhard et al. 2009) in providing a filter to identify outlying sites and sudden or rapid change. Outlying sites may reflect human activity, but may also be a result of naturally atypical geology or hydrology. In areas of high priority, groundwater models or other more intensive assessment methods can be applied at a later date with the support of ongoing data collection. This would allow the ranges to be refined, natural processes to be differentiated, and anomalies due to atypical local aquifers to be identified.

The project intends to inform water quality planning and decision making processes as outlined below.

1.3 Updates to earlier draft reporting

Earlier draft groundwater reports were publicly released in 2017 for Fitzroy and Burdekin regions. Following further review and feedback, methods have been refined and further analysis of datasets undertaken. These are outlined in section 3.

1.4 National water quality management framework

The National Water Quality Management Strategy (NWQMS) is an Australian Government initiative in partnership with state and territory governments. It includes the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (AWQG) and other guidance materials, available from the updated Water Quality Australia website. Under the NWQMS and the EPP (Water), properly developed and approved local water quality guidelines hold higher precedence over state or national guidelines, and form a technical basis for development of water quality objectives (WQOs) under the EPP (Water). This approach enables WQOs to be tailored to reflect regional aquifer conditions.

The development of percentiles as a basis for local WQOs for Fitzroy and Burdekin region groundwaters is in line with this approach to provide the best protection for fresh water-dependent ecosystems.

The AWQG (2000) state:

> "*It is not possible to develop a universal set of specific guidelines that apply equally to the very wide range of ecosystem types or production systems, in varying degrees of health, in Australia and New Zealand. Environmental factors can reduce or increase the effects of physical and chemical parameters at a site and these factors can vary considerably across the two countries. A framework is provided that allows the user to move beyond single-number, necessarily conservative values, to guidelines that can be refined according to local environmental conditions — that is, to developing site-specific guidelines. This is a key message of the Water Quality Guidelines…."*
>
> *"This can produce values more appropriate to a particular water resource. Although tailoring guidelines to local conditions requires more work in some cases, it results in much more realistic management goals. It therefore has the potential to reduce costs for industry*." (ANZECC & ARMCANZ, 2000, Introduction to the guidelines, 8 – 9.)

This message is also reflected in the NWQMS guideline document, *Guidelines for groundwater quality protection in Australia*, available from http://www.waterquality.gov.au/:

> *'Even where guideline values are available, it may be more appropriate to determine guideline values that are specific to an individual groundwater system so that local conditions, groundwater quality and its variability, and community values can be explicitly recognised in the guideline values'* (2013; 19).

Guidance issued by the former Department of Science, Information Technology and Innovation (DSITI) makes similar observations:

> '*Groundwater quality guidelines may be locally defined to consider water quality issues specific to the groundwater system in question*.' (DSITI; 2017; 46)

1.5 Management intent for groundwaters

The AWQG (2000) notes that:

> *'Groundwater is an essential water resource for many aquatic ecosystems, and for substantial periods it can be the sole source of water to some rivers, streams and wetlands. Groundwater is also very important for primary and secondary industry as well as for domestic drinking water, particularly in low rainfall areas with significant underground aquifers.*
>
> *Generally these Guidelines should apply to the quality both of surface water and of groundwater since the environmental values which they protect relate to above-ground uses (e.g. irrigation, drinking water, farm animal or fish production and maintenance of aquatic ecosystems). Hence groundwater should be managed in such a way that when it comes to the surface, whether from natural seepages or from bores, it will not cause the established water quality objectives for these waters to be exceeded, nor compromise their designated environmental values. An important exception is for the protection of underground aquatic ecosystems and their novel fauna. Little is known of the lifecycles and environmental requirements of these quite recently-discovered communities, and given their high conservation value, the groundwater upon which they depend should be given the highest level of protection.*
>
> *As a cautionary note the reader should be aware that different conditions and processes operate in groundwater compared with surface waters and these can affect the fate and transport of many organic chemicals. This may have implications for the application of guidelines and management of groundwater quality.'* (ANZECC & ARMCANZ 2000, The Guidelines, Box 1.2; p1-2)

Accordingly, the intent is to maintain current water quality (where water quality is in natural condition). Where there is evidence of anthropogenic disturbance in groundwater quality, a long term goal to improve water quality may be established and reflected by the adoption of water quality objectives for affected indicators.

Further details on groundwater planning and management are contained in the NWQMS guideline document, *Guidelines for groundwater quality protection in Australia*. It outlines a process to support the overall objective of the NWQMS, focusing on protecting and enhancing groundwater quality to support the nominated environmental values and preventing groundwater contamination.

1.6 Environmental Protection (Water) Policy

The quality of Queensland surface and groundwaters is protected under the Environmental Protection (Water) Policy 2009 – the EPP (Water). The EPP (Water) achieves the object of the *Environmental Protection Act 1994*, to protect Queensland's waters while supporting ecologically sustainable development. It provides the structure for establishing environmental values (EVs), management goals and water quality objectives (WQOs), including consulting with stakeholders, and considering the economic and social impacts of protecting EVs. At the completion of consultation and consideration of all submissions, EVs and WQOs are recommended for inclusion in Schedule 1 of the EPP (Water).

Fitzroy Basin EVs and WQOs (surface and groundwaters) were scheduled in 2011. Capricorn-Curtis Coast EVs/WQOs were scheduled in 2014. Burdekin Haughton-Don region waters are not currently scheduled. Post feedback and any further amendment, the consultation draft groundwater information and mapping for these areas would form a basis for updates to groundwater EVs and WQOs under the EPP (Water) in the above areas. For information on review processes for surface water EVs and WQOs, refer to the department's website.

EPP (Water) EVs and WQOs inform statutory and non-statutory water quality management planning and decision-making. In particular, recent amendments to the *Environmental Protection Act* in regard to resource projects and resource activities have placed a key focus on the impact of the exercise of underground water rights on groundwater quality and environmental values:

> '**126A Requirements for site-specific applications—particular resource projects and resource activities**
>
> *(1) This section applies to a site-specific application, involving the exercise of underground water rights, for—*
>
> *(a) a resource project that includes a resource tenure that is a mineral development licence, mining lease or petroleum lease; or*
>
> *(b) a resource activity for which the relevant tenure is a mineral development licence, mining lease or petroleum lease.*
>
> *(2) The application must also state the following—*
>
> *(a)-(c)…*
>
> *(d) the environmental values that will, or may, be affected by the exercise of underground water rights and the nature and extent of the impacts on the environmental values;*
>
> *(e) any impacts on the quality of groundwater that will, or may, happen because of the exercise of underground water rights during or after the period in which resource activities are carried out;*
>
> *(f) strategies for avoiding, mitigating or managing the predicted impacts on the environmental values stated for paragraph (d) or the impacts on the quality of groundwater mentioned in paragraph (e).'*

This report and related mapping identify environmental values and establish water quality percentiles (as a input to WQOs) by groundwater chemistry zone across multiple indicators including major ions, salinity, metals, pH, nutrients, and sodium adsorption ratio. If the general water quality characteristics of the environment are known, the certainty attached to site specific testing is enhanced, and efforts can be focussed on relevant gaps.

1.6.1 Environmental values

EVs are the qualities of water that make water suitable for supporting aquatic ecosystems and human uses and values (summarised in Appendix 2 - e.g. irrigation, stock watering, drinking water, recreation, cultural and spiritual values). Refer to the EPP (Water) for more details. The *Guidelines for groundwater quality protection in Australia* note that:

> *'More than one environmental value category will often be applicable for a single groundwater system. Different parts of the groundwater system and connected surface water systems may*

> *also be assigned different environmental value categories due to natural variations in quality and value or variable land uses across the extent of the aquifer. This may result in the need to delineate zones of the groundwater system that encapsulate the different categories.' (2013; 19)*

Mapping of human use/value EVs based on interpreted groundwater uses and values was included in the draft groundwater reporting publicly released in 2017 for Fitzroy, Burdekin, and Don-Haughton basins. (Fitzroy EVs had previously been scheduled under the EPP [Water] in 2011 and Capricorn-Curtis Coast EVs in 2014). Updates to EVs are summarised in section 3 of this report, and shown in plans accompanying this report available from the department's website. These include specification of EVs by groundwater chemistry zone. Post-consultation feedback and any further amendment, final EVs will be recommended for inclusion in the EPP (Water) amendment materials.

1.6.2 Water quality objectives

WQOs are long-term goals for water quality management that protect environmental values. They are typically established for a range of water quality characteristics. For human use environmental values (e.g. irrigation, stock watering), WQOs under the EPP (Water) are typically based on national water quality guidelines, including Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) and Australian Drinking Water Guidelines (NHMRC, 2004, as amended). Tables containing links to source national guidelines were included in surface water reports for Fitzroy, Burdekin and Don-Haughton basins released in 2017 for public comment. They will be reviewed for updates when included in EPP (Water) schedule documents.

The *Guidelines for groundwater quality protection in Australia* note that:

> *'In some circumstances, the natural groundwater quality will exceed some of the water quality guideline values for the agreed environmental value category. In this case, the groundwater quality should be maintained within the natural range of variability. This approach would require a detailed baseline assessment to establish natural groundwater quality and variability upon which the water quality objectives and guideline values can be based.' (2013; 20)*

This report includes background water quality results (as a range of percentiles) from the updated analyses of data. Based on analysed data, Table 4 of this report provides broad commentary on the characteristics of chemistry zones and a general indication of their potential suitability for different human water uses, relative to guideline values. Note that to ascertain suitability of a specific water source (e.g. a bore) for a given use (e.g. irrigation) more detailed testing may be required, and the broad results in Table 4 are not intended to provide this level of detail.

For the aquatic ecosystem EV, this can include both aquatic ecosystems that solely inhabit groundwater (including bacteria, e.g. iron reducing reducing bacteria, stygofauna, e.g. crustaceans, beetles, worms), and groundwater dependent ecosystems (GDEs). However the *Guidelines for groundwater quality protection in Australia* note that '*no water quality guidelines are available for these (stygofauna) communities*' and that '*there are currently no water quality guidelines for groundwater-dependent ecosystems (GDEs) that rely on the subsurface presence of groundwater* (vegetation)' (2013; 35). This status is also reflected in the DSITI groundwater guideline (2017; 47).

Further information on subterranean habitats and fauna is available from the WetlandInfo website, and from the Queensland Subterranean Aquatic Fauna Database, which provides a catalogue of subterranean aquatic fauna sampling undertaken in Queensland. These environments and their supported stygofauna include:

- lack of sunlight and corresponding stable temperature (minimal daily or seasonal change)
- low/limited nutrient supply from external sources (and no primary photosynthesis)
- generally stable water quality (within a given aquifer, but may vary spatially across different aquifers)
- reliance on a minimum pore space to enable habitation (where pore space varies by geology)
- high degree of endemism (adapted to local habitat conditions)
- low dispersal capabilities
- low reproduction rates
- high sensitivity to changes in water quality relative to natural conditions

Hose et al (2015) note that:

'*Stygofauna are generally adapted to stable environmental conditions, including water quality. Changes to water quality that are beyond the range of conditions normally experienced by stygofauna pose a threat to their survival*.' (2015; 40)

The Department's *Monitoring and Sampling Manual* reports that in Queensland stygofauna have been described at depths of up to 60m below ground, at electrical conductivities above 50,000µS/cm and in both acidic and alkaline environments (DES, 2018).

In relation to pH, Hose et al. note that:

> '*Importantly, it is changes to pH away from the typical background level that are likely to be problematic for stygofauna, as they are for other freshwater invertebrates…. thus requiring understanding the local conditions in order to assess the risks associated with changed in water quality*.' (Hose et al., 2015; 42)

For salinity they note that:

> '*Field studies…suggest that the salinity tolerance of most stygofauna is limited to salinity level (measured by water electrical conductivity) less than 5000 µS/cm…. It might be expected then that changes to salinity of groundwater above 5000 µS/cm may by (sic) toxic to stygofauna. However, this threshold does not indicate the sensitivity of stygofauna to changes in salinity; those inhabiting and adapted to relatively fresh groundwater will be potentially sensitive to changes well below this level. It is likely that stygofauna are adapted to local conditions so that changes from background salinity could be deleterious*.' (Hose et al., 2015; 41)

Accordingly, for the aquatic ecosystem EV, this report establishes background water quality percentile values for pH, salinity and other indicators by groundwater chemistry zone. For larger alluvial zones, this report identifies percentiles for groundwaters found closer to stream channels ('near stream') because of the potential for recent interaction with surface waters, which can significantly vary the water chemistry. The full suite of indicators and percentiles is shown in Appendix 3 (Tables 5 and 6). These percentiles are intended to form a basis for derivation of aquatic ecosystem groundwater WQOs under the EPP (Water). The intent is to maintain current water quality (20^{th}, 50^{th} and 80^{th} percentile ranges) where water quality is in natural condition. Where there is evidence of anthropogenic disturbance in groundwater quality, a long term goal to improve water quality may be reflected by adoption of an alternative (e.g. 40^{th} percentile) value.

1.7 Great Barrier Reef water quality projects

This work is complemented by a range of projects to address water quality in Great Barrier Reef catchments. Further work has been undertaken to develop basin-specific load targets for Great Barrier Reef catchments, including the Burdekin and Fitzroy basins.

The *Reef 2050 Long-Term Sustainability Plan*, prepared by Australian and Queensland governments, is the overarching framework for protecting and managing the Great Barrier Reef from 2015 to 2050. The Plan is a key component of the Australian Government's response to the recommendations of the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Committee. At the core of the Plan is an outcomes framework that will drive progress towards an overarching vision:

> '*To ensure the Great Barrier Reef continues to improve on its Outstanding Universal Value every decade between now and 2050 to be a natural wonder for each successive generation to come*.'

The *Reef 2050 Water Quality Improvement Plan 2017-2022* is a nested plan under the water quality theme of the Reef 2050 Plan. The plan addresses all land-based run-off flowing from the catchments adjacent to the Great Barrier Reef. The plan contributes to delivering a net benefit for the Reef ecosystem and the social, cultural, environmental and economic values it provides. The objectives of the plan align with the themes of Reef 2050 Plan. The plan includes 2025 end of catchment load targets for reductions in dissolved inorganic nitrogen, fine sediment and particulate nutrients based on Great Barrier Reef Marine Park water quality guidelines for healthy corals and seagrass. It includes a concentration-based target for all reef basins for pesticides to achieve protection of 99% of species at the end of catchment.

Under the Enhancing and broadening reef regulations proposal, the Queensland Government released for public comment a consultation regulatory impact statement (RIS). The RIS looked at the costs and benefits of the regulatory proposals to reduce land-based pollutants flowing to waterways and the Reef. Complementing the concentration-based draft objectives in this report, the draft reef regulations propose that end of catchment load targets in the *Reef 2050 Water Quality Improvement Plan* will also be included in the EPP (Water) to inform decision-makers about how best to manage risks to water quality.

2 Project scope

2.1 Regional setting

The Fitzroy and Burdekin regions cover considerable variations in climate, topography and landuse. Rainfall is characterised by a distinct summer wet season (December–April), and although it can exceed 2,000mm in the northeast, it declines southward and inland to an annual average of approximately 500mm over the majority of the area (DNRM 2002). In addition, the unusually high rainfall variability results in intermittent major floods (Nicholls1988). As a result, rivers in the dry inland areas are highly ephemeral, the proportion of rainfall contributing to runoff being estimated as averaging seven per cent (Gordon 2007; Pulsford 1993).

Topographic data (GA 2004) shows that most of the landscape is flat to undulating, with the low lying coastal plains rising to broad tablelands in the interior. However, hilly to mountainous headwaters are associated with the Great Dividing Range, particularly in the north around the Upper Burdekin Sub-basin, the southwestern boundary with Fitzroy and Burdekin regions around Carnarvon, and on parts of the watershed between the Fitzroy and Burdekin basins. Hydrological complexity is added to by extensive stream regulation through large storages such as the Burdekin Falls Dam in the Burdekin, Fairbairn Dam in the Fitzroy and by a series of weirs, particularly in the on the Fitzroy and Dawson Rivers. Inter-basin transfers of water also take place, from the Burdekin to the Haughton River via Clare Weir, and from Awoonga Dam on the coast to Callide Dam behind the coastal range.

Landuse data (DSITI 2017) indicates grazing on native pastures as the predominant use, but there are significant areas of cropping including groundwater irrigation, mostly for sugar in the coastal areas and cotton inland. There are extensive coal seams in the region, while other mining activities are associated with metals and gem stones (DNRM 2008). There are also a number of national parks, such as Carnarvon Gorge, Mount Etna Caves, Bowling Green Bay, and Dalrymple (DNPSR 2017). The major towns include Rockhampton, Gladstone, Emerald, Ayr and Charters Towers.

2.2 Geology and groundwater

Although climate and local hydrology are also important, the varied and complex geology of the Fitzroy and Burdekin regions, as described in Day (1983) and Radke et al., (2012), has a major influence on groundwater quality. The most significant geological features in the region from a groundwater quality perspective are the Precambrian shield, the Great Dividing Range (GDR), the Pre-Great Artesian Basin (GAB) Bowen and Galilee Basins, and the eastern edge of the GAB, including some of the recharge area. Overlying these units are widespread Cainozoic deposits, recent alluvials, and Tertiary basalts. Refer to the glossary for further definitions.

The geology across the Fitzroy and Burdekin regions is shown on Figures 2 and 3 (adapted from the Queensland geology map provided by DNRM [2015]). A colour scheme has been adopted which summarises the geology to highlight the aspects of most significance to water quality.

The geological structure of the Fitzroy and Burdekin regions is centred on the Tasman Fold Belt System, although the western edge is now obscured by more recent geological formations (Rast et al. 1983). The Tasman Fold Belt developed along the eastern side of Australia before separation from Gondwanaland. The structure began to form in the Precambrian, continuing into the early Mesozoic, as material was eroded from a previously formed continent to fill a deep, offshore trench to the east. This process was accompanied by copious volcanic activity. The mainly Palaeozoic marine sediments and volcanics that had accumulated in the trench were folded, metamorphosed and intruded by granite over several episodes during the long period that the fold belt was active (Foster 2016; Richard et al.1983; Wood 2006).

By the middle of the Palaeozoic, the Tasman Fold Belt had stabilised in the west, and joined with the old continent (craton) to form a basement block. The basement then began to sag into depressions, which rose and fell over time, forming subsequent generations of sedimentary basins over a changing hydrological landscape. The first of these to form was the Drummond Basin, a large, predominantly freshwater system, which was later uplifted and eroded (Olgers 1969). Eastern and western remnants of the Drummond are now exposed over much of the Suttor catchment. The area between these remnants has been completely eroded away, in places, down to the Precambrian basement (Wood 2006). This central strip dividing the remains of the Drummond now extends through the Suttor and into the Nogoa catchment, and is known as the Anakie Inlier. It is rich in mineral deposits, particularly gold, with gems around Rubyvale at its southernmost extension. The Drummond Basin sediments are low porosity, and tend to yield moderate to very saline, sodium chloride groundwaters, while the fractured trap rocks of the Anakie Inlier have a very variable water chemistry, with the metamorphics being the freshest.

As the Drummond Basin was rising, the basement on either side sagged downwards to form new adjoining and partially overlapping depressions. These were the Galilee Basin to the west, and the Bowen Basin, slightly later, in the east. The Bowen and Galilee basins are separated by the Springsure Shelf, a north-trending sub surface ridge between Anakie and Springsure (Esterle et al. 2002). The Bowen Basin is a major source of coal in Queensland, and is exposed over a large, triangular-shaped area of central Queensland, being 600km long and up to 250km wide. It is mostly located in the Fitzroy, where it underlies virtually all of the Dawson, Comet and Mackenzie sub-basins, as well as large parts of the Isaac. It extends north into the Burdekin Basin, partially underlying the Bowen and Suttor sub-basins, and south beneath the Surat Basin and into New South Wales. An eastern extension of the Bowen Basin, containing rare, Mesozoic coals, reaches the coast in the Styx Basin. The earliest beds of Bowen Basin sediments, laid down on the remains of the Drummond Basin and Anakie Inlier, were mostly volcanics. They were followed by a sequence of Palaeozoic coal measures interspersed with both marine and freshwater sediments (Mutton 2003; Veevers et al.1964), but by the Mesozoic, all deposition was terrestrial, forming three, basin wide formations: the Rewan, the Clematis Sandstone, and the Moolayember. The Rewan is composed of low porosity sandstone and mudstone, but the Clematis is predominantly quartzose and an effective aquifer. The Moolayember aquitard completes the sequence.

Groundwater in the eastern and northern Bowen Basin exposures is normally extracted from the coal bearing Back Creek and Blackwater Formations. It is usually moderately to very saline, and dominated by sodium chloride. However, groundwater bores in the south, particularly from around the southern and western tributaries of the Dawson and eastern tributaries of the Nogoa are mainly accessing the upper Clematis Sandstone and Moolayember Formations, which yield moderately saline, sodium bicarbonate water, similar to that of the Great Artesian Basin (GAB) springs which are present in the area. Some parts of the Bowen are thickly overlain by basalts, the influence of which produces a less saline water, with more even cations. (Herczeg 2008, 1991).

The Galilee Basin overlies the Drummond Basin, and consists of a sequence of Middle Palaeozoic to early Mesozoic, mainly freshwater sediments with minor marine influences. Much of the Galilee Basin is concealed beneath the Eromanga, but the eastern edge is exposed along the western border of the Suttor catchment, extending into the northern Nogoa catchment. The sediments are of similar age to those of the Bowen Basin, but the older beds are mostly terrestrial, with some volcanics. Coal was deposited in the late Palaeozoic to early Mesozoic, along with some volcanics. Subsequent uplift led to more terrestrial sedimentation, including the Rewan–Clematis–Moolayember succession which also occurs in the Bowen. As with the Bowen, the Galilee was uplifted with slight folding during the early Mesozoic, and a period of erosion followed before the onset of Eromanga sedimentation (Day 1983; Esterle et al. 2002, p. 56; Van Heeswijck 2010). Most of the groundwater in the Galilee Basin is extracted from the Warang and Clematis Sandstones. Much of it tends to be saline with a sodium chloride chemistry, except in the south, where the Clematis within the Nogoa Catchment produces moderately saline sodium bicarbonate groundwater, as is typical of GAB aquifers.

The chemistry of other Pre-GAB aquifers, such as the Callide Creek Coal Measures and the Colinlea Sandstone in the Springsure Shelf area between the Bowen and Galilee, have variable chemistry, but are usually of moderate salinity with evenly proportioned cations.

Another period of gentle folding and uplift in the early Mesozoic ended the formation of the Bowen and Galilee Basins (Dickins & Malone 1973), which were then eroded till about 200 million years ago, when the surface once again began to sag into a new series of depressions. This again totally altered the drainage system, and led to the formation of the Great Artesian Basin (GAB). In the Queensland section of the GAB, the depressions formed as two major sub-basins divided by the Nebine Ridge which is now covered by sediment. The Surat Basin lies to the east of the ridge, and the Eromanga Basin to the west. These new depressions were filled by a sequence of permeable quartzose sandstones, alternating with relatively impermeable confining beds of mudstone and siltstone (Habermehl & Lau 1997). Only the eastern edge of the Eromanga and the northern edge of the Surat are within the Fitzroy Burdekin regions, but crucially, they include intake areas in the southern Fitzroy Basin, and the western edge of the Burdekin Basin, where recharge occurs through surface water, either directly to the aquifers or through more recent intervening beds. The GAB aquifers typically yield sodium bicarbonate groundwaters of moderate salinity, and some corrosive tendencies.

The GDR was uplifted around 65 to 32 million years ago, tilting the GAB to the southwest and creating artesian pressures in the aquifers. As a result, springs broke out along structures such as fault lines, thin confining beds, or other obstructions to flow. Lines of such springs are found in sandstone terrains around the southern headwaters of the Dawson, and the watershed between the Comet and Dawson catchments.

The uplift also brought about the extensive basaltic eruptions which occurred over the last 20 to 2 million years. Lava flows were widespread over the emerging range, but subsequent erosion has now mostly reduced them to dissected remnants which are widespread as volcanic necks or basalt capped mesas (GABCC 2014). However, extensive areas remain in the northern and southwestern sections of the Upper Burdekin Sub-basin, and along the northern and eastern watersheds between the Nogoa and its adjoining catchments. The basalt itself is pervious in many areas, and produces groundwater which is unusually high in magnesium compared to most groundwaters in Queensland (McNeil et al. 2005).

At the beginning of the Cainozoic, (the era that began at the end of the Mesozoic, about 65 million years ago, continuing through the Tertiary to the present), the landscape of central Queensland was subject to intense chemical weathering due to the prevailing climate, in places to over 100m depth. Silica was leached from the surficial horizons, leaving clay with iron stained bands. The dissolved silica was flushed lower in the soil profile as a gel, where it solidified into rocky layers and masses known as silcrete. Removal of overlying material by subsequent erosion exposes the silcrete, resulting in a hard, stony surface referred to as duricrust which is still evident in places as flat topped uplands. Tertiary freshwater sediments such as the Biloela Formation which were being deposited at the time were also subjected to these weathering regimes. Large floodplains were formed over the Cainozoic landscape, but a drying climate over the last 12 million years has reduced stream discharge, and left the original floodplains, referred to as Cainozoic or weathered alluvium, covering larger areas than are presently active. Weathering has greatly reduced their permeability (Croke et al. 2011; Jones 2006), and although they may contain limited supplies of groundwater it is usually saline (1,500–5,000µS/cm as defined in Table 2) and high in sodium chloride.

The upper reaches of the current stream channels are often deeply incised into the surrounding Cainozoic systems, developing small recent floodplains around them (Croke et al. 2011). These recent alluvials usually yield good quality groundwaters which may be relatively hard in terms of usage guidelines, but limited recharge increases their vulnerability to hydrological stress, with consequent risk of contamination from saline seepages issuing from adjacent older deposits. An example of this is the western edge of the Callide Creek alluvium, where saline seepages have contaminated the floodplain during times of hydrological stress.

When the GDR initially formed, the divide between coastward and inland draining catchments was further to the east. However, the higher coastal rainfall and steeper topography enabled the coastal Fitzroy and Burdekin Catchments to cut through the GDR and form extensive river systems in the drier landscapes behind the coastal ranges. The most extensive inland floodplains are in the Dawson catchment including the Callide Creek, and the Emerald area, which are utilised for both dry land and irrigated cropping, and the coastal area, particularly around the Burdekin Delta, where sugar cane is irrigated. Elsewhere grazing is the main rural industry, with mining also significant.

The Burdekin Delta is a major irrigation area situated in the dry tropics of North Queensland. Hopley (1970) describes the 500km² delta (up to 1,250km² if the adjoining floodplain is included) as the largest cuspate delta in Australia, with coastal landforms being influenced by Burdekin River distributaries between Cape Upstart in the north, and Cape Cleveland in the south. It formed over Palaeozoic trap rocks during the Holocene, with the landscape and climatic conditions of the Burdekin Basin being conducive to a rapid build-up of sediment. These conditions included generally moderate relief, an abundance of unconsolidated weathered material accumulated since the Tertiary, and the passage of the river over the Burdekin Falls at the edge of the Tertiary erosion surface only 130km from the coast.

The delta has been the subject of extensive groundwater monitoring and modelling to promote its sustainable management (McMahon et al. 2000). It is flood-dominated, rather than being strongly wave-influenced (Bristow et al. 2000; Fielding et al. 2005; Narayan et al. 2006). The complex aquifer system consists of laterally discontinuous lenses of alluvial and deltaic sands and gravels, which are embedded in silts, clays, and organic mud to a maximum depth of around 150m (Hopley 1970) with outcrops of bedrock in the south and southwest. The hydrology and water quality of the delta is correspondingly complex, and more so because sea level fluctuations during the Ice Age led to residual salinity patterns resulting from spells of inundation and retreat. Lenehan and Bristow (2010) reported increases in groundwater salinity as a result of evapotranspiration of irrigation water, leaching of salts from deeper soil layers to the aquifer, increased contamination with relict seawater, and recent seawater intrusion.

Other water quality problems known to affect the groundwater are the presence of acid sulphate soils in low lying coastal areas (Powell & Martens 2005), and pesticides as detected by Shaw et al. (2012) in a number of bores in the Burdekin delta and Irrigation Area. Of the pesticides, Shaw et al indicated that none exceeded human health guidelines for drinking water (NHMRC 2011), although chlorpyrifos concentrations were above the ecosystem health guideline (ANZECC, 2000). A study by Vardy et al. (2015) indicated exchange of pesticides and nutrients between ground and surface water in the riparian zones of the lower Burdekin River and Barratta Creek alluvials. Monthly sampling was carried out over an 18 month period, where groundwater nitrate frequently exceeded QWQG guidelines, as did phosphate occasionally. Eighteen pesticides were measured in the groundwater, with concentrations being generally low at most sites. The most commonly detected was the herbicide atrazine with its breakdown products, which were present at all sites. Of all the pesticides measured, only diuron and metolachlor were detected at concentrations above ANZECC (2000) guidelines, and neither reached the Australian Drinking Water Guidelines (NHMRC 2011).

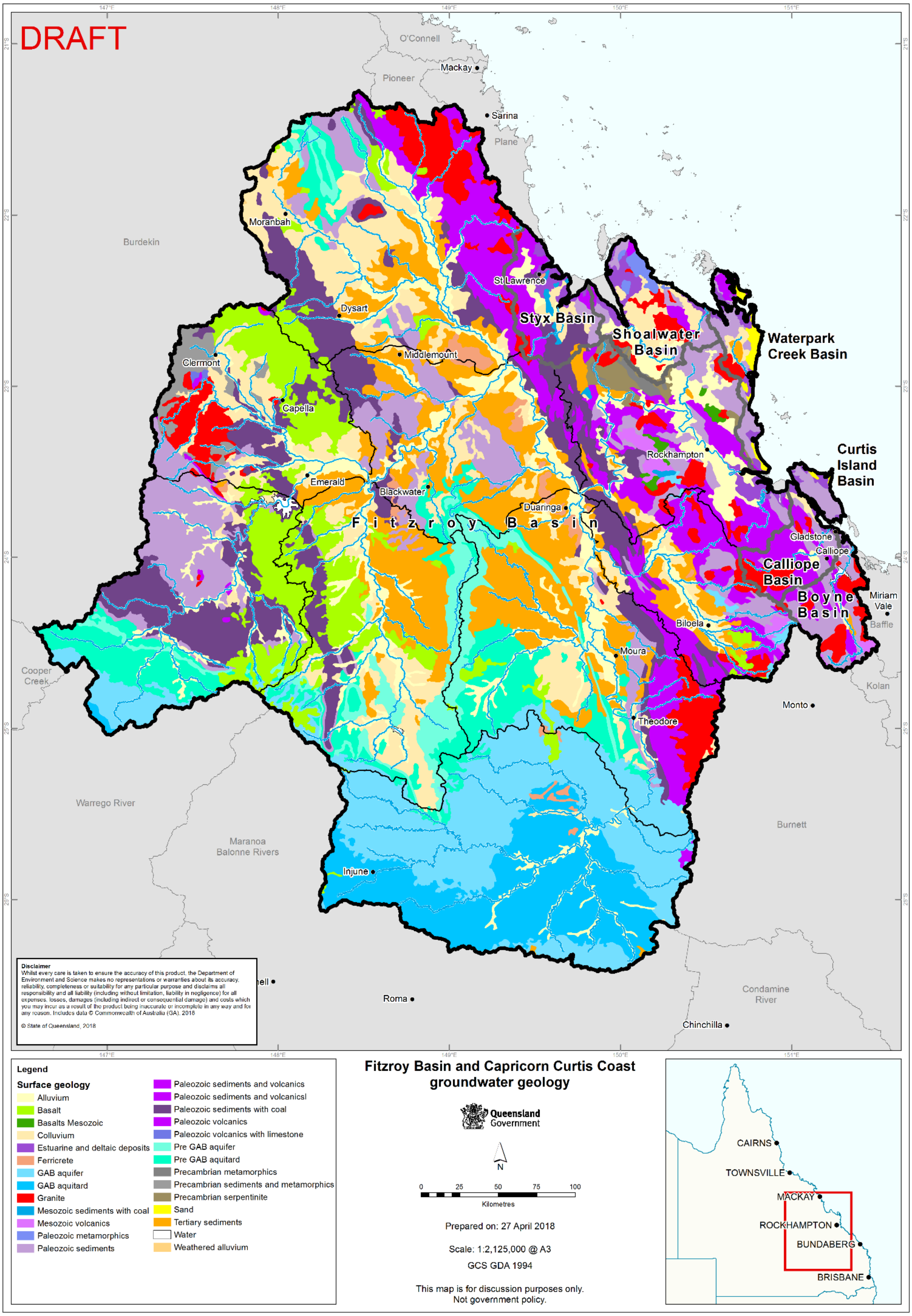

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Figure 2: Surface geology of Fitzroy and Capricorn-Curtis Coast

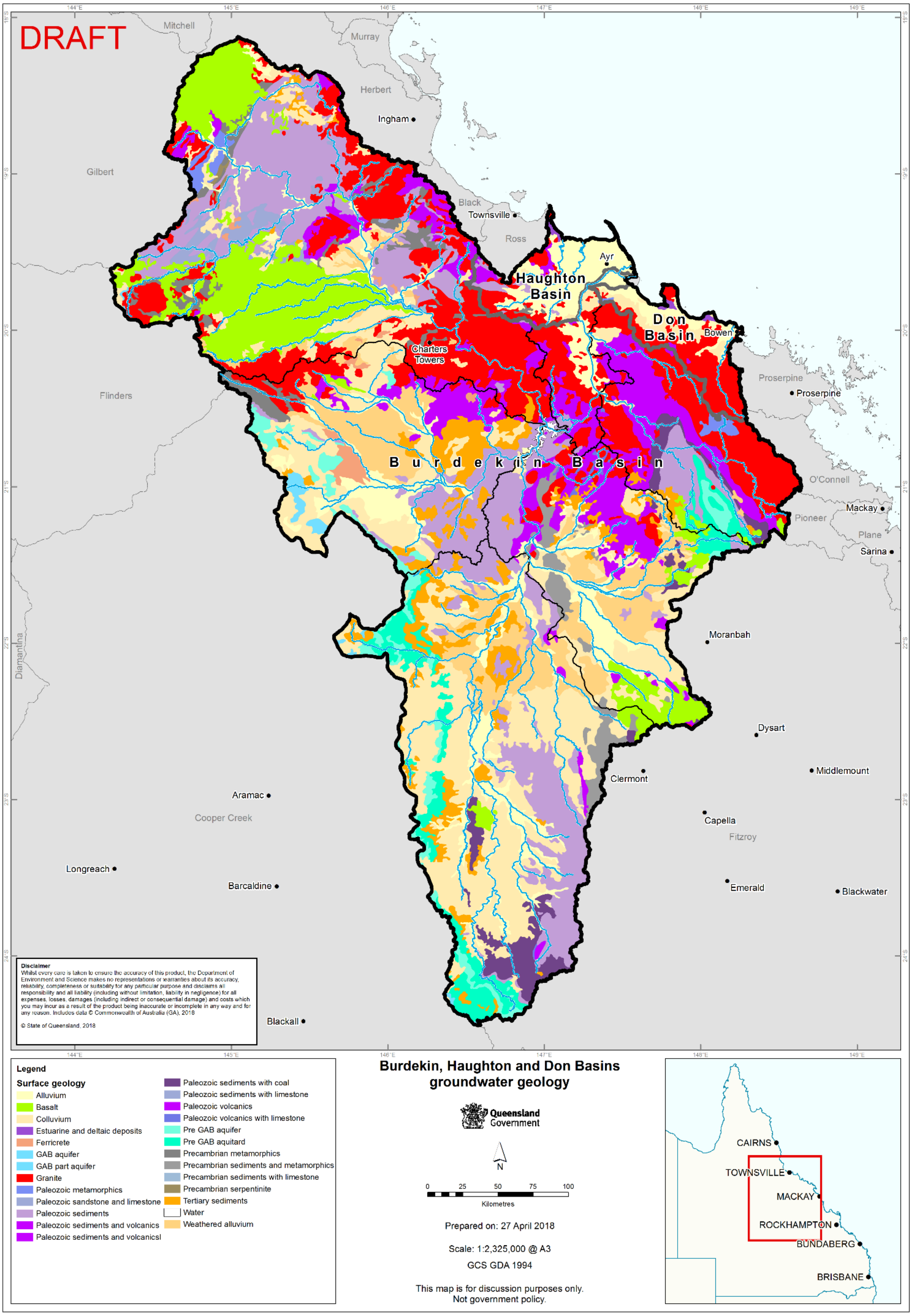

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Figure 3: Surface geology of Burdekin, Haughton and Don basins

2.3 Aquifer class, aquifer types and permeability

Groundwater has been defined by many sources such as (Kresic 2007; Marsily 1986; Manning 1997; NWS NOAA 2017; Sen 2014). In summary it can be considered as any water which lies in the saturated zone below the water table, the point where all interconnected pores or voids within soils, rocks, and permeable sediments are saturated. It does not include soil moisture, or the capillary fringe peripheral to the water table, where porous material remains damp from upward seepage. Further information on groundwater types and processes (including conceptual models) is available from WetlandInfo and in the DSITI groundwater guideline (2017).

The term 'aquifer' does not have a precise definition, but it can be described as 'a layer of rock or sediment that contains sufficient permeable material to store and transmit significant quantities of water to wells, springs and groundwater fed (gaining) streams.' The permeability (or hydraulic conductivity) of a material is its capacity to transmit water (in m/day) at a hydraulic gradient of one (a 45 degree slope), so that the actual flow transmitted is the permeability multiplied by the existing hydraulic gradient (Ferris et al. 1962). This definition of an aquifer is partially subjective, as the term 'significant quantities' of water depends on the required use. For instance, a permeability of less than 1m/day may be satisfactory for domestic purposes (Drever 2005), but not for irrigation.

Aquifers are classified as either confined or unconfined, and then by the type of material or lithology that they are composed of. In an unconfined aquifer, the water table fluctuates freely with variations in recharge, groundwater flow and pumping rates, and the hydraulic gradient is calculated as the difference in water table elevation between two points. By contrast, a confined aquifer is overlain by an aquiclude or confining layer. An aquiclude or confining layer is a bed of rock or sediment which, although it may be porous and capable of storing water, can only transmit it at negligible rates. If a confined aquifer is penetrated by a bore, the water will rise to the potentiometric surface, which is an elevation related to the height of the recharge source and hydraulic gradient. This may be above the local water table or even the ground surface. A layer that retards but does not prevent the flow of water to or from an adjacent aquifer is referred to as an aquitard, and the adjacent aquifer is semi-confined, or leaky aquifer. Distinguishing between aquifers and aquitards is often particularly difficult within the GAB because of complex hydrology and structural disruptions such as faulting and fracturing.

To better represent the variability of geological formations in the GAB (GABCC, 2014), Smerdon et al. (2012) expanded classifications into five intermediates: 'aquifer', 'partial aquifer', 'leaky aquitard', 'tight aquitard' and 'aquiclude'. Rocks such as unweathered granite which have no interconnected voids and are unable to store or transmit water are referred to as aquifuges.

AGSA (2017) class aquifer lithology as unconsolidated or consolidated. Unconsolidated sediments are generally unconfined, and made up of soft loose, friable, surficial material, ranging from clay to sand to gravel. In Queensland unconsolidated aquifers mainly occur in alluvium, dune sands, colluvium, lake bed, or coastal and deltaic deposits. Of these, alluvium deposited in river channels or on floodplains provide the most productive aquifers in the State. For this assessment, the alluvium has been further subdivided at 30m below surface into shallow and deeper categories, so that the groundwater chemistry zone percentiles can take account of the differing water quality processes that operate at depth.

Consolidated aquifers are composed of either fractured rocks, for example granite, limestone, basalt, and metamorphics, or sediments such as sandstone, siltstone and shale which are cemented but contain pore spaces. In fractured rock aquifers, the groundwater is stored in fissures, joints, bedding planes and cavities. Yield is extremely variable, and recharge is usually local and intermittent. The most important type of fractured rock aquifer in Queensland in terms of groundwater yield is porous basalt, with occasional supplies also found in granites, limestones, and trap rocks (metamorphics, volcanics and deep water marine sediments) usually associated with the Great Dividing Range (GDR). Basalts were deposited over the landscape as lava flows interbedded with other volcanic materials and sediments. Water is stored in and flows through vertical joints, interflow deposits, and the tops and bottoms of flows which are cracked by rapid cooling, and contain porous vesicles formed by escaping gases (Singhal & Gupta 1999). Groundwater associated with Queensland basalts tend to be high in magnesium. They are also rich in the accessory mineral olivine. Drever (2005) showed that if a basalt contained even a small percentage of olivine, this could release sufficient magnesium to account for the relatively high proportion observed in basaltic groundwaters.

Another distinctive type of consolidated aquifer is formed by the dissolution of carbonate geology such as limestone, dolomite, or marble. As explained by AGSA (2017), fractures and weathered zones may become considerably enlarged due to dissolution of the rock by carbon dioxide and soil acids in percolating waters, and the rock may become sufficiently porous to store and transmit large quantities of groundwater. The resulting landscape, known as karst, contains unusual surface and subsurface features including sinkholes and caves, springs and disappearing streams, as well as complex underground drainage systems. The water quality of karst aquifers tends to be very hard because of the dissolved calcium and magnesium bicarbonates, but such aquifers are rare in Queensland, and of limited extent.

Although less permeable than alluvium and fractured rock aquifers, consolidated sediments cover vast areas. They may retain significant intergranular porosity, depending on how well the grains are rounded and sorted, and the extent to which they are cemented together, particularly in coarse grained sandstones. Bedding planes in sediments also enhance porosity, and the structure of the rock is also relatively soft and weak, and therefore prone to fracturing (Kresic 2007). These aquifers are an important resource for Queensland, particularly the major confined sandstone aquifers of the GAB. There are also several smaller sedimentary basins of various ages which are not part of the GAB, as well as underlying terrestrial basins such as the Bowen and Galilee, which predated the GAB and were uplifted and eroded before its formation. Some of these non-GAB sedimentary sequences contain locally important aquifers, or other resources such as coal and oil shale.

The extensive Cainozoic deposits which overlie the GAB are mostly unconsolidated, but they also include sandstone such as the Glendower Formation as well as weathered alluvium. The Cainozoic alluvial flood plains overlying much of the GAB cover a greater area than their modern counterparts because they were deposited in wetter periods during the Cainozoic (Radke et al. 2012), and, because of stream piracy following uplift of the Great Dividing Range, westward flowing streams lost their high rainfall headwaters to the steeper eastern catchments (GABCC 2014; Herbert 1980). These systems were then subjected to the intense weathering regimes that occurred over the period. As a result, the minerals which comprised the sands and gravels of the older alluvials became decayed, losing their structure and porosity. Soluble salts were liberated in the process, and were added to those accumulated through rainfall in an environment where evapotranspiration greatly exceeds precipitation. Because of these factors, yields are generally poor, and quality is saline to brackish (DPI 1994; GABCC 2014).

The Glendower Formation is mainly composed of quartzose sandstone which is believed to have been deposited by an ancient river system, and was extensively weathered after formation, being lateritised and frequently silicified as were other contemporary surfaces. Remnants now form low hills and tablelands, interspersed with large areas of Cainozoic alluvium and often capped by duricrust, a hard crust formed at or near the surface of the ground as a result of the upward migration and evaporation of mineral-bearing ground water (DNRM 2016a; Idnurm & Senior 1978; Wilson & Taylor 2012)

Hydraulic conductivity is a parameter related to permeability, and is measured in distance travelled along the flow path, at a hydraulic gradient of one (45 degrees). It is measured in m/day. Some representative values of hydraulic conductivity from published sources are shown in Table 1, to illustrate typical rates of groundwater flow for a few, relevant, aquifer types. Although such hydrological parameters vary greatly, both vertically and spatially, within a large aquifer, these values indicate relative differences in time taken for a groundwater to travel from its recharge source, or for time needed for an area to recover from pumping stress.

Characteristics of the aquifer types in the region and their water quality concerns are illustrated in Figure 4 (adapted from McNeil & Raymond 2011).

Table 1: Estimates from the literature of hydraulic conductivity ranges for aquifer types relevant to the Fitzroy and Burdekin regions

Aquifer quality	Aquifer type	Hydraulic conductivity (m/day)	Reference
Aquifer	Medium sand	0.1–45	Domenico & Schwartz (1990)
Aquifer	Condamine Alluvium	3–30	Dafney & Silburn (2013)
Aquifer	Permeable basalt	0.01–850	Freeze & Cherry (1979)
Aquifer	Hooray Sandstone	0.15–1.5	Smerdon & Ransley (2012)
Aquifer	Hutton Sandstone	0.1–0.5	USQ (2011)
Aquifer	Precipice Sandstone	0.1–1	DNRM (2016b)
Aquifer	Clematis Sandstone	0.00016–42	OGIA (2016)
Partial aquifer	Glendower/Winton	0.06	Shaw (2016)
Partial aquifer	Birkhead Formation	0.0002–0.83	USQ (2011)
Partial aquifer	Cadna-Owie Formation	0.003–0.059	Jiang (2014)
Aquitard	Rewan Formation	0.000008–1.86	QWC (2012)
Aquitard	Walloon Coal Measures	0.001–0.005	USQ (2011)
Aquitard	Evergreen Formation	0.0005–0.001	USQ (2011)
Aquiclude	Rolling Downs Group	< 0.00001	Jiang (2014)
Aquiclude	Marine clay	0.000000072–0.00018	Dafney & Silburn (2013)

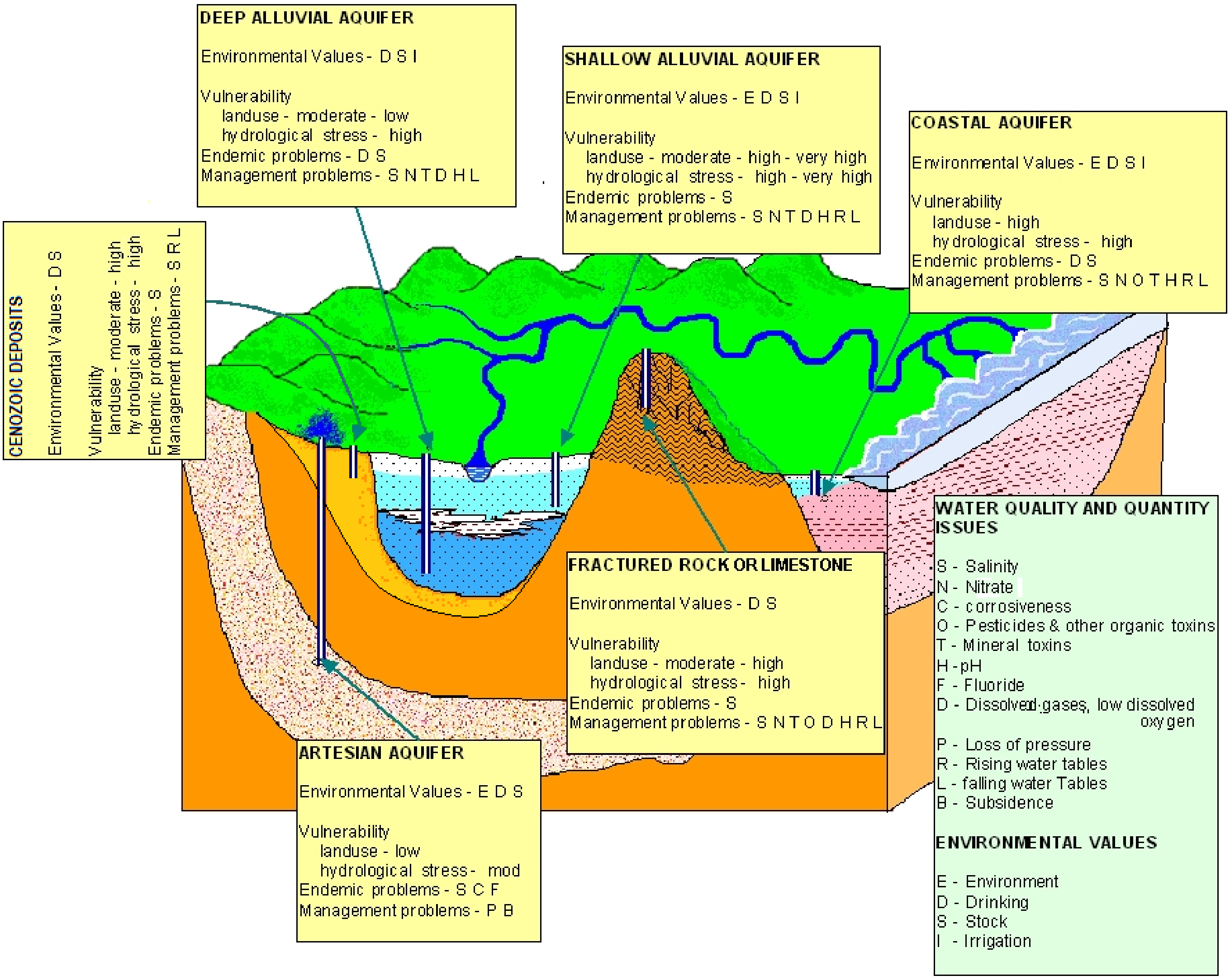

Figure 4: Aquifer types in the Fitzroy–Burdekin regions, with their water quality vulnerabilities and environmental values, adapted from McNeil & Raymond 2011

3 Methods

The statistical and conceptual methods used to assess groundwater quality and establish zones in the Fitzroy and Burdekin regions is consistent with those used for the adjoining Queensland Murray Darling Basin (QMDB) (McNeil et al. 2017, and addendum 2018), and the zones spatially connect across these two regions where appropriate. The data assessment was conducted using a suite of automated procedures designed to integrate with the DNRME database.

3.1 Updates to previous draft reporting

Draft groundwater reports for Fitzroy, Burdekin and Don-Haughton basins were publicly released in 2017 for comment[2] (along with a separate report for groundwaters of the Queensland Murray-Darling Basin). The following updates have been made to data analysis and treatment across the areas to ensure consistency in methods, and to combine water quality data sets across surface water basin boundaries where they form part of the same groundwater chemistry zone. Comparable changes were made to the MDB groundwater report (as reflected in the 2018 addendum to that report released on the department's website).

- Data use and treatment: for those chemistry zones crossing surface water basin boundaries, datasets have been combined, and updated percentiles generated (previously the datasets had been separated according to the surface water basin in which they occurred). This applies to:
    - Fractured Rock
        - Fitzroy zone 3 (Eastern Basement with Basalt Remnants) data merged with QMDB zone 4 (North Western Basin Remnants)
        - Burdekin zone 7 (Main Range Volcanics) data merged with QMDB zone 4 (North Western Basalt remnants)
    - Mid GAB aquifer
        - Fitzroy zone 3 (Bungil and Mooga Outcrops) data merged with QMDB zone 6 (North Wallumbilla Bungil and Mooga
    - Lower GAB aquifer
        - Fitzroy zone 1 (Central Surat Springbok Area continued) data merged with QMDB zone 1 (Central Surat Springbok Area)
        - Fitzroy zone 4 (Northern Walloons continued) data merged with QMDB zone 7 (Northern Walloons)
        - Fitzroy zone 5 (Northeastern Hutton Outcrop continued) data merged with QMDB zone 5 Northeastern Hutton Outcrop)
        - Fitzroy zone 9 (Northern Hutton Outcrop continued) data merged with QMDB zone 6 (Northern Hutton Outcrop)
    - Basal GAB aquifer
        - Fitzroy zone 2 (Eastern Central Area continued) data merged with QMDB zone 2 (Eastern Central Area)
        - Fitzroy zone 3 (Precipice Outcrop continued in Upper Dawson) data merged with QMDB zone 1 (Precipice Outcrop)
        - Fitzroy zone 5 (South Eastern Evergreen Outcrop continued) data merged with QMDB zone 3 (North Eastern Evergreen Outcrop)
    - Earlier sedimentary basins partially underlying the GAB
        - Fitzroy zone 2 (Southern Galilee Clematis) data merged with QMDB zone 3 (Galilee Basin)

[2] EHP. 2017. *Draft environmental values and water quality objectives for groundwaters of Fitzroy River Basin and Capricorn Curtis Coast*. Brisbane: Department of Environment and Heritage Protection, Queensland Government.

EHP. 2017. *Draft environmental values and water quality objectives for groundwaters of Burdekin, Don and Haughton River Basins*. Brisbane: Department of Environment and Heritage Protection, Queensland Government

    - Fitzroy zone 8 (Lower Bowen continued) data merged with QMDB zones 1 (Lower Bowen) and 2 (Upper Bowen)

- Updated extraction (as at 25/5/18) and analysis of data from DNRME database
- Aquifer and groundwater chemistry zone classification. Review and update of aquifer classes and chemistry zones, including mapping updates
- Percentiles: additional percentiles included for each chemistry zone (e.g. 20th, 40th, 70th percentiles)
- Environmental values/water uses: EVs applying to a given chemistry zone have been standardised across surface water basin boundaries (where relevant), with reference to the Queensland Government Water Entitlements Registration Database, consultation with DNRME on interpretation of database categories relative to EPP Water EV groups, and other interpretation. The larger range of EVs was adopted.
- GIS/mapping updates
    - Mapping layers have been updated to provide clearer linkage of both aquifer class and chemistry zone names across broad project regions (QMDB, Fitzroy and Burdekin)
    - EVs attribution by chemistry zone has been updated to provide the same set of EVs for a given chemistry zone where it extends across surface basin boundaries (based on the inclusion of all relevant EVs from the now joined zone). EVs maps are provided as consultation draft pdfs on the department's website in association with this report.

3.2 Data

The main data source for the project was the Queensland Natural Resources, Mines and Energy (DNRME) Database (GWDB). The current groundwater chemistry data of the Fitzroy and Burdekin regions is extensive, but there are spatial and temporal variations in coverage, with most emphasis on highly productive coastal aquifers.

The dataset comprises about 29,700 sub-artesian lab-analysed samples from 8,400 bores, of which there are approximately 21,800 alluvial samples from 4,800 alluvial bores. Samples from Cainozoic and fractured rock sources comprise the remainder. There are about 1,000 artesian lab-analysed samples from 500 bores, and 1,300 samples for pre-GAB basins from 700 bores, some of which access artesian aquifers.

The water quality samples are supplemented by over 2,500 groundwater level measurements from around 6,600 bores, mostly since the mid-1960s.

The distribution of laboratory-analysed water quality samples (typically including electrical conductivity, major ions and in some cases nutrients) across the region is shown in Figures 5 and 6, indicating that sampling intensity has been uneven, and reflecting the fact that groundwater is not present in all areas.

Additionally, OGIA have collected over 100 samples from 18 bores in the Dawson River headwaters of the Fitzroy Basin (data downloaded 23/7/18). These access GAB aquifers and aquitards, as well as other formations including coal seams in the Pre GAB basins. This has supplemented the data to calculate percentiles in one Mid GAB zone, three Lower GAB zones, three Basal GAB zones, and two Pre GAB zones. The OGIA data includes trace elements for which we do not yet have sufficient data to calculate percentiles, however these elements been commented on where they expand the groundwater chemistry information in a zone. Because additional data is constantly being added through various monitoring programs, it is appropriate to recalculate the percentile ranges periodically to improve reliability. Hence, a further review of the database was conducted as at 18/9/18, and it was decided that a reasonable indicator for recalculation would be when the additional data available reached 20% of the existing data. Under this rule, two zones were recalculated with the addition of the updated OGIA samples, one in the Basal GAB (zone 4 – 'Ruined Castle Evergreens') and the other in the Pre-GAB (zone 8 – 'lower Bowen continued'). There was little change in lower Bowen continued, but more refinement in the Ruined Castle Evergreens, where very few samples had been available previously. This result appears to affirm the 20% update threshold applied in this study.

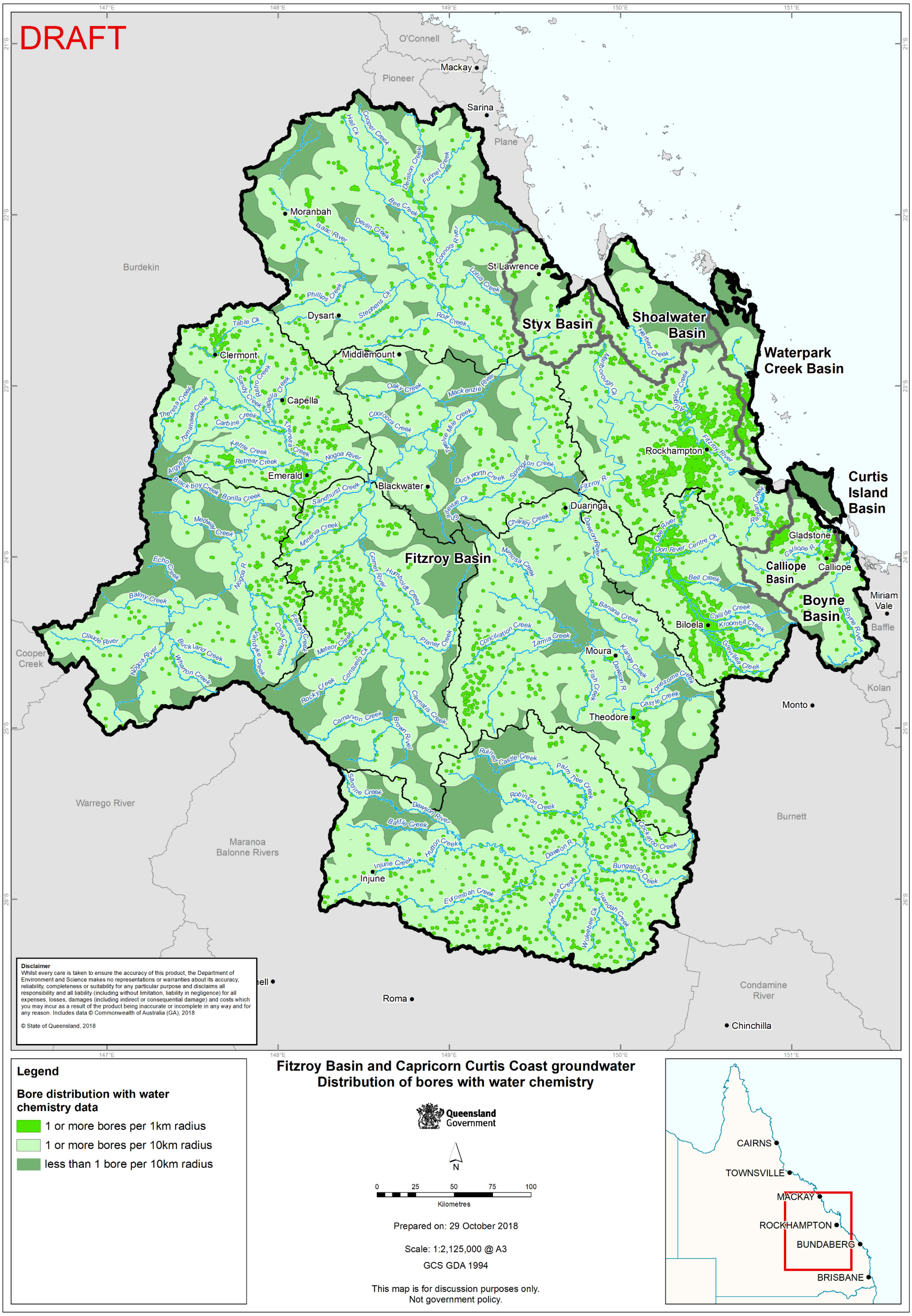

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Figure 5: Distribution of bores with water chemistry across the Fitzroy and Capricorn-Curtis Coast

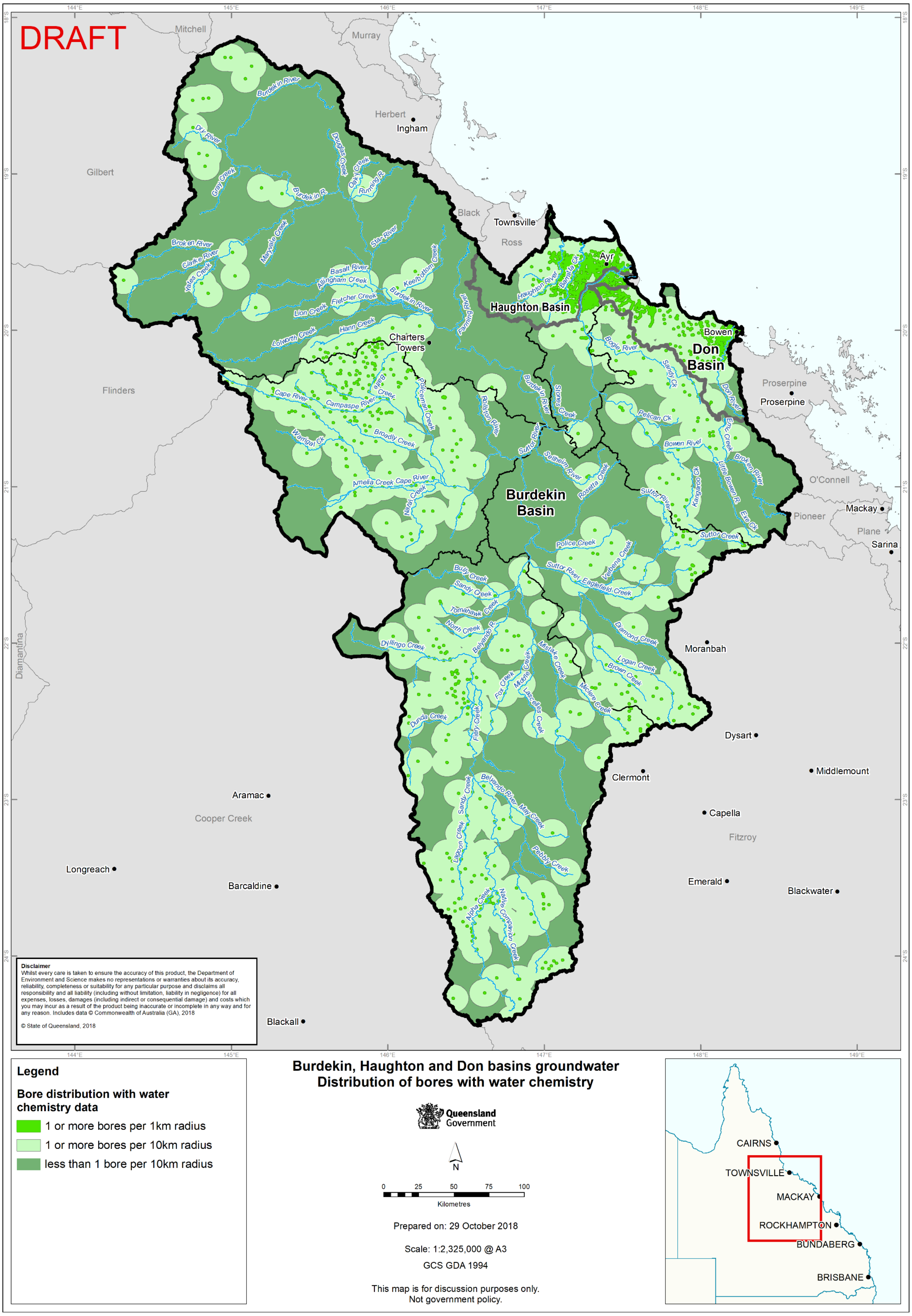

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Figure 6: Distribution of bores with water chemistry across the Burdekin, Don and Haughton river basins

3.3 Bore to aquifer attribution

Groundwater quality is extremely variable because of frequently prolonged contact with localised contaminants. Groundwater chemistry zones are therefore intended to differentiate reasonably homogeneous portions of aquifers, so that water chemistry ranges within them are narrow enough to differentiate them.

There are numerous aquifers of varying size and significance within the region, some overlying or inter fingering with others. Consequently, a classification of major aquifer types was required, including division of large systems such as the GAB, to avoid difficulties in mapping overlapping units. Therefore, aquifer types occurring in Queensland have been subdivided into nine major classes for mapping purposes. Seven of these classes occur in the Fitzroy and Burdekin regions, each of which includes a few dominant aquifers as well as a number of minor geological formations accessed by some bores. The chemistry zone boundaries for each aquifer class were intended to be mapped around distributions of similar water chemistry and a consistent suite of aquifers. As an example, in the Lower GAB Zone, '4 Northern Walloons', most of the bores access the Hutton Sandstone, but with some using the Durabilla member of the Walloons aquitard.

For this reason, all bores used in the study were required to be attributed to a specific aquifer, and the aquifers to a specific class for zoning and calculation of percentiles. Most bores contributing water quality and water level information were already attributed to individual aquifers during the development of the Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017, and the remainder were attributed using OGIA (2016), or surface geology if shallow and satisfactorily located.

An attribution table (Table 2) was constructed to classify the relevant aquifers into classes for mapping the Burdekin and Fitzroy region. There are three subartesian types representing alluvial and fractured rock systems, and the deposits overlying the GAB. Five classes were used to represent the GAB, which is a complex of layered and interconnected aquifers and aquitards. These were broadly grouped on the divisions used by Smerdon et al. (2012), but with the bottom sequence divided into 'lower' and 'basal' layers to reduce inhomogeneity. A class was also defined for the basins (partially) underlying the GAB, in this case the Bowen and Galilee. The classes relevant to the Burdekin Fitzroy region are listed below. Two intermediate aquifer classes are also used, these being Mesozoic sediments that are not part of the GAB, but may be included on the same maps, and Palaeozoic sedimentary basins, which may be mapped with fractured rock, although they probably also retain some porosity. Attribution of bores to aquifer classes is shown spatially in Figures 23 and 24 of this report.

Table 2: Summary of aquifer classes in the Fitzroy-Capricorn-Curtis and Burdekin-Don-Haughton regions, to which bores were assigned on basis of their attributed water-bearing geological formation [1]

Aquifer Class[1]	Range	Aquifer types	Aquifer sub types	Examples
1) Alluvium	Quaternary to recent alluvium, divided into reaches according to stream, extent and hydrology	Alluvium		Fitzroy alluvium, Bed sand, River sand, Floodplain
		Estuarine delta and coastal deposits		Coastal sediments, Estuarine and deltaic deposits, coastal swamps and salt flats
		Sand		Sand dunes, Drift sand, Beach sand
		Miscellaneous		Anthropological debris
		Open water (as recorded on the geological map, DNRM, 2015)		Open water, surface water

Aquifer Class[1]	Range	Aquifer types	Aquifer sub types	Examples
2) Fractured rock	Hard (non-porous) rock aquifers with water contained in fractures, joints, or solution cavities in the case of limestones.	Basalt (Cainozoic)		Gin Gin Basalt, Main Range Volcanics, Tertiary Basalt
		Late Mesozoic basalts		Alton Downs Basalt, Cretaceous Basalt
		Granite (including all coarse grained plutonic rocks)		Granite, Mooramin Granite, Burwood Complex, Cretaceous intrusives
		Mesozoic to Cainozoic volcanic complexes with mainly non-basaltic lavas		Cretaceous Volcanics, Mount Salmon Volcanics, Mount Cooper Trachyte
		Trap Rock: Late Proterozoic to Triassic, usually deep water marine sediments and volcanics, mostly associated with formation of the Great Dividing Range (GDR)	Metamorphics	Inkerman Metamorphics, Key Creek Gneiss, Lucky Creek Metamorphic Group
			Deep water marine deposits, usually deformed	Curtis Island Group, Wandilla Formation, Greenvale Formation
			Volcanics, mostly andesitic	Greybank Volcanics, Camboon Volcanics, Capella Creek Group
			If attribution refers to large, fairly mixed group	Berserker Group, Rockhampton Group
		GDR Limestones		Mount Etna Limestone, Douglas Creek Limestone, Burdekin Formation
	The Proterozoic North Australian Craton which crops out in two areas in north-west and north Queensland. Much of the sediment was deposited in a shallow marine environment, with extensive limestone and dolomite. Most of the area has been subsequently deformed, metamorphosed and mineralised, although some parts remain relatively undisturbed	Metamorphics		Cape River Metamorphics, Anakie Metamorphics, Charters Towers Province

Aquifer Class[1]	Range	Aquifer types	Aquifer sub types	Examples
2) Fractured rock (ctd)	Serpentinite	Serpentinite minerals, very high in magnesium and low in silica, intruded into major fault zones in Proterozoic to Palaeozoic		Princhester Serpentinite, Ultramafics, Boiler Gully Complex
3) Cainozoic deposits (including deposits overlying GAB)	Tertiary deposits, mostly weathered and unconsolidated or poorly consolidated, overlying older formations including the Great Artesian Basin (GAB)	Weathered Alluvium		Cainozoic, weathered alluvium, coloured clays, Tertiary undefined
		Colluvium		Colluvium, Cainozoic colluvium, Hillwash
		Ferricrete		Duricrust, Ferricrete, Silcrete
		Tertiary formations deposited within sedimentary basins		Glendower and Elliot Formations, Ts-QLD
		Tertiary sediments containing lignite, coal and oil shale and limestone		Biloela Formation, Rundle Formation, Nagoorin beds, Duaringa Formation
	Localised Cainozoic volcanic activity	Non basaltic lava plugs which followed flood basalts		Cape Hillsborough Beds, Peak Range Volcanics, Tertiary plugs
6) Mid GAB aquifers	Mid level (Jurassic to Lower Cretaceous) highly productive confined aquifers	Surat	Aquifer	Mooga Sandstone,
			Part aquifer	Bungil Formation,
			Aquitard	Orallo Formation, Minmi Member
		Eromanga	Aquifer	Gilbert River Formation
			Part aquifer	Ronlow Beds
7) Lower GAB aquifers and aquitards	Series of Jurassic aquitards and confined aquifers underlying the Mid-Level Aquifers	Surat	Aquifer	Hutton Sandstone,
			Aquitard	Injune Creek Group, Walloon Coal Measures, Eurombah Formation
		Eromanga	Aquifer	Hutton Sandstone
			Part aquifer	Eulo-Queen Group
			Aquitard	Birkhead/Walloon

Aquifer Class[1]	Range	Aquifer types	Aquifer sub types	Examples
8) Basal GAB formations	Lower Jurassic aquifers and aquitards subdivided from the Lower GAB for convenience as they tend to overlap	Surat	Aquifer	Precipice Sandstone, Boxvale Sandstone
			Aquitard	Evergreen Formation
		Eromanga	Aquifer	Precipice Sandstone
			Part aquifer	Raceview Formation
			Aquitard	Evergreen Formation, Base of the Jurassic
9) Earlier sedimentary basins partially underlying the GAB	Terrestrial, late Palaeozoic to Triassic basins that predate and underlie the GAB, and may contain coals and hydrocarbons. They underwent erosion before GAB sedimentation began. Some of these sediments also occur within the Bowen Basin, isolated and not underlying the GAB	Bowen, Galilee Basins		Clematis Sandstone (aquifer), Dunda Beds, Rewan Group(Aquitard), Warang Sandstone, Moolayember Formation
10) Mesozoic sediments which are not part of the GAB	Includes reasonably undisturbed Late Palaeozoic to Mesozoic sediments that are not within the boundaries of the GAB.	Callide, Styx, Mulgildie Basins		Burrum Coal Measures, Kin Kin beds, Styx Coal Measures
11) Palaeozoic sedimentary basins	Includes basins containing relatively unaltered freshwater or shallow marine sediments, where deposition took place between the Proterozoic and Triassic. They may or may not underlie the GAB or earlier basins.	Bundock, Burdekin, Clarke River, Drummond, Miclere Basins		Joe Joe Group, Clarke River Group, Mount Mulgildie Coal Measures, Back Creek Group Blackwater Group

Notes:

1. Aquifer classes 4 and 5 are not included in the table. While they are among the nine defined for Queensland, they do not occur in the Fitzroy and Burdekin regions.

3.4 Statistical assessment

All available surface and groundwater water data were combined, and samples with similar chemistry were grouped through a two stage clustering procedure, based on the major ions, which is described in McNeil et al. (2005). The surface water was included in the clustering process so that comparable chemistry could be used as an indicator of possible surface water/groundwater interaction. Five major chemical groups were identified:

1. Sodium bicarbonate: Typical of many GAB waters
2. Sodium chloride: Highly saline, related to poor drainage, residual salt or seawater intrusion
3. Even cations: Characteristic of basalts and trap rocks of the Great Dividing Range
4. Mg rich: Mostly associated with basalts
5. Surface water type: Relatively low salinity, high in bicarbonate, mixed cations, near surface.

Each bore was assigned, with its aquifer class, to a colour representing its most consistent water group, and each group was plotted as a GIS layer.

3.5 Defining chemistry zone boundaries

The bores for each aquifer class, coloured in terms of predominant water group, were plotted spatially using ArcGIS 10.4. The bores were also used to produce another layer, with symbols for aquifer attribution on the basis of water and aquifer assemblage and compared with other GIS layers, including surface geology, rainfall, climate, and topography.

The major features of each aquifer class were used as a background layer, over which to construct the chemistry zones. The background features were catchment boundaries for the alluvial map, surface geology for the Cainozoic deposits, and areas mapped as fractured rock. Specific layers were obtained for widespread GAB formations and outlines of the Bowen and Galilee Basins to define sub surface aquifers and basin boundaries for the GAB and underlying basins maps.

For each aquifer class, zones were initially traced subjectively around clusters of similar water and aquifer groups, then the interim zones were visually assessed alongside other landscape and climate characteristics to identify areas where refinements could be made. As bores vary in density, with tight concentrations divided by sparsely populated peripheral areas, the refinement of zone boundaries was driven by features likely to be associated with particular groundwater chemistry, primarily the dominant geology, and further guided by elevation and surface water chemistry where data was scarce. Land use (DSITI 2017) and historical rainfall were also investigated as additional information sources for guidance in zone delineation.

Since alluvium tends to occur in irregular, sometimes very narrow strings along streams, and may merge into the surrounding, more weathered materials, the alluvial boundaries can be hard to define precisely. Draft mapping from 2017 has been refined to incorporate additional areas identified as alluvium, including DNRM Groundwater Alluvial Boundaries QLD (published 9/12/02) and Detailed Surface Geology QLD (published 24/5/18 – limited to the alluvium categories), and then cross checked with the aquifer classification of bores. Bores outside of the initial boundary but classified as Alluvium have been incorporated into the updated alluvial zone as buffered points. However, it should be noted that boundaries may be confirmed or revised by site investigations.

3.6 Defining parameter ranges for chemistry zones

Current baseline water quality was then calculated for each chemistry zone, represented by percentiles of each parameter recorded in the GWDB. Appendix 1 provides detailed information for zones, with descriptions in Table 4. Appendix 3 provides water quality percentile ranges in Table 5 (Fitzroy, Capricorn-Curtis) and Table 6 (Burdekin, Don-Haughton). Some of the more extensive alluvial zones, as well as some overlying the GAB, show substantial water quality variation close to the stream. This is expected given the proximity to recharge, so the zones concerned are provided with percentiles for a 1.5km buffered area each side around the stream ('near stream') as well as for the zone as a whole (where the whole zone includes the near stream and all other areas for that zone). The near stream zone is shown on large scale plans accompanying this report, available on the department's website.

Data mining programmes were then applied to extract hydrological and aquifer statistics for each zone, and to compare the water quality to guidelines, calculate trends for groundwater level, EC and nitrate for alluvial zones, and to identify general water quality hazards. These are presented on Table 4 in Appendix 1, with a major ion plot to define the character of the zone, and its reason for its inclusion as a separate identity. Current baseline water quality for each zone was then calculated as percentiles of available water quality parameters. Data mining procedures were then used to further define the zone water quality characteristics in terms of condition, as defined by DEHP (2009) guidelines, and trend using the methodology developed by McNeil & Raymond (2011).

This study acknowledges that the zones and their baseline ranges represent current conditions with varying levels of accuracy, chiefly because data is limited particularly for the pre-European period; however, it is emphasised that these draft values are in line with the precautionary principle (Cousins et al. 2016; Eberhard et al. 2009) in providing a filter to identify outlying sites and sudden or rapid change. Outlying sites may reflect human activity, but may also be a result of naturally atypical geology or hydrology. In areas of high priority, groundwater models or other more intensive assessment methods can be applied at a later date with the support of ongoing data collection. This would allow the ranges to be refined, natural processes to be differentiated, and anomalies due to atypical local aquifers to be identified.

Zone borders are acknowledged as being approximate, because there is often a gradual or irregular merging of the groundwater between adjacent zones, because there is uncertainty in the boundaries between individual aquifers, and because data is often scarce around zone borders. Therefore, refinement of the borders would be expected with the support of ongoing data collection. It could also be enhanced for areas of sufficient priority, by the use of groundwater models, or other more intensive assessment techniques.

Groundwater models enable an understanding of the local hydrology, and its interactions with water chemistry, for instance in the Callide Creek alluvium (Henry 1979), or in the Burdekin Delta (McMahon et al. 2000; Wang et al. 2012). Assessment techniques, including multivariate analyses and trend analysis, also help to chemically define individual water bodies, as demonstrated for the Atherton Basalts, north of the region, by Locsey & Cox (2003), and changes in dominant source through time, as in the Callide by McNeil (2002). In summary, investment in monitoring and assessment would allow percentile ranges to be refined, natural processes to be differentiated and anomalies due to atypical local aquifers to be identified.

4 Results

4.1 Groundwater chemistry zones for the Fitzroy and Burdekin regions

Regional groundwater chemistry zones were established across nine aquifer classes (Table 3, Figures 7–20), and ranges for major ions, pH, and electrical conductivity calculated where sufficient data were available (Tables 5 and 6). Attribution of bores (for which there was lab-analysed water quality data) to aquifer classes is shown in Figure 23 (Fitzroy-Capricorn-Curtis coast) and Figure 24 (Burdekin-Don-Haughton). Larger scale map plans showing EVs by chemistry zone are provided on the department's web page accompanying this report.

Table 3: Aquifer class descriptions for Fitzroy-Capricorn-Curtis and Burdekin-Don-Haughton regions

Aquifer class	Description, including component chemistry zones[1]	Figure reference
Alluvia	Recent alluvium divided into 27 chemistry zones based on water quality and factors such as extent of alluvium, and sub-catchment characteristics. It includes deltaic sediments in the Burdekin Delta and in some other coastal areas, and acid sulphate soils may be prevalent in low lying coastal locations. Water quality is moderate to saline NaCl or $NaHCO_3$, generally hard with a tendency to scale. Groundwater in larger, deeper catchments may be altered in the vicinity of streams, due to recent recharge. Zones containing basalts or other weatherable terrains tend to be richer in Ca and Mg. Data sufficiency varies, with best for the Burdekin delta and the adjoining coastal catchments. For the Fitzroy, the downstream and coastal areas, the Calliope and Lower Boyne, and the Callide sub-catchment of the Dawson. The area between the Lower Comet to the northern Nogoa catchments are also moderately rich in data.	7 & 8
Fractured rock	Aquifers in hard rock with water stored in fractures or permeable sandstones other than those considered part of the GAB, or the Bowen and Galilee Basins. Divided into 12 zones on the basis of rock type, location and water quality, with four in basalt, one with substantial serpentinite, and the remaining granite and trap rock, including some from the Precambrian. Based on reasonable amounts of data, water quality in the basalts is moderately saline, with Mg then Na, with HCO_3 then Cl. It is hard, with a tendency to scale. There is little data for the other zones, but the water quality appears mainly to be of moderate to high salinity, with Na then Ca, and Cl. The Serpentinite may be high in nickel.	9 & 10
Cainozoic deposits (including sediments overlying the GAB)	The overlying sediments consist of Tertiary sediments, particularly in the Dawson catchment and including the Biloela Formation, as well as weathered Cainozoic alluvium surrounding and underlying recent alluvium. Sand dunes occur in some coastal areas, particularly on Curtis Island. Based on few data, the water quality varies spatially but is usually moderately to highly saline NaCl, with lower salinity and higher HCO_3 near streams. It has the capacity to contribute saline seepages to nearby alluvial aquifers under stress, such as has occurred in the Callide.	11 & 12
Mid GAB aquifers	Only the edge of this layer, which contains the main confined GAB aquifers, are present within the region, however, these do include recharge areas. The Eromanga Basin overlaps the Upper Burdekin and Suttor zones in 3 small, western extensions, considered as 1 zone, with water being extracted from the Ronlow Beds and Gilbert River Formations. The Dawson catchment in the Fitzroy overlaps the northernmost Surat Basin as 2 zones, with water being drawn from shallow Bungil, Mooga, Orallo, and Gubberamunda Formations, with springs being common.	13 & 14

Aquifer class	Description, including component chemistry zones[1]	Figure reference
Lower GAB	The lower GAB aquifers also only outcrop as a small patch of the Eromanga in the north-western Suttor catchment, with a more extensive area in the upper Dawson sandstone country. The water quality is very variable, due to the complex lithology, as water is withdrawn from the Hutton and Springbok aquifers, as well as several aquitards, including the Westbourne, Injune Creek, and Walloon Coal Measures. The groundwater is probably also influenced by overlying geology, and has been divided into seven zones.	15 & 16
Basal GAB	This division represents the lowest beds in the GAB, mainly the Evergreen aquitard and underlying Precipice Sandstone. It is basically confined to the Fitzroy Basin, underlying the Lower GAB Formations in the Fitzroy, and extending along the southern headwaters of the Comet and Nogoa Catchments. Six chemistry zones have been defined, based on lithology and limited water quality data. The groundwater is generally moderately saline, dominated by HCO_3 with either Na, or mixed cations in outcrop areas near basaltic remnants.	17 & 18
Earlier basins partially underlying the GAB (i.e. pre GAB)	The Permian-Triassic Bowen and Galilee Basins represent hydrological networks that pre-date the GAB and were eroded before GAB sedimentation commenced. They were laid down contemporaneously, comprise the same geological formations in their upper layers, and are united in the Springsure area. Both contain important coal deposits. The Bowen Basin underlies the Surat, and most of the Fitzroy, and extends into the Bowen Basin in the Burdekin. The Galilee, to the west, underlies the Eromanga, the southern Nogoa headwaters and the western edge of the Suttor. The main aquifer is the Clematis Sandstone, but numerous formations are accessed, some of them coal bearing, so that the water quality is very complex. Fourteen zones are identified on the basis of location and hydrological unit, with four in the Galilee, nine in the Bowen, and one at the intersection.	19 & 20

Notes:

1. Water quality characteristics of springs are expected to relate to the source aquifer from which a spring emanates (subject to local catchment and other influences). Further work is proposed to review and, where feasible, identify water quality characteristics of springs.

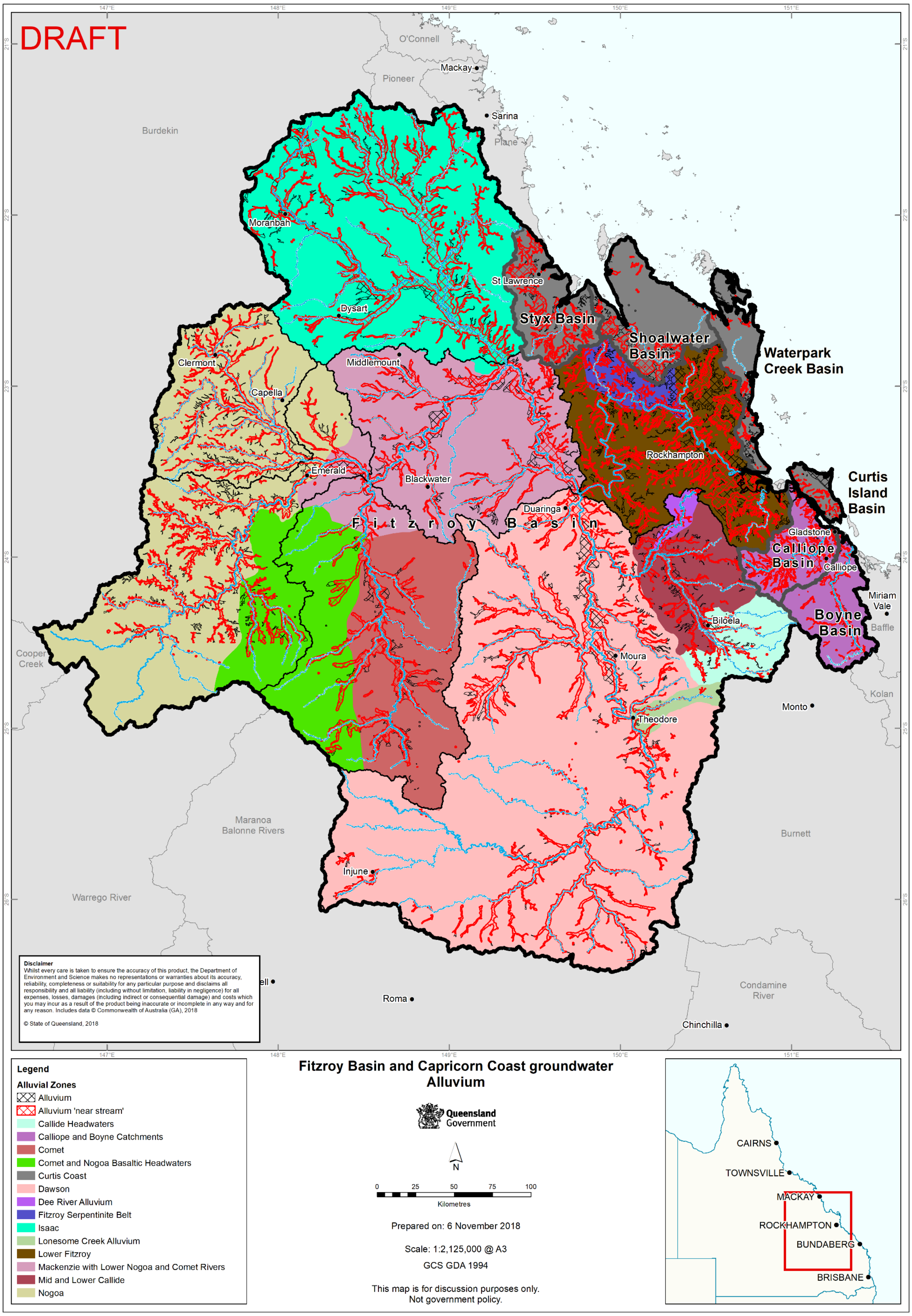

Figure 7: Alluvium zones - Fitzroy and Capricorn-Curtis coast

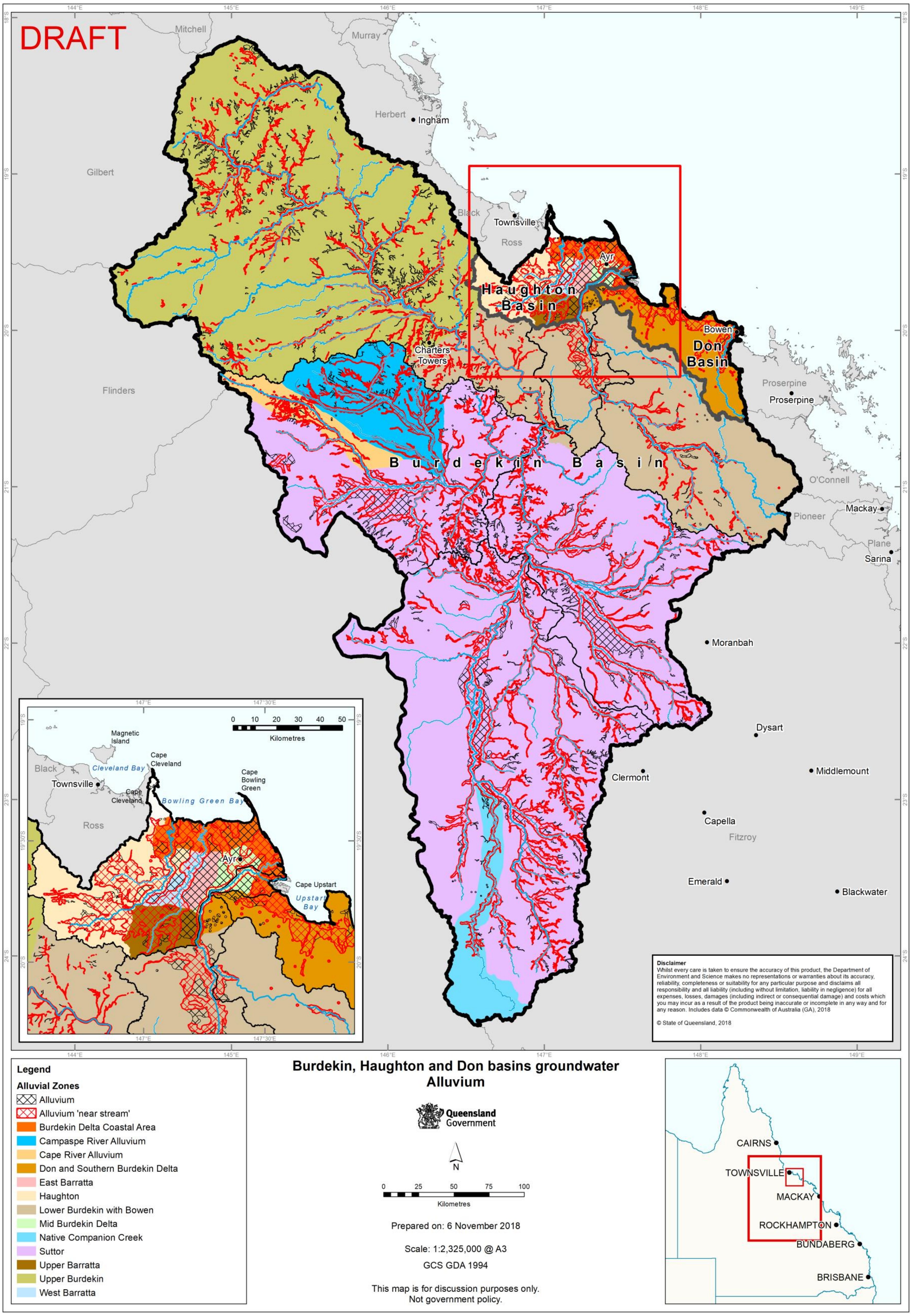

Figure 8: Alluvium zones – Burdekin, Haughton and Don basins

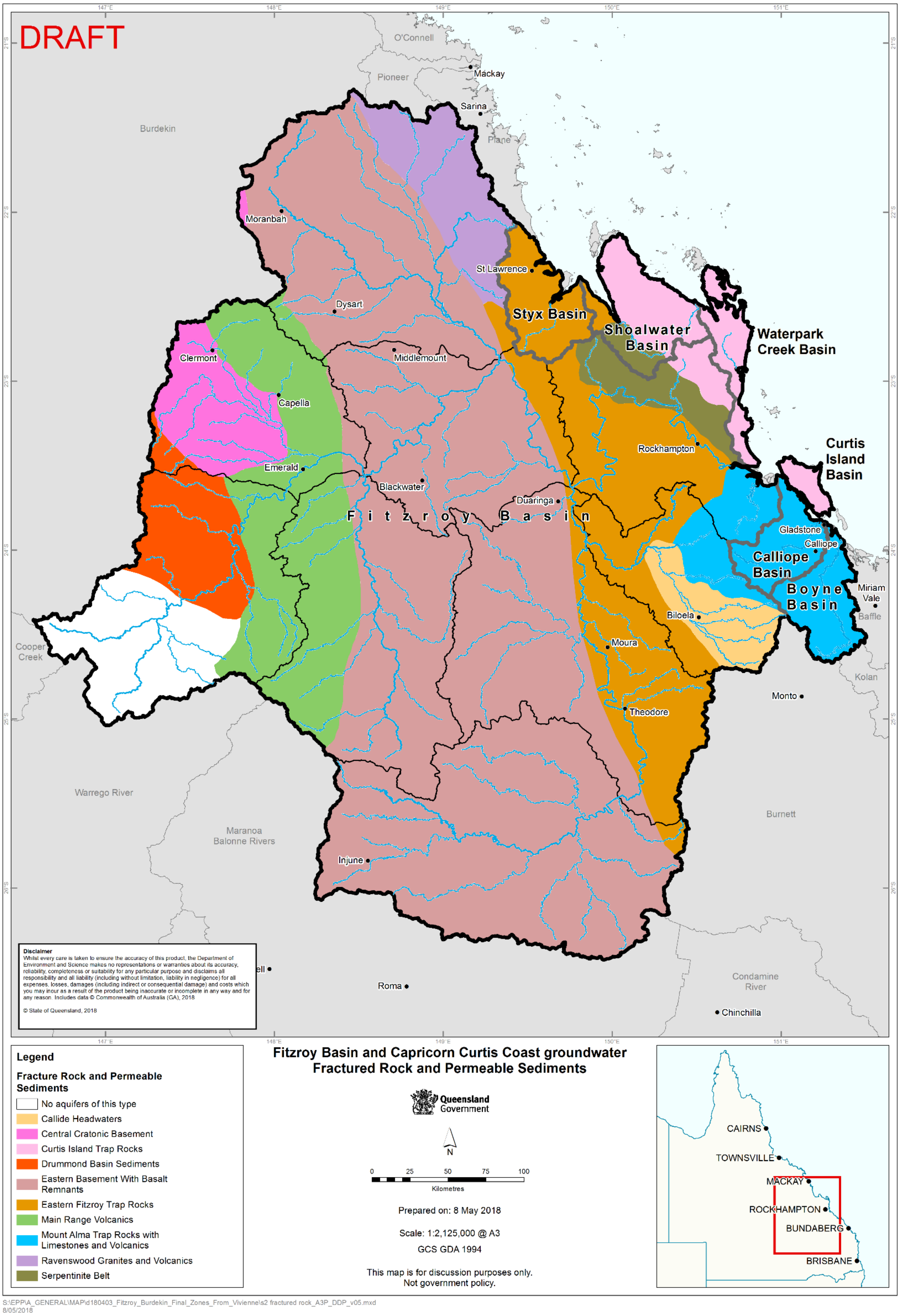

Figure 9: Fractured rock zones – Fitzroy and Capricorn-Curtis coast

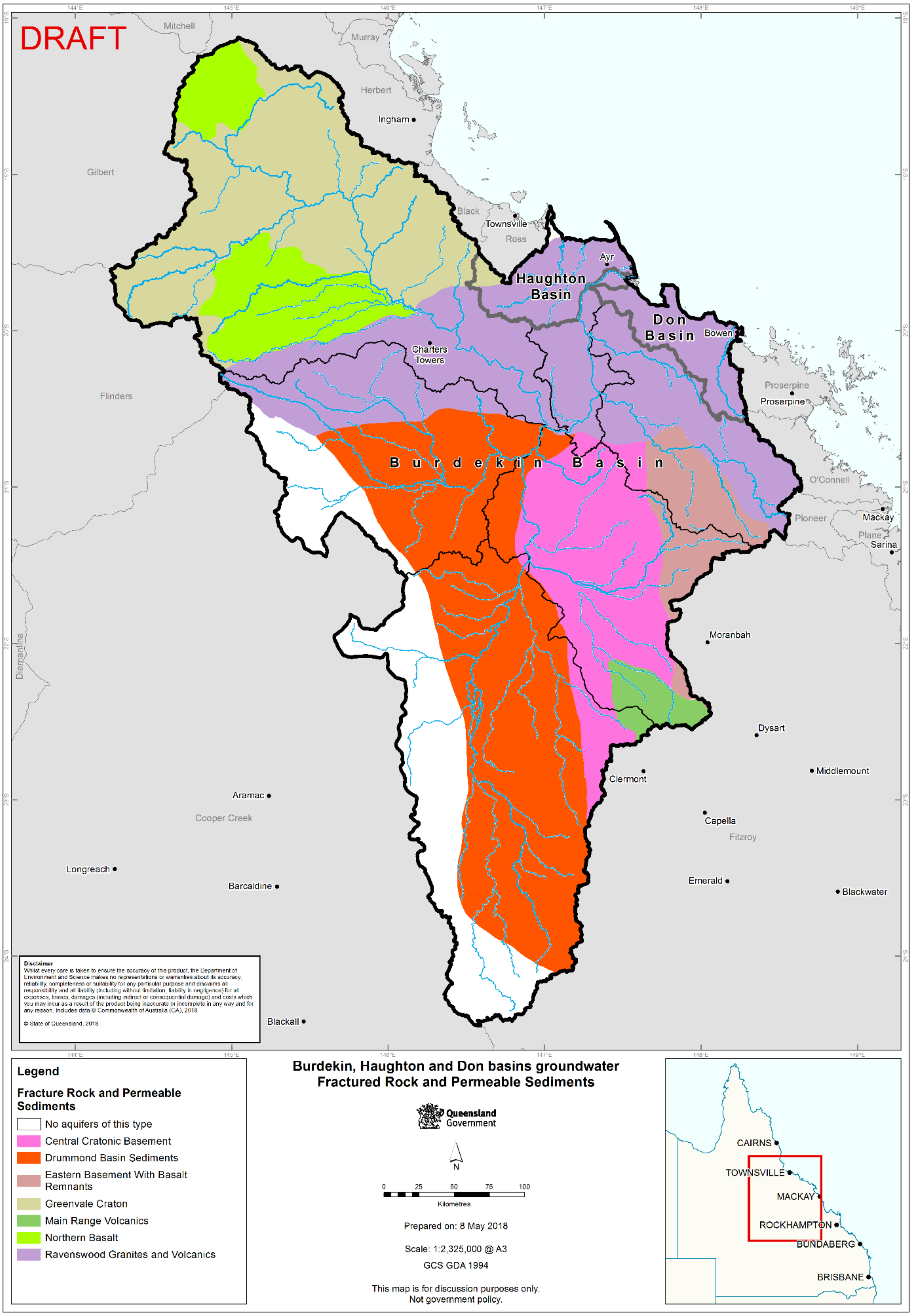

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Figure 10: Fractured rock zones – Burdekin, Haughton and Don basins

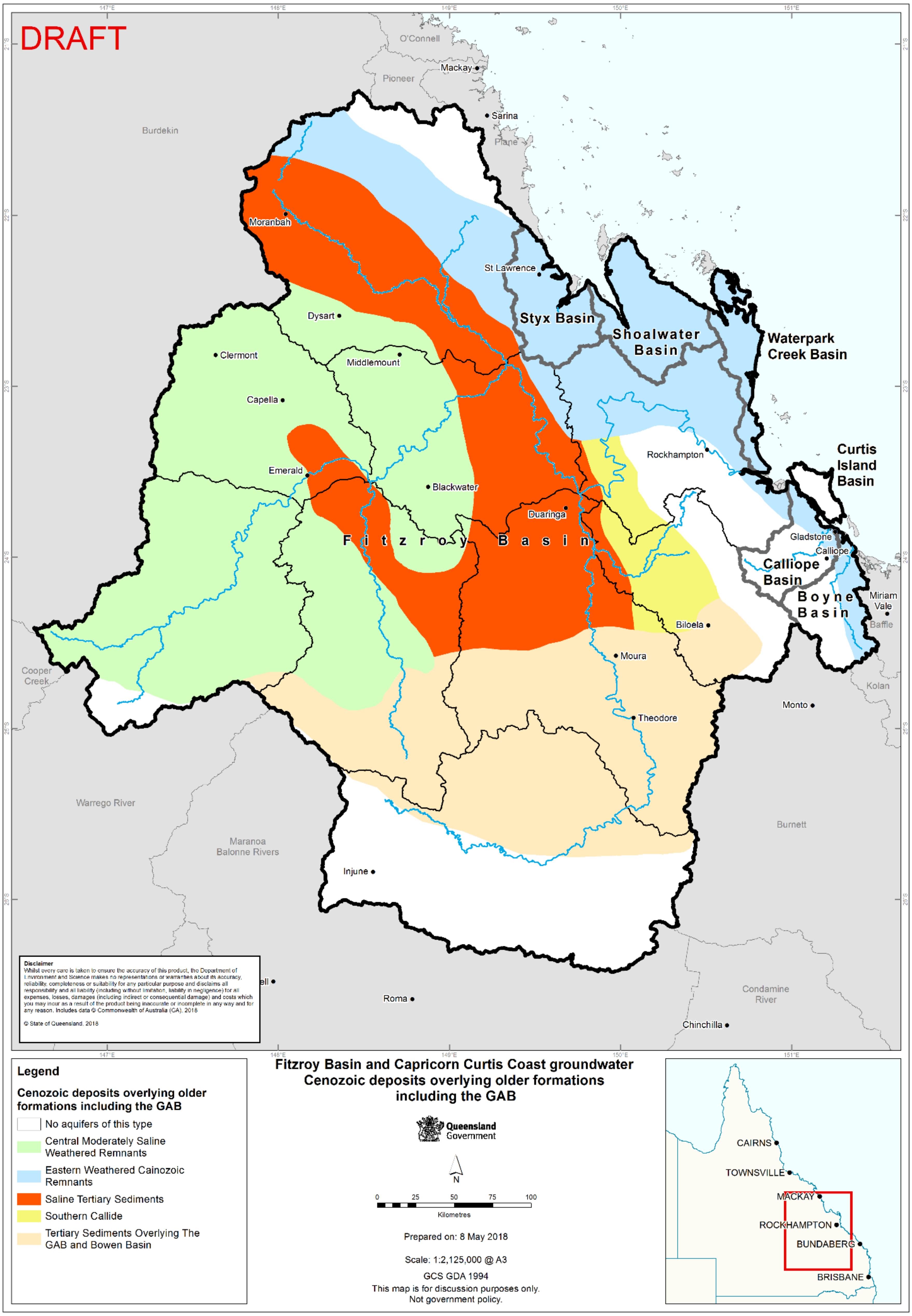

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Figure 11: Cainozoic zones – Fitzroy and Capricorn-Curtis Coast

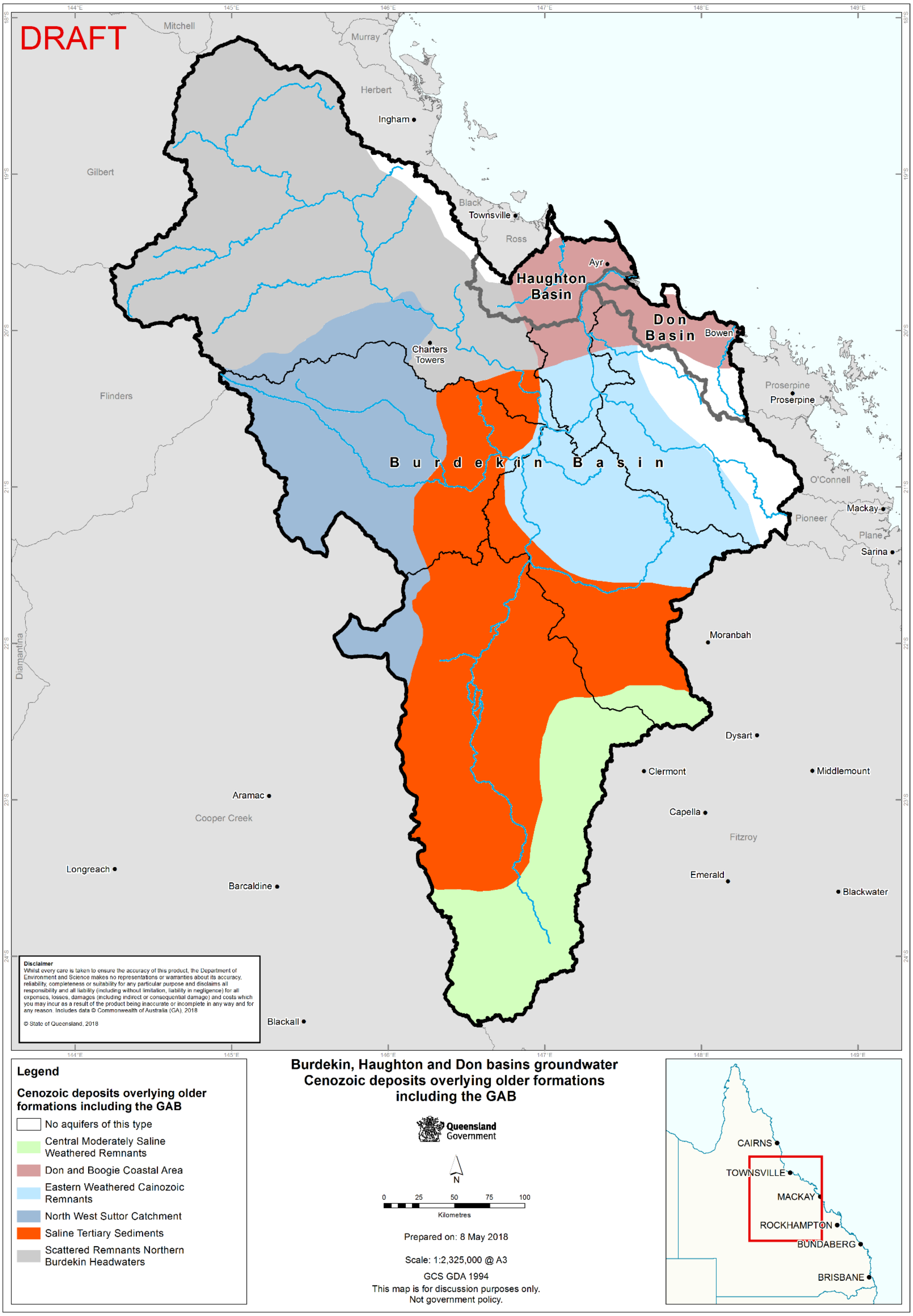

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Figure 12: Cainozoic zones – Burdekin, Haughton and Don basins

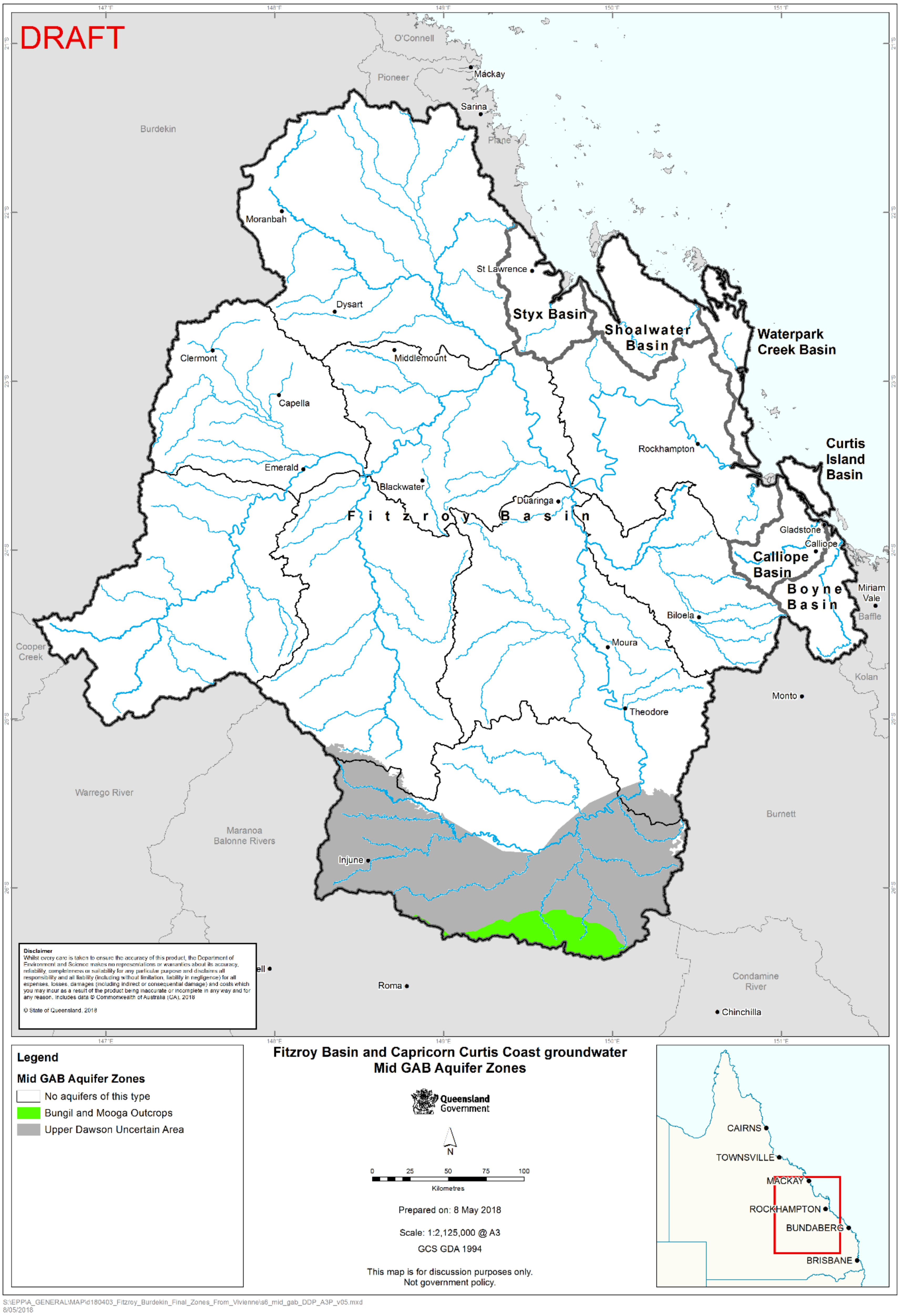

Figure 13: Mid GAB zones – Fitzroy and Capricorn-Curtis Coast

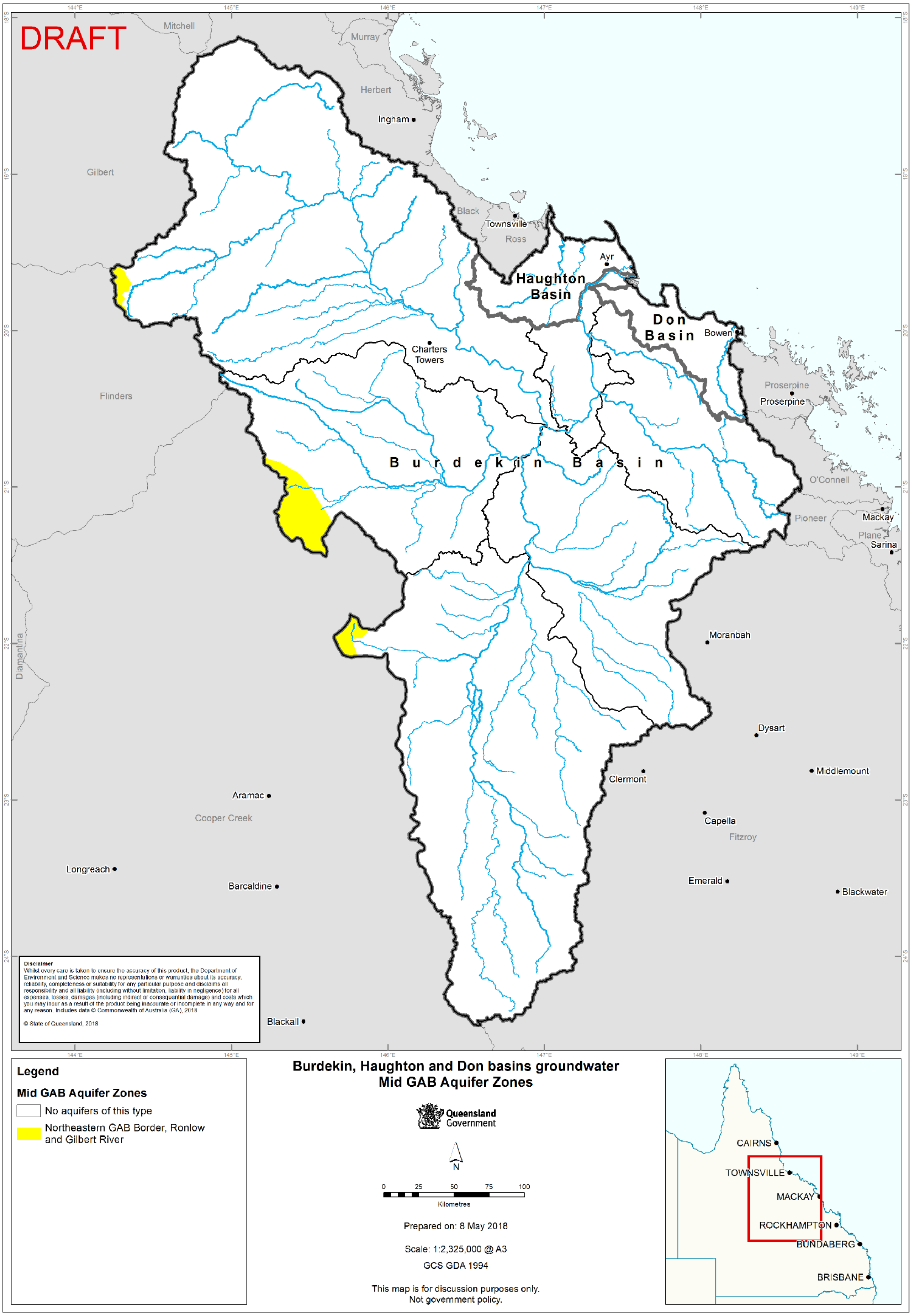

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Figure 14: Mid GAB zones – Burdekin, Haughton and Don basins

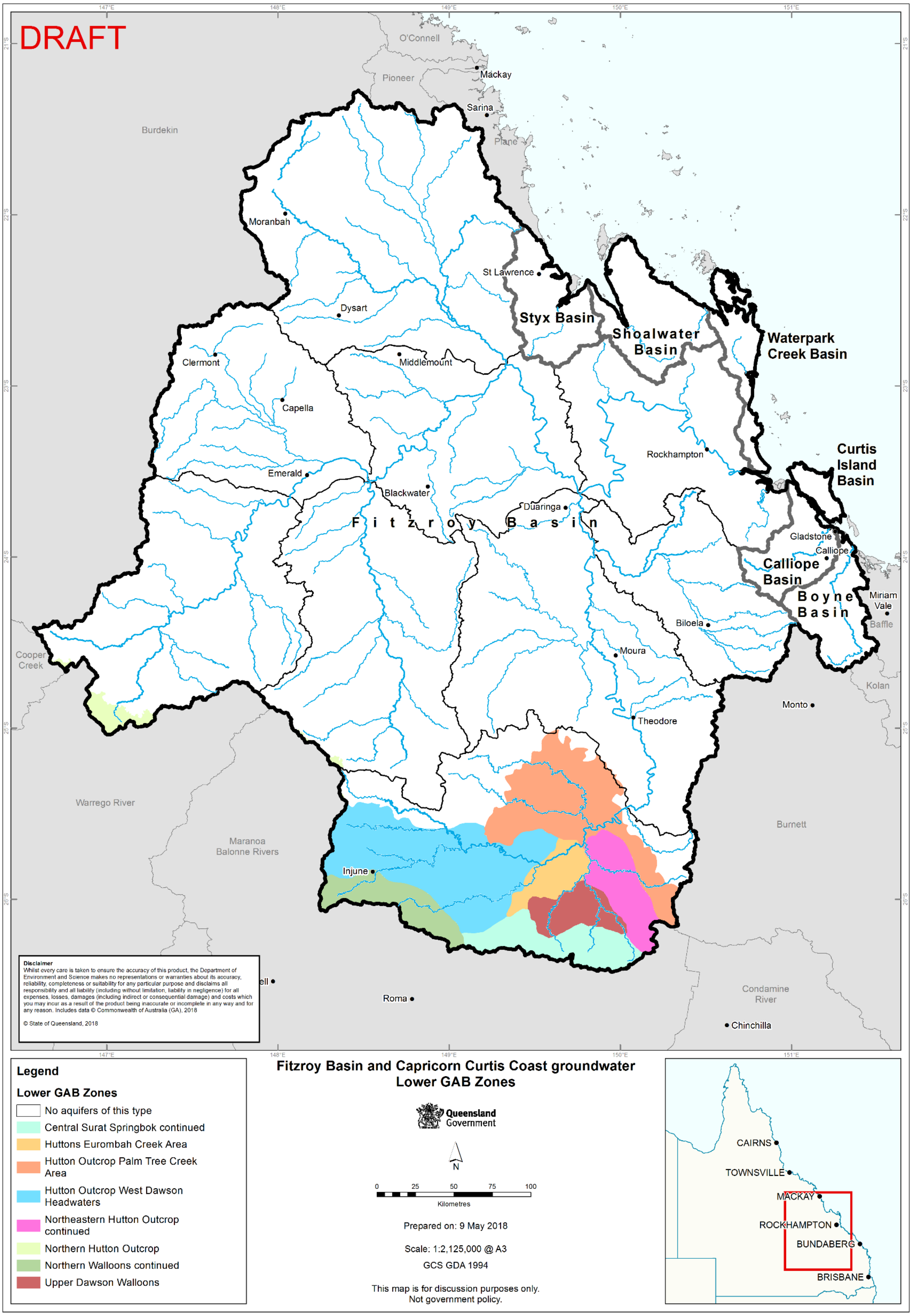

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Figure 15: Lower GAB zones – Fitzroy and Capricorn-Curtis Coast

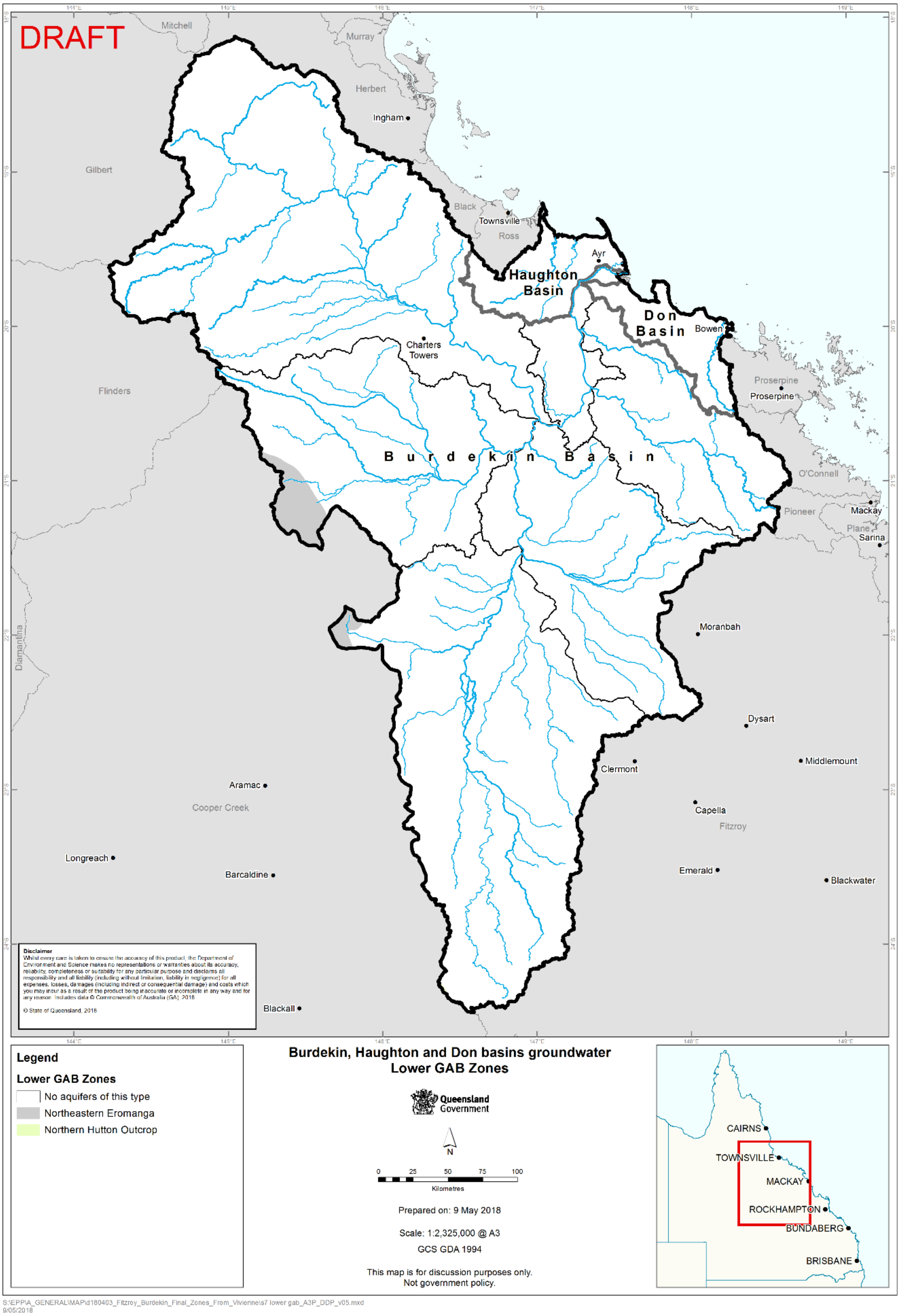

Figure 16: Lower GAB zones – Burdekin, Haughton and Don basins

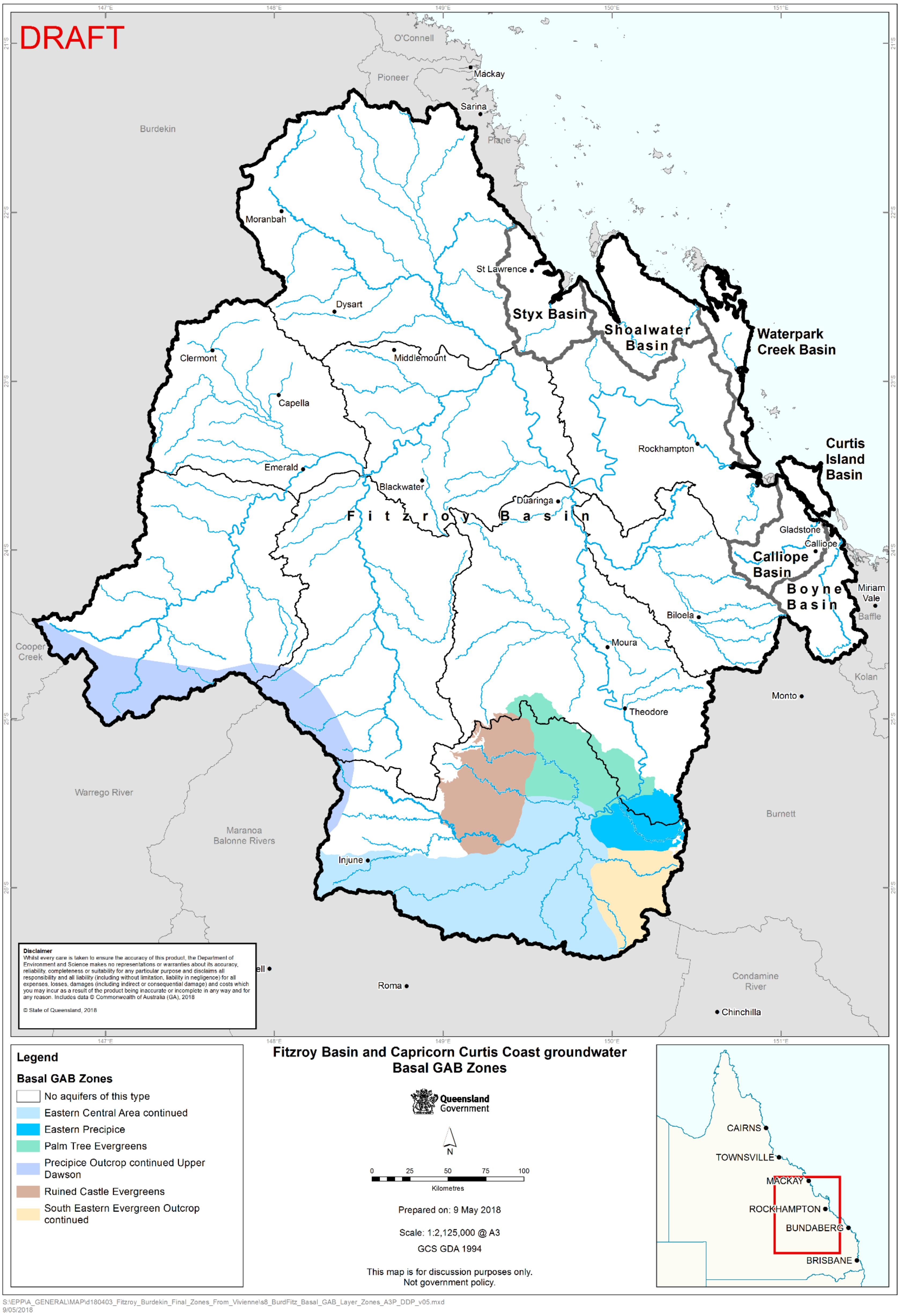

Figure 17: Basal GAB zones – Fitzroy and Capricorn-Curtis Coast

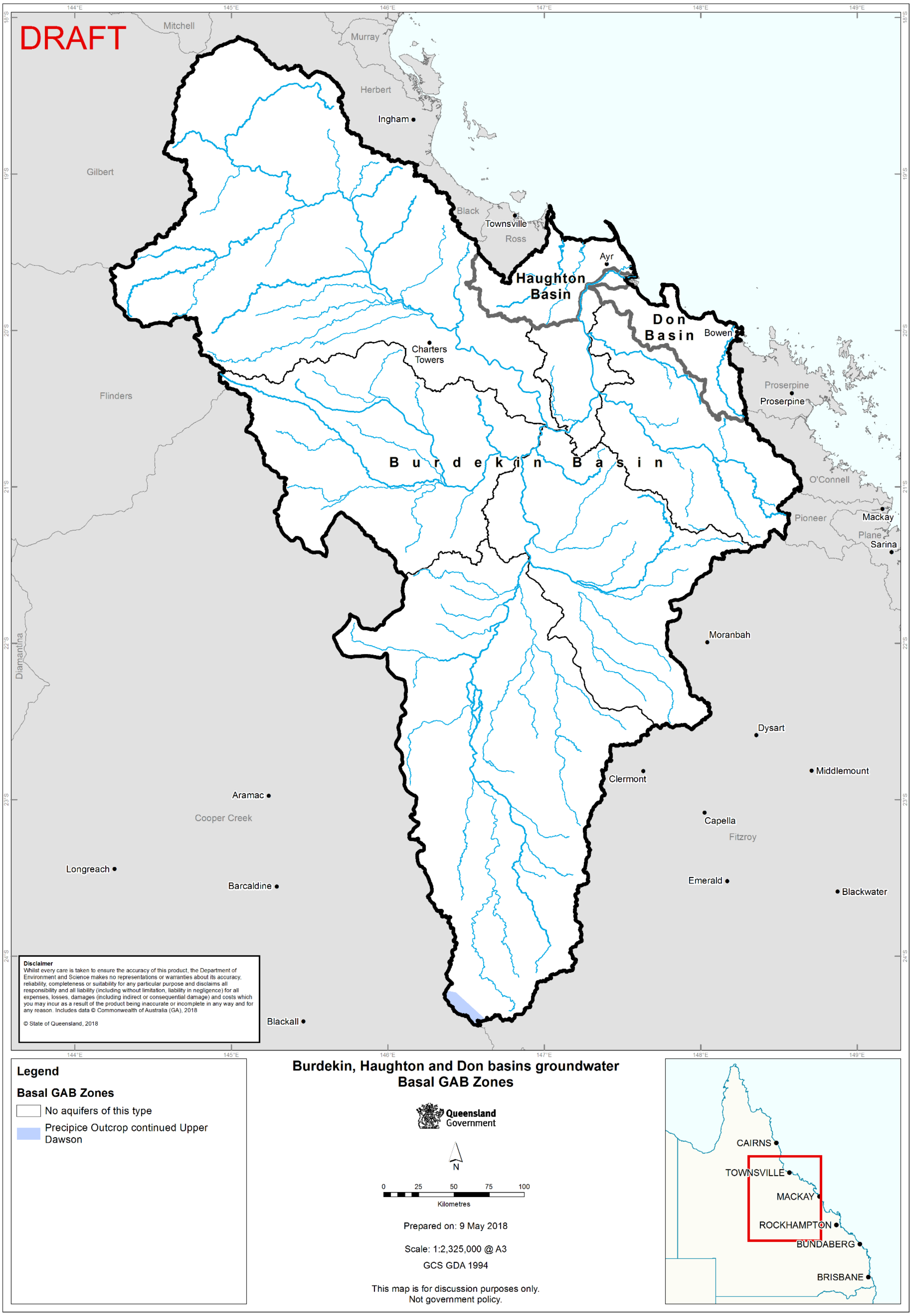

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Figure 18: Basal GAB zones – Burdekin, Haughton and Don basins

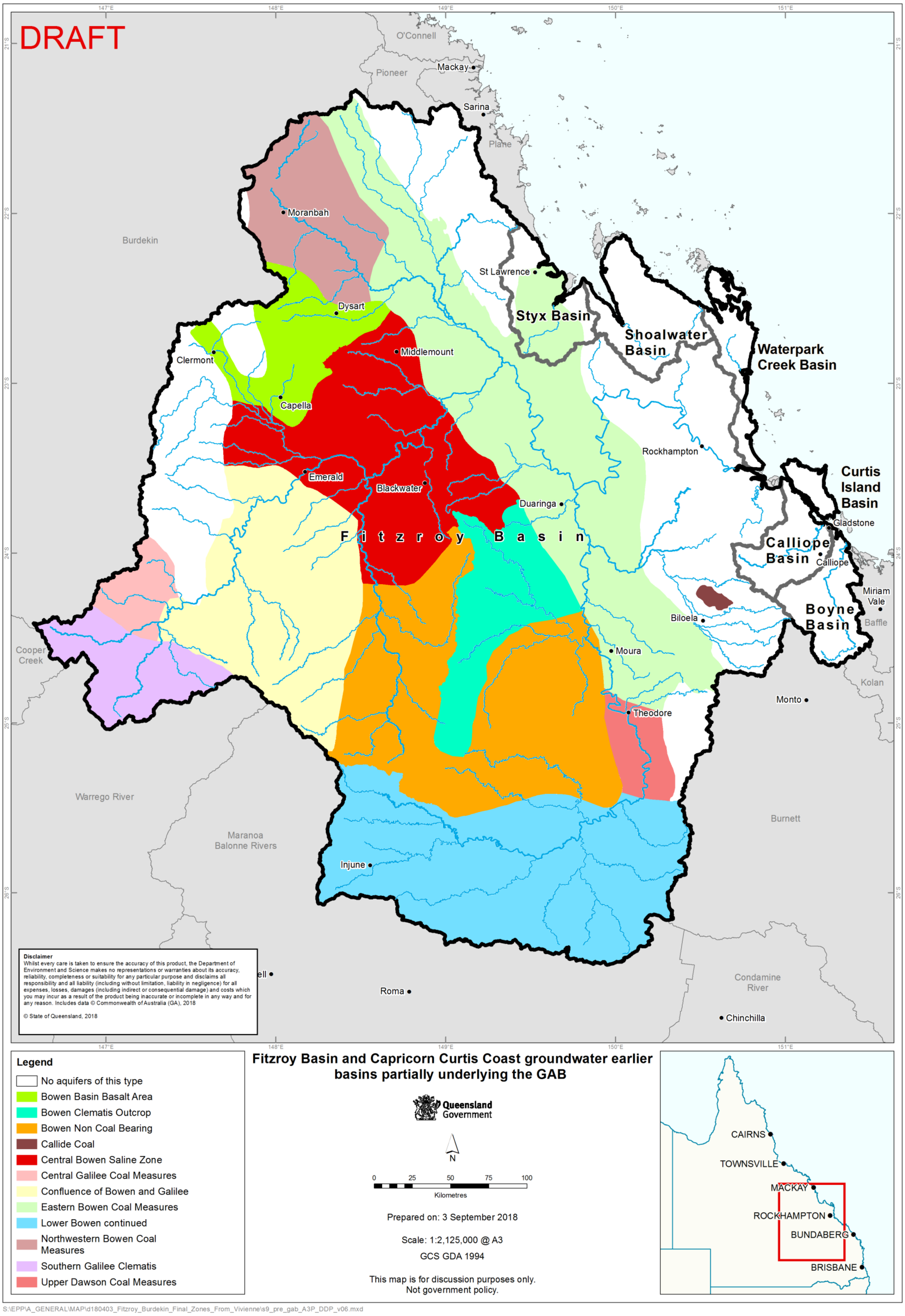

Figure 19: Pre GAB zones – Fitzroy and Capricorn-Curtis Coast

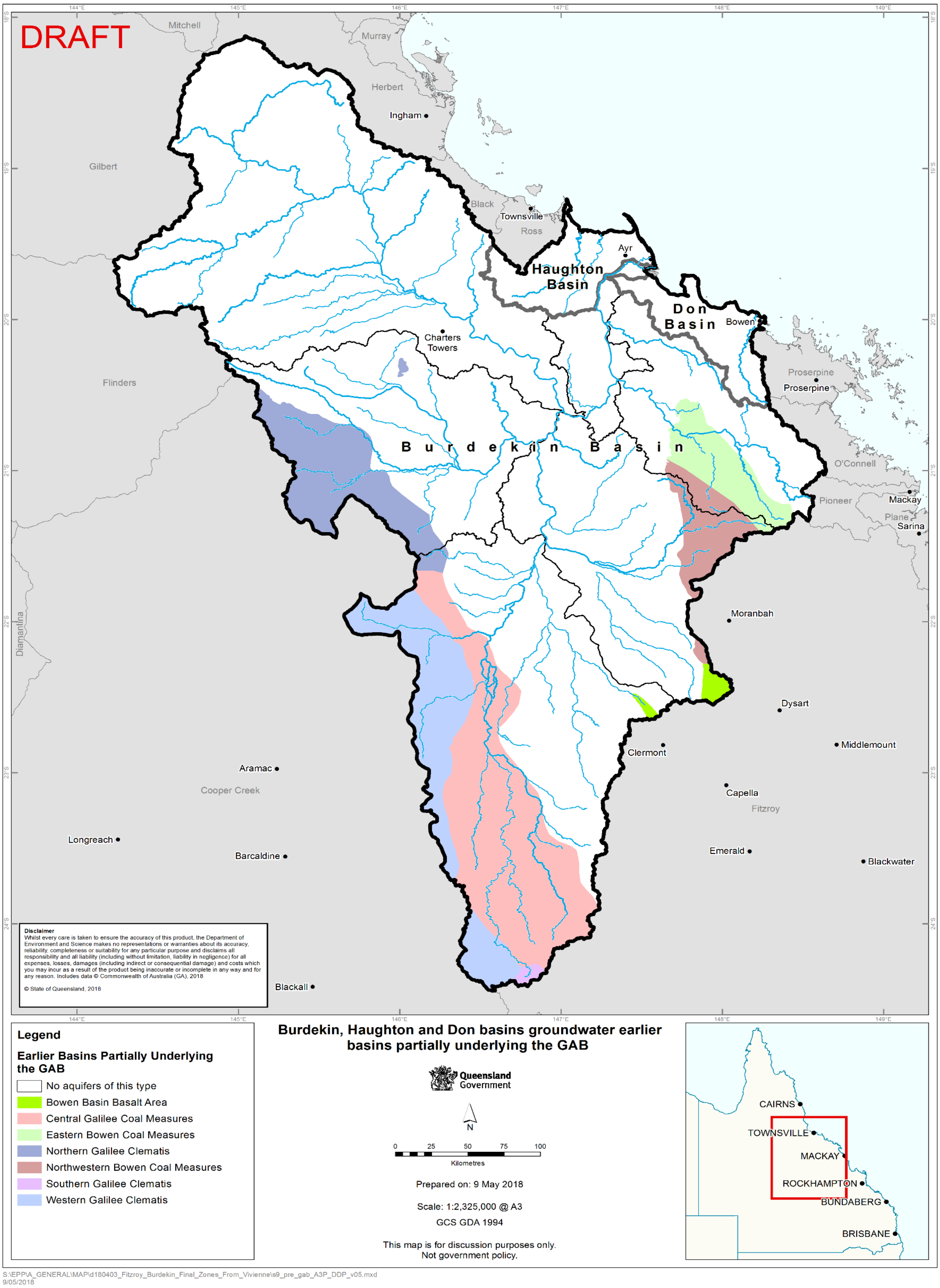

Figure 20: Pre GAB zones – Burdekin, Haughton and Don basins

5 Discussion of regional groundwater chemistry variation

The Burdekin and Fitzroy Basins are large and geologically complex, so that most of the typical groundwater chemistry types in Queensland are present in some part of the region. Data reliability for characterisation/comparisons has been calculated on the basis of number of samples per km^2 with 'excellent' being more than 1 per km^2, such as on the alluvium of the Burdekin Delta, to 'very poor' with less than 0.05 per km^2 over most of the Cainozoic cover. Less than 20 samples are regarded as unreliable for characterisation/comparison.

Table 4 in Appendix 1 summarises these results. Note that to ascertain suitability of a specific water source (e.g. a bore) for a given use (e.g. irrigation) more detailed testing may be required, and the broad results in Table 4 are not intended to provide this level of detail.

The regional groundwaters tend to be saline and hard in comparison to surface water, limiting suitability for general purposes and leading to precipitates being deposited over time. Salinity and percentage of sodium (SAR >8) are also frequently excessive for sensitive crops. Salinity also frequently affects the taste of groundwater used for potable supplies, but it is almost always acceptable for stock, despite rare concerns about salinity, nitrate and fluoride. To provide an overview comparison with surface water aquatic ecosystem guidelines, a comparison has been made with regional guideline values in the Queensland Water Quality Guidelines (QWQG). These include, for example, pH and salinity (the latter outlined in Appendix G of the QWQG). Most of the groundwater exceeds surface water aquatic ecosystem guidelines for salinity, which is not surprising as groundwater has more contact with soils and rocks from which salts can be dissolved. Additionally, depending on location, the pH range and TN levels may not correspond to QWQG surface water guideline values.

Compared to Queensland in general, the regional groundwaters appear to be comparatively high in sodium, with most aquifers also being relatively saline. Much of the water chemistry data is from high yielding coastal aquifers, which tend to be sodium dominated and may be vulnerable to seawater intrusion around estuarine environments. Most of the rest of the region is in the interior of large, flat, dry catchments, where salts accumulate because flushing is poor. These interior catchments do contain some heavily exploited groundwater systems, such as the alluvium of the Callide Valley, which are susceptible to saline incursions from adjacent unconsolidated Cainozoic deposits (McNeil, 2002). The GAB aquifers within the region are notably sodic, while the frequently coal bearing, pre-GAB aquicludes tend to yield very saline groundwaters.

5.1 Groundwater chemistry in the Burdekin Basin

The major groundwater resource in the Burdekin Basin is the Burdekin River Delta. This area is difficult to classify into zones, despite a good data record, due to the complex history of delta formation and the subsequent development of irrigation for the sugar industry. In accordance with this, the zones may be refined on the basis of the latest groundwater models. For this report, the delta area includes the adjoining hinterland. It covers the portion of the Lower Burdekin Sub-basin downstream of the Fanning River, as well as the adjoining Bowen Sub-catchment, the coastal Don catchment to the south of the delta, and the Haughton and Barratta catchments to the north of the delta.

The local headwaters of the Delta area are composed of rugged granite with some trap rock, with some Bowen Basin sediments in the southwest corner of the Bowen Catchment. In general, the Delta Area groundwaters are dominated by Na, with chloride also high but varying with EC. Salinity patterns in the alluvial groundwaters reflect the complexity of the hydrology. In general, saline levels are moderate in the more upstream section, but rise towards the coast. High salinity levels also occur in the Don River Basin and the Barratta headwaters. On the other hand, the lowest salinity occurs in two portions of the area, divided by a highly saline strip of alluvium. The first fresher portion is on the Burdekin Delta itself, inland from the coast, and the other is on the middle reaches of Barratta Creek close to the stream. The only other aquifer class in the Delta Area is in fractured rocks, which may yield small groundwater supplies at shallow to moderate depths (down to approximately 25m). The salinity in these aquifers is moderate to very high in the granites and Bowen Basin sediments, but fresher in the trap rocks.

Away from the coast, the Burdekin Basin is lightly developed, with little groundwater use. The Upper Burdekin Sub-basin forms the northwest headwaters of the Burdekin River. This is a lightly developed area which has few towns, retains more than 80 per cent of its natural vegetation, and includes several national parks such as the Great Basalt Wall and Paluma Range on the Star River. Two large basalt tablelands occupy the north and southeast of the catchment, with the underlying granites and trap rocks of the Greenvale Craton exposed in the hilly terrain between them although partially overlain by Tertiary deposits. The extensive basalt deposits usually yield moderately saline groundwaters, of fairly typical basaltic composition, being dominated by HCO_3 with even cations. The basalts, as with other fractured rock aquifers, are vulnerable to contamination. This is because rapid recharge from the surface limits the filtering and protecting chemical environment of the soil layer (Biggs 2014; Biggs et al.

2000; Entry & Farmer 2001; Finegan 1994; Mull et al. 1991; Moody 1996). The storage capacity of a fracture zone may also be hydrologically isolated so that accumulated contaminants are unable to disperse. The strips of alluvium around the streams are too narrow to hold significant groundwater resources, but the few groundwater samples attributed to the alluvium are from depths of around 40–100m. This is deeper than would be normal from such small alluvial deposits, and the low salinity, NaCl chemistry suggests that an alluvial origin is unlikely. However, small yields of saline $NaCaHCO_3$ groundwater can be obtained from fractured Precambrian and trap rock.

The remainder of the Burdekin Basin is the Suttor sub-basin, in the hot, dry south and central area. It is hydrogeologically very complex, with several aquifer classes, but none likely to produce high yields. Development is light, and landuse is mostly grazing, with some cropping, mostly dryland, and forestry around the basalt country. More than 80 per cent of the natural open forests or woodlands remain in the north and west, but only 20–30 per cent in the southern and central area along the Belyando River. The landscape and geology are complex, with rugged to hilly headwaters and an undulating central area, mostly covered by Tertiary sediments and flood plain deposits. Galilee Basin sediments underlie much of the sub-basin, and outcrop through Tertiary deposits along the hilly western watershed and downstream reaches where there are some associated coal deposits. Outcrops of the Eromanga Basin Ronlow Beds narrowly intersect the northwest watershed of the Suttor. Trap rocks and granite outcrop in the central section which may yield small supplies from fracture zones, and there are a few basalt residuals in the east. The alluvial system appears to be over 60m deep in places but with high salinity (up to 6,600µS/cm) NaCl groundwaters. However, it is fresher near the streams and in some small sub-catchments. The freshest quality water is obtained from the artesian aquifers of the Galilee Basin such as the Warang and Clematis Sandstones, where the mean EC is around 700µS/cm, however, these groundwaters are sometimes corrosive.

5.2 Groundwater chemistry in the Fitzroy Basin

The Fitzroy has a variety of aquifer types, including some important alluvial systems, large basaltic aquifers, and a small area of the GAB in the southern Dawson headwaters which is a significant recharge area (Kellet et al. 2003). Much of the Fitzroy is also underlain by the Galilee and Bowen Basins, which yield both highly saline groundwaters and useful artesian supplies.

The Isaac Sub-basin, in the northeast corner of the Fitzroy Basin, is bordered by ranges except downstream in the south, where the Isaac flows into the Mackenzie River. The geology west of the Isaac River is composed of hilly Bowen Basin sediments containing major coal seams, which are overlain in the central area by undulating Tertiary deposits. In the east there are steep dissected headwaters of granite and trap rock associated with some mineralisation. An alluvial floodplain of up to 10km wide and 30m deep has formed around the Isaac River and its tributaries, and much of the area downstream has been cleared for irrigation and dryland cropping. The alluvial groundwater has been moderately sampled, indicating that the salinity ranges from low to moderate at around 300µS/cm to 2,500µS/cm, with lower and less variable salinity near the streams. Na exceeds Mg except in the vicinity of basalt remnants, and HCO_3 is usually the major anion, although the proportion of Cl increases with EC. This is reasonably typical of GDR groundwaters, and is normally suitable for drinking and other domestic uses, despite hardness, and for most irrigation and stock. The surface water chemistry at low flows may resemble that of nearby alluvial groundwaters, but the groundwater is generally more saline, often exceeding the QWQG surface water salinity guideline values for aquatic ecosystems (as groundwater TN may do at times when compared with surface water guidelines). Water levels possibly rose over the last 20 years, with a possible fall in EC over the last 10 years, and some of the alluvium may be vulnerable to contamination because of shallow and possibly rising water tables. The non-alluvial formations tend to yield small supplies of usually highly saline NaCl groundwaters, but these have not been well sampled.

The coastal area of the Fitzroy includes the Lower Fitzroy Sub-basin, the Styx, Shoalwater and Waterpark catchments to the north, the Calliope and Boyne catchments to the south, and Curtis Island, which is separated from the mainland by a narrow strait just north of Gladstone. The geology is variable, but mainly trap rocks and granites of Palaeozoic to Precambrian age. Serpentinite outcrops in the trap rocks around the Fitzroy River between Marlborough and Alligator Creeks, forming dissected hills except where it is overlain by Tertiary sediments or Mesozoic basalts. Back Creek sediments of the Bowen Basin outcrop in the west along the edge of the Fitzroy flood plain, along with scattered residuals of younger Mesozoic volcanics, basalt flows and Tertiary sediments. Sand dunes and estuarine deposits with mangroves and salt marshes are scattered along the coast line including Curtis Island, where there is a narrow belt of intertidal acid sulphate soils. Oil shales are found in the Calliope catchment. Floodplains are up to 12km wide in the Lower Fitzroy, but minor elsewhere. Irrigated cropping is carried out around Eden Bann Weir, but much of the area is urbanised and industrialised, with the cities of Rockhampton and Gladstone and several other major towns. Industrial areas and mining activities include coal seam gas export facilities on Curtis Island.

Most of the groundwater in this area is saline, with median ECs greater than 2,000µS/cm. There is a trend in composition from HCO_3 with balanced cations, to a NaCl dominated seawater composition as EC increases. The main exception to this is the alluvium within the Serpentinite Belt, with moderately saline $MgHCO_3$ chemistry, which is compatible with serpentinite and basaltic terrains. The salinity appears high enough to affect taste, and water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with occasional scale. The water quality appears to be moderate for irrigation, except for sensitive crops because of high salinity and percentage of sodium (SAR >8). It is usually suitable for stock. The surface water is chemically similar to nearby groundwater, but the groundwater is more saline. Groundwater EC and TN often exceed QWQG regional surface water guidelines for aquatic ecosystems.

The Dawson Sub-basin, which takes up the southeastern quarter of the Fitzroy Basin, is a major groundwater area with important alluvial aquifers, some basalt, as well as some intake beds of the GAB. It is also underlain by the Bowen Basin. The dissected sandstone country, in the southern upstream headwaters of the Dawson, includes exposures of GAB aquifers such as the Hutton Sandstone, as well as aquicludes such as the coal bearing Walloons. As the river flows northwards, the GAB outcrop gives way in the middle and lower reaches to the more undulating Bowen sediments, with sandstones exposed in the west, and the coal bearing Back Creek Group being partially blanketed by Tertiary deposits east of the Dawson Range. The GAB and Pre GAB formations in the southern Dawson headwaters vary from moderately saline Na HCO_3 groundwater, to highly saline NaCl. The Cainozoic deposits tend to be highly saline, and may contaminate adjoining alluvial aquifers, but the chemistry of the fractured rock aquifers is variable, depending on lithology and local climatic conditions. Basalt remnants are scattered across the mid reaches of the Dawson. Floodplains of up to 10km wide have formed around the major streams with moderately deep alluvium down to about 25m, with irrigation being supported by several weirs on the mid and lower reaches of the Dawson River. The salinity in the alluvium is usually moderate, but high around Lonesome Creek, the Dee River, and the middle and lower reaches of Callide Creek. The cations are even, or slightly sodic, and the proportion of Cl increases with EC.

The Callide Valley is an eastern sub-catchment which is incised into a Tertiary basin, enclosed by granites and trap rocks. It is intensively developed, with several major towns, the largest of which is Biloela, and industries include a power station. The alluvium is an important groundwater irrigation area, where the groundwater is supplemented by upstream dams and weirs, as well as by interbasin transfer from the Awoonga Dam on the coast. The alluvium of the Callide Valley has been divided into three zones, covering the headwaters, the lower and middle reaches, and the downstream confluence with the Dee River alluvium. It is represented by about 7,000 groundwater samples from over 1,600 bores. The salinity ranges from moderate to occasionally very high, but with evenly distributed cations. It increases with depth and distance downstream, being around 1,500µS/cm to 4,450µS/cm in the middle reaches at moderate depths, the salinity probably affects taste but is suitable for stock. It is poor for general purposes because of high EC and hardness, and may be unsuitable for sensitive crops because of high salinity and percentage of sodium (SAR>8). The groundwater EC often exceeds QWQG surface water aquatic ecosystem guidelines, as may TN and pH. Some of the groundwater may be vulnerable to contamination because of saline seepages from the Cainozoic material if the aquifer is over-pumped.

The Comet, Nogoa and McKenzie sub-basins make up the central and western portion of the Fitzroy. This area is, again, complex hydrologically, but does contain some significant groundwater assets. It is variably developed, with the rugged south-eastern highlands being largely state forest and conservation, including Carnarvon National Park, while the downstream north and northeast are extensively cleared for cropping, some of it irrigated.

The whole area is underlain by the Bowen Basin, with the Nogoa also being underlain by the Galilee Basin. Bowen Basin aquifers outcrop in the hilly headwaters, but elsewhere they are buried beneath undulating Tertiary deposits or basalt remnants. The Mackenzie sub-basin contains coal bearing sediments of the Bowen Basin Back Creek Group which support mines such as Blair Athol and Blackwater, although being mostly blanketed by undulating Tertiary sediments. The watershed between Comet and Nogoa sub-basins is defined by a basaltic tableland, and an extensive stretch of basalt also covers much of the northern headwaters east of Theresa Creek. Sandstones of the Eromanga, Galilee and Bowen Basin are exposed as dissected hills in the southernmost headwaters of the Nogoa, and probably contribute to GAB recharge. However, the oldest rocks are the Precambrian to Palaeozoic trap rocks and granites which outcrop in the northern and central Nogoa, and are mined for sapphires. There are substantial irrigation areas on the floodplains of the south west Fitzroy, largely supplied by Fairbairn Dam. Most of the alluvium yields moderately saline NaMg HCO_3 water, with even cations where there are basalts upstream, or occasionally sodic if flowing through Tertiary deposits. Groundwater EC exceeds QWQG surface water aquatic ecosystem guidelines and TN and pH may also exceed guidelines.

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7 Appendix 1 – Chemistry zone descriptions

The information in Tables 4–6 apply to the groundwater zones shown in Figures 7–20. A brief description of the zone characteristics is provided in Table 4, with percentile ranges of water quality parameters at each zone provided in Table 5 (Fitzroy, Capricorn-Curtis) and 6 (Burdekin, Don-Haughton). Figures 21 and 22 provide further explanation in support of Table 4, while Figures 23 and 24 provide an attribution of bores (for which there was lab-analysed water quality data) to aquifer classes.

The salinity categories in the tables are based on median EC in µS/cm:

EC <200: very low

EC 200–500: low

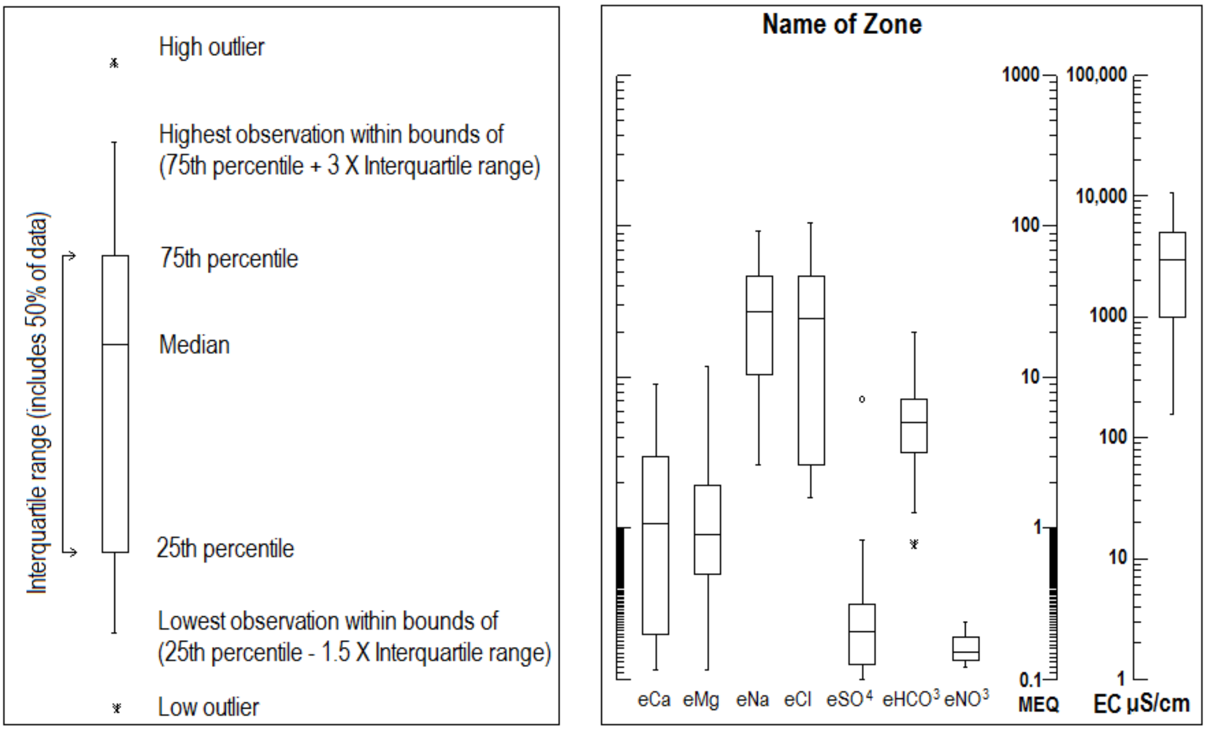
EC >500–1,500: moderate

EC >1,500–5,000: high

EC >5,000: very high

Salinity is classified variable if the range is more than twice the median.

The comments in Table 4 are more detailed for the alluvial zones, which cover the entire region and account for the most productive aquifers. Zone areas mentioned in the comments are compared only with zones of the same type, for instance, a 'smaller' alluvial zone may be of much greater area than a 'smaller' Lower GAB zone. Where there is sufficient data, the plots shown on Table 4 display the essential chemical character of the zone, and are explained in Figure 21. These patterns of salinity and major ion distribution reflect the processes affecting the water, and vulnerability to unmeasured water quality aspects such as contaminants, corrosiveness and dissolved metals.



The higher the box on the EC column on the right, the greater the overall salinity. The longer the box, the greater the variability.

Units of major ions are milliequivalents per litre (MEQ) which reflects their chemical strength, rather than by weight (mg/L)

Figure 21: Explanation of major ion plots shown on Table 4

Examples of major ion plots of groundwater types which are typical of Queensland are shown on Figure 22, although the groundwater in most zones is of an intermediate type.

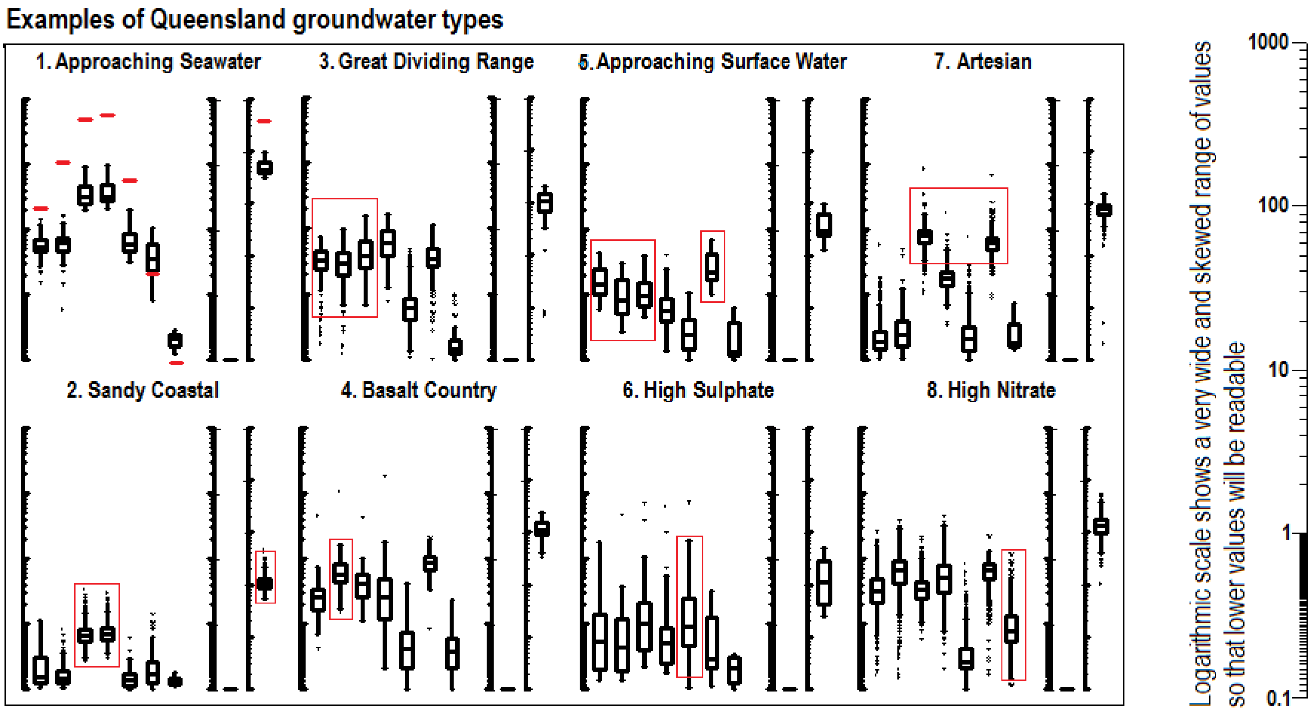


Figure 22: Examples of nomograms representing groundwater types found in Queensland

Most groundwaters in Queensland show tendencies towards one of the following examples:

- Approaching seawater–High salinity NaCl. The higher the salinity rises, the more the composition tends to be dominated by sodium chloride and resembles that of seawater, shown in red. This is because as groundwater from most sources increases in salinity, the more soluble cation sodium becomes more prominent, as does chloride among the anions and to a lesser extent sulphate. On the other hand, calcium bicarbonate may precipitate. This example is from the Rolling Downs Group, the main aquitard overlying the GAB
- Sandy coastal–Low salinity NaCl. These groundwaters are also high in sodium chloride, as indicated, but low to very low in salinity. Recharge is rapid, through porous, leached sands with very little mineral content, so that most of the salts are derived from marine spray droplets, either windblown or in rainfall. The very low salinity, alkalinity and hardness of such waters leads to unstable pH, with values below four not being uncommon. The groundwater in these areas resembles the surface water, which supports highly specialised ecosystems. The porous nature of the sand leaves these waters vulnerable to pollution from overlying development, and the acidity can make them corrosive to metals with which they come in contact. The example is from North Stradbroke Island.
- Great Dividing Range–Broadly even cations, with Na slightly dominant, and the proportion of Cl with respect to HCO_3 rising with salinity. These groundwaters are typical of alluvial valleys draining the GDR. The salinity and hardness is moderate to high as a result of plentiful weathering minerals in the landscape and relatively slow groundwater movement through clayey lensoidal aquifers, and the pH is usually 7.5 to 8. This example is from the alluvium of Callide Creek.
- Basalt country–Cations dominated by Mg. This groundwater type resembles the Great Dividing Range type, apart from the high proportion of magnesium, which is very rare in Queensland except in ground and surface waters in the immediate vicinity of basaltic terrain. Bores in basalt may be vulnerable to pollution from overlying development because of rapid recharge into often small, localised aquifers. The example shown is from the Main Range Volcanics around the Upper Condamine catchment.

- Approaching typical surface water composition–Low to moderate salinity, high in HCO_3 with Ca, being the highest cation but none dominating overall. This type is very common in streams, particularly over the interiors of large, subhumid, inland catchments (rainfall 500–1,000mm/year) (McNeil et al., 2005). Similar chemistry in groundwater suggests recent interaction with surface water. This example is from the Barratta Creek alluvium.
- High sulphate–Low to moderate salinity, with anions dominated by SO_4**.** SO_4 concentrations in Queensland's natural waters are, on average, relatively low when compared to international data (McNeil et al. 2005). SO_4, like Cl, is a conservative ion, and increases in prominence as salinity rises, but only 20 per cent of analyses with EC less than 5,000µS/cm in the GWDB have more than eight per cent, SO_4, and only 10 per cent have more than 12 per cent. The reason is probably the age and weathered character of much of the Queensland landscape, and the fact that most Tertiary volcanic activity was basaltic. High background levels of groundwater sulphate are only found where there is low relief and less than 500mm rainfall, allowing gypsum to accumulate in the soil profile. The given example represents weathered alluvium and ferricrete from the south-eastern Gulf of Carpentaria around Einasleigh.
- Most common artesian groundwater–Moderately saline $NaHCO_3$. Ground waters from the eastern and central parts of the GAB are characterised by $NaHCO_3$ type waters, thought to be due to dissolution of carbonates in the aquifer, and cation exchange of Na for Ca and Mg (Herczeg et al. 1991).The example is from the Hooray Sandstone in the western QMDB.
- High nitrate–NO_3 greater than 1mg/L. The common form of nitrogen analysed in groundwater is NO_3, because of the relatively anaerobic environment, and consequently its concentration is much less the than other major ions. It is sourced from the surface, and reaches the groundwater when either the nitrogen supply is too great, or the leaching too rapid for the uptake capacity of plants. Although most occurrences of high NO_3 are anthropogenic in origin, natural sources such as native legumes, termite nests, birds inhabiting recharge waters, or some geological deposits can contribute. The highest concentrations of groundwater nitrate are generally closest to the water table, due to active denitrification processes deeper in the aquifer (Mull et al. 1991). The groundwater systems most vulnerable to nitrate contamination are sand and gravel or fractured rock (Spalding & Exner 1991). Moody (1996) considers that, at least in the US, NO_3-N concentrations greater than 3mg/L (14mg/L NO_3) in groundwater may be influenced by human activities. The median concentration in the GWDB is 1mg/L (0.2mg/L TN), with only 12 per cent exceeding 14mg/L NO_3. Only 20 per cent of GWDB analyses have a NO_3 reading of over one per cent, and only 10 per cent have more than have more than three per cent NO_3. The example of high NO_3 waters shown is from the Toowoomba basalts. Another example of proportionately high NO_3 would be low salinity groundwaters from the Mulgrave River alluvium underlying the irrigation of sugar cane.

Table 4 also provides broad commentary on characteristics of groundwater chemistry zones relative to national or Queensland guidelines for water uses (e.g. irrigation, stock) and aquatic ecosystems. However, to ascertain suitability of a specific water source (e.g. a bore) for a given use (e.g. irrigation) more detailed testing may be required, and the broad results in Table 4 are not intended to provide this level of detail. Refer to notes after Table 4 for further details. Note that for decision making under EP Act/EPP (Water) refer to values and objectives included in schedule 1 of the EPP (Water).

Data reliability for characterisation, comparison with guidelines

Data reliability for characterisation and comparison with guidelines in Table 4 is based on the following:

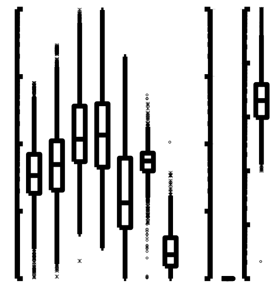
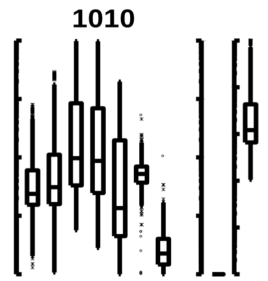
- Lab-analysed samples per km^2: 'excellent' >1; 'good' 1–0.5; 'moderate' 0.5–0.1; 'poor' 0.1–0.05; 'v poor' <0.05;
- 'unreliable' < 20 samples overall.

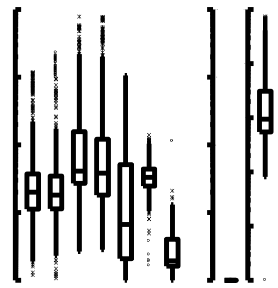
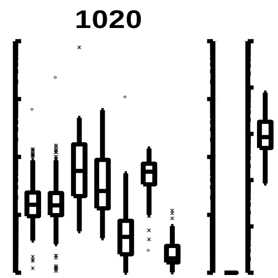
Individual groundwater sources within these zones (e.g. a particular bore) may provide different water suitability characteristics from the overall summary.

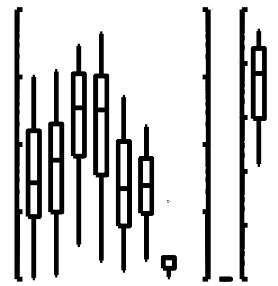
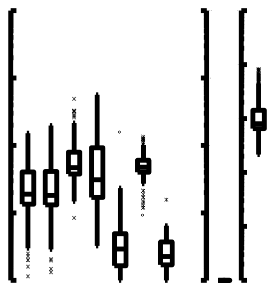
Bore attribution to aquifer class

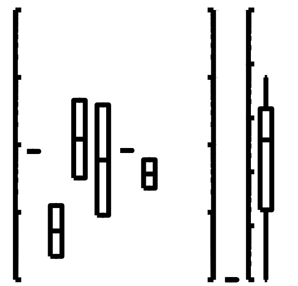
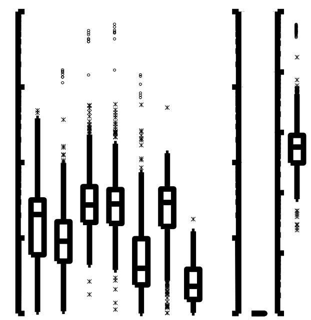
Following the methods outlined in section 3, attribution of bores (for which there was lab-analysed water quality data) to aquifer classes is shown in Figure 23 (Fitzroy-Capricorn-Curtis coast) and Figure 24 (Burdekin-Don-Haughton).

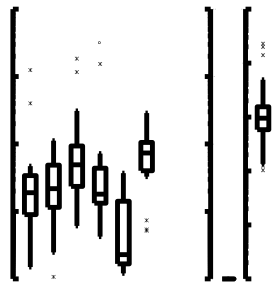
Table 4: Groundwater chemistry zone descriptions and characteristics

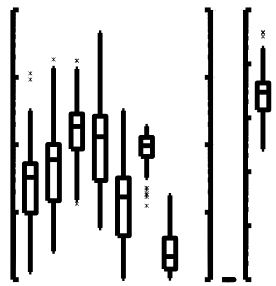
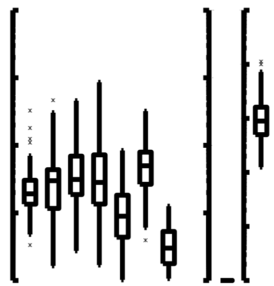
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 1	1 - Don and Southern Burdekin Delta	excellent	Na Ca	Cl	770	2200	6400	high but variable
	Near stream	excellent	Na	Cl	600	1125	9106	moderate but variable
	Comments The Don and Southern Burdekin Delta represents the alluvium along the coastal strip between the Burdekin and (Burdekin) Don Rivers. The terrain is characterised by hilly granitic headwaters, sloping to a coastal plain with stretches of alluvium around 7km wide, and a combined area of some 957km^2. Cape Upstart National Park is a granitic headland. The annual rainfall is 800–1,000mm being wetter in south, and the natural vegetation, of which about 80 per cent remains, is open forest to woodland or grassland, with small, scattered patches of rainforest, and stretches of salt marsh and mangroves along the coast. Acid sulphate soils may be present in the tidal zones. Landuse is mostly grazing, but with some sugarcane, and horticulture around coastal towns such as Gumulu, Guthalungra, and particularly Merinda in the moister south. Although it is one of the smaller alluvial zones, with a catchment area of 3,760km^2, it contains much of the data for the region. There is a reasonable spread of water quality data, with at least some recent data. The alluvial bores are mainly of moderate depth with shallow also significant, with depths extending from 7m to 25m. The salinity ranges from moderate to very high, increasing with depth accompanied by changes in water chemistry. The surface water is fresher at than the groundwater, with low to moderate salinity, evenly distributed cations, and HCO_3 as the major anion, however, there may be some local similarity near streams. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited in bores over time, with some scale on heating. Suitability for irrigation is moderate, but poor for sensitive crops because of the high salinity and occasionally high percentage of sodium (SAR>8). It is normally suitable for stock. EC often exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN may do also. pH upper range values occasionally exceed the QWQG aquatic ecosystem surface water quality guidelines. Water levels probably rose over the last 20 years, but EC probably fell over the last 10, perhaps having risen in the past. Some of the groundwater is probably vulnerable to contamination because of the proximity of marine and estuarine conditions as well as water tables near the surface.							 Total zone  Near stream

<table>
<tr><th rowspan="2">Aquifer class</th><th rowspan="2">Chemistry zone and comment [1, 4]
Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.</th><th rowspan="2">Data reliability for comparison [2]</th><th colspan="2">Dominant Ions</th><th colspan="3">EC Percentiles (µS/cm) [3]</th><th rowspan="2">Salinity description and major ion plots</th></tr>
<tr><th>Cations</th><th>Anions</th><th>20th</th><th>50th</th><th>80th</th></tr>
<tr><td rowspan="4">Alluvium
Zone 2</td><td>2 - Haughton</td><td>excellent</td><td>Na Ca</td><td>HCO_3 Cl</td><td>485</td><td>974</td><td>6059</td><td>moderate but variable</td></tr>
<tr><td>Near stream</td><td>excellent</td><td>Na</td><td>HCO_3</td><td>440</td><td>850</td><td>1990</td><td>moderate</td></tr>
<tr><td colspan="7" rowspan="2">Comments
The Haughton alluvial zone comprises the Haughton Catchment, apart from the downstream area east of Barratta, which is included in the Coastal Strip Zone. Granites and trap rock form the rugged headwaters of the Haughton R in the northwest, and a section of Bowling Green Bay National Park in the northeast. These descend to a flatter central plain of broad but irregular patches of alluvium with a total area of 657km^2. The average rainfall is 700–1,000mm, which rises to 1,800mm in the highland areas. Only about 30 per cent of the natural eucalypt woodlands to open forest remains, except the headwaters which includes patches of rainforest. The drier lower terrain includes some grassland and wetlands. The downstream Haughton alluvium around Horseshoe Lagoon is intensively irrigated for sugar cane, but most of the remainder is used for grazing. There are some small mineral deposits, mainly gold around the granites. The zone area of 1,924km^2, making it one of the smaller alluvial zones, but is regionally important in numbers of data, which is mostly concentrated in the sugar producing area. There is a relatively recent data record. The bores mostly access moderate to deep alluvium, extending from 14m to 42m. The salinity ranges from low to very high, with occasional outliers resembling seawater. It increases with depth and distance from the stream. The surface water chemistry is variable, but tends to resemble local groundwater, suggesting some interaction. The groundwater is normally suitable for drinking and other domestic uses, despite occasional high EC and hardness. Precipitates may form in bores with occasional scale. The suitability of the groundwater for irrigation is reasonable, although the quality is only moderate for sensitive crops because of the salinity and occasionally high percentage of sodium (SAR >8). It is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines and TN and pH (upper range values) may do also. Water levels probably rose over the last 20 years, but EC appears stable over the last 10 years although it probably rose in the past. Some of the groundwater is probably vulnerable to contamination because of the proximity of marine and estuarine conditions, and shallow and possibly rising water tables.</td><td>
Total zone</td></tr>
<tr><td>
Near stream</td></tr>
</table>

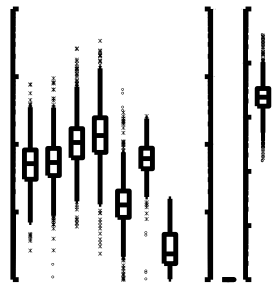
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 3	3 - Suttor	v poor	Na	Cl	821	6500	21380	very high but variable
	Comments The Suttor zone consists of the Suttor sub-basin, apart from the small, northern Cape River and Campaspe catchments, and the south west, Native Companion Creek catchment. With an area of 63380km^2, the Suttor is the largest of the alluvial zones but with only 6,250km^2 of alluvium and a minor proportion of the data. There is very little information for this sized area, and none of it recent. The climate is hot and arid, steppe, with only 500 - 700mm of annual rainfall. More than 80 per cent of the natural open forests or woodlands remains in the north and west, but only 20–30 per cent in the southern and central area along the course of the Belyando River. The landscape and geology are complex, with rugged to hilly headwaters and an undulating central area, mostly covered by Tertiary sediments and flood plain deposits. The zone overlies the pre GAB Galilee Basin along the hilly western border, where Galilee sediments outcrop through the Tertiary. The Bowen Basin is also overlapped downstream on the Suttor River some coal deposits are associated with these basins. The edge of the Eromanga Basin also narrowly intersects the northwest edge of the zone, with outcrops of Ronlow Beds. There are also some exposures of trap rock and granite in the central section containing small mineral deposits, and a few basalt residuals in the east. The alluvial system is also very varied, but mostly moderately to very deep at 14m to 87m. Usual salinity (20th–80th percentile) ranges vary from 800µS/cm to 21,000µS/cm. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Some bores may be subject to corrosiveness, and precipitates may form in others with occasional scale. Landuse is mostly grazing, with some mostly dryland cropping and forestry around the basalt country. The quality appears to be moderate for irrigation, except for sensitive crops because of elevated sodium (SAR>8), and salinity in some bores. The water should be tested before giving to stock because of occurrences of excessive salinity. The surface water is varied but does not resemble the groundwater, being of low to moderate salinity, HCO_3 dominated, with mostly even cations Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) may do also. Data is inadequate to assess water level behaviour over the last 20 years. EC and nitrate trends cannot be estimated because of insufficient data. Some of the groundwater may be vulnerable to contamination because of shallow and possibly rising water tables and the thickness of the water column which may be less than 2m in places.							
Alluvium Zone 4	4 - Lower Burdekin with Bowen	moderate	Na Ca	HCO_3	583	790	2250	moderate
	Near stream	moderate	Na Ca	HCO_3	554	682	886	
	Comments The Lower Burdekin with Bowen Zone comprises the Bowen Catchment, and the adjoining section of the lower Burdekin Catchment which is downstream of the Fanning Rivers at Selheim, but inland of the Coastal Strip Zone. Although it is one of the bigger alluvial zones, with an area of 19515km^2, it represents a minor proportion of the region's samples. The terrain consists of rugged to hilly dissected trap rocks and granite, with Bowen Basin sandstones in the southern headwaters. There are extensive coal deposits between Collinsville and Newlands in the Bowen Catchment, and mineral deposits associated with the granites. The only substantial strip of alluvium is around the Burdekin north of Dalbeg, where it enters the Coastal Plain. This is around 40km long and 18km wide, with an area of 737km^2, but is shallow and intruded by granite hills. Virtually all of the bores access moderate to occasional shallow alluvium, extending from 12m to 29m. The climate ranges from warm and temperate, with rainfall of over 1000mm on the ranges in the east, to hot and semi-arid in the west with a rainfall of 600mm. The natural vegetation is woodland to open forest, with grasslands and brigalow on the Bowen Basin sediments in the south. There are significant areas of rainforest in the mountainous areas, where more than 80 per cent remains uncleared, but there is only about 60 per cent of remnant vegetation in the upper Bowen. Most of the							

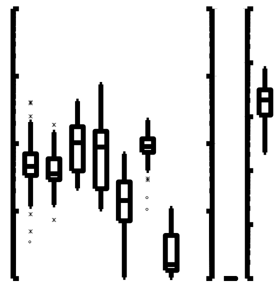
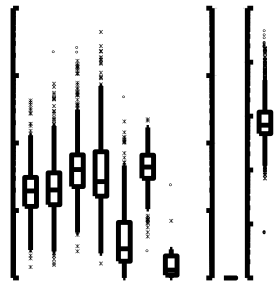
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20^{th}	50^{th}	80^{th}	
	land is grazed, with some forestry and sugar cane as well as several small towns including Ravenswood, Millaroo, and Eungella, and Eungella National Park is the largest of several conservation areas. The Burdekin Dam is located on the mid-western boundary. The data record can be regarded as historical only. The salinity ranged from moderate to high, but variable, being between 580µS/cm and 2,250µS/cm (20^{th}–80^{th} percentiles). The water is normally suitable for drinking and other domestic uses, although there are recordings of high EC and hardness. Precipitates may form in bores with some scaling. The irrigation status of the water seems reasonable, although the quality is only moderate for sensitive crops because of high salinity. It is normally suitable for stock. The surface water is also usually of moderately saline, but more saline and variable along eastern Bowen tributaries, Broken R and Pelican Creek. It is dominated by HCO_3 but with even cations. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) frequently do as well.							
Alluvium Zone 5	5 - Upper Burdekin	unreliable	id	id	id	id	id	variable
	Comments The Upper Burdekin Sub-basin forms the northwest headwater of the Burdekin Catchment. It is one of the biggest zones, with an area of 36,245km^2, but only 963km^2 of alluvium and only 1 complete water quality sample, collected in 1974. The underlying geology consists of granites and trap rocks, frequently containing small mineral deposits, which are overlain in places by residual Tertiary deposits. Extensive basaltic tablelands cover much of the north and southwest, but the rest of the terrain is hilly with narrow strips of alluvium around streams. Rainfall on the north eastern highlands ranges up to 2,000mm, but drier conditions prevail in the south, so that average rainfall over most of the zone is 650–750mm. The natural vegetation, of which more than 80 per cent remains, is commonly low eucalypt woodland with a spinifex understorey, or eucalypt forest and woodlands on the flatter country. There are patches of grassland and rainforest on the basalts, particularly around the Great Basalt Wall around Lolworth Creek in the south. Landuse is mostly grazing and conservation, with few towns, and several national parks including the Great Basalt Wall and Paluma Range on the Star River in the southeast. The surface water in the basalt runoff is mostly low salinity, dominated by HCO_3, with even cations, but runoff from the granites and trap is more sodic. The few recorded bores mainly access deep alluvium, extending from 43m to 114m, with salinity varying from very low to 5,600µS/cm, but there is insufficient data for further assessment.							
Alluvium Zone 6	6 - Curtis Coast	moderate	Na Ca	Cl	270	570	1025	moderate
	Comments The Curtis Coast alluvial Zone includes Curtis Island, lying just north of the Port of Gladstone and south of the Fitzroy estuary, as well as the relatively small, coastal catchments of Waterpark Creek, Shoalwater, and the Styx River to the north of the estuary. The total area of the zone is 9315 km2, of which Curtis Island contributes 576 km2.The island is separated from the mainland by the Narrows, a strait about 3 km wide in the south but less than 1 km in the north. The basement geology is trap rock, outcrop in a series of northwest trending ridges, particularly on Curtis Island, overlain in the central catchments by broad, flatter areas of weathered alluvium and colluvium in the north, with some granite outcrops. Extensive areas of sand dunes, wetlands and estuarine deposits have formed along the coastline. Annual rainfall is 800mm to over 2000mm on steeper terrain, including patches of rainforest. Most of the zone is lightly developed, with more than half of the natural eucalypt woodlands and open forest remaining and large areas of state forest and nature conservation including Curtis Island and Byfield National Parks. Mangroves and tidal salt marshes cover the low lying areas connected to the coast, with wallum vegetation on the sand dunes. A mainly residential area is centred around Yeppoon, and coal seam gas export facilities, including natural gas liquefaction plants, are situated in the Curtis Island industrial precinct on the southwest coast south of Grahams Creek. There are no significant waterways in this zone, and most of the groundwater is obtained from around 3000 km2 of colluvium, sand dunes and other coastal deposits of moderate depth, particularly the Farnborough Sands near							

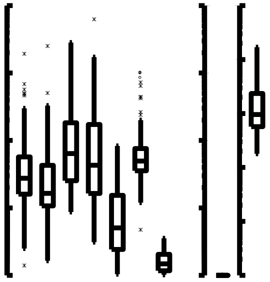
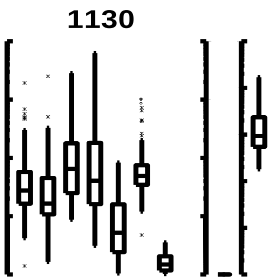
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
	Yeppoon in the south of the Waterpark catchment. The water appears suitable for most purposes, although EC and TN may exceed QWQG aquatic ecosystem surface water quality guidelines, and pH (lower range values) may be below the guidelines in places.							
Alluvium Zone 7	7 - Comet	moderate	Na Mg	HCO_3	751	1348	4200	moderate
	Comments The Comet Zone comprises the eastern and central part of the Comet Catchment. It excludes the downstream area north of Springsure Creek, which is within the 'Mackenzie with Lower Nogoa and Comet Rivers Zone', and also the west of the catchment which is part of the 'Comet and Nogoa Basaltic Headwaters' Zone. The Zone is underlain by the Bowen Basin, including substantial coal deposits, and mostly also by the Palaeozoic Drummond Basin beneath it. Bowen Basin aquifers outcrop in the hilly regions around the headwaters, but elsewhere they are buried beneath undulating Tertiary deposits or basalt remnants. This zone is moderately sized, with a total area of 9,320km^2, but contains only 72km^2 of alluvial flood plains, up to 5–10km wide, around the Comet and its tributaries. The rainfall is 600–750mm, being highest in southern headwaters, which supports a natural vegetation of open forests and brigalow, with patches of rainforest on the floodplains. Grasslands are common on basalt country. Much of this been cleared, despite the presence of several conservation areas and national parks, except on the hilly eastern Planet Creek catchment. Only 20 per cent of natural vegetation remains downstream on the Comet floodplain which is intensively cropped. Most of the bores appear to access moderately deep alluvium with occasional deeper bores, with a range of 20m down to 77m. The small amount of data is not recent, and may not be fully representative, but records variable salinity from moderate to high, being between 750µS/cm and 4200µS/cm (20th to 80th percentiles). The water is normally suitable for drinking but it may not be ideal for other general purposes because of excessive hardness. Precipitates may form in bores with occasional scale. It appears to be reasonable for irrigation, although the quality is only moderate for sensitive crops because of elevated salinity, but It is normally suitable for stock. The surface water is usually moderately saline, and dominated by HCO_3. The cations are evenly distributed where there are basalts upstream, or occasionally sodic if flowing through Tertiary deposits. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also. Some groundwater may be vulnerable to contamination because of contact with basalt.							

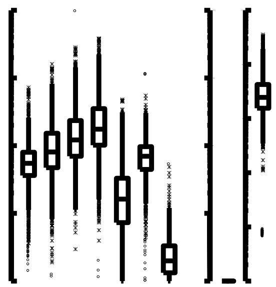
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 8	8 - Mackenzie with Lower Nogoa and Comet Rivers	v poor	Na	Cl	1319	3155	5533	high
	Near stream	v poor	Na Mg	Cl HCO_3	1367	3140	4530	high
	Comments The Mackenzie with Lower Nogoa and Comet Rivers Zone has an area of 15,574km^2, making it one of the bigger alluvial zones. It includes the Mackenzie Sub-basin, with the inflowing lower Nogoa and Comet Sub-basins to the west. The hilly country on the east and western edges of the zone are composed of coal bearing sediments of the Bowen Basin Back Creek Formation, which are mostly blanketed by undulating Tertiary sediments in the central area. The Back Creek Formation supports coal mines such as Blackwater, as well as coal seam gas. About 1,938km^2 of alluvial floodplains, 5–10km wide, have formed around the major streams. The annual rainfall of 550–650mm supported open eucalypts forests and brigalow, with patches of rainforest in the moister east. Only 30–40 per cent of this vegetation remains except in some headwater areas. Grazing covers most of the landscape, with patches of forestry and conservation. There is also a small irrigation area, downstream on the lower Mackenzie River. There is a large irrigation area near Emerald, upstream of this zone, which is based on cotton and supplied by Fairbairn Dam. The zone is represented by a minor proportion of the regional samples. The limited water quality record may not be fully representative, being only available from the western Emerald Irrigation Area, just downstream of Theresa Creek and the Nogoa River, but the record is reasonably up to date. Most of the bores access moderately deep alluvium, with deep also significant, as depths extend from 12m to 100m. The salinity of groundwater nearer the surface ranges from 830µS/cm to 3,707µS/cm, with a composition of $NaHCO_3$, but below 60m the average EC is around 4,000µS/cm, with the composition of NaCl. Salinity may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores with occasional scale. EC and percent sodium are excessive for sensitive crops in some locations (SAR >8). It is normally suitable for stock. The surface water is mostly low salinity, HCO_3 dominated, and usually with even cations but more sodic at some stages of flow. It is probably influenced by basaltic runoff, and does not resemble the nearby groundwater. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, TN frequently does, and pH (upper range values) may do also. Water levels possibly rose over the last 20 years. EC possibly rose over the last 10 years as well as historically. Some of the groundwater may be vulnerable to contamination because of contact with basalt aquifers, and the thickness of the water column may be limited in places.							 Whole zone
Alluvium Zone 9	9 - Nogoa	moderate	Na Mg	HCO_3	466	962	2457	moderate
	Comments This zone covers the Nogoa Sub-basin excluding the eastern edge, the southern portion of which lies within the 'Comet and Nogoa Basaltic Headwaters zone', and the northern downstream portion is part of the 'Mackenzie with Lower Nogoa and Comet Rivers zone'. It is one of the larger alluvial zones, with a total area of 22,074km^2, but contains little alluvium and represents only a minor proportion of the regional data. Sandstones of the Eromanga, Galilee and Bowen Basin are exposed as dissected hills in the southernmost headwaters, but the Galilee and Bowen Basin sediments downstream include coal bearing formations with mines in the south such as Blair Athol. Mineralised Precambrian to Palaeozoic trap rocks and granites outcrop in the northern and central region, and are mined for sapphires in the vicinity of Sapphire and Rubyvale. An extensive stretch of basalt covers much of the northern headwaters east of Theresa Creek. Cainozoic floodplains with more subdued relief, surround Theresa Creek and to a lesser extent, other major streams, into which, recent floodplains with a total area of about 656km^2 have been incised. The bores access alluvium of moderate or occasionally shallow depth, extending from 15m to 37m. Annual rainfall is low, at 550–650mm, except on the central western headwaters around the Zamia Range, where it ranges up to 800mm. The natural vegetation is brigalow in the east, grading to eucalypt woodland in the west, with mainly grassland on the basalt. Much of the basalt has been cleared for							

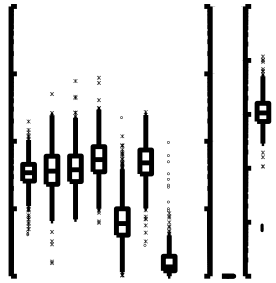
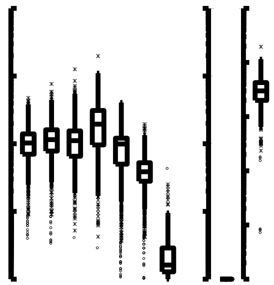
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
	dryland cropping, and the lower reaches of Theresa and Retreat Creeks are part of the large, cotton based irrigation area around Emerald which is supported by Fairbairn Dam. The rest of the zone is relatively lightly developed, with significant areas of state forest and conservation including most of Carnarvon National Park. The data record is moderately adequate, with at least some recent samples. It indicates that salinity tends to fall with depth. The shallower groundwater ranges above 2000µS/cm, and has a composition of Na Mg with HCO_3 Cl, whereas groundwater at the bottom of the alluvium has a range of only 379µS/cm to 496µS/cm, with a composition of Na Ca HCO_3. Samples from around the granites are elevated in Na. Salinity may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores. The irrigation status of the water seems reasonable, although the quality is only moderate for sensitive crops in shallower bores because the salinity may be elevated. It is suitable for stock. The surface waters are fresher than the shallower groundwaters, but of similar composition, however, EC often exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN may at times. pH (upper range) values are occasionally slightly in excess of QWQG aquatic ecosystem surface water quality guidelines. Water levels possibly rose over the last 20 years, and EC may have fluctuated over the long term. Some of the groundwater may be vulnerable to contamination as it is obtained from basalt as well as alluvium, with shallow and possibly rising water tables.							

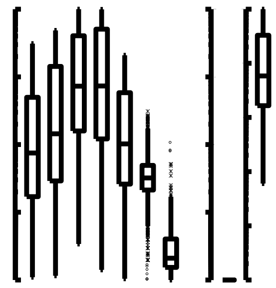
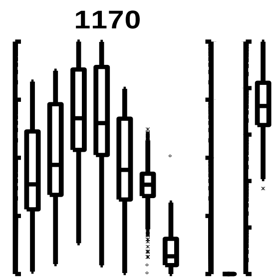
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 10	10 - Lower Fitzroy	moderate	Na Mg	Cl	430	678	1404	high
	Near stream	excellent	Na Ca	Cl	425	622	1065	high
	Comments The Lower Fitzroy, is a moderate sized zone, with an area of 9,585km^2, encompassing most of the Lower Fitzroy Sub-basin downstream of the confluences with the Dawson and Mackenzie Rivers to the estuary. However, it excludes the coastal section between Marlborough and Alligator Creeks which comprises the 'Fitzroy Serpentinite Belt' Zone. The geology is variable, but mainly trap rocks and granites of Palaeozoic to Precambrian age with small mineral deposits, mainly alluvial gold. The terrain is hilly except on the floodplains, which are up to about 12km wide along the major streams, with a total area of 1,688km^2. Most bores are at moderate depth of between 10m and 24m. Back Creek sediments of the Bowen Basin outcrop in the west along the edge of the Fitzroy flood plain, along with scattered residuals of more recent deposits including Mesozoic volcanics and basalt flows as well as Tertiary sediments. The annual rainfall is relatively high, being over 1,600mm in the eastern ranges, and 750–1,000mm over most of area. The moist conditions supported open eucalypt forest with significant patches of rainforest, with drier woodland and brigalow in the west, however this zone is quite densely settled, with most of the native vegetation being cleared. Only 10–40 per cent remains in the centre of the zone, but up to 60 per cent on the borders. Although most of the area is grazed, there is an extensive urban area around Rockhampton, which extends eastwards from the Fitzroy floodplain. There are significant stretches of mangroves and salt marshes around the Fitzroy estuary and Raglan Creek, with acid sulphate soils in the intertidal area. The zone is average in terms of data, with a moderate coverage, but not very current. The chemistry varies in from moderate to high in salinity with Cl as the dominant anion, and changes in composition through the profile. The highest salinity is found at moderate depths close to the streams, where it is around 1,347µS/cm to 3,500µS/cm, with even cations becoming more sodic and moving towards seawater composition as the EC rises. This is likely due to estuarine influences. The water is normally unsuitable for drinking because of salinity, and poor for general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The water appears to be of moderate quality for irrigation, except for sensitive crops because the salinity may be elevated. It is normally suitable for stock. The surface water is varied in composition, but usually of moderately saline, with even cations and reasonably equal proportions of HCO_3 and Cl. It is usually fresher than local groundwater but of similar composition. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN may do also. Water levels were probably stable over the last 20 years.							 Total zone

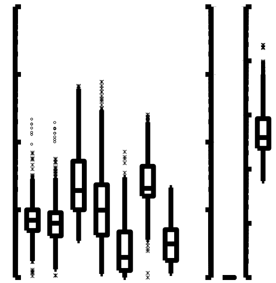
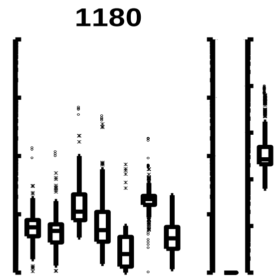
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 11	11 - Calliope and Boyne Catchments	poor	Na Ca	HCO_3	414	525	665	moderate
	Comments This is a moderate sized zone of 2241km2, south of the Fitzroy estuary, which includes the Calliope and Boyne Catchments, as well as some small coastal creeks. The catchment is composed of dissected, hilly to undulating country, with about 75km^2 of alluvium in small patches around the Calliope and Boyne rivers. The alluvial bores tend to be moderately deep, most being from 11m to 31m. The underlying geology is mainly trap rock and granite, with some, mostly metalliferous mineral deposits and limestone around Mt. Larcom. Oil shales are found in Cainozoic sediments close to the estuarine mangroves and salt marshes along the coastal strip next to Curtis Island. The eastern coastal lowlands are poorly drained, and there is risk of intercepting ASS in the deltaic and estuarine areas. The climate is relatively moist, with a rainfall of 800–1,000mm supporting a natural vegetation of eucalypt woodland to open forest, with a significant proportion of rainforest on the steeper areas. Agriculture, mainly grazing, accounts for about 65% of the zone, although the Boyne headwaters include protected areas of high ecological value. The downstream, flow of the Boyne River is highly regulated by Awoonga Dam, which supplies several major industrial sites centred on the city of Gladstone. Other important local industries include tourism and fishing. From the limited data record, there is a trend in composition with increasing EC, from HCO_3 with balanced cations, to a NaCl dominated seawater composition. It is usually suitable for most purposes, although EC may occasionally affect taste, and precipitates are likely to be deposited over time. The surface water is similar to the groundwater, but EC often exceeds QWQG aquatic ecosystem surface water quality guidelines, as does TN. Water tables possibly fell over the last 20 years.							
Alluvium Zone 12	12 – Isaac	moderate	Na Mg	HCO_3	430	678	1404	moderate
	Near stream	moderate	Na Mg	HCO_3	425	622	1065	
	Comments Although average in terms of data, the Isaac Sub-basin is one of the biggest alluvial zones, with an area of 2,2364km^2, and it forms the north-eastern corner of the Fitzroy Basin. It is bordered by ranges except in the south, where the Isaac River flows into the Mackenzie River. The geology west of the Isaac River is composed of hilly Bowen Basin sediments containing major coal seams, overlain in the central area by undulating Tertiary deposits. In the east are steep dissected headwaters of granite and trap rock, associated with some mineralisation. In the flatter central area there are 1632km^2 of alluvial floodplain, up to 10km wide around the Isaac River and its tributaries. This alluvial system is very varied, but most bores are of moderate depths of between 16m and 31m. The rainfall is highest in the eastern ranges, where it may exceed 1600mm, but over most of the area it is 600–800mm. The natural vegetation is mostly open forests and woodlands of brigalow or dry eucalypts, becoming denser on the floodplains and highlands with scattered patches of rainforest. Much of it has been cleared for irrigation and dryland cropping downstream, but 60–90 per cent of natural cover remains on the ranges. Most of the area is grazed, with few major towns and but several small patches of forestry and conservation. The data record is moderate coverage for a zone of this size. The salinity ranges from low to moderate at 300µS/cm and 2,538µS/cm, being of low and less variable salinity near streams. It is generally below 900µS/cm in the deepest parts of the alluvium, but moderate to high around the edges, tending to be sodic except in the vicinity of basalt remnants. The proportion of Cl increases with EC. The water is normally suitable for drinking and other domestic uses, despite hardness. It seems reasonable for irrigation, although the quality is only moderate for sensitive crops because salinity may be elevated. It is suitable for stock. The surface water is mostly moderate in salinity with evenly distributed anions and cations, and may resemble local groundwater when flows are low, but EC often exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN may at times. Water levels possibly rose over the last 20 years, and EC							

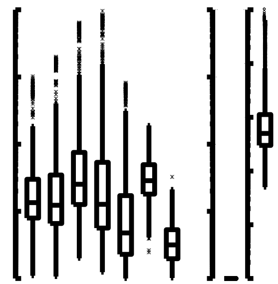
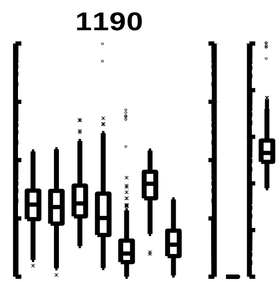
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
	possibly fell over the last 10, although it was probably stable in the past. Some of the groundwater may be vulnerable to contamination because of contact with basalt aquifers and shallow and possibly rising water tables.							
Alluvium Zone 13	13 - Dawson	v poor	Na Ca	HCO_3	482	825	2001	moderate but variable
	Comments The Dawson Zone includes most of the Dawson sub-basin, which occupies the south-eastern quarter of the Fitzroy basin. The zone excludes most of the Don River catchment, upstream of its confluence with the Dee River, and east of the Banana Range. This sub-catchment, on the lower reaches of the Dawson River, includes the Callide Valley. Also excluded is the small sub-catchment of Castle Creek, also on the eastern side. The zone has an area of 43,108km^2, making it one of the biggest, although representing only a minor proportion of the regional samples. The southern upstream headwaters of the Dawson are formed of dissected sandstone country including exposures of GAB aquifers and aquicludes such as the coal bearing Walloons. As the river flows northwards, the GAB gives way in the middle and lower reaches to the more undulating Bowen sediments, with sandstones exposed in the west, and the coal bearing Back Creek Group, partially blanketed by Tertiary deposits, east of the Dawson Range. Basalt remnants are scattered across the mid reaches of the Dawson. In the northeast, the watershed with the coastal catchments is formed of steep, dissected ranges of mineralised granite and trap rocks. Floodplains formed around the major streams occupy some 2833km^2 and are up to about 10km wide. The alluvium is mainly of moderate depth extending from 15m to 25m. Rainfall is 550–750mm, supporting a natural vegetation of mostly dry brigalow or eucalypt woodland and open forests, with frequent patches of rainforest on the GAB sandstones and around Mimosa Creek, where about 60–90 per cent of natural vegetation remains in conservation or state forests. The rest of the zone is largely cleared for dryland cropping, with some irrigation downstream, supported by several weirs on the mid and lower reaches of the Dawson. The historical data record may not be fully representative of an area this size. The salinity ranges from moderate to high, being between 380µS/cm and 2,828µS/cm, but mostly low to moderate with scattered high outliers. Salinity may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores with occasional scale. The irrigation status of the water seems reasonable, although the quality is only moderate for sensitive crops because of occasionally high salinity and percentage of sodium (SAR >8). It is normally suitable for stock. The surface water is very variable in composition. It is mostly quite fresh with even cations on the GAB outcrops in south, but becomes more saline and sodic downstream. However, groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also. Some of the groundwater may be vulnerable to contamination because water tables may be shallow.							 Total zone  Near stream

Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 14	14 - Mid and Lower Callide	good	Na Mg	Cl	1257	2160	4200	high
	Comments The Mid and Lower Callide, has an area of 3918km^2, with 472km^2 of alluvium, which makes it one of the smaller zones although it contains much of the data for the region. It consists of the lower and middle section of the Callide Creek subcatchment, and its confluence with the Dee R. The east of the zone has a landscape of dissected hills, sloping to undulating country surrounding the floodplains, before steepening again to the west. Virtually all of the bores access alluvium of moderate depths of between 12m to 19m. Coal is mined southeast of the alluvium to support Callide Power Station. Rainfall is about 650 - 800mm, with the original vegetation on the floodplain being open eucalypt forests and woodland, although only 10 per cent of this remains. However, up to 40 per cent of the open brigalow and eucalypt woodlands surrounding the alluvium remains, including patches of rainforest. The alluvium is intensively irrigated, using groundwater supplemented by upstream dams and weirs, while dryland cropping is carried out on the adjoining lowlands. Water is also obtained to support a power station by interbasin transfer from the Awoonga Dam on the coast via the Stag Creek Pipeline. There are several major towns in the zone, the largest of which is Biloela, with some state forests and conservation areas on the higher country. The data record represents a reasonable spread of water quality data, with at least some recent. The salinity ranges from moderate to occasionally very high, and increases with depth, being around 1,500µS/cm to 4,450µS/cm at moderate depths, with evenly distributed cations. The range at the deepest levels is 6,560µS/cm to 13,500µS/cm, with the percentage of Ca also increasing, suggesting sluggish flow with ion exchange. Salinity probably affects taste, and the water is poor for general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The suitability of the groundwater for irrigation is moderate, but poor for sensitive crops because of high salinity and occasionally high percentage of sodium (SAR>8). It is normally suitable for stock. The surface water quality is varied, with the mainstream of the Callide being low to moderate in salinity, with Na and HCO_3 predominating, while the tributaries are characterised by even cations and Cl, followed by HCO_3 among the anions. Groundwater EC often exceeds guidelines, and TN and pH (upper range values) may do also. Some of the groundwater may be vulnerable to contamination because of shallow water tables, and limited thickness of the water column which may be less than 5m in places.							 Total zone

Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 15	15 - Callide Headwaters	excellent	Even	Cl HCO_3	668	1050	1700	moderate
	Near stream	excellent	Na Ca	HCO_3	654	1006	1700	moderate
	Comments Callide headwaters includes the southern headwaters of Callide Creek, which lie on the eastern edge of the Dawson sub-basin. It includes the tributaries of Grevillia, Kariboe, Kroombit, and Upper Callide Creeks, and is one of the smaller zones, with an area of only 2,552km^2, but is regionally important in numbers of data. The alluvial aquifer is formed In the central west, where a blanket of undulating Tertiary sediments has been incised by the lower reaches of the streams to form a broad 103km^2 flood plain. The basement geology is made up of Palaeozoic volcanics and sediments with some granite, forming steep dissected hills. Remnants of the overlying Bowen Basin Formations are exposed in the west, particularly along the upper Prospect Creek subcatchment. Basalt residuals as well as some basal GAB sandstones are also found in the headwaters. The alluvium is mostly of moderate depth, extending from 13m to 20m. The rainfall is 650 - 700mm over most of the area, but up to 1000mm on the eastern headwaters, which support a substantial proportion of rainforest and wet eucalypt forest including Kroombit Tops National Park. Elsewhere, the natural vegetation was open eucalypt forest, with brigalow surrounding the lower reaches of the streams, but most of this has been cleared for intensive irrigated and dryland cropping or urban development such as the town of Biloela. The remainder of the zone is mainly grazing, with some state forest and conservation areas. The data record represents a reasonable spread of data, with at least some recent. The groundwater salinity ranges from moderate to high, being between 530µS/cm and 2,019µS/cm, with the average increasing with depth, and the proportion of Cl increasing with EC. The cations are even or with Mg predominating, which is typical of recharge from primarily trap and basaltic terrains. The salinity probably affects taste, and the water is poor for general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with occasional scale. The salinity may be excessive for sensitive crops but it is suitable for stock. The surface water is fresher than the groundwater, being mostly of low to moderate salinity, high in HCO_3 and with even cations. It may resemble the local groundwater at low flows, but would be influenced by storages and regulated flows, including Callide Dam. EC and TN may exceed QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) may do also. Water levels probably rose over the last 20 years, but EC appears stable over the last 10 years and probably was in the past.							
Alluvium Zone 16	16 - Dee River Alluvium	excellent	Even	Cl	1830	3000	4650	high
	Near stream	excellent	Even	HCO_3	1798	3000	4650	high
	Comments This zone consists of the alluvium of the Dee River upstream of its confluence with Callide Creek in the east of the lower Dawson sub-basin. With an area of 523km^2, it is one of the smallest zones but regionally significant in numbers of data. The landscape is mostly dissected hilly country, composed of Palaeozoic volcanics and granite intrusions, which are associated with gold and copper mines at Mt Morgan. A 3km wide, 47km^2 alluvial strip is incised into an undulating Cainozoic floodplain, to merge with the Callide alluvium at the southern, downstream end of the Callide catchment. Alluvial bores are mostly moderate in depth, or occasionally shallow, extending from 12m to 19m. The rainfall is 650 - 800mm. About 30 per cent of the original rainforest, eucalypt forests and woodland remains in the upper catchment, although all but 10 per cent of the floodplain downstream, and the surrounding open brigalow forest remains uncleared. The predominant landuse on the floodplain is irrigation and dryland cropping. This is a relatively densely settled zone associated with urban development and mining, with several towns including Mt Morgan, in the north and Wowan in the south. The data record represents a good spread, with at least some recent data. The salinity is usually high, being between 1,433µS/cm and 5,600µS/cm, with a unique composition for Queensland groundwaters in terms of the unusually high proportion of SO_4,							

Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
	which predominated over Cl in about half of the samples. The cations are even, or Na dominated followed by Mg, except at the deepest levels, where NaCl predominates. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time, with some scaling. The suitability of the groundwater for irrigation is moderate, but poor for sensitive crops because the salinity may be elevated. It is normally suitable for stock. The surface water resembles groundwater, particularly in terms of high levels of sulphate, but groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN often does as well. Water levels probably rose over the last 20 years, but EC probably fell over the last 10 continuing a past trend.							
Alluvium Zone 17	17 - Burdekin Delta Coastal Area	excellent	Na	Cl	1240	4480	42900	very high but variable
	Near stream	excellent	Na	Cl	1150	4370	22200	high but variable
	Comments Burdekin Delta Coastal Area, is the coastal plain associated with the boundary of the Burdekin Delta, extending from the mouth of the Haughton, over the mouths of Barratta Creek and the Burdekin River, to include Bowling Green Bay and Cape Bowling Green. It is one of the smallest zones with an area of 1,077km² but is regionally important in numbers of data. The plain is composed of 861km² of flat lying alluvium, merging with estuarine and deltaic deposits towards the coast line. The climate is tropical, and the winter is dry, although rainfall exceeds 1,000mm in the east and west, and 800mm in the central area. Mangroves and tidal salt marshes extend up to 12km inland, with a presence of acid sulphate soils in the intertidal zone. Behind these are tussock grasslands, swamps and wetlands. Cape Bowling Green and the coastline westward are part of the Bowling Green National Park. The remainder of the zone, in areas furthest from the coast, had a natural vegetation of open eucalypt woodlands, but most of this has been cleared for intensive irrigation of sugar cane. There are a number of towns, including Giru and Barratta. The data record represents a good spread, with at least some recent data. The alluvial bores extend from shallow to deep, the range being 8m to 54m, but most are of moderate depth. This zone is in a low lying coastal location, and is characterised by high salinity NaCl groundwater. The EC range (20th–80th %iles) is around 1,200µS/cm to 43,000µS/cm at moderate depths, except near streams, where the water becomes fresher and less Cl dominated. However, there are outliers throughout the lower alluvium which resemble seawater in composition. The salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The suitability of the groundwater is poor because salinity and the proportion of sodium may exceed irrigation guidelines in some locations (SAR >46). The water should be tested before giving to stock as there are occurrences of excessive salinity. The only surface water data is from the lower reaches of the Haughton River in the north. Here it is of low to moderate salinity, but still Na dominated, and interaction with the groundwater is possible. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also. Water levels probably rose over the last 20 years, and EC over the last 10, continuing a past trend. Some of the groundwater is probably vulnerable to contamination because of the proximity of marine and estuarine conditions, rising EC trends as well as shallow and rising water tables.							 Total zone  Near stream

Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 18	18 - West Barratta	excellent	Na	HCO_3	224	390	986	low but variable
	Near stream	excellent	Na Ca	HCO_3	196	268	576	low
	Comments The Barratta catchment, to the north of the Burdekin Delta, is divided into several zones because of the rich data record and high variability of water quality. The West Barratta Zone includes the western side of the low lying, central reaches of the Barratta Creek floodplain. It comprises the western half of the middle reaches of Barratta Creek subcatchment, extending from Claredale to Barratta, and including Barratta Creek along its eastern border. It merges with other delta zones; the Haughton River floodplain to the north, the Burdekin alluvium to the south, the Upper Barratta to the west, and the East Barratta to the east. It is one of the smallest zones with an area of 222km^2, being almost all alluvium. It is average in density of data. The alluvial bores extend from shallow to deep, the range being 13m to 39m, but most are of moderately depth. The climate is tropical with a dry winter and mostly 850–900mm of annual rainfall. It supported a natural landscape of eucalypt woodland to open forest, of which 30–40 per cent has been cleared for the irrigation of sugar cane. The data record represents a good data spread, although not up to date. The salinity ranges from low to moderate but variable, being between 185µS/cm and 1,606µS/cm. The water is mostly sodic, although the cations are more evenly distributed in downstream reaches of the west Barrattas. It is normally suitable for drinking and other domestic uses, although some bores may be subject to corrosion. It is reasonable for irrigation, although the percentage of Na may occasionally be excessive for sensitive crops (SAR >8). It is normally suitable for stock. The surface water resembles the groundwater, but is less saline and Na dominated. EC may exceed QWQG aquatic ecosystem surface water quality guidelines and pH (upper range values) may do also. Water levels appear to have risen over the last 20 years, and EC appears to have risen over the long term. Some of the groundwater is probably vulnerable to contamination because of the proximity of marine and estuarine conditions, and shallow and possibly rising water tables.							 Whole zone  Near stream

<table>
<tr><th rowspan="2">Aquifer class</th><th rowspan="2">Chemistry zone and comment [1, 4]
Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.</th><th rowspan="2">Data reliability for comparison [2]</th><th colspan="2">Dominant Ions</th><th colspan="3">EC Percentiles (µS/cm) [3]</th><th rowspan="2">Salinity description and major ion plots</th></tr>
<tr><th>Cations</th><th>Anions</th><th>20th</th><th>50th</th><th>80th</th></tr>
<tr><td rowspan="4">Alluvium
Zone 19</td><td>19 - Mid Burdekin Delta</td><td>excellent</td><td>Na Ca</td><td>HCO_3</td><td>275</td><td>505</td><td>1415</td><td>low but variable</td></tr>
<tr><td>Near stream</td><td>excellent</td><td>Even</td><td>HCO_3</td><td>267</td><td>450</td><td>970</td><td>low</td></tr>
<tr><td colspan="7" rowspan="2">Comments
The Mid Burdekin Delta Zone consists of the central alluvium of the Burdekin Delta, extending from Clare Weir in the southwest, to merge downstream with the Burdekin Delta Coastal Plain Zone. It adjoins the East Barratta zone in the west, the Upper Barratta Zone in the south, and the Barratta floodplain to the north. It is one of the smallest zones, being part of the complex Burdekin Delta region, but is regionally important in numbers of data. The landscape is one of flat to undulating alluvial plains, with one or two isolated hills. The area of 322km^2 is virtually all alluvium of mainly moderate depth with bores extending from 12m to 36m. The climate is tropical, with a dry winter, and an annual rainfall of 750–1000mm which declines to the west. The natural vegetation was eucalypt woodland to open forest with some areas of grassland in the drier northwest. There were also scattered wetlands near the coast, and narrow strips of rainforest along the Burdekin. However, the area is now intensively developed for sugarcane irrigation, with large urban centres such as Ayr. It contributes to interbasin transfer, where surface water is discharged to irrigation channels in the neighbouring East Barratta Zone at Clare Weir. The data record represents very good spread, with at least some recent data. The salinity ranges from low to moderate, being between 218µS/cm and 1,500µS/cm, with mostly even cations or occasional Na dominance, except in the deepest groundwater, where salinity is higher with outliers of over 11,000µS/cm. The water is normally suitable for drinking and other domestic uses, despite hardness. Precipitates may form in bores with occasional scale. The suitability of the groundwater for irrigation is reasonable, although the quality is only moderate for sensitive crops because of variable salinity and occasionally higher percentage of sodium (SAR >8). It is suitable for stock. The surface water data is limited, but it appears to resemble the groundwater, although QWQG aquatic ecosystem surface water quality guidelines are often exceeded by groundwater EC, and occasionally by TN and pH (upper range values). Water levels appear to have risen over the last 20 years, but EC was probably stable over the last 10, having risen in the past. Some of the groundwater is probably vulnerable to contamination because of the proximity of marine and estuarine conditions, and shallow and possibly rising water tables.</td><td>
Whole zone</td></tr>
<tr><td>
near stream</td></tr>
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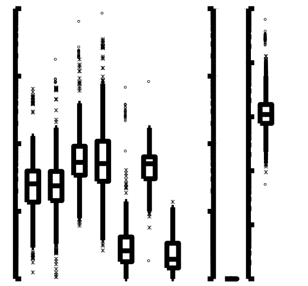
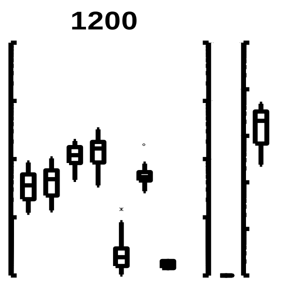
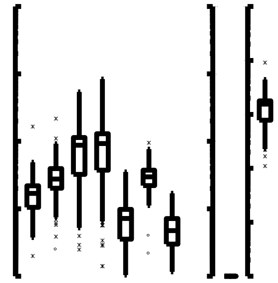
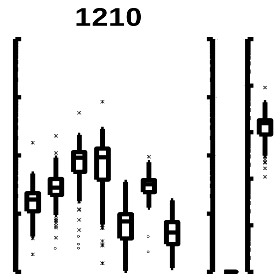
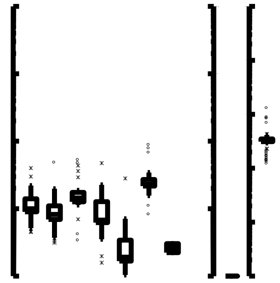
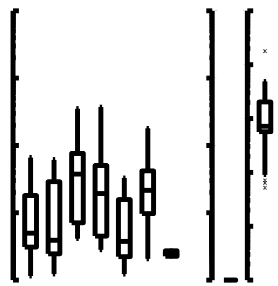
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 20	20 - East Barratta	moderate	Na Ca	Cl HCO_3	650	1100	1950	moderate
	Near stream	poor	Na Ca	Cl	529	2100	3702	moderate-high but variable
	Comments The Barratta catchment, to the north of the Burdekin Delta, is divided into several zones because of the rich data and high variability. The East Barratta Zone includes the eastern bank of the low lying, central reaches of the Barratta Creek floodplain, excluding the Creek itself. It extends from the Upper Barratta Zone, downstream to West Barratta township, where it merges with the Burdekin Delta Coastal Plain, and also lies between the West Barratta Zone and the Mid Burdekin Delta Zone. It has an area of 206km², making it one of the smallest zones, but 178km² are alluvium, and it is regionally important in percentage of data. The terrain consists of merged floodplain deposits of Barratta Creek alluvium and the Burdekin River alluvium, with bores extending from 15m to 36m, being mostly moderate, with some deep and a few shallow. The zone has a tropical, dry winter climate with an annual rainfall around 750–800mm. The natural vegetation was eucalypt open forests and woodlands, with strings of melaleuca around the stream channels and grasslands and wetlands downstream, however, intensive irrigation of sugarcane now covers most of the area, with some grazing of native vegetation on scattered areas of greater relief near the borders. The data record provides a reasonable coverage, with at least some recent data. The groundwater salinity is usually moderate, but ranges to high in some areas, with the EC usually between 530µS/cm and 3,700µS/cm (20th–80th %iles). The composition is either Na dominated or with even cations, with the average EC decreasing and becoming less variable with depth, while the percentage of Na increases. The proportion of Cl increases with EC. The water is normally suitable for drinking and other domestic uses, although there are recordings of high EC and hardness. Precipitates may form in bores with occasional scale. The salinity may be excessive for sensitive crops but is normally suitable for stock. There are no main streams, and therefore no surface water data, but adjoining segments suggest it would be mostly low salinity HCO_3, with even cations or occasionally Na predominant. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also. Water levels appear to have risen over the last 20 years, as has EC over the last 10, continuing a longer term rising trend. Some of the groundwater is probably vulnerable to contamination because of the proximity of marine and estuarine conditions, and shallow and possibly rising water tables.							 Whole zone  Near stream

Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 21	21 - Native Companion Creek	poor	Na	Cl	642	1560	1930	moderate–high
	Comments Native Companion Creek is a small, northward flowing, sub-catchment at the western edge of the southern tip of the Suttor Sub-basin. It extends to its confluence with the Belyando .It is has an area of only 3,275km^2, of which 303km^2 is alluvium, a minor proportion of the regional samples. Galilee Basin sandstones outcrop as bands of hills in the southern headwaters, grading to undulating country downstream, where the narrow strip of alluvium has incised into Cainozoic deposits before merging with the Belyando floodplain, bore depths extend from 10m to 52m but are mostly at the deeper levels. Other bores access scattered remnants of Tertiary sediments and basalt. The annual rainfall is only 400-550mm, with a corresponding natural vegetation of open brigalow forest in the upper catchment, but grading to dry eucalypt woodlands on the central Cainozoic floodplain. Development is light, with grazing on native vegetation the primary landuse. The data record may not represent current conditions. The recorded salinity is moderate, with a 20th – 80th %iles range of 640µS/cm to 1,930µS/cm, and high in Na, but it is fresher near the stream. Salinity may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. The quality appears to be moderate for irrigation, except for sensitive crops because salinity may be elevated. It is normally suitable for stock. There is only one surface water site, with very low to low salinity HCO_3 water, and mainly even cations. Groundwater EC and frequently TN exceed QWQG aquatic ecosystem surface water quality guidelines. Water levels possibly rose over the last 20 years, but EC was probably stable in the past. If development took place in the future, some of the groundwater may be vulnerable to contamination because of shallow and possibly rising water tables, and the thickness of the water column which may be limited in places.							 Whole zone  Near stream

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Alluvium Zone 22	22 - Cape River Alluvium	moderate	Na Ca	HCO_3	236	330	350	low
	Comments The Cape River occupies a small sub-catchment, downstream to its confluence with the alluvium of Amelia Creek, a low order tributary of the Suttor. It excludes the downstream tributary of Warrigal Creek. It is one of the smallest zones with an area of 1,575km^2 and represents only a minor proportion of the regional samples. The hilly, dissected landscape of the western headwaters is composed of Precambrian granites and metamorphics featuring small gold deposits. Downstream, the 109km^2 alluvial floodplain is incised into undulating weathered Tertiary deposits, sometimes duricrusted, which slope to the east and partially overlap the Galilee Basin downstream. Groundwater depths extend from 15m to 54m but are mostly of moderate depth. The rainfall is 550–750mm, although wetter in the western headwaters which are vegetated with eucalypt open forest, merging to woodlands downstream, with patches of brigalow in the drier downstream areas away from the floodplain. The major landuse is grazing on the native vegetation. The data record is not recent enough to give confidence on current condition. However, the recorded salinity is usually low being between 158µS/cm and 384µS/cm. It is dominated by HCO_3 with relatively even cations, and is normally suitable for drinking and other domestic uses. It is also suitable for irrigation and stock. The surface water resembles local groundwater but is fresher, and groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, as may pH (upper range values). Some of the groundwater is probably vulnerable because of shallow water tables with relatively large water level fluctuations in terms of thickness of the water column.							
Alluvium Zone 23	23 - Campaspe River Alluvium	poor	Na	HCO_3	466	962	2457	moderate but variable
	Near stream	unreliable	Na	HCO_3	375	760	2263	moderate
	Comments The Campaspe Rive and its tributaries, as well as Broadly Creek, occupy a small sub-catchment of the Suttor Sub-basin The zone extends downstream to the alluvium of Amelia Creek, a low order tributary of the Suttor. The zone has an area of 5,708km^2 is moderately sized but represents a minor proportion of the regional alluvial samples. The hilly headwaters are composed of granite and trap rock with some mineralisation, as well the Warang Sandstone Formation of the Galilee Basin and remnants of basalt. The topography downstream is undulating, where stretches of alluvium up to about 4km wide, with a total area of 334km^2, have been incised into the weathered Tertiary deposits. The bores appear to be mostly of moderate depth although the range extends from 3m to 24m. The annual rainfall is 550–700mm, being wettest in the western headwaters. These headwaters and the floodplains are covered by eucalypt woodlands and open forest, with drier woodlands, brigalow and patches of grassland on the lower slopes away from the streams. At least 80 per cent of native vegetation remains, and the primary landuse is grazing, with some cropping, conservation, and mining activity. The data record is too historical to be confident that it is reflects current conditions. The recorded salinity is variable, being between 133µS/cm and 2,623µS/cm, but is fresher close to the stream. The $NaHCO_3$ composition is similar to GAB groundwaters. Salinity may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness or corrosiveness. It seems reasonable for irrigation, although only moderate for sensitive crops because of salinity and							 Whole zone

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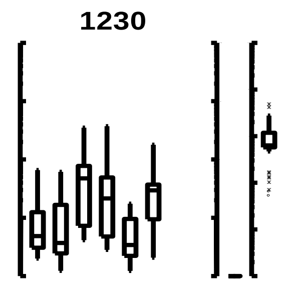
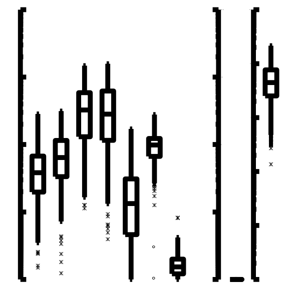
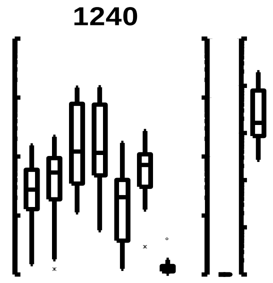
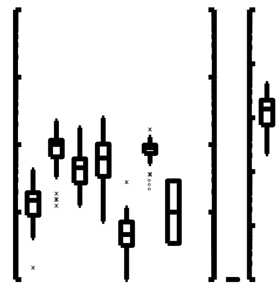
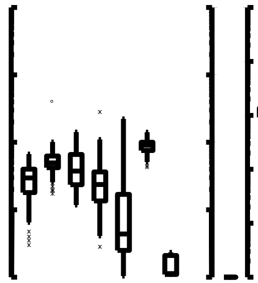
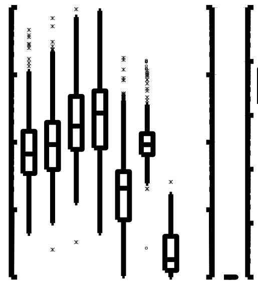
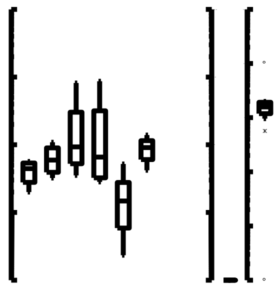
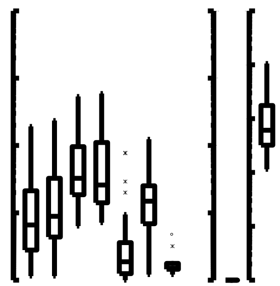
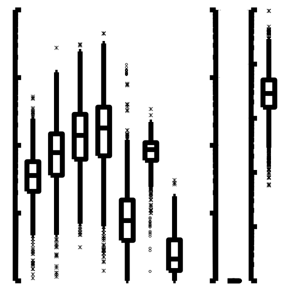
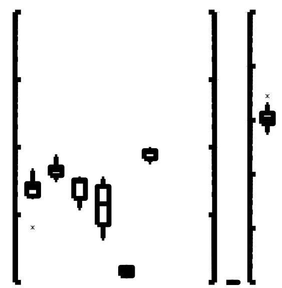
			Cations	Anions	20th	50th	80th	
	occasionally high percentage of sodium (SAR>8). It is normally suitable for stock. There is no surface water chemistry data available, but environmental compatibility with surface water is probably poor as groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines. pH (upper range values) are occasionally slightly in excess of QWQG aquatic ecosystem surface water quality guidelines. Some of the groundwater is probably vulnerable to contamination because of shallow water tables with relatively large water level fluctuations in terms of thickness of the water column.							 Near stream
Alluvium Zone 24	24 - Upper Barratta	good	Na	Cl	1863	3930	8152	high
	Near stream	good	Na	Cl	920	2350	5799	high but variable
	Comments The Upper Barratta with an area of 606km² is one of the smallest zones, but average in numbers of data. It covers the upper headwaters of Barratta Creek, extending east to the Burdekin, and including a portion of the Burdekin mainstream from north of the town of Milaroo, downstream to Clare Weir. The dissected southern headwaters are composed of occasionally mineralised granite and trap rock, sloping north to underlie the, 384km² alluvial plain which merges across the East and West Barratta Creek zones. Alluvial bores usually extend from 18m to 28m, being mostly moderate in depth but some deeper. This zone also adjoins the Mid Burdekin Delta and the Haughton zones. The climate is tropical, with a moderate rainfall of 750–800mm, being wettest in the southern headwaters which border the Leichhardt range. This area supports patches of rainforest, but the rest of the natural vegetation is mostly eucalypt woodland and open forest which is used for grazing. The eastern floodplain, between the Burdekin and the lower reaches of Barratta Creek, has been cleared for the intensive irrigation of sugarcane, supported by regulated flows in the Burdekin River via Gladys Lagoon and Clare Weir. Grasslands and wetlands are a feature of the lower stream courses in the south, while the main town is Mulgrave. The data record represents a reasonable spread, with at least some recent samples. The salinity ranges from moderate to very high, ranging up to 11,508µS/cm and is dominated by NaCl, but it is usually lower near streams. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some							 Whole zone

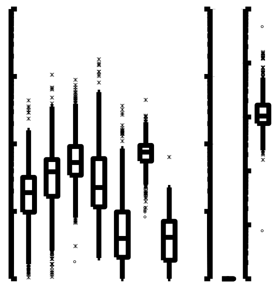
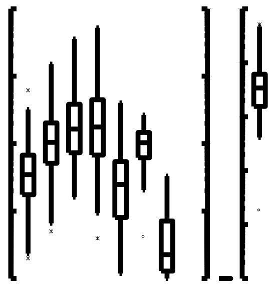
Aquifer class	**Chemistry zone and comment** [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	**Data reliability for comparison** [2]	**Dominant Ions**		**EC Percentiles (µS/cm)** [3]			**Salinity description and major ion plots**
			Cations	**Anions**	**20th**	**50th**	**80th**	
	scaling. The suitability of the groundwater for irrigation is usually moderate, but the salinity of some bores may exceed irrigation guidelines, and the elevated sodium (SAR>8) in some locations is poor for sensitive crops but it is suitable for stock. Despite a lower salinity near streams, the groundwater bears little resemblance to the surface water, which is low to moderate in salinity, HCO_3 dominated and with and even cations. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do as well. Water levels probably rose over the last 20 years, as EC probably did over the last 10 years, continuing a longer term trend. Some of the groundwater is probably vulnerable to contamination because of the proximity of marine and estuarine conditions, and shallow and possibly rising water tables.							 Near stream
Alluvium Zone 25	25 - Fitzroy Serpentinite Belt	poor	Mg	HCO_3	429	1400	2208	moderate
	Comments Serpentinite can confer distinctive water quality characteristics. The Fitzroy Serpentinite Belt covers the area around the Fitzroy River between Marlborough and Alligator Creeks, where extensive outcrops of serpentinite occur. It comprises an area of 1849km^2, being one of the smaller zones, and represents a minor proportion of the regional data. The serpentinite forms dissected hills, except where it is overlain by Tertiary sediments. These Tertiary deposits are, as are the outcrops of Precambrian to Palaeozoic trap rocks and granites. There are 255km^2 of floodplains around Marlborough Creek, parts of the Alligator Creek, and the Lower Fitzroy River. The alluvial system extends from moderate depths to below 100mm but most bores are within the moderate to deep range of 16m to 38m. The annual rainfall is mostly around 800–900mm but over 1000mm in the northern headwaters of Marlborough Creek. This supports eucalypt woodland or open forest, which is denser on the floodplain, with occasional patches of brigalow and rainforest. About 50–60 per cent of the natural vegetation remains, with several areas of state forest and conservation. Irrigated cropping is carried out around Eden Bann Weir, and there is some mining activity, particularly for chromite and the gem chrysophrase. The remaining landuse is grazing on native vegetation, with Marlborough and Yaamba being the major towns in the zone. The data record is considered historical only, and relatively sparse. The recorded salinity ranges is usually moderate, ranging up to 2,456µS/cm. The chemistry is $MgHCO_3$, which is compatible with serpentinite and basaltic terrains. Salinity may sometimes affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time, with some scaling. The water quality appears to be moderate for irrigation, except for sensitive crops because of elevated salinity. It is suitable for stock. The surface water usually resembles the groundwater, but is occasionally Na dominated. However, groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also.							

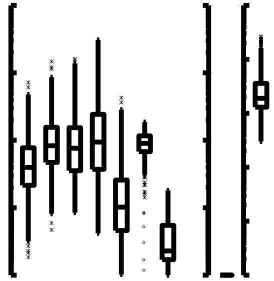
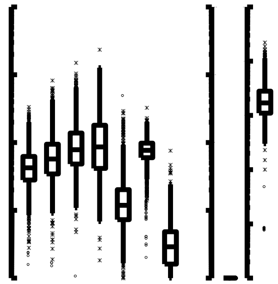
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20^{th}	50^{th}	80^{th}	
Alluvium Zone 26	26 - Comet and Nogoa Basaltic Headwaters	poor	Mg Na	HCO_3	852	1050	1423	moderate
	Near stream	poor	Even	Cl	829	1020	1403	moderate
	Comments The Comet and Nogoa Basaltic Headwaters define the basaltic exposures occupying the watershed between the south-eastern headwaters of the Nogoa, particularly Vandyke Creek and its tributaries, and the upper reaches of the western tributaries of the Comet River. This is one of the bigger alluvial zones, with an area of 10,976km^2, but it only contains 545km^2 of alluvium and represents a minor proportion of the regional samples. The geology consists of dissected basalt overlying sediments of the Bowen Basin, with some coal seams in the north. The rugged, headwaters of the Great Dividing Range in the south, decline in relief downstream to stretches of hills, with undulating country in the north and east. Nearly all of the bores accessing alluvium are of moderate depth but the recorded range is 18m to 48m. A diverse environment results in varied patterns of natural vegetation, The rainfall range is 550–750mm being hot and dry on the flatter terrain in the north, but moister on the rugged southeaster highlands which is largely state forest and conservation areas including Carnarvon National Park. Here the basalts support rainforest and wet eucalypt forest. Elsewhere the vegetation is open forest or woodland of varying density, and patches of brigalow, and grasslands on the basalt. The north and northeast are extensively cleared for cropping, some irrigated, and the main town is Springsure. The data record may not represent current conditions. The recorded salinity is usually moderate being between 725µS/cm and 1,710µS/cm. It is high in HCO_3, with even cations, or dominated by Mg, which is typical of basalt areas. The water is normally suitable for drinking, but poor for general purposes because of excessive hardness. Precipitates are likely to be deposited over time with occasional scale. The water quality appears to be moderate for irrigation, but salinity may occasionally be excessive for sensitive crops. It is suitable for stock. The surface water is generally of lower salinity than the groundwater, but reasonably similar in composition. However, groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also. Water levels are probably stable over the last 20 years, but some of the groundwater may be vulnerable to contamination because water tables may be shallow and the thickness of the water column may be limited in places.							
Alluvium Zone 27	27 - Lonesome Creek Alluvium	good	Na Ca	Cl	1362	3120	8233	high but variable
	Comments Lonesome Creek is a small, westward flowing tributary, sharing a watershed with the Upper Callide zone on the eastern side of the central Dawson sub-basin. It has an undulating topography, with lower relief downstream in the west, and bands of hills in the centre of the catchment. It has an area of 675km^2, making it is one of the smallest alluvial zones, but it has an average amount of data. Most of the zone consists of granite and trap rocks, overlain by a remnant of Bowen Basin sediments, but this has been partially blanketed downstream by Cainozoic floodplain material and a short stretch of recent alluvium with an area of 29km^2 which merges with that of the Dawson River at Theodore. Bores on the alluvium extend from 16m to 22m being mostly of moderate depth. The rainfall is 600–700mm, being wettest downstream on the floodplain. The original vegetation on the floodplain was open eucalypt and acacia forests, but about 80 per cent has been cleared for intensive irrigated and dryland cropping. About 30–40 per cent of the original vegetation remains in the rest of the catchment, with extensive areas of rainforest in the eastern headwaters dry woodland and acacia over the granite belt in the central catchment. These areas are mostly grazed apart from occasional plots of dryland cropping. Although the data is not current, the salinity ranges from moderate to very high, with 20^{th}–80^{th} %ile range of 1,360µS/cm to 8230µS/cm but with deep outliers up to 16,336µS/cm. The cations are even at moderate salinities, but the proportions of Na and Cl rise with EC							

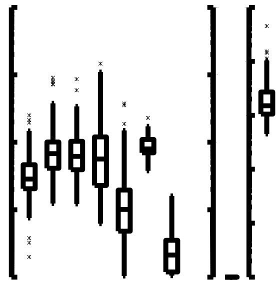
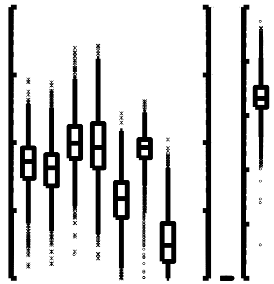
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
	and eventually approach seawater composition. The salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The water quality appears to be moderate to poor for irrigation because EC may exceed irrigation guidelines, and sodium is occasionally excessive for sensitive crops (SAR>8). It is normally suitable for stock. The surface water is very variable in salinity, but usually high in Na. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also. Water levels are stable over the last 20 years, but some of the groundwater is probably vulnerable to contamination because of shallow water tables and limited depth of alluvium.							
Fractured Rock Zone 1	1 - Drummond Basin Sediments	very poor	Na	Cl	1700	4500	13514	high but variable
	Comments This zone comprises a broad strip of Drummond Basin sediments extending through the Central Suttor and Nogoa Sub-basins. It is one of the biggest fractured rock zones having an area of 37,322km^2 but it only represents a minor proportion of the samples. The landscape is flat to hilly, and partially blanketed by Cainozoic deposits. The aquifers are composed of Drummond Basin sediments. Bores access a wide variety of trap rocks, with 50 per cent being either Bulliwallah Formation or Ducabrook Formation, and 10 per cent being Neranleigh Fernvale, and are mostly deep to very deep, extending from 20m to 109m. The data record is limited and historical only. The existing data are moderately to very highly saline and sodic, with NaCl predominating and the proportion of Cl rising with EC. However, low salinity groundwaters do occur occasionally in the Neranleigh Fernvale and Good Night Formations, the Camboon Volcanics, and the southern watersheds of the Nogoa and Belyando Rivers. These are HCO_3 dominated with even cations. For most of the groundwater, salinity affects taste, and it may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The water quality appears to be poor for irrigation, because salinity may exceed irrigation guidelines as well as elevated sodium (SAR >8), and levels of fluoride which may exceed the 2mg/L irrigation guideline in some bores. The water should be tested before giving to stock as there are occurrences of excessive salinity. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also. Some of the groundwater may be vulnerable to contamination because of the fractured nature of the aquifer, shallow water tables, and limited aquifer storage.							
Fractured Rock Zone 2	2 - Greenvale Craton	unreliable	Na Ca	HCO_3	842	1582	1943	moderate–high
	Comments Greenvale Craton is one of the biggest fractured rock zones, having an area of 23,276km^2 in the eastern and central sections of the Upper Burdekin catchment. Small groundwater yields are obtained from fractured Precambrian and Palaeozoic granites and metamorphics, with Cainozoic deposits and a few basalt remnants. The bores extend from 38m to 70m and are mostly deep to very deep. About 10 per cent of the bores are drilled in basalt outliers. The data record is limited. The recorded salinity varies from moderate to high at between 341µS/cm and 5,280µS/cm, with the highest values being from Neurum Granite. pH (upper range values) are occasionally in excess of QWQG aquatic ecosystem surface water quality guidelines. Some of the groundwater may be vulnerable to contamination because rapid recharge from the surface and shallow water tables.							

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Fractured Rock Zone 3	3 - Eastern Basement With Basalt Remnants	very poor	Na	HCO_3	1033	1500	2922	moderate
	Comments The Eastern Basement With Basalt Remnants is the largest of the fractured rock zones, with an area of 79,644km^2. It consists of a long strip of dissected ranges and tablelands behind the coast, stretching from the Bowen Sub-basin southwards, through the Isaac and Mackenzie sub-basins, to eventually underlie the sediments of the Dawson sub-basin. The bores are mostly deep to very deep ranging from 26m to 85m. About 35 per cent of them access basalt aquifers, with the rest attributed to trap rocks, particularly of the Rockhampton Group, granites, and some sediments. Despite its size, this zone, only represents a minor proportion of the groundwater samples. The data record provides very little information for an area this size, but available data is reasonably up to date. The salinity ranges from moderate to high, being between 804µS/cm and 4,380µS/cm, but it tends to decrease with depth. The cations are Na dominated, or occasionally even, and HCO_3 is the major anion. Salinity may affect taste, and the water may not be ideal for other general purposes because of high EC, hardness and pH. Precipitates may form in bores with some scaling. EC and percent sodium are excessive for sensitive crops (SAR>8). It is suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, as may TN and pH (upper range values).							
Fractured Rock Zone 4	4 - Curtis Island Trap Rocks	poor	Na	Cl	418	1150	2840	moderate but variable
	Comments Curtis Island Trap Rocks Zone includes Curtis Island and the adjoining north coast area from Yepoon through Shoalwater, to the Herbert Creek estuary. This is one of the smallest fractured rock zones, with an area of only1,562km^2, and it represents a correspondingly minor proportion of the samples. Groundwater is extracted from fractured trap rocks, mainly Palaeozoic sediments and granites, covered in places by Cainozoic and coastal deposits. The bores are mostly moderate to deep, extending from 21m to 45m, with 65 per cent from the Curtis Island Formation, and 30 per cent from the Doonside Formation of the Wandilla Group. The data record is relatively sparse with an uneven distribution, most of the bores being located in the Yepoon area, north of the Fitzroy estuary. There is some recent data. The general NaCl water chemistry reflects the coastal location, with salinity ranging up to over 2,800µS/cm and the composition approaching seawater as EC rises. However, the Wandilla Formation is relatively low in salinity with a higher proportion of HCO_3 while the Curtis Island Formation has more variable groundwater. Levels of salinity in the zone occasionally affect taste, and the water is sometimes poor for general purposes because of high EC and hardness, or occasional evidence of corrosion. It would be reasonable for irrigation, although the salinity may be too high for sensitive crops but it is suitable for stock. Groundwater EC often exceeds QWQG aquatic ecosystem surface water quality guidelines, as may TN at times.							

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Fractured Rock Zone 5	5 - Ravenswood Granites and Volcanics	very poor	Na Mg	Cl	1300	2865	5800	high
	Comments The Ravenswood Granites and Volcanics is a mountainous granitic area, including the course of the Burdekin River below its northern headwaters. It includes some of the upper headwaters of the Haughton, Bogie and Broken Rivers in the eastern coastal area, as well as the western tributaries of the Burdekin. It is one of the biggest fractured rock zones, with an area of 37,725km^2, and is regionally important in numbers of data. Fractured granite accounts for 50 per cent of the bores, with basalt making up 10 per cent, and the rest being assorted trap rocks. Depths are shallow to moderate, extending from 7m to 26m. The data record is not up to date but reasonably distributed, with a greater concentration of bores nearer the coast in the east, particularly around the lower reaches of the Don catchment. The salinity range is moderate to very high. It declines with depth, being between 1,156µS/cm and 6,655µS/cm in shallow groundwater, but only 1,100µS/cm to 2,587µS/cm in deeper parts. The corresponding composition trends from NaCl to Na Mg HCO_3. Water chemistry in the granites is usually moderately to very saline, with the proportion of NaCl increasing towards seawater composition at high ECs. The basalts are very low to moderate in salinity, with a mainly $NaCaHCO_3$ composition at low ECs, moving to even cations and slightly Cl dominated as the EC rises. The trap rocks are usually very low to moderate in salinity, except for the Precambrian, which tends to be moderately to highly saline. High salinity bores are also more frequent near the coast. Salinity in this zone usually affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The water quality appears to be moderate for irrigation, but the salinity and percentage of sodium (SAR>8) is occasionally excessive for sensitive crops. It is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, as TN frequently does, and pH (upper range values) may do also.							
Fractured Rock Zone 6	6 - Northern Basalts	unreliable	Mg	HCO_3	804	1050	1442	moderate
	Comments The Northern Basalts is a moderately sized zone, consisting of two large basalt tablelands, with a combined area of 9,876km^2, in the Upper Burdekin Sub-basin. The tablelands are divided by trap rocks of the Greenvale Craton Zone. The aquifer system is mostly deep to very deep, extending from 28m to 86m, with 65 per cent of the bores being attributed to basalt, with the rest mostly granite. The data record is limited. The recorded salinity is usually moderate to occasionally low, being between 779µS/cm and 1,550µS/cm. Most of the samples, including all of the basalts, are moderate in salinity and dominated by HCO_3 with even cations. The groundwater composition in the granite and trap rocks is more varied, and includes some low salinity $NaCaHCO_3$ waters. There is not data to rate the water for condition.							

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Fractured Rock Zone 7	7 - Main Range Volcanics	very poor	Na Mg	HCO_3	688	1032	1866	moderate
	Comments The Main Range Volcanics Zone is a basaltic tableland on the watershed of the Comet and Nogoa catchments, extending through the northern headwaters of the Nogoa and into the Suttor. It is one of the bigger fractured rock zones, with an area of 18,093km^2, and is and is regionally important in numbers of data. The basalt aquifer system extends from 11m to 83m, but is mostly moderate to very deep. It overlies coal bearing sediments of the Back Creek Group. The data record is relatively sparse considering the size of the area, but at least some is relatively recent data. The salinity ranges from moderate to high, with a range of 454µS/cm to 878µS/cm and a chemistry of Mg Na HCO_3 in the upper levels, which is typical of basalt. The salinity rises with depth, to a range of 797µS/cm to 3,575µS/cm and a composition of $NaHCO_3$ due to the influence of the underlying geology. Salinity may affect taste, particularly in the deeper groundwaters, and they may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores with occasional scale. EC and percent sodium are excessive for sensitive crops in some areas (SAR>8). It is normally suitable for stock. EC may exceed QWQG aquatic ecosystem surface water quality guidelines, as may TN and pH (upper range values). Some of the groundwater may be vulnerable to contamination because of rapid recharge from the surface and limited storage volume.							
Fractured Rock Zone 8	8 - Central Cratonic Basement	very poor	Na Mg	Cl	1369	3335	7565	high
	Comments The Central Cratonic Basement lies on the southern side of the Suttor catchment, extending south into the northern Nogoa catchment. It consists of Precambrian and Palaeozoic sediments, volcanics and granites, overlain centrally by Cainozoic deposits. With an area of 19,574km^2, it is one of the bigger zones but only represents a minor proportion of the samples. The aquifers are varied, but mostly fractured granites and metamorphics, particularly the Anakie Metamorphics. Depths vary between 12m to 97m, being mostly moderately to very deep. The data record is historical and may not be representative of current conditions. The salinity is usually moderate to high, very variable at between 920µS/cm and 17,910µS/cm. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time, with some scaling. The water quality appears to have elevated sodium or salinity levels in some areas which may exceed irrigation guidelines. It is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also.							

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Fractured Rock Zone 9	9 - Serpentinite Belt	poor	Na Mg	Cl HCO_3	1110	1800	4018	high
	Comments A small zone, with an area of 2,586km^2 on the northern edge of the Lower Fitzroy Catchment, between Marlborough and Alligator Creek. Where bands of serpentinite have intruded through Precambrian deposits, and have subsequently been in intruded by granites and partially overlain by trap rocks, alluvium, and remnants of Mesozoic basalt. The groundwater system is very varied, but includes Trap rocks such as the Berserkers, Mesozoic basalts including the Alton Downs Formation, as well as occasional serpentinite and granite. Depths are mostly moderate to deep, extending from 13m to 42m. The data record is average but old. The salinity ranges from moderate to high, being between 893µS/cm and 7,273µS/cm. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The salinity may excessive for sensitive crops but it is suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also.							
Fractured Rock Zone 10	10 - Eastern Fitzroy Trap Rocks	poor	Na Mg	Cl HCO_3	1000	1680	3191	high
	Comments The Eastern Fitzroy Trap Rocks are a patch of Palaeozoic volcanics and sediments, including the coal bearing Back Creek Group, lying behind the coast of the in the Lower Fitzroy sub-basin and its watershed with the Dawson sub-basin. With an area of 19,376km^2 it is one of the bigger zones and is regionally important in numbers of data. The sediments have been intruded by granites and partially overlain by more recent deposits The aquifers are in fractured trap rocks and granites, with occasional basalt remnants. Bore depths are moderate at 12m to 33m. The data record is historical and may not be representative of current condition. The salinity ranges from moderate to high at between 760µS/cm and 4,707µS/cm. Salinity levels occur which would affect taste, and reduce water quality for general purposes because of high EC and hardness. Precipitates are likely to be deposited over time. The salinity may excessive for sensitive crops but is suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, as TN frequently does, and pH (upper range values) may also.							

Aquifer class	**Chemistry zone and comment [1, 4]** **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	**Data reliability for comparison [2]**	**Dominant Ions**		**EC Percentiles (µS/cm) [3]**			**Salinity description and major ion plots**
			Cations	**Anions**	**20th**	**50th**	**80th**	
Fractured Rock Zone 11	11 - Callide Headwaters	very poor	Mg Na	HCO_3	1050	1663	3767	moderate–high
	Comments The Callide Headwaters with an area of 3,136km^2 is one of the smaller zones and represents a minor proportion of the samples. The area surrounding the Callide Creek alluvium consists of hilly trap rock and granite headwaters, partially overlain in the south by basaltic remnants, and in the north by patches of GAB sandstone. Downstream, the alluvium is surrounded by weathered Tertiary deposits. The aquifers are very varied, the most common being basalt, but also granite and trap rocks such as the Kroombit Beds. Depths rage from 10m to 79m, being mostly moderate to deep. The data record is relatively old and sparse in coverage. The recorded salinity ranges from moderate to high, being between 822µS/cm and 8,790µS/cm. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The salinity may be excessive for sensitive crops but it is suitable for stock. EC, TN and pH (upper range values) often exceed QWQG aquatic ecosystem surface water quality guidelines.							
Fractured Rock Zone 12	12 - Mount Alma Trap Rocks with Limestones and Volcanics	moderate	Na Ca	Cl HCO_3	1240	2015	3608	high
	Comments Mount Alma Trap Rocks with Limestones and Volcanics, Zone with an area of 5353km^2, is a moderate sized zone but regionally important in numbers of data. It extends over the Calliope, Boyne, and parts of the eastern Callide and Lower Fitzroy catchments. The aquifers consist of trap rocks including the Mount Alma, Capella Creek and Mount Holly Formations, with depths extending from 7m to 50m, being mostly shallow to deep. The salinity ranges from moderate to high, being between 880µS/cm and 5,310µS/cm. The data record is relatively old and sparse in coverage. Salinity may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores. The salinity may be excessive for sensitive crops in some areas. It is normally suitable for stock. EC and TN often exceed QWQG aquatic ecosystem surface water quality guidelines. Some of the groundwater is probably vulnerable to contamination because it is obtained from a limestone aquifer.							

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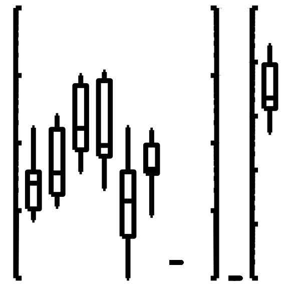
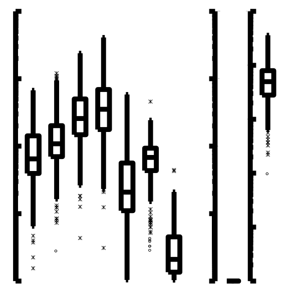
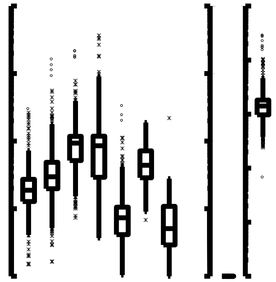
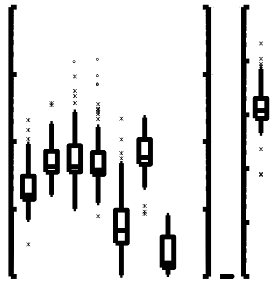
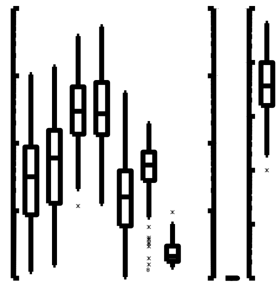
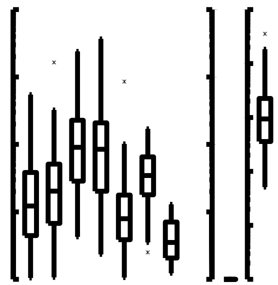
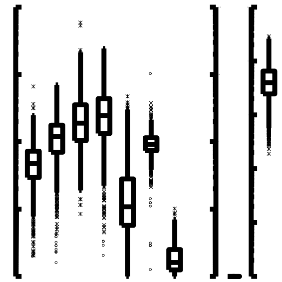
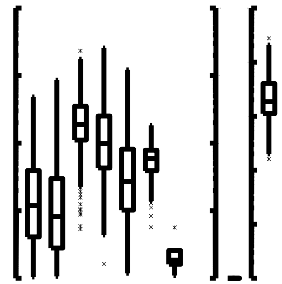
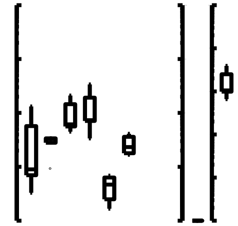
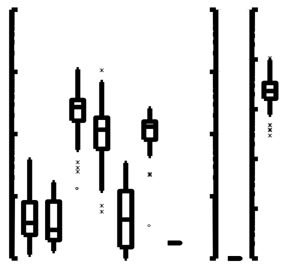
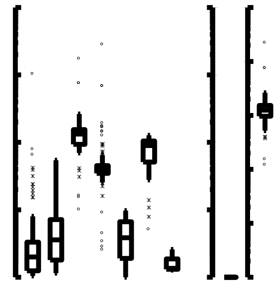
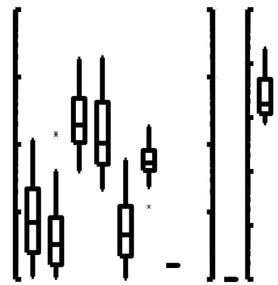
			Cations	Anions	20th	50th	80th	
Cainozoic Deposits (including Deposits overlying GAB) Zone 1	1 - Scattered Remnants Northern Burdekin headwaters	id	id	id	id	id	id	id
	Comments Scattered Remnants North is located in the Upper Burdekin Sub-basin, and includes small scattered deposits of Cainozoic limestones, sediments, weathered alluvium and colluvium, occasionally overlain by younger alluvium or basalt. Based on very limited data, the bores appear to access Cainozoic colluvial deposits and ferricrete. Although it covers a large area of 35,221km2, there is insufficient data to comment on condition.							
Cainozoic Deposits (including Deposits overlying GAB) Zone 2	2 - Eastern Weathered Cainozoic Remnants	unreliable	Na Mg	Cl HCO_3	1007	1760	9519	high but variable
	Comments Eastern Weathered Cainozoic Deposits has a large area of 33,900km^2 although it represents only a few samples. It consists of scattered Cainozoic deposits, mainly associated with river channels along the dissected Great Dividing Range from the Bowen to the Boyne. Groundwater is obtained from colluvial deposits and Tertiary sediments groundwater at depths of 31m to 83m, being mostly deep to very deep. The data record is limited and not very current. The salinity ranges from moderate to very high, being between 1,100µS/cm and 10,500µS/cm. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores with occasional scale. Sodium levels are excessive for sensitive crops in some areas (SAR>8), and EC may exceed irrigation guidelines in some bores. The water should be tested before giving to stock as there are occurrences of excessive salinity. EC, pH (upper range values) and TN may exceed QWQG aquatic ecosystem surface water quality guidelines.							
Cainozoic Deposits (including Deposits overlying GAB) Zone 3	3 - Southern Callide	poor	Na Ca	Cl	2285	4895	8405	high
	Comments The Southern Callide is one of the smaller Cainozoic zones, with an area of 10,894km^2, but is average in numbers of data. It consists of Tertiary sediments and some weathered alluvium surrounding the floodplain of Callide Creek, extending through the lower terrain around the southern reaches of the Fitzroy. More than half of the bores access the Biloela Formation, the rest being in other Tertiary deposits at depths extending from 14m to 90m, being mostly moderately to very deep. The data record is historical and may not be representative of current conditions. The salinity ranges from high to very high, being between 1,950µS/cm and 13,000µS/cm. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The water quality is poor for irrigation because sodium levels are excessive for sensitive crops (SAR>8), and EC may exceed irrigation guidelines in some bores. It is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, as TN frequently does, and pH (upper range values) may as well.							

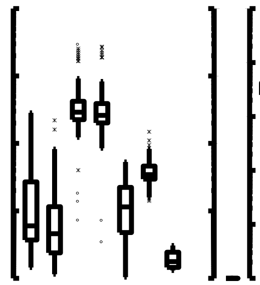
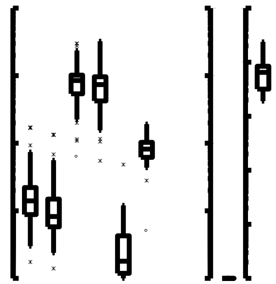
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Cainozoic Deposits (including Deposits overlying GAB) Zone 4	4 - Central Moderately Saline Weathered Remnants	very poor	Na	Cl	880	1410	1953	moderate
	Comments The Central Moderately Saline Weathered Remnants Zone has an area of 56,779km² making it one of the largest of the Cainozoic zones, but average in numbers of data. It consists of small, scattered Cainozoic deposits, mainly weathered alluvium, centred on the Nogoa catchment but also covering substantial areas of the Comet, Mackenzie Isaac and Suttor catchment. Groundwater is obtained from Tertiary sediments and colluvial deposits, at depths extending from 19m to 81m.The data record is insufficient to be fully representative of such a large area although at least some is recent data. The salinity ranges from moderate to high, being between 644µS/cm and 3,088µS/cm. The water should be tested before drinking as there are occurrences of high nitrate levels. It may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores. The salinity may be excessive for sensitive crops but it is suitable for stock. EC and TN often exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) may also.							
Cainozoic Deposits (including Deposits overlying GAB) Zone 5	5 - Tertiary Sediments Overlying The GAB and Bowen Basin	very poor	Na Mg	HCO_3	820	1186	2305	moderate
	Comments The Tertiary Sediments Overlying The GAB and Bowen Basin Zone has a large area of 30,049km², making it one of the biggest Cainozoic zones but represented by only a minor proportion of the samples. It consists of fragmented tablelands of Tertiary sediment, much of it duricrusted, scattered over the GAB and Bowen Basin. Groundwater is obtained from the Tertiary sediments including the Biloela Formation, as well as colluvium at depths of 18m to 151m, but mostly moderate or deeper. The data record is historical and not necessarily fully representative of current condition. The salinity ranges from moderate to high, being between 770µS/cm and 3,765µS/cm. It may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores with occasional scale. The salinity may be excessive for sensitive crops in some areas, but it is suitable for stock. EC, TN and pH (upper range values) may exceed QWQG aquatic ecosystem surface water quality guidelines.							

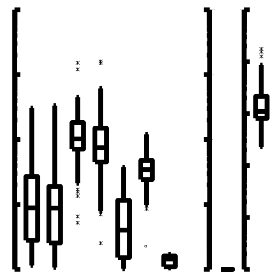
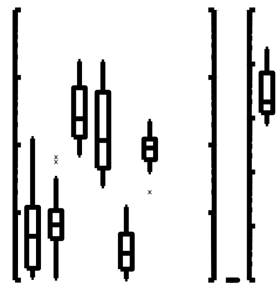
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Cainozoic Deposits (including Deposits overlying GAB) Zone 6	6 - Saline Tertiary Sediments	very poor	Na	Cl	1019	3760	12306	high but variable
	Comments The Saline Tertiary Sediments Zone is the largest of the Cainozoic zones but represents only a minor proportion of the samples. It is an extensive area of flat to undulating terrain east of the GDR, occupying 60,554km² of the central Suttor, Isaac and Mackenzie catchments, as well as the northern Dawson and Comet catchments. The extensive tablelands of Tertiary sediments are underlain by Pre GAB formations, some of them coal bearing. The bores mainly access colluvial deposits and Tertiary sediments, including the carbonaceous Duaringa Formation. Bore depths extend from 31m to 149m and are mostly deep to over 100m. The data record is mainly historical. The salinity is moderate to very high, ranging between 580µS/cm and 16,100µS/cm. It affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores with occasional scale. The water quality is poor for irrigation because sodium levels are excessive for sensitive crops (SAR >8), and EC may exceed irrigation guidelines in some bores, and may occasionally be excessive for stock. It also exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also.							
Cainozoic Deposits (including Deposits overlying GAB) Zone 7	7 - North West Suttor Catchment	very poor	Na	Cl	276	940	2585	moderate but variable
	Comments The North West Suttor Catchment, has an area of 19,412km², but represents only a minor proportion of the samples. It contains extensive areas of weathered alluvium, with lacustrine and other Cainozoic deposits, overlying trap rock. Groundwater is extracted from the Cainozoic deposits, and occasionally from the Campaspe Formation, at depths of 10m to 59m, being mostly moderate to deep. The data record is limited to earlier data. The salinity ranges from low to high, being between 243µS/cm and 4,264µS/cm. It may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. Some bores may be subject to corrosiveness, and precipitates may form in others. EC and percent sodium are occasionally excessive for sensitive crops (SAR>8) but the water is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines and TN may also.							

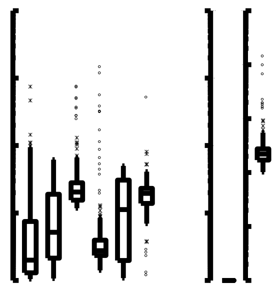
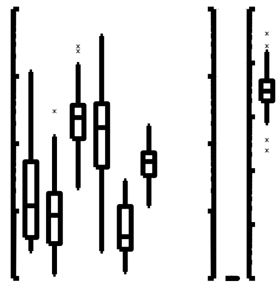
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Cainozoic Deposits (including Deposits overlying GAB) Zone 8	8 - Don and Bogie Coastal Area	moderate	Na Mg	Cl	2100	3950	7250	high
	Comments The Don and Bogie Coastal Area is a moderate sized zone with an area of 10,813km^2, but is regionally important in numbers of data. It consists of remnants of weathered Cainozoic alluvium which borders the Burdekin Delta and adjoining coastal plain. Virtually all of the bores access Cainozoic colluvium, at mostly moderate depths of between 8m and 30m. The data record, although relatively sparse, at least includes some recent data. The salinity ranges from high to very high, being between 1,500µS/cm and 9,820µS/cm. It affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time, with some scaling. The water quality is poor for irrigation because sodium levels are excessive for sensitive crops in some areas (SAR >8), and EC may exceed irrigation guidelines in some bores. It is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, as TN frequently does, and pH (upper range values) may do also.							
Mid GAB aquifers Zone 1	1 - Upper Dawson Uncertain Area	id	id	id	id	id	id	id
	Comments Upper Dawson Uncertain Area covers 22,814km2 of outcrops of both GAB aquifers and less permeable beds. Although it probably contains most of the Mid GAB sediments within the region, and is within the GAB recharge area, the thickness and extent of the aquifers is uncertain. The most frequently accessed groundwater is from the Orallo Mudstone aquitard, however, the more porous Gubberamunda, Mooga and Bungil Formations are also used. The groundwater is mostly very deep, extending from 38m to 299m. The water chemistry cannot be commented on as only one sample is available							

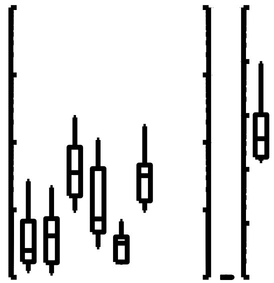
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Mid GAB aquifers Zone 2	2 - Northeastern GAB Border, Ronlow and Gilbert River	id	id	id	id	id	id	id
	Comments There are a few, small outcrops of Ronlow and Gilbert River Formations where the western edge of the Upper Burdekin and Suttor sub-basins intersects the eastern edge of the Eromanga Basin. Although very small, with a total area of only 4464km2, these areas probably contribute to GAB recharge. Based on very limited data, the groundwater is extracted from the Ronlow Beds, with some from the Cadna-Owie Formation, both part aquifers. The bores appear to be very deep, ranging from 127m to 158m. Only five samples have been collected from four bores, between 1969 and 2007.The moderate to high recorded salinity is 659µS/cm to 3900µS/cm. There is insufficient data to comment on condition.							
Mid GAB aquifers Zone 3	3 - Bungil and Mooga Outcrops	Very poor	Na	Cl	1983	3867	8893	High
	Comments Bungil and Mooga Sandstone aquifers outcrops near the GDR in the southernmost headwaters of the Dawson Catchment. They contribute to the GAB recharge area. This zone has been merged with Zone 6 - North Wallumbilla Bungil and Mooga in the QMDB to enhance data availability. These zones are a continuation of the same aquifer systems, with similar water chemistry. The salinity is high, but can be variable, and the chemistry is dominated by Na Cl. The EC exceeds drinking water guidelines, and both EC and Na can be excessive for sensitive crops. Samples submitted by OGIA from two bores in the Gubberamunda Sandstone indicated some corrosive tendency, with bromide in excess of drinking water guidelines, mercury above environmental guidelines, and an aesthetically undesirable level of hydrogen sulphide. This is insufficient data to regard the trace element results as characteristic of the zone.							
Lower GAB Zone 1	1 - Central Surat Springbok (continued from QMDB)	very poor	Na	HCO_3	1042	1300	2100	high
	Comments This Lower GAB zone has an area of only 1989km^2. It outcrops in the southern Dawson headwaters, to the north of the mid GAB Formations which it underlies. The major aquifer is the Hutton Sandstone, but several aquitards are also being accessed, in particular the Westbourne, Injune Creek and the Walloons. The groundwater is mostly very deep, extending from 47m to 772m. The data record is old and limited (relying on samples from the adjoining QMDB zone). The recorded salinity ranges from moderate to high, being between 424µS/cm and 5,156µS/cm. The water should be tested before drinking as fluoride levels in some locations may exceed the drinking guideline of 1.5mg/L. It is not usually suitable for general purposes because it tends to be corrosive, with the pH range extending beyond guidelines. The salinity is excessive for sensitive crops, and the proportion of sodium can exceed normal irrigation guidelines (SAR >46). Fluoride outliers may also exceed 2mg/L, the maximum recommended for irrigation. The water should be tested for fluoride before giving to stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) often does also. Samples submitted by OGIA from three bores in the Springbok and Hutton Sandstones indicated elevated levels of some trace elements, with bromide, fluoride and boron in excess of drinking water guidelines, and iron aesthetically undesirable. Mercury, copper and selenium were frequently above environmental guidelines, and one sample from the Springbok exceeded environmental guidelines for a range of trace elements (e.g. cadmium and chromium). This is insufficient data to regard the trace element results as characteristic of the zone.							

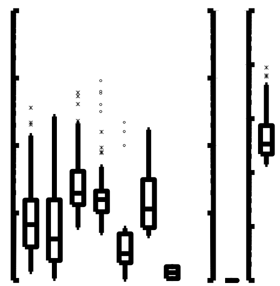
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20[th]	50[th]	80[th]	
Lower GAB Zone 2	2 - Northeastern Eromanga	Very poor	id	id	822	1050	3200	moderate
	Comments The Northeastern Eromanga Zone lies in the area where the western edge of the Suttor sub-basin intersects the eastern edge of the Eromanga Basin. It partially underlies Mid GAB sediments, and is largely overlain by Cainozoic deposits, but it probably contributes to GAB recharge. It is one of the bigger Lower GAB zones, with an area of 14,689km2, but currently has very limited complete water analyses. Based on very limited data, more than half of the bores access the Hutton Sandstone, with the Eulo Queen also important. The groundwater is very deep, extending from 224m to 409m. The recorded salinity ranges from low to moderate, with the 20th–80th %ile range of 820–3200µS/cm. No complete chemical samples were available, but this zone appears to extend under the Thompson River catchment to the west, where more samples may become available in the future.							
Lower GAB Zone 3	3 - Hutton Outcrop West Dawson Headwaters	v poor	Na	HCO_3	910	1250	1546	moderate
	Comments Hutton Outcrop West Dawson Headwaters underlies the north western portion of the mid GAB Upper Dawson Uncertain Zone. It has an area of 5802km^2, which is moderately sized, and represents a minor proportion of the samples. Most of the bores access the Hutton Sandstone, with some in the less pervious Durabilla Formation. Groundwater depths extend from 81m to 334m but are mostly deeper than 100m. The data record is relatively sparse, but reasonably up to date. The salinity ranges from moderate to high, being between 708µS/cm and 1,650µS/cm. The water is normally suitable for drinking, but some records indicate fluoride levels above the drinking guideline of 1.5mg/L. The water is poor for general purposes because of softness and pH range. It tends to be corrosive, but occasional bores experience scale. The water quality appears to be moderate for irrigation, because salinity may be excessive for sensitive crops, levels of fluoride may approach or exceed 2mg/L in some locations, and the proportion of sodium can exceed irrigation guidelines in some areas (SAR>46). It is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) often does as well.							
Lower GAB Zone 4	4 - Northern Walloons continued from QMDB	very poor	Na	Cl	1100	2200	5696	moderate but variable
	Comments The Northern Walloons (continued from QMDB) Zone is a continuation of the Northeastern Walloons QMDB Zone. It is a one of the smaller Lower GAB zones with an area of 1,635km^2, underlies the south western portion of the mid GAB 'Upper Dawson Uncertain' Zone. Most of the bores access the Hutton Sandstone, with some in the Durabilla Member of the Walloons aquitard. Groundwater depths extend from 91m to 395m and are mostly deeper than 100m. The data record has an old and relatively sparse coverage. The recorded salinity ranges from moderate to very high, being between 809µS/cm and 6,802µS/cm. The salinity affects taste, and some records indicate fluoride levels above the drinking guideline of 1.5mg/L. The water may not be ideal for other general purposes because of high EC and pH range outside guidelines. It tends to be corrosive, but occasional bores experience scale. The water quality appears only moderate for irrigation, because salinity may be excessive for sensitive crops, and levels of fluoride approach or may exceed 2mg/L in some locations. The proportion of sodium can also exceed irrigation guidelines in some areas (SAR >46). The water is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, pH (upper range values) often does, and TN may do also.							

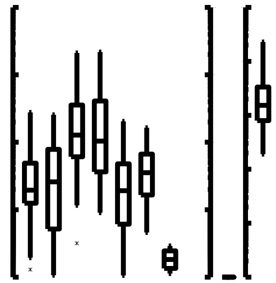
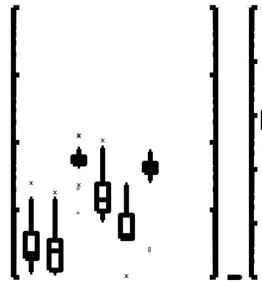
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Lower GAB Zone 5	5 - North-eastern Hutton Outcrop continued from QMDB	very poor	Na	Cl	2000	3050	5670	high
	Comments The North-eastern Hutton Outcrop (continued from QMDB) underlies the eastern portion of the mid GAB Upper Dawson Uncertain Zone, and is a continuation of the Lower GAB North-eastern Hutton Outcrop QMDB Zone. With an area of 1,682km² it is a smaller zone, at least within the Fitzroy Basin, and representing a minor proportion of the Lower GAB samples. Most of the bores access the Hutton Sandstone, or occasionally the Durabilla member of the Walloons aquitard. Groundwater depths extend from 52m to 305m, but are mostly deeper than 100m. The data record has a relatively sparse coverage but with at least some recent data. The salinity ranges up to 5,670µS/cm (80th %ile), and would affect taste. The water may not be ideal for other general purposes because of high EC, hardness and pH range. It can be corrosive, or occasionally scale. The water quality appears to be moderate for irrigation, because the salinity may be excessive for sensitive crops and the proportion of sodium can exceed normal irrigation guidelines in some areas (SAR >46). It is suitable for stock. EC often exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may also. One bore in the Hutton Sandstone was sampled by OGIA, indicating a number of trace elements occasionally exceeding environment guidelines, with bromide occasionally in excess of drinking water guidelines, and manganese above irrigation guidelines. This is insufficient data to regard the trace element results as characteristic of the zone.							
Lower GAB Zone 6	6 - Upper Dawson Walloons	very poor	Na	Cl	2883	6460	8945	high but variable
	Comments The Upper Dawson Walloons outcrop in the Horse and Juandah Creek tributaries of the Dawson headwaters. The zone lies north of the Mid GAB sandstones outcrops and has an area of only 1,219km². The bores access the Walloons, or other less pervious formations such as Injune Creek, Springbok and Birkhead. Bore depths extend from 30m to 304m and are mostly over 100m. The data record is old and limited. The salinity ranges up to very high, being recorded up to 9,315µS/cm. It affects taste, and fluoride levels may occasionally exceed drinking water guidelines (1.5mg/L). The water may not be ideal for other general purposes because of high EC and hardness. Some bores may be subject to corrosiveness, with others experiencing occasional scale. The water quality appears to be poor for irrigation, as levels of fluoride may approach or exceed 2mg/L in some locations, and salinity and the proportion of sodium may exceed normal irrigation guidelines (SAR >46). It is suitable for stock. EC often exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) may do also.							

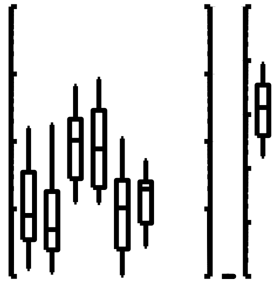
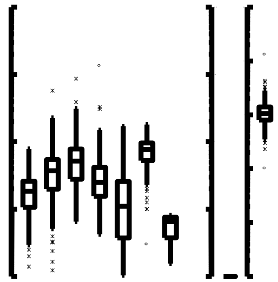
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Lower GAB Zone 7	7 - Hutton Outcrop Palm Tree Creek Area	very poor	Na	Cl	612	1100	2259	moderate
	Comments The Hutton Outcrop Palm Tree Creek Area is a zone located in the Dawson headwaters to the north of the Upper Dawson Walloons. It extends along the margin of the Comet and Nogoa catchments. It is moderately sized, with an area of 5,107km², and contributes to GAB recharge. Most of the bores access the Hutton Sandstone, with some using members of the Walloons, particularly the Durabilla, or occasionally the Birkhead. Groundwater depths extend from 38m to 294m, but are mostly over 100m. The data record is mostly historical. The recorded salinity ranges from moderate to high, being between 289µS/cm and 3,464µS/cm. It may affect taste, and the water may not be ideal for other general purposes because of high EC and corrosive tendencies. EC and percent sodium are excessive for sensitive crops (SAR >8) but suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) may also.							
Lower GAB Zone 8	8 - Huttons Eurombah Creek Area	very poor	Na	Cl	1229	2010	8577	high but variable
	Comments Huttons Eurombah Creek Area is a small zone of 1,071km², which follows the Eurombah Creek alluvium and retards recharge to the GAB. It underlies the central north area of the Mid GAB Upper Dawson uncertain area. Most of the bores access the Hutton Sandstone, with some in the Walloons, or occasionally in the Birkhead. Groundwater depths extend from 22m to 721m and are mostly deep to over 100m. The data record is historical. The recorded salinity ranges from moderate to very high but variable, being between 156µS/cm and 10,780µS/cm. It is likely to affect taste, and fluoride levels may occasionally exceed drinking water guideline values (1.5mg/L) in some areas. The water may not be ideal for other general purposes because the EC and pH ranges are not within guidelines. It tends to be corrosive, but occasional bores may experience scale. The water quality may be poor for irrigation in some locations, because levels of fluoride in outliers may approach or exceed 2mg/L, and salinity and proportion of sodium may exceed normal irrigation guidelines in some bores (SAR >46). It is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) often also. One bore was sampled three times by OGIA in the Walloon Coal Measures. Barium was in excess of drinking water guidelines in one sample, while mercury exceeded environmental guidelines. This is insufficient data to regard the trace element results as characteristic of the zone.							
Lower GAB zone 9	9 - Northern Hutton Outcrop (merged with QMDB zone 6)	Very poor	Na Ca	HCO_3	437	570	934	moderate
	Comments Most of the Northern Hutton Outcrop Zone is within the QMDB, it intrudes into the southwestern edges of the Fitzroy and Burdekin. It occupies the watershed between the Warrego and Nogoa catchments, and the divide between the Surat and Eromanga Basins around the Chesterton Range. The combined zone is moderate in size for the Lower GAB, with an area of 10,300km². It contributes to GAB recharge, the Hutton Sandstone aquifer outcropping as hilly terrain, overlain in the south by the Injune Creek aquitard. The majority of the bores access the Hutton Sandstone, with a proportion using less permeable overlying formations such as the Birkhead, Durabilla, and Injune Creek. Most bores appear to be around 150m to 170 m deep, with water levels around 70m to 115m below the surface. Based on limited data, the ground water appears suitable for most purposes, although the EC usually exceeds Queensland surface water quality guidelines for the area. The recorded salinity is usually below 1000µS/cm, but with occasional high outliers. pH (upper range values) may exceed QWQG aquatic ecosystem surface water quality guidelines.							

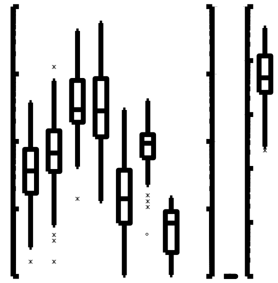
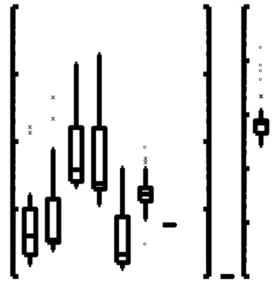
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Basal GAB Zone 1	1 - Eastern Precipice	moderate	Na	HCO_3	163	220	302	low
	Comments The small Eastern Precipice Zone follows the Cockatoo Creek tributary of the Dawson, and is an area of 1583km^2 of Precipice Sandstone aquifer, outcropping in the east, or underlying the Hutton in the West, and contributing to GAB recharge. The main aquifer is Precipice Sandstone, with some bores in the Evergreen Formation aquitard. The groundwater is very deep, extending from 81m to 323m. The data record is historical. The salinity ranges from very low to low, being between 148µS/cm and 349µS/cm. The water is normally suitable for drinking, but poor for general purposes because of excessive softness and a tendency to be corrosive. The quality is only moderate for sensitive crops because the proportion of sodium may be elevated (SAR >8). It is normally suitable for stock, and moderately compatible with QWQG aquatic ecosystem surface water quality guidelines. Three samples submitted by OGIA from one bore (Precipice Sandstone) indicated mercury above environmental guidelines, and one instance of bromide in excess of drinking water guidelines. This is insufficient data to regard the trace element results as characteristic of the zone.							
Basal GAB Zone 2	2 - South Eastern Evergreen Outcrop continued from QMDB	very poor	Na	Cl	1225	2950	5465	high
	Comments South Eastern Evergreen Outcrop (continued from QMDB), is an area of 2,229km^2 of Evergreen Formation lying on the southeast corner of the Dawson Catchment. It contributes to GAB recharge, outcropping in the east, but underlying the Hutton in the west. More than half of the bores access the Evergreen aquitard, with most of the remaining located in the Precipice Sandstone. Groundwater depths extend from 102m to 655m and are mostly over 100m. The data record is historical. The recorded salinity ranges from moderate to high, with outliers up to 12,850µS/cm. There is insufficient data to rate the water for drinking or general purposes, but some fluoride outliers might be approaching or above drinking water guideline values, and bores may have corrosive tendencies. The water quality may be poor for irrigation in some areas, as salinity and proportion of sodium may occasionally exceed irrigation guidelines (e.g. for sensitive crops in some bores, where SAR >8). Also levels of fluoride may approach or exceed 2mg/L in some outliers. It is normally suitable for stock. EC and pH (upper range values) may exceed QWQG aquatic ecosystem surface water quality guidelines. One bore in the Precipice Sandstone was sampled a number of times by OGIA. One sample contained elevated boron, in excess of health, environmental and irrigation guidelines. Copper, mercury and selenium were above environmental guidelines at times. This is insufficient data to regard the trace element results as characteristic of the zone.							
Basal GAB Zone 3	3 - Precipice Outcrop in Upper Dawson	very poor	Even	HCO_3	247	340	440	low
	Comments The Precipice Outcrop in Upper Dawson Zone in the hilly upper reaches of the western Dawson tributaries around Robinson Creek and Ruined Castle Creek. It consists of a long but narrow outcrop of Precipice Sandstone, 17,677km^2 in area, extending along the watersheds with southern headwaters of the Comet and Nogoa Sub-basins. It contributes to GAB recharge, and is a mix of Evergreen and Precipice Formations, partially overlain by Mid GAB formations including the Hutton Sandstone. Virtually all of the bores access the Evergreen Formation aquitard, with groundwater depths from 93m to 195m but are mostly deeper than 100m. The data record includes some recent data. The salinity ranges from very low to low, being between 143µS/cm and 884µS/cm. The water is normally suitable for drinking and other domestic uses, and for irrigation and stock. pH (upper range values) may also exceed QWQG aquatic ecosystem surface water quality guidelines.							

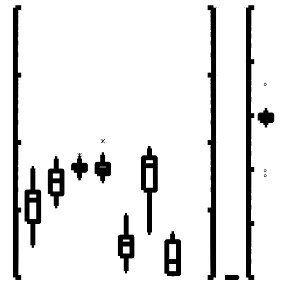
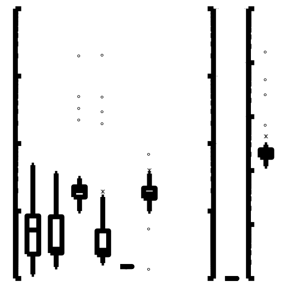
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Basal GAB Zone 4	4 - Ruined Castle Evergreens	unreliable	Na	HCO_3 Cl	169	191	865	low but variable
	Comments Ruined Castle Evergreens Zone lies in the hilly upper reaches of the western Dawson tributaries around Robinson Creek and Ruined Castle Creek. It is a mix of Evergreen and Precipice Formations which contributes to GAB recharge, and is partially overlain by Mid GAB formations including the Hutton Sandstone. It is one of the smaller zones, with an area of 3,492km^2, and nearly all of the bores access the Evergreen Formation aquitard. Groundwater depths extend from 52m to 299m and are mostly over 100m. The GWDB record is limited and historical, but is supplemented by OGIA monitoring of three bores attributed to the Precipice Sandstone, which were extensively sampled between 2014 and 2016. The salinity is generally low, but with some outliers as high as 2,604µS/cm, and there may be some tendency to form scale. The proportion of NaCl rises as the EC increases. Trace element sampling by OGIA indicates occasional levels of arsenic and bromide in excess of drinking water guidelines, with mercury, arsenic and selenium sometimes exceeding environmental guidelines. This is insufficient data to regard the trace element results as characteristic of the zone.							
Basal GAB Zone 5	5 - Eastern Central Area (continued from QMDB)	very poor	Na	HCO_3	185	1040	1463	moderate but variable
	Comments The Eastern Central Area Zone is a continuation of the Eastern Central Zone of the Basal GAB in the QMDB. It extends across the southern border of the Dawson Catchment as far north as Palm Tree Creek, and is overlain by lower GAB aquitards. With an area of 9,479km^2, it is moderately sized. More than half of the bores access the Precipice Sandstone, with the Evergreen Formation also significant. Groundwater depths extend from 64m to 1,056m and are mostly deeper than 100m. The data record, though limited, is reasonably current. The salinity ranges from very low to moderate, being between 146µS/cm and 1,391µS/cm. There is insufficient data to rate the water for drinking or general purposes, but it tends to be corrosive, and some areas may exceed drinking water guidelines for fluoride (1.5mg/L). EC and percent sodium are excessive for sensitive crops (SAR >8), and may exceed irrigation guidelines for fluoride in locations. It is normally suitable for stock, but fluoride outliers may exceed stock guidelines for drinking (2mg/L) and testing may be warranted. EC and pH (upper range values) may exceed QWQG aquatic ecosystem surface water quality guidelines.							

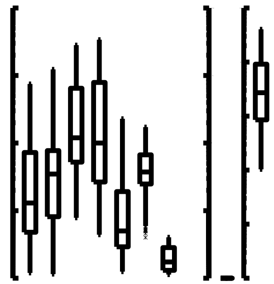
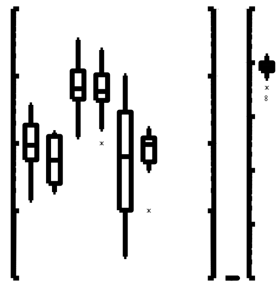
Aquifer class	Chemistry zone and comment [1, 4] **Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.**	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Basal GAB Zone 6	6 - Palm Tree Creek Evergreens	poor	Na	Cl	168	305	820	low but variable
	Comments The relatively small Palm Tree Evergreens Zone, with an area of 3,263km^2, lies at the most northern extent of the GAB in the Fitzroy. It comprises the west bank of the Dawson River around the lower reaches of Palm Tree Creek, and is mostly overlain by Lower GAB aquifers including the Hutton Sandstone. The main aquifer is the Precipice Sandstone, with the Evergreen also significant. The groundwater is very deep, extending from 61m to 239m. The data record is historical. The recorded salinity ranges from very low to moderate, being between 157µS/cm and 3,300µS/cm. The water is normally suitable for drinking, but poor for general purposes as it can be corrosive. The water quality is reasonable for irrigation and suitable for stock. The pH (lower range value) may fall outside (below) the range specified in the QWQG aquatic ecosystem surface water quality guidelines and EC may exceed them.							

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Earlier basins partially underlying GAB Zone 1	1 - Central Galilee Coal Measures	very poor	Na	Cl	780	1555	4600	high but variable
	Comments The Central Galilee Coal Measures, with an area of 12,265km^2, is one of the bigger Pre GAB zones, underlying most of the southern Suttor Sub-basin and extending into the southwest Nogoa. Galilee Basin sediments, including coal seams, are exposed in the south but overlain by Cainozoic deposits in the north. The major aquifer is the Colinlea Sandstone, with other bores accessing coal bearing formations such as the Bandanna, Joe Joe and Blackwater members. The groundwater is mostly deep, extending from 28m to 176m. The data record has a limited distribution and is not current. The recorded salinity ranges from moderate to high, being between 400µS/cm and 9,030µS/cm. It may affect taste, and outliers may exceed fluoride drinking water guidelines. Water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores. EC and percent sodium are excessive for sensitive crops (SAR >8), and fluoride may exceed guideline values in some areas. It is normally suitable for stock, although fluoride outliers may exceed stock guidelines for drinking (2mg/L) and testing may be warranted. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also.							
Earlier basins partially underlying GAB Zone 2	2 - Southern Galilee Clematis	very poor	Na	HCO_3	450	571	1252	moderate
	Comments This moderately sized zone is an area of 4,569km^2 of undulating hills of Clematis Sandstone in the southernmost headwaters of the Nogoa Catchment. It is partially overlain by the more rugged terrain of the GAB Hutton and Precipice Sandstones. Virtually all of the bores access the Clematis Sandstone, with depths of 77m to 267m and mostly over 100m. The data record is historical. The recorded salinity ranges from low to moderate, being between 74µS/cm and 1,488µS/cm. There is insufficient data to rate the water for drinking or general purposes, but it tends to be corrosive. EC and percent sodium are excessive for sensitive crops (SAR >8), but the water is normally suitable for stock. EC and pH (upper range values) may occasionally exceed QWQG aquatic ecosystem surface water quality guidelines.							

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Earlier basins partially underlying GAB Zone 3	3 - Western Galilee Clematis	poor	Na	Cl	210	470	3375	moderate but variable
	Comments The Western Galilee Clematis defines outcrops of Clematis Sandstone that are partially overlain by Cainozoic deposits, lying along the western edge of the Suttor Catchment. It is a moderately sized zone, with an area of 8,838km^2, and the major aquifers are the Clematis and Colinlea Sandstones, although some bores access the Moolayember aquitard. The groundwater is mostly very deep, extending from 56m to 215m. The data record is historical. The recorded salinity ranges from low to high, being between 204µS/cm and 5,301µS/cm. It may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. Occasional bores may show evidence of corrosion. EC and percent sodium (SAR >8) may be excessive for sensitive crops, but the water is normally suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines.							
Earlier basins partially underlying GAB Zone 4	4 - Confluence of Bowen and Galilee	very poor	Na Mg	HCO_3	744	1080	1700	moderate
	Comments This zone, which marks the union of the Galilee and Bowen Basins. It is one of the bigger zones, having an area of 12,949km^2, and roughly covering the western half of the Comet Sub-basin and the eastern part of the central Nogoa Sub-basin. The underlying sediments of the coal bearing Back Creek and Blackwater Groups are partially covered by basalts of the Main Range volcanics. The major aquifer in the zone is the Colinlea Sandstone, but coal bearing formations such as the Aldebaran and other members of the Back Creek and Blackwater Groups are also important. The groundwater is mostly very deep, extending from 28m to 149m. The data record is historical, and may be poorly distributed. The salinity ranges from moderate to high, being between 450µS/cm and 1,840µS/cm. The water is normally suitable for drinking but may not be ideal for other general purposes because of excessive hardness. Precipitates may form in bores with occasional scale. EC and percent sodium (SAR >8) are excessive for sensitive crops in some locations. It is suitable for stock. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also.							

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Earlier basins partially underlying GAB Zone 5	5 - Central Bowen Saline Zone	very poor	Na	Cl	2500	5690	14730	high but variable
	Comments Central Bowen Saline Zone is one of the bigger zones, with an area of 14,533km^2. It underlies the downstream reaches of the western Mackenzie River Sub-basin, as well as the lower reaches of its upstream tributaries, and extends into the adjoining Comet and Nogoa Sub-basins. It consists of Bowen Basin sediments of the Back Creek and Blackwater Groups, some coal bearing, partially overlain by more recent deposits including basalts, Tertiary sediments, and both weathered and recent alluvium. Most of the bores access coal bearing formations of the Back Creek and Blackwater Groups, with the most significant aquifers being the Aldebaran and Rangal Coal Measures. The groundwater is mostly very deep, extending from 26m to 143m. The data record is limited but reasonably up to date. The salinity ranges from high to very high, being between 1,600µS/cm and 20,100µS/cm. This affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. Sodium levels are excessive for sensitive crops (SAR>8), and EC may exceed general irrigation guidelines in some bores. The water should be tested before giving to stock as there are occurrences of excessive salinity. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also.							 89
Earlier basins partially underlying GAB Zone 6	6 - Northern Galilee Clematis	very poor	Na	Cl	415	690	790	moderate
	Comments This zone represents outcrops of Clematis Sandstone, mostly overlain by more recent deposits, in the headwaters of the Cape River subcatchment on the northwest edge of the Suttor Sub-basin. It is a moderately sized zone, with an area of 6,093km^2. The major aquifer is the Betts Creek Coal Measures, but the Clematis and Warang Sandstones are also used, as well as the Rewan Formation. The groundwater is mostly very deep, extending from 43m to 127m. The data record is historical, and may be poorly distributed. The recorded salinity ranges from low to moderate, being between 325µS/cm and 3,270µS/cm. The water is normally suitable for drinking, but outliers may have fluoride values greater than drinking water guidelines (1.5mg/L). The water is poor for general purpose as it tends to be corrosive. The proportion of sodium may be excessive for sensitive crops in some areas (SAR >8), and fluoride outliers may exceed irrigation guidelines (2mg/L). Water is generally suitable for stock although fluoride outliers may exceed stock guidelines for drinking (2mg/L) and testing may be warranted. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines.							

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Earlier basins partially underlying GAB Zone 7	7 - Callide Coal	moderate	Na Mg	HCO_3 Cl	789	939	1055	moderate
	Comments This Callide Coal is one of the smallest zones, occupying an area of 201km² in the central Callide Creek subcatchment between Callide and Bell Creeks. It covers the Callide Coal Measures, which are largely overlain by GAB sandstones and Tertiary sediments. Virtually all of the bores access the Callide Coal Measures, with moderate to deep groundwater extending from 24m to 122m. The data record is limited and historical. The recorded salinity is usually moderate being between 750µS/cm and 1,138µS/cm, and the water is suitable for drinking but may not be ideal for other general purposes because of excessive hardness or occasional corrosiveness. The salinity may excessive for sensitive crops but is suitable for stock. TN may exceed QWQG aquatic ecosystem surface water quality guidelines, and pH (lower range values) may be under the QWQG pH range.							
Earlier basins partially underlying GAB Zone 8	8 - Lower Bowen (continued from QMDB)	very poor	Na	HCO_3	218	1700	3001	moderate–high
	Comments This Lower Bowen (continued) zone is a continuation of the Lower Bowen Zone of the QMDB, and underlies the GAB in the southern Dawson headwaters. It is one of the bigger zones, with an area of 17,886km², and the groundwater is very deep, extending from 113m to 453m. Most bores access the low porosity Rewan and occasionally Moolayember Formations. The data record is historical. The recorded salinity range (20th-80th %iles) is 218µS/cm–3001µS/cm. This water is normally suitable for drinking, but fluoride values may be above drinking water guidelines (1.5mg/L) in some areas. Water is poor for general purposes because it is too soft. It tends to be corrosive, and may exceed normal irrigation guidelines in some bores (SAR >46), and fluoride values may be above irrigation guidelines (2mg/L) in some areas. It is normally suitable for stock, but should be tested for fluoride as values in some records are above the stock guidelines (2mg/L). pH (upper range) values may exceed QWQG aquatic ecosystem surface water quality guidelines. Four bores in the Bandanna Formation were monitored extensively by OGIA between 2014 and 2016. These indicated occasional levels of arsenic and barium in excess of drinking water guidelines, while boron frequently exceeded drinking and environmental guidelines, and occasionally irrigation guidelines also, while Mercury and selenium were frequently above environmental guidelines. However there is insufficient data to regard the trace element results as characteristic of the zone.							

Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Earlier basins partially underlying GAB Zone 9	9 - Bowen Non Coal Bearing	very poor	Na	Cl	702	2400	11370	high but variable
	Comments The Bowen Non Coal Bearing Zone is one of the bigger Pre GAB zones, with an area of 18,617km². The groundwater is mostly very deep, extending from 29m to 762m and mostly over 100m. The major aquifer is the low porosity Moolayember Formation, with the Rewan Formation and some Clematis Sandstone. The data record is historical and may be poorly distributed. The salinity ranges from moderate to very high but variable, being between 168µS/cm and 19,060µS/cm. The salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Some bores may be subject to corrosiveness, and precipitates may form in others with occasional scale. The water quality is poor for irrigation because sodium levels are excessive for sensitive crops (SAR>8), and EC may exceed irrigation guidelines in some bores. The water should be tested before giving to stock as there are occurrences of excessive salinity. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range) values may do also.							
Earlier basins partially underlying GAB Zone 10	10 - Upper Dawson Coal Measures	unreliable	Na	Cl	6496	8170	10663	very high
	Comments The Upper Bowen Coal Measures, situated along the middle reaches of the Dawson River between Cockatoo Creek and Castle Creek, consist of members of the Back Creek and Blackwater Groups, overlain in the west by sandstones and weathered to recent alluvium. This is one of the smaller zones with an area of 2040km². The aquifers are members of the coal bearing Back Creek Group. The most exploited aquifer is the Flat Top part aquifer, but others include the Baralaba and Gyranda Formations and occasionally the Barfield Formation. The groundwater is shallow to deep, ranging from 7m to 61m. The data record is historical and limited. The recorded salinity ranges up to very high, being as much as 12,069µS/cm. The salinity would affect taste and reduce water quality for general purposes because of high EC and hardness. Precipitates are likely to be deposited over time, with some scaling. The water is unsuitable for irrigation because salinity and sodium may exceed guidelines in some areas (SAR >46), but it is normally suitable for stock. EC also exceeds QWQG aquatic ecosystem surface water quality guidelines.							

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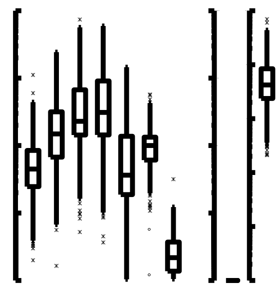
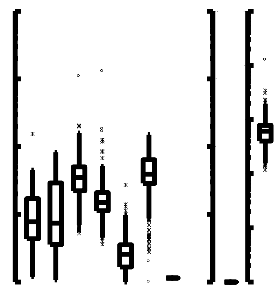
<tr><th rowspan="2">Aquifer class</th><th rowspan="2">Chemistry zone and comment [1, 4]
Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.</th><th rowspan="2">Data reliability for comparison [2]</th><th colspan="2">Dominant Ions</th><th colspan="3">EC Percentiles (µS/cm) [3]</th><th rowspan="2">Salinity description and major ion plots</th></tr>
<tr><th>Cations</th><th>Anions</th><th>20th</th><th>50th</th><th>80th</th></tr>
<tr><td rowspan="2">Earlier basins partially underlying GAB
Zone 11</td><td>11 - Eastern Bowen Coal Measures</td><td>very poor</td><td>Na Mg</td><td>Cl</td><td>2005</td><td>4200</td><td>10670</td><td>high but variable</td></tr>
<tr><td colspan="7">Comments
The Eastern Bowen Coal Measures is a belt of coal bearing sediments extending from the Bowen Basin in the north, through the central Isaac and Mackenzie Catchments, incorporating the Styx and western Fitzroy to the east, and continuing through the upper central Dawson to Castle Creek. With an area of 26,238km^2, is one of the biggest zones, but with an average number of data, The coal bearing sediments are mainly Back Creek Group, underlain by trap rocks, and overlain in the west by Tertiary sediments and weathered to recent alluvium. Bores access members of the coal bearing Back Creek and Blackwater Groups, such as the Boomer Formation, with depths mostly moderate to deep, extending from 15m to 75m. The data record may not be fully representative but at least there is some recent data. The salinity ranges from high to very high but variable, being between 1,190µS/cm and 19,100µS/cm. It affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates are likely to be deposited over time with some scaling. The water quality is poor for irrigation because sodium levels are excessive for sensitive crops (SAR >8), and EC may exceed irrigation guidelines in some bores. The water should be tested before giving to stock as there are occurrences of excessive salinity. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also.</td><td></td></tr>
<tr><td rowspan="2">Earlier basins partially underlying GAB
Zone 12</td><td>12 - Bowen Clematis Outcrop</td><td>poor</td><td>Na</td><td>HCO_3</td><td>356</td><td>610</td><td>850</td><td>moderate</td></tr>
<tr><td colspan="7">Comments
Bowen Clematis Outcrop in the northwest corner of the Dawson Catchment around Mimosa Creek. has an area of 5,580km^2 and is a moderate sized zone, centred on outcrops of Clematis Sandstone and Rewan Formation, partially covered by Tertiary sediments and weathered to recent alluvium The groundwater is very deep, extending from 92m to 524m, with the main aquifer being the Clematis Sandstone, with some less pervious Moolayember and Rewan Formations. The data record is relatively sparse but with at least some recent data. The salinity ranges from low to moderate, being between 246µS/cm and 940µS/cm, and the water is normally suitable for drinking although it may not be ideal for other general purposes because of excessive hardness, or occasionally corrosiveness. In some outliers the quality is only moderate for sensitive crops (SAR>8) but is suitable for stock. EC often exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) may do also.

Two bores in the Clematis Sandstone were monitored extensively by OGIA between 2014 and 2016. The only significant issues were mercury and selenium levels which were frequently above environmental guidelines, but there is insufficient data to regard the trace element results as characteristic of the zone.</td><td></td></tr>
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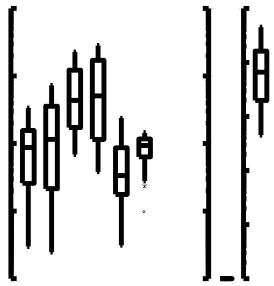
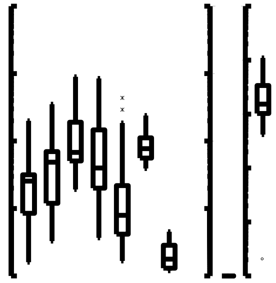
Aquifer class	Chemistry zone and comment [1, 4] Note: This broad comparison does not replace the need for site specific testing to ascertain quality of a water source for particular uses.	Data reliability for comparison [2]	Dominant Ions		EC Percentiles (µS/cm) [3]			Salinity description and major ion plots
			Cations	Anions	20th	50th	80th	
Earlier basins partially underlying GAB Zone 13	13 - North-western Bowen Coal Measures	very poor	Na	Cl	1836	6640	18453	Very high
	Comments North-western Bowen Coal Measures consist of Bowen Basin sandstones and coal bearing sediments in the north-western headwaters of the. The groundwater is mostly deep to very deep, extending from 30m to 119m, with most bores accessing members of the coal bearing Blackwater Group such as the Rangal and Moranbah Coal Measures, but others using the Rewan aquitard. The data record is limited but reasonably up to date. The salinity ranges from high to very high but variable, being between 1,264µS/cm and 24,016µS/cm. Salinity affects taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores with occasional scale. The water quality is poor for irrigation because sodium levels are excessive for sensitive crops (SAR >8), and EC may exceed irrigation guidelines in some bores. The water should be tested before giving to stock as there are occurrences of excessive salinity. Groundwater EC exceeds QWQG aquatic ecosystem surface water quality guidelines, and pH (upper range values) may do also.							
Earlier basins partially underlying GAB Zone 14	14 - Bowen Basin Basalt Area	very poor	Na Mg	HCO_3	840	1565	3707	high
	Comments Bowen Basin Basalt Area lies between the northeast Nogoa and southwest Isaac sub-basins. It is moderately sized, with an area of 7,417km^2, and represents a minor proportion of the Pre GAB samples. It consists of Bowen Basin sediments, overlain in the west by basalts and by Cainozoic deposits in the east. The groundwater is mostly deep to very deep, extending from 29m to 125m. Most of the bores access members of the coal bearing Back Creek Group, such as the Blair Athol and Blenheim Formations, but others use members of the Blackwater Group. The data record is limited and not current. The recorded salinity ranges from moderate to high, being between 745µS/cm and 4,136µS/cm. Salinity may affect taste, and the water may not be ideal for other general purposes because of high EC and hardness. Precipitates may form in bores with occasional scale. EC and percent sodium are excessive for sensitive crops in some areas (SAR >8), but the water is normally suitable for stock. EC often exceeds QWQG aquatic ecosystem surface water quality guidelines, and TN and pH (upper range values) may do also.							

Notes to Table 4

1. Aquifer class and chemistry zone: refer to descriptions (including Table 3) and mapping in this report. In some locations (mainly within the alluvial aquifer class) a chemistry zone is identified by entire zone and the ‘near stream’ (within 1.5km of stream channel) component of the zone, where near stream water quality characteristics may be different from overall zone. Overall zone includes near stream and other areas. Near stream zone is shown on large scale plans accompanying this report, available on the department’s website.

2. Data reliability for making comparisons with water suitability is based on samples per km^2: ‘excellent’ >1; ‘good’ 1–0.5; ‘moderate’ 0.5–0.1; ‘poor’ 0.1–0.05; ‘v poor’ <0.05; ‘unreliable’ <20 samples overall. Sample numbers for each chemistry zone are provided in Tables 5 and 6.

3. EC percentiles: refer to Tables 5 (Fitzroy, Capricorn-Curtis) and 6 (Burdekin, Don-Haughton) for greater detail on EC and other indicator percentiles.

4. Comparison with guideline values. Note that to ascertain suitability of a specific water source (e.g. a bore) for a given use (e.g. irrigation) more detailed testing may be required, and the broad results in Table 4 are not intended to provide this level of detail. The following values have been used for comparison purposes in Table 4. Note that these are indicative/average values and variations in tolerances will occur within a given water use (e.g. according to stock or crop type) and according to particular groundwater source. Outliers may have lower suitability than other percentile values:

<u>Stock:</u>

- Total dissolved solids (TDS) is a measure of salinity which is roughly proportional to EC. TDS guideline values for stock are based on tolerances and effects on stock condition etc. They vary by type of stock, with sheep being the most resilient and poultry and dairy cattle being among the most vulnerable. Refer to ANZECC 2000 Table 4.3.1 for more details applicable to particular stock tolerances. The guideline value of <6,000mg/L which is used here to assess suitability, equates to approximately EC<10,000µs/cm (rounded), and is the level at which moderately tolerant stock such as horses and pigs may start to lose condition (Table 9.3.3 “Tolerances of livestock to total dissolved solids (salinity) in drinking water”, P 9.3–11, Volume 3, Primary industries, Chapter 9, ANZECC 2000).
- Nitrogen in groundwater is virtually all in the form of nitrate, because organic nitrogen is broken down or recycled by chemical and biological processes in the soils and unsaturated zone (Hem 1985, DeSimone & Howes 1998). Therefore, the nitrate/nitrite guideline given in ANZECC section 4.3.3.3 is a satisfactory representation of total nitrogen in groundwater. This is equivalent to TN <90mg/L.
- F <2mg/L – ANZECC 2000 Table 4.3.2, page 4.3–5

Hem, JD 1985, 'Study and Interpretation of the Chemical Characteristics of Natural Water'. USGS Water Supply Paper 2254, 3. US Govt. Printing Office, Washington, DC., 264 p.

DeSimone, LA & Howes, BL 1998, 'Nitrogen transport and transformations in a shallow aquifer receiving wastewater discharge: A mass balance approach'. *Water Resources Research*, vol. 34, no 2: 271-285.

<u>Irrigation:</u>

Irrigation water quality requirements vary according to multiple factors, e.g. crop type and tolerances, root zone, soil characteristics and whether application is under short term or longer term conditions. Refer to ANZECC (2000) section 4.2.4 for further details (including Table 4.2.4 and 4.2.5). Values adopted for comparison are:

- EC short term < 7,000µS/cm; long term/sensitive crops < 1,000µS/cm. Sources: ANZECC 2000 Section 4.2.4.1 ‘Irrigation salinity and sodicity’, and Chapter 9 Sections 9.2.1 and 9.2.3, explain the complex relationship between salt tolerance, soil type, and the salinity of irrigation water, and the problems with picking general guidelines. These values were selected and adapted from Table 9.2.5, with 1,000µS/cm being mid-range for moderately sensitive crops such as most fruit, and 7,000µS/cm being towards the upper limit for very tolerant crops such as cotton.
- Sodium Adsorption Ratio (SAR) is related to the percentages of calcium and magnesium in the water. It affects soil structure and permeability, particularly over time, with the Impact depending on salinity, soil structure, and rainfall and crop type. The guidelines adopted from ANZECC (2000) Table 9.2.15, Table 9.2.6 and Figure 9.2.3, are <8 SAR, which may cause leaf damage to very sensitive crops or long term damage to the structure of clayey soils, and <46, above which soil structure is likely to be damaged over time, and moderately sensitive crops can suffer stunted growth. Refer to ANZECC (2000) Section 9.2.3 ‘Salinity and sodicity’ for more details.
- F <2 mg/L – which is the short-term trigger value for irrigation water given in ANZECC (2000) Section 9.2.5.11 ‘Fluoride’.

<u>Domestic use:</u>

Corrosiveness/fouling: The following have been applied as an indication of water quality corrosion and fouling potential relating to general farm/domestic use (impacts on wells, pumping, pipeline, storage tanks, etc.). Source: ANZECC (2000), section 4.2.10.

- pH: 5-8.5
- hardness ($CaCO_3$): 60-350mg/L
- LSI: >2 - The Langelier Saturation Index (LSI) is mainly a predictor of fouling. A value of 2 is scale forming but non corrosive, CAC (1965).
- Ryznar Index: <6. The Ryznar Stability Index (RSI) is based on a number of variables, and is similar to the LSI but tends to give more conservative results. Scaling becomes more likely as the level drops below 6. This measure is not considered a good indicator of corrosion, although this may occur due to other factors at levels above 6 (CAC 1965)
- LR: >10 - The Larson-Skold Index (LR) is based on the ratio between sulphate and chloride to bicarbonate and carbonate. Withers (2005) reports that waters are less likely to be corrosive if the LR is below 0.8, but increasingly likely as the LR exceeds 1.2.

<u>Drinking water</u> – The health and aesthetic guidelines used were those given in NHMRC & NRMMC (2011, as updated), with the health criteria for which there was sufficient data being nitrate (50 mg/L as nitrate, equivalent to 10 mg/L as N), and fluoride (1.5mg/L). EC (aesthetic/taste) <1,700µS/cm. The relationship between EC and TDS varies. EC X 0.64 approximately generates TDS values of about 1,100mg/L (no specific health guideline established).

CAC 1965, '*Handbook of Air Conditioning System Design*'. Carrier Air Conditioning Company, McGraw-Hill Books, New York.

NHMRC & NRMMC, 2011, *'Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy'*, National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

Withers, A 2005, 'Options for recarbonation, remineralisation and disinfection for desalinisation plants'. *Desalinisation*, vol. 179, 11-24.

<u>Surface water aquatic ecosystem comparisons</u>: An important aspect of groundwater chemistry is its impact if discharged into surface water. Groundwater quality has been compared with the surface water aquatic ecosystem guidelines from QWQG (2009, as amended). In the case of EC, these guidelines are those for the surface water Queensland Salinity Zones provided in Appendix G of QWQG (2009). Where a groundwater chemistry zone underlies more than one surface water salinity zone, the surface water zone that covers the majority of the area has been used. For other indicators (e.g. pH, TN), comparisons are in relation to QWQG surface water regional guidelines (e.g. pH 6.5–8, TN 500µg/L or 0.5 mg/L), unless otherwise indicated. Note that EVs and WQOs have been scheduled in the EPP (Water) for Fitzroy region, and apply for decision making under the EP Act/EPP (Water).

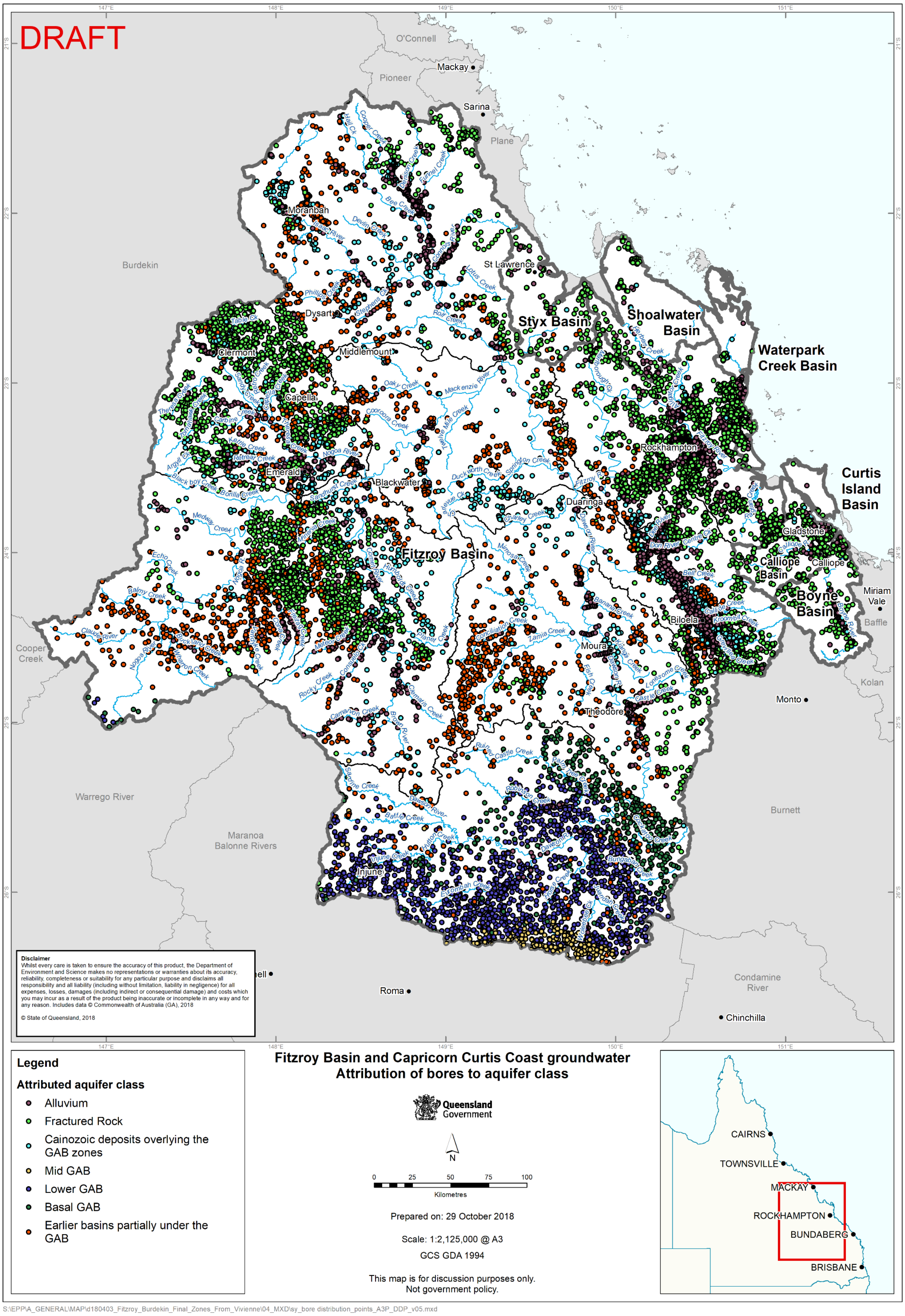
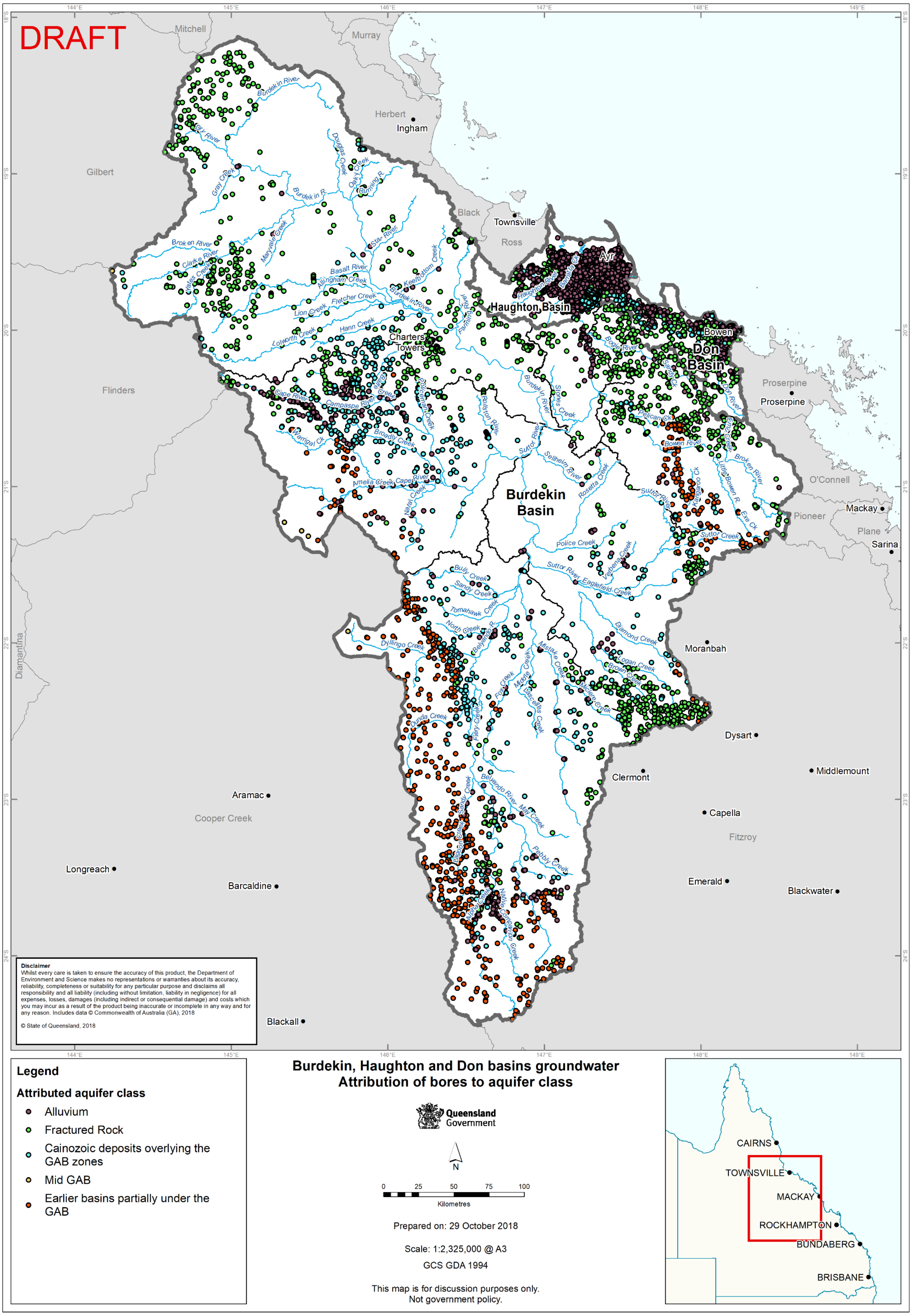


Figure 23: Bore attribution to aquifer class in the Fitzroy Basin and Capricorn–Curtis coast



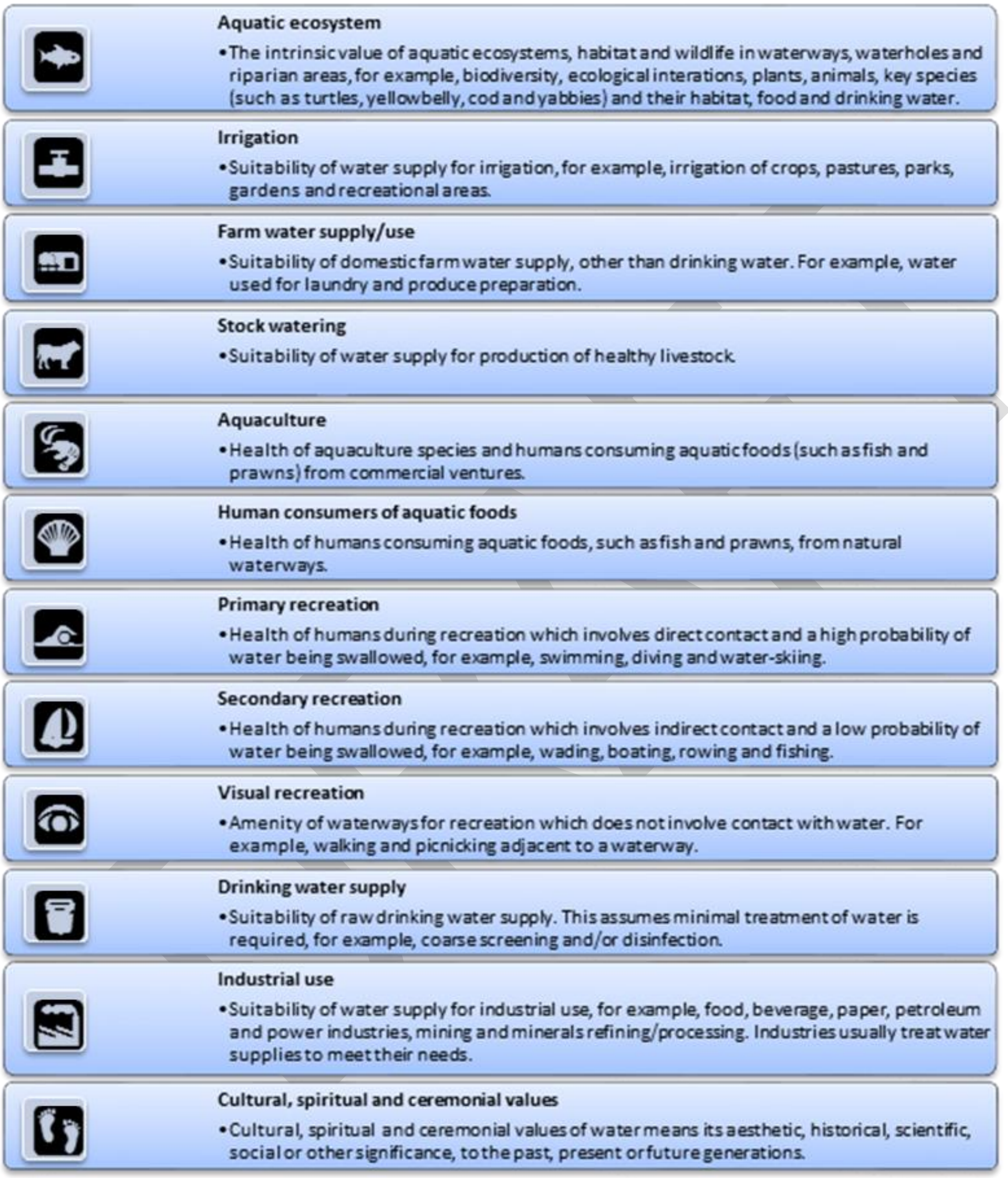
S:\EPP\A_GENERAL\MAP\d180403_Fitzroy_Burdekin_Final_Zones_From_Vivienne\04_MXD\sy_bore distribution_points_A3P_DDP_v05.mxd

Figure 24: Bore attribution to aquifer class in the Burdekin, Haughton and Don basins

8 Appendix 2 Human use EVs

Human use EVs are shown in mapping available from the department's website. Guidelines to support human use EVs are based on relevant national guidelines (updated where applicable by State sources).

The range of EVs is summarised in the table below.



Environmental value	Definition
Aquatic ecosystem	• The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways, waterholes and riparian areas, for example, biodiversity, ecological interations, plants, animals, key species (such as turtles, yellowbelly, cod and yabbies) and their habitat, food and drinking water.
Irrigation	• Suitability of water supply for irrigation, for example, irrigation of crops, pastures, parks, gardens and recreational areas.
Farm water supply/use	• Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.
Stock watering	• Suitability of water supply for production of healthy livestock.
Aquaculture	• Health of aquaculture species and humans consuming aquatic foods (such as fish and prawns) from commercial ventures.
Human consumers of aquatic foods	• Health of humans consuming aquatic foods, such as fish and prawns, from natural waterways.
Primary recreation	• Health of humans during recreation which involves direct contact and a high probability of water being swallowed, for example, swimming, diving and water-skiing.
Secondary recreation	• Health of humans during recreation which involves indirect contact and a low probability of water being swallowed, for example, wading, boating, rowing and fishing.
Visual recreation	• Amenity of waterways for recreation which does not involve contact with water. For example, walking and picnicking adjacent to a waterway.
Drinking water supply	• Suitability of raw drinking water supply. This assumes minimal treatment of water is required, for example, coarse screening and/or disinfection.
Industrial use	• Suitability of water supply for industrial use, for example, food, beverage, paper, petroleum and power industries, mining and minerals refining/processing. Industries usually treat water supplies to meet their needs.
Cultural, spiritual and ceremonial values	• Cultural, spiritual and ceremonial values of water means its aesthetic, historical, scientific, social or other significance, to the past, present or future generations.

Figure 25: Environmental values icons and definitions

9 Appendix 3 Water quality percentiles (basis for aquatic ecosystem WQOs)

Table 5: Fitzroy and Capricorn-Curtis Coast: Statistical summaries of water chemistry by groundwater zone

Refer to notes after table.

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
	ALLUVIUM																												
Alluvium	6 – Curtis Coast	Samples	377	377	377	377	377	377	374	374	377	377	373	373	360	360	952	377	562	362	350	369	328	328	64	64	377	360	81
		10th	19	35	2	5	3	9	5	1	28	26	2.4	1	0.00	0	160	19	5.6	6.0	7.5	0.00	0.000	0.000	0.000	0.000	1.35	0.000	0.000
		20th	32	43	4	7	5	11	17	11	41	39	5.4	2	0.00	0	270	36	6.2	21.0	11.0	0.00	0.000	0.000	0.005	0.000	1.76	0.000	0.000
		40th	55	53	27	17	8	14	121	29	82	47	12.0	5	0.50	0	447	111	7.1	113.6	14.5	0.10	0.010	0.010	0.010	0.000	2.27	0.109	0.000
		50th	63	57	39	27	11	16	165	37	100	53	15.0	6	0.60	0	570	148	7.4	138.0	16.0	0.10	0.020	0.010	0.020	0.005	2.57	0.130	0.000
		70th	90	68	54	37	16	20	237	48	140	65	25.2	10	1.50	0	830	209	7.9	201.9	20.0	0.12	0.040	0.102	0.033	0.010	3.38	0.326	0.000
		80th	133	73	68	42	22	22	279	54	201	74	47.4	16	2.60	1	1025	255	8.0	232.0	22.0	0.20	0.099	0.190	0.060	0.015	4.26	0.565	0.000
		90th	331	82	86	47	48	26	328	63	424	81	126.5	27	7.80	2	1977	366	8.1	273.3	26.0	0.50	0.357	0.407	0.124	0.030	11.30	1.696	0.000
Alluvium	7 – Comet	Samples	35	35	35	35	35	35	35	35	35	35	32	32	19	19	49	35	37	35	16	29	12	8	1	1	34	19	3
		10th	27	21	1	4	3	6	45	42	15	6	0.0	0	0.00	0	416	16	7.1	39.0	8.7	0.10	0.000	0.000	id	id	0.88	0.000	id
		20th	40	28	6	5	9	8	240	45	22	9	0.0	0	0.00	0	543	73	7.3	198.5	15.7	0.10	0.000	0.001	id	id	1.30	0.000	id
		40th	61	40	35	14	25	25	340	67	52	18	6.0	1	0.00	0	751	184	7.5	283.0	21.5	0.20	0.010	0.010	id	id	1.86	0.000	id
		50th	100	54	38	23	27	28	445	73	60	24	7.5	2	0.00	0	950	236	7.8	365.0	25.0	0.20	0.010	0.010	id	id	2.72	0.000	id
		70th	162	69	60	33	54	35	564	85	130	35	11.9	2	**0.20**	**0**	1348	383	8.0	480.0	**36.7**	0.30	**0.029**	**0.011**	id	id	5.36	**0.043**	id
		80th	221	73	74	37	63	36	676	89	177	51	27.3	4	0.50	0	1685	414	8.2	559.0	47.5	0.47	1.770	0.019	id	id	6.66	0.109	id
		90th	320	86	86	38	73	45	771	93	230	55	122.0	8	2.58	0	4200	491	8.5	632.0	59.1	0.60	16.860	0.020	id	id	14.01	0.561	id

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	8 - Mackenzie with Lower Nogoa and Comet Rivers	Samples	81	81	81	81	81	81	81	81	81	81	81	81	77	76	116	81	97	81	75	81	75	75	53	53	81	77	0
		10th	167	41	6	3	7	5	341	15	37	12	11.5	2	0.00	0	886	45	6.7	280.2	32.0	0.15	0.000	0.000	0.000	0.000	3.29	0.000	id
		20th	200	51	16	5	15	10	444	20	78	26	15.6	3	0.50	0	1319	98	7.1	371.4	56.0	0.18	0.000	0.000	0.005	0.000	5.38	0.109	id
		40th	365	68	41	8	45	19	530	29	360	45	61.0	4	2.36	0	2197	288	7.6	449.5	71.0	0.30	0.005	0.005	0.010	0.015	11.14	0.513	id
		50th	495	70	70	10	78	20	628	34	620	60	79.8	5	3.00	0	3155	561	7.8	521.0	74.0	0.35	0.005	0.005	0.010	0.015	11.38	0.652	id
		70th	653	79	91	14	105	26	722	57	940	65	131.9	7	7.10	0	4200	658	8.0	608.6	81.0	0.67	0.010	0.015	0.030	0.015	13.00	1.543	id
		80th	710	84	143	22	130	29	792	70	1250	74	154.3	7	9.76	0	5533	923	8.2	662.6	95.5	0.97	0.040	0.050	0.070	0.025	15.39	2.122	id
		90th	1141	92	251	29	307	31	899	84	2448	79	207.0	8	20.94	1	10920	1806	8.5	744.4	105.0	1.42	0.110	0.190	0.146	0.032	16.46	4.552	id
Alluvium	8 - Mackenzie with Lower Nogoa and Comet Rivers near stream	Samples	17	17	17	17	17	17	17	17	17	17	17	17	12	12	27	17	21	17	12	17	11	11	11	11	17	12	0
		10th	48	33	29	5	21	16	250	19	57	23	4.2	1	0.00	0	724	186	6.3	205.0	25.7	0.22	0.000	0.000	0.006	0.000	1.60	0.000	id
		20th	78	37	35	15	40	19	303	23	109	37	6.9	2	0.00	0	1637	250	6.7	248.9	27.8	0.30	0.000	0.000	0.010	0.000	2.24	0.000	id
		40th	203	41	47	22	71	26	496	47	363	44	41.9	4	0.12	0	2690	407	7.4	409.1	68.3	0.32	0.009	0.000	0.029	0.009	3.26	0.026	id
		50th	**241**	**43**	**113**	**27**	**78**	**29**	**557**	**50**	**466**	**45**	**62.2**	**4**	**0.55**	**0**	3140	**567**	7.8	**467.0**	**77.5**	**0.50**	**0.010**	**0.010**	**0.070**	**0.010**	**3.49**	**0.120**	id
		70th	497	51	170	30	124	32	810	56	861	69	93.0	4	2.58	0	4108	966	8.0	672.2	92.0	0.63	0.010	0.142	0.164	0.025	6.83	0.561	id
		80th	589	67	229	32	129	33	903	59	1063	74	101.3	6	4.05	0	4530	1168	8.1	747.4	95.1	0.67	0.070	0.373	0.392	0.027	10.15	0.880	id
		90th	693	79	278	35	147	36	1093	75	1290	78	106.1	6	9.51	1	7686	1338	8.3	922.8	109.2	0.87	0.210	1.104	0.980	0.034	14.44	2.067	id
Alluvium	9 - Nogoa	Samples	226	226	226	226	225	225	222	222	226	226	223	223	177	177	294	226	252	226	152	223	151	136	79	78	225	177	1
		10th	31	29	18	6	10	13	125	32	26	16	4.9	2	0.00	0	360	93	6.8	96.1	18.0	0.12	0.000	0.000	0.005	0.000	1.19	0.000	id
		20th	41	35	23	10	13	18	155	38	37	20	12.5	4	0.30	0	466	124	7.1	124.7	23.0	0.18	0.000	0.000	0.010	0.000	1.38	0.064	id
		40th	65	42	32	17	28	25	222	44	85	31	31.0	7	1.40	0	760	195	7.5	176.0	32.0	0.22	0.010	0.010	0.030	0.010	2.01	0.304	id
		50th	87	44	40	20	37	28	317	51	109	36	39.3	8	2.20	0	962	268	7.6	256.5	34.0	0.27	0.010	0.010	0.040	0.010	2.32	0.478	id
		70th	160	58	60	32	51	34	470	65	238	49	69.2	12	5.00	1	1603	369	7.9	383.5	46.0	0.40	0.042	0.020	0.080	0.015	4.27	1.087	id
		80th	379	68	71	36	71	36	669	70	423	52	114.8	13	10.60	2	2457	456	8.1	535.7	58.2	0.49	0.083	0.043	0.100	0.020	7.53	2.304	id
		90th	748	77	92	40	95	40	912	78	841	57	178.9	17	20.00	5	4205	572	8.2	764.1	66.3	0.60	0.348	0.483	0.158	0.030	14.01	4.348	id

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																									
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	10 – Lower Fitzroy	Samples	538	538	538	538	538	538	538	537	537	537	534	534	396	396	2320	600	672	537	380	527	473	360	140	138	538	396	37
		10th	35	31	13	9	9	14	127	24	42	23	2.0	1	0.00	0	300	72	6.5	105.0	26.5	0.10	0.000	0.000	0.000	0.000	1.18	0.000	0.033
		20th	46	38	20	15	12	19	166	33	52	28	4.4	2	0.00	0	430	111	6.7	136.0	35.5	0.10	0.000	0.000	0.000	0.000	1.59	0.000	0.065
		40th	70	45	32	22	21	25	233	51	80	35	8.0	2	0.50	0	580	186	7.0	195.0	47.0	0.17	0.010	0.010	0.010	0.000	2.36	0.109	0.065
		50th	93	49	39	24	25	27	268	56	95	40	10.0	2	0.50	0	678	215	7.2	224.0	50.0	0.20	0.010	0.020	0.010	0.010	2.83	0.109	0.065
		70th	132	57	55	28	39	30	365	65	182	53	16.4	4	1.20	0	1000	303	7.6	300.0	55.0	0.25	0.030	0.180	0.020	0.015	4.06	0.261	0.131
		80th	196	64	74	31	60	32	427	68	350	61	31.0	5	2.40	0	1404	377	7.8	350.0	58.0	0.30	0.070	0.360	0.020	0.015	5.63	0.522	0.163
		90th	462	75	119	36	112	36	557	74	965	72	58.2	8	4.69	1	2538	745	8.1	466.4	64.0	0.40	0.300	0.840	0.030	0.015	8.48	1.020	0.163
Alluvium	10 - Lower Fitzroy near stream	Samples	406	406	406	406	406	406	406	406	406	406	405	405	310	310	1789	468	516	406	303	401	384	288	92	90	406	310	35
		10th	35	30	12	9	8	13	127	29	40	22	2.0	1	0.00	0	285	70	6.5	104.1	26.8	0.10	0.000	0.000	0.000	0.000	1.12	0.000	0.033
		20th	41	37	18	15	12	19	166	41	47	25	4.7	2	0.00	0	425	109	6.7	136.0	35.0	0.10	0.000	0.001	0.000	0.000	1.38	0.000	0.065
		40th	64	45	31	22	20	25	214	56	72	32	7.8	2	0.40	0	565	179	7.0	175.0	46.0	0.16	0.010	0.010	0.010	0.000	2.16	0.087	0.065
		50th	78	49	36	24	23	27	262	60	83	36	9.0	3	0.50	0	622	203	7.1	215.0	49.0	0.20	0.010	0.040	0.010	0.010	2.62	0.109	0.065
		70th	109	57	46	28	32	30	317	67	132	45	13.9	4	0.60	0	870	272	7.5	264.7	54.0	0.25	0.033	0.200	0.020	0.015	3.55	0.130	0.131
		80th	134	64	55	32	39	32	370	71	182	54	23.5	5	1.50	0	1065	310	7.7	303.6	57.0	0.30	0.070	0.400	0.020	0.015	4.67	0.326	0.163
		90th	248	76	74	36	58	34	439	75	370	63	52.0	9	2.50	1	1648	383	8.0	362.0	63.0	0.40	0.300	1.000	0.030	0.015	7.09	0.543	0.163
Alluvium	11 - Calliope and Boyne Catchments	Samples	187	187	187	187	187	187	187	187	187	187	185	185	187	187	363	187	268	186	186	187	134	133	51	51	187	187	17
		10th	30	31	25	31	10	19	123	42	39	22	5.0	2	0.00	0	365	107	6.7	104.0	21.0	0.10	0.000	0.000	0.005	0.000	1.13	0.000	0.000
		20th	36	32	32	33	13	20	150	50	45	27	6.0	3	0.00	0	414	134	7.0	124.7	23.0	0.10	0.000	0.000	0.005	0.000	1.26	0.000	0.000
		40th	45	34	39	38	15	23	175	58	60	33	9.8	4	0.40	0	487	163	7.3	146.9	27.0	0.19	0.005	0.005	0.010	0.000	1.44	0.087	0.000
		50th	48	36	43	40	16	24	185	60	65	35	11.5	4	0.50	0	525	175	7.6	154.0	28.0	0.20	0.010	0.010	0.010	0.000	1.48	0.109	**0.000**
		70th	51	38	49	42	17	25	204	62	75	37	17.3	6	0.70	0	572	193	7.7	169.0	31.0	0.21	0.013	0.020	0.013	0.005	1.58	0.152	0.000
		80th	57	41	61	45	20	27	241	66	94	42	28.9	10	1.10	0	665	229	8.0	198.9	37.0	0.24	0.020	0.040	0.020	0.015	1.78	0.239	0.000
		90th	68	45	68	47	23	27	278	69	113	48	37.0	12	1.88	0	746	255	8.1	231.6	42.0	0.30	0.030	0.318	0.070	0.015	2.06	0.409	0.000

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	12 - Isaac	Samples	538	538	538	538	538	538	538	537	537	537	534	534	396	396	2320	600	672	537	380	527	473	360	140	138	538	396	37
		10th	35	31	13	9	9	14	127	24	42	23	2.0	1	0.00	0	300	72	6.5	105.0	26.5	0.10	0.000	0.000	0.000	0.000	1.18	0.000	0.033
		20th	46	38	20	15	12	19	166	33	52	28	4.4	2	0.00	0	430	111	6.7	136.0	35.5	0.10	0.000	0.000	0.000	0.000	1.59	0.000	0.065
		40th	70	45	32	22	21	25	233	51	80	35	8.0	2	0.50	0	580	186	7.0	195.0	47.0	0.17	0.010	0.010	0.010	0.000	2.36	0.109	0.065
		50th	93	49	39	24	25	27	268	56	95	40	10.0	2	0.50	0	678	215	7.2	224.0	50.0	0.20	0.010	0.020	0.010	0.010	2.83	0.109	0.065
		70th	132	57	55	28	39	30	365	65	182	53	16.4	4	1.20	0	1000	303	7.6	300.0	55.0	0.25	0.030	0.180	0.020	0.015	4.06	0.261	0.131
		80th	196	64	74	31	60	32	427	68	350	61	31.0	5	2.40	0	1404	377	7.8	350.0	58.0	0.30	0.070	0.360	0.020	0.015	5.63	0.522	0.163
		90th	462	75	119	36	112	36	557	74	965	72	58.2	8	4.69	1	2538	745	8.1	466.4	64.0	0.40	0.300	0.840	0.030	0.015	8.48	1.020	0.163
Alluvium	12 - Isaac near stream	Samples	406	406	406	406	406	406	406	406	406	406	405	405	310	310	1789	468	516	406	303	401	384	288	92	90	406	310	35
		10th	35	30	12	9	8	13	127	29	40	22	2.0	1	0.00	0	285	70	6.5	104.1	26.8	0.10	0.000	0.000	0.000	0.000	1.12	0.000	0.033
		20th	41	37	18	15	12	19	166	41	47	25	4.7	2	0.00	0	425	109	6.7	136.0	35.0	0.10	0.000	0.001	0.000	0.000	1.38	0.000	0.065
		40th	64	45	31	22	20	25	214	56	72	32	7.8	2	0.40	0	565	179	7.0	175.0	46.0	0.16	0.010	0.010	0.010	0.000	2.16	0.087	0.065
		50th	78	49	36	24	23	27	262	60	83	36	9.0	3	0.50	0	622	203	7.1	215.0	49.0	0.20	0.010	0.040	0.010	0.010	2.62	0.109	0.065
		70th	109	57	46	28	32	30	317	67	132	45	13.9	4	0.60	0	870	272	7.5	264.7	54.0	0.25	0.033	0.200	0.020	0.015	3.55	0.130	0.131
		80th	134	64	55	32	39	32	370	71	182	54	23.5	5	1.50	0	1065	310	7.7	303.6	57.0	0.30	0.070	0.400	0.020	0.015	4.67	0.326	0.163
		90th	248	76	74	36	58	34	439	75	370	63	52.0	9	2.50	1	1648	383	8.0	362.0	63.0	0.40	0.300	1.000	0.030	0.015	7.09	0.543	0.163
Alluvium	13 - Dawson	Samples	122	122	122	122	122	122	116	116	122	122	112	112	95	95	224	122	121	120	82	109	79	70	14	14	122	95	30
		10th	36	36	17	11	6	6	146	16	27	14	0.0	0	0.00	0	373	71	6.9	121.5	18.0	0.10	0.000	0.000	0.009	0.000	1.24	0.000	0.000
		20th	54	39	25	16	8	10	195	38	45	20	0.0	0	0.00	0	482	99	7.0	160.0	20.0	0.10	0.000	0.000	0.010	0.012	1.76	0.000	0.000
		40th	73	46	40	26	15	16	275	56	101	30	2.1	1	0.50	0	671	163	7.4	220.5	24.0	0.16	0.020	0.010	0.020	0.015	2.88	0.109	0.000
		50th	114	49	50	30	18	17	293	59	120	40	7.4	1	1.00	0	825	200	7.5	239.5	26.0	0.20	0.020	0.010	**0.020**	**0.015**	3.63	0.217	0.000
		70th	249	65	68	36	30	21	437	74	255	51	19.3	2	2.60	0	1250	288	8.0	357.5	34.9	0.30	0.050	0.600	0.020	0.050	5.90	0.565	0.000
		80th	408	72	101	40	49	22	540	78	487	61	27.1	3	4.75	1	2001	492	8.2	435.5	38.2	0.40	0.124	1.550	0.020	0.050	7.96	1.033	0.000
		90th	511	79	305	44	102	24	766	83	949	86	72.5	5	6.40	2	3202	1237	8.3	618.0	54.3	0.50	1.000	7.600	0.031	0.050	13.40	1.391	0.000

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na^3		Ca^3		Mg^3		$HCO_3{}^3$		Cl^3		$SO_4{}^3$		$NO_3{}^3$		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	14 - Mid and Lower Callide	Samples	2384	2384	2383	2383	2381	2381	2382	2381	2383	2383	2366	2366	1996	1995	3509	2484	2432	2381	1886	2349	1796	1717	200	200	2378	1996	578
		10th	102	34	46	10	34	23	180	10	187	44	16.0	2	0.00	0	890	275	7.2	150.0	9.0	0.10	0.000	0.000	0.005	0.000	2.35	0.000	0.000
		20th	130	37	65	15	47	26	225	16	285	54	23.5	3	0.00	0	1257	368	7.5	189.0	20.0	0.10	0.000	0.000	0.005	0.010	2.71	0.000	0.000
		40th	185	42	96	23	69	28	309	22	455	63	43.0	4	0.50	0	1840	523	7.7	257.9	31.0	0.20	0.020	0.010	0.020	0.015	3.39	0.109	0.000
		50th	233	44	110	25	84	29	365	26	540	68	56.0	5	1.00	0	2160	621	7.8	306.0	34.0	0.20	0.020	0.010	0.020	0.015	3.90	0.217	0.000
		70th	355	50	150	30	131	32	504	33	850	75	105.0	7	2.50	0	3300	892	8.0	423.0	39.0	0.25	0.050	0.040	0.060	0.020	5.47	0.543	0.000
		80th	489	55	182	32	175	34	589	38	1237	79	155.0	9	4.40	0	4200	1154	8.1	490.0	41.0	0.30	0.080	0.100	0.165	0.030	7.11	0.957	0.000
		90th	1005	62	256	34	255	38	720	47	2010	84	310.0	12	8.00	1	6800	1582	8.2	600.0	45.0	0.40	0.150	0.650	0.530	0.050	12.02	1.739	0.000
Alluvium	15 - Callide Headwaters	Samples	1474	1474	1474	1474	1474	1474	1472	1472	1474	1474	1465	1465	1214	1214	2134	1560	1503	1473	1181	1461	1063	1032	173	173	1473	1214	179
		10th	44	28	41	21	21	26	158	26	85	33	12.0	3	0.00	0	530	190	7.2	130.0	18.0	0.10	0.000	0.000	0.000	0.000	1.28	0.000	0.000
		20th	53	30	48	25	26	28	185	34	115	39	16.8	4	0.50	0	668	227	7.4	153.1	24.0	0.10	0.000	0.000	0.005	0.010	1.48	0.109	0.000
		40th	74	33	62	31	38	32	245	42	160	45	24.4	4	1.00	0	914	310	7.7	203.0	29.0	0.20	0.010	0.010	0.020	0.010	1.81	0.217	0.000
		50th	86	35	68	33	43	33	290	45	188	48	28.0	5	1.60	0	1050	355	7.8	239.0	31.0	0.20	0.010	0.010	0.020	0.015	1.99	0.348	0.000
		70th	130	37	86	36	65	36	415	51	270	54	41.0	7	3.40	0	1455	479	8.0	345.0	35.0	0.29	0.020	0.010	0.050	0.020	2.45	0.739	0.000
		80th	149	40	97	38	79	38	494	55	322	58	55.2	9	4.70	1	1700	545	8.1	410.0	38.0	0.30	0.030	0.020	0.099	0.030	2.76	1.022	0.000
		90th	194	44	110	39	99	42	573	63	390	62	92.0	13	7.22	1	2000	650	8.2	479.0	43.0	0.40	0.040	0.050	0.650	0.050	3.46	1.570	0.000
Alluvium	15 - Callide Headwaters near stream	Samples	1213	1213	1213	1213	1213	1213	1211	1211	1213	1213	1205	1205	1002	1002	1780	1284	1242	1213	979	1202	881	858	150	150	1213	1002	154
		10th	43	28	40	21	21	26	154	26	82	32	11.5	3	0.00	0	520	187	7.2	126.8	17.0	0.10	0.000	0.000	0.003	0.000	1.24	0.000	0.000
		20th	50	30	47	25	25	28	180	33	108	39	16.0	3	0.50	0	654	220	7.4	149.1	23.0	0.10	0.000	0.000	0.005	0.010	1.43	0.109	0.000
		40th	72	33	60	31	36	32	230	41	151	46	24.0	4	1.13	0	870	293	7.7	190.0	29.0	0.18	0.010	0.010	0.020	0.013	1.81	0.246	0.000
		50th	85	35	66	33	42	33	262	45	185	49	28.0	5	1.80	0	1006	343	7.8	216.0	30.0	0.20	0.010	0.010	0.020	0.015	1.97	0.391	0.000
		70th	127	37	85	36	65	36	408	52	275	55	39.0	7	3.50	1	1470	482	8.0	340.0	34.0	0.28	0.020	0.010	0.040	0.018	2.40	0.761	0.000
		80th	146	40	97	38	81	39	487	56	325	58	49.0	9	4.90	1	1700	546	8.1	410.0	37.0	0.30	0.030	0.020	0.085	0.025	2.73	1.065	0.000
		90th	185	44	110	40	99	42	573	64	388	63	82.0	12	7.40	1	2000	649	8.3	479.0	42.0	0.40	0.050	0.067	0.625	0.050	3.38	1.609	0.000
Alluvium	16 - Dee River Alluvium	Samples	1776	1776	1776	1776	1774	1774	1774	1773	1775	1775	1770	1769	1710	1709	2198	1799	1931	1771	1615	1770	1400	1387	86	86	1773	1710	336
		10th	95	24	91	20	63	30	95	6	180	30	110.0	6	0.00	0	1400	473	7.0	79.6	19.0	0.10	0.000	0.000	0.005	0.000	1.66	0.000	0.000
		20th	125	27	125	27	85	33	145	9	270	38	190.5	12	0.50	0	1830	675	7.3	120.7	27.0	0.10	0.020	0.000	0.005	0.000	2.00	0.109	0.000
		40th	205	30	175	32	115	35	201	10	540	52	420.0	26	1.00	0	2600	905	7.6	169.0	34.0	0.10	0.040	0.010	0.010	0.015	2.87	0.217	0.000
		50th	255	32	205	33	135	36	230	11	680	58	480.0	30	2.00	0	3000	1075	7.7	191.0	37.0	0.10	0.050	0.010	0.010	0.015	3.23	0.435	0.000

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
		70th	335	35	260	35	182	37	285	14	970	66	560.0	40	4.20	0	3950	1407	7.8	239.0	44.0	0.20	0.090	0.010	0.030	0.015	3.89	0.913	0.000
		80th	390	38	300	36	210	38	350	17	1248	71	600.0	47	6.00	0	4650	1601	7.9	294.0	50.0	0.20	0.120	0.030	0.060	0.015	4.55	1.304	0.000
		90th	507	49	350	38	250	39	485	23	1510	78	660.0	57	9.85	0	5600	1850	8.0	403.4	57.0	0.30	0.200	0.160	0.159	0.020	5.90	2.141	0.000
Alluvium	16 - Dee River Alluvium near stream	Samples	1566	1566	1566	1566	1565	1565	1565	1564	1565	1565	1561	1560	1510	1509	1952	1584	1718	1562	1426	1562	1247	1237	82	82	1564	1510	298
		10th	93	24	90	21	61	30	91	6	165	29	120.0	7	0.00	0	1368	467	7.0	75.0	19.0	0.10	0.000	0.000	0.005	0.000	1.63	0.000	0.000
		20th	120	27	125	28	83	33	140	8	255	37	203.0	13	0.50	0	1798	661	7.3	116.0	26.0	0.10	0.020	0.000	0.005	0.000	1.92	0.109	0.000
		40th	205	30	176	32	116	35	201	10	550	52	430.0	26	1.00	0	2600	919	7.6	169.0	34.0	0.10	0.040	0.010	0.010	0.015	2.87	0.217	0.000
		50th	260	32	210	33	140	36	232	11	690	58	485.0	30	2.00	0	3000	1100	7.7	193.5	36.0	0.10	0.050	0.010	0.010	0.015	3.24	0.435	0.000
		70th	340	35	270	35	185	37	290	14	980	66	560.0	41	4.00	0	3950	1423	7.8	239.9	42.0	0.20	0.090	0.010	0.029	0.015	3.90	0.870	0.000
		80th	390	38	305	36	215	38	350	16	1250	71	600.0	48	6.00	0	4650	1620	7.9	293.0	49.0	0.20	0.120	0.030	0.051	0.015	4.52	1.304	0.000
		90th	495	49	355	38	252	40	470	23	1550	78	664.0	58	9.85	0	5600	1858	8.0	392.2	55.0	0.30	0.200	0.160	0.136	0.020	5.77	2.141	0.000
Alluvium	25 - Fitzroy Serpentinite Belt	Samples	29	29	29	29	29	29	29	29	29	29	29	29	25	25	62	29	29	29	24	28	21	21	16	16	29	25	2
		10th	29	19	12	5	18	39	142	38	39	24	4.9	2	0.00	0	356	122	7.1	117.2	41.5	0.07	0.000	0.000	0.000	0.001	1.09	0.000	id
		20th	41	25	18	7	25	41	202	50	65	28	6.4	2	0.55	0	429	156	7.4	166.9	47.0	0.10	0.000	0.000	0.007	0.010	1.19	0.120	id
		40th	79	30	24	9	120	54	519	57	172	37	15.7	3	1.40	0	1030	525	7.7	454.0	53.1	0.11	0.000	0.000	0.010	0.010	1.51	0.304	id
		50th	89	31	29	10	121	59	550	58	215	38	18.9	3	1.80	0	1400	571	7.8	468.0	60.0	0.13	0.000	0.000	**0.015**	**0.015**	1.79	0.391	id
		70th	110	36	32	15	130	61	572	65	262	42	27.3	3	3.40	0	1637	671	8.1	481.0	64.3	0.15	0.010	0.010	0.061	0.027	2.19	0.739	id
		80th	146	40	39	20	153	69	625	69	371	45	34.4	4	4.25	1	2208	708	8.3	533.0	69.2	0.16	0.025	0.013	0.076	0.030	2.56	0.924	id
		90th	216	42	53	24	190	73	710	72	539	59	37.1	4	5.70	1	2465	883	8.4	600.0	79.6	0.19	0.118	0.086	0.108	0.075	3.41	1.239	id
Alluvium	26 - Comet and Nogoa Basaltic Headwaters	Samples	54	54	54	54	54	54	54	54	54	54	52	52	42	42	63	54	52	54	37	50	11	9	2	2	54	42	0
		10th	45	18	13	6	31	23	386	46	40	10	0.0	0	0.00	0	758	232	7.6	330.0	14.6	0.05	0.000	0.000	id	id	0.91	0.000	id
		20th	52	20	29	13	48	32	418	55	46	11	5.0	1	0.00	0	852	309	7.8	366.5	20.9	0.10	0.000	0.003	id	id	1.07	0.000	id
		40th	76	28	50	19	57	42	524	73	60	14	12.0	2	0.50	0	1000	353	8.0	440.0	31.6	0.20	0.000	0.010	id	id	1.63	0.109	id
		50th	85	32	59	22	62	43	553	78	85	19	15.5	3	0.50	0	1050	395	8.0	460.0	41.0	0.20	**0.010**	**0.010**	id	id	1.84	0.109	id
		70th	140	40	71	28	72	50	599	84	115	23	35.9	6	1.00	0	1300	466	8.1	500.3	47.8	0.27	0.012	0.018	id	id	2.75	0.217	id
		80th	176	48	82	30	79	53	632	87	130	27	90.4	12	2.56	0	1423	489	8.2	529.4	50.0	0.33	0.020	0.041	id	id	3.72	0.557	id
		90th	219	60	99	38	110	57	691	88	178	36	180.6	25	6.80	1	1630	585	8.5	570.2	58.4	0.40	0.024	0.320	id	id	4.86	1.478	id

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	26 - Comet and Nogoa Basaltic Headwaters near stream	Samples	33	33	33	33	33	33	33	33	33	33	31	31	27	27	37	33	31	33	21	30	7	7	2	2	33	27	0
		10th	41	19	24	9	26	21	364	50	37	9	3.0	1	0.00	0	613	181	7.5	316.0	12.8	0.05	id	id	id	id	0.91	0.000	id
		20th	50	20	29	13	48	34	396	65	44	11	5.0	1	0.00	0	829	276	7.9	361.4	19.1	0.10	id	id	id	id	1.05	0.000	id
		40th	66	28	52	19	58	42	509	75	55	13	11.8	2	0.23	0	973	367	8.0	429.2	32.7	0.20	id	id	id	id	1.51	0.050	id
		50th	78	28	60	22	63	44	555	78	68	16	16.0	3	0.50	0	1020	398	8.0	479.0	38.0	0.20	id	id	id	id	1.64	0.109	id
		70th	115	37	69	29	72	53	606	84	103	21	62.6	10	0.76	0	1300	461	8.1	506.4	47.0	0.28	id	id	id	id	2.40	0.165	id
		80th	177	44	80	31	77	53	649	88	117	23	118.9	16	1.55	0	1403	494	8.2	554.5	49.3	0.35	id	id	id	id	2.93	0.337	id
		90th	225	63	97	38	87	57	695	90	134	29	209.6	30	3.70	0	1458	590	8.5	576.6	50.0	0.40	id	id	id	id	5.30	0.804	id
Alluvium	27 - Lonesome Creek Alluvium	Samples	306	306	305	305	306	306	306	306	306	306	306	306	272	272	671	306	314	306	271	302	229	227	61	61	305	272	75
		10th	109	39	54	6	27	14	261	5	151	41	8.3	1	0.00	0	970	264	7.2	226.1	24.0	0.10	0.000	0.000	0.005	0.015	2.73	0.000	0.000
		20th	160	44	66	11	40	19	360	12	261	49	22.1	3	0.00	0	1362	340	7.4	305.0	27.0	0.19	0.005	0.000	0.005	0.015	3.78	0.000	0.000
		40th	315	52	96	19	74	22	470	22	600	62	60.3	4	0.63	0	2450	565	7.7	390.0	32.9	0.20	0.020	0.010	0.019	0.015	5.90	0.137	0.000
		50th	462	55	135	22	110	23	550	26	1100	68	93.5	4	1.35	0	3120	811	7.8	461.5	36.0	0.20	0.030	0.020	0.020	0.050	7.09	0.293	0.000
		70th	1000	61	255	27	211	26	719	40	1950	77	145.0	6	3.00	0	6700	1514	8.1	615.8	41.0	0.30	0.060	0.180	0.020	0.050	11.34	0.652	0.000
		80th	1735	66	341	29	347	28	890	46	3511	82	288.7	7	5.00	0	8233	2081	8.2	744.9	44.0	0.39	0.134	0.605	0.040	0.053	17.52	1.087	0.000
		90th	5336	79	686	32	618	30	1191	53	8595	85	1065.3	10	10.30	1	15094	4363	8.3	1026.8	46.4	0.40	0.268	1.680	0.076	0.116	38.56	2.239	0.000

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
	FRACTURED ROCK																												
Fractured rock	1 - Drummond Basin Sediments	Samples	105	105	105	105	104	104	105	105	105	105	98	98	62	62	192	105	113	105	46	100	51	43	15	15	104	62	7
		10th	140	50	10	4	5	2	62	2	120	18	5.3	0	0.00	0	1250	58	7.1	51.0	15.1	0.10	0.000	0.000	0.000	0.000	4.14	0.000	id
		20th	235	59	19	5	13	6	133	5	220	30	19.4	2	0.00	0	1700	152	7.4	109.5	21.0	0.19	0.000	0.010	0.005	0.000	6.61	0.000	id
		40th	435	70	60	10	29	12	270	11	420	70	83.3	6	0.50	0	3473	322	7.7	224.5	28.0	0.37	0.010	0.017	0.020	0.010	10.75	0.109	id
		50th	650	72	85	12	45	13	370	15	860	74	135.0	7	0.55	0	4500	450	7.8	306.0	32.5	0.49	0.020	0.020	**0.050**	**0.010**	13.25	0.120	id
		70th	942	77	156	15	87	16	491	26	1517	79	266.3	10	1.42	0	7505	759	7.9	407.0	37.0	0.82	0.040	0.080	0.100	0.016	16.95	0.308	id
		80th	1527	87	299	21	171	21	734	48	2830	88	528.8	16	3.15	0	13514	1377	8.2	609.0	46.0	1.50	0.079	0.200	0.200	0.028	24.35	0.685	id
		90th	2480	91	444	33	290	27	880	69	4240	93	779.1	22	5.93	0	24500	2155	8.3	733.0	60.0	2.52	0.240	0.626	0.400	0.050	29.94	1.289	id
Fractured rock	3 - Eastern Basement With Basalt Remnants* (merged with residuals in QMDB referred to as '4 North western basalt remnants')	Samples	99	99	98	98	98	98	97	97	97	97	95	95	67	67	187	98	161	98	48	84	53	53	14	5	98	67	14
		10th	108	34	4	2	1	1	221	11	68	21	5.0	1	0.00	0	804	15	7.7	186.2	16.3	0.07	0.000	0.000	0.010	id	2.60	0.000	0.000
		20th	157	46	10	3	4	3	361	25	102	25	11.6	2	0.00	0	1033	49	8.0	308.1	18.0	0.10	0.000	0.000	0.010	id	3.68	0.000	0.005
		40th	200	63	23	6	41	16	434	45	182	37	21.1	3	0.05	0	1304	223	8.3	362.6	21.0	0.20	0.000	0.000	0.010	id	6.20	0.011	0.016
		50th	225	68	32	7	52	21	519	50	275	44	30.0	4	0.30	0	1500	331	8.3	431.5	25.0	0.29	0.010	0.010	**0.010**	id	9.65	0.065	**0.033**
		70th	364	83	57	12	79	32	651	65	430	56	92.0	6	2.08	0	2172	514	8.5	538.7	43.1	0.36	0.040	0.030	0.020	id	15.67	0.452	0.082
		80th	668	93	109	18	129	39	719	71	933	67	130.5	8	3.33	0	2922	750	8.5	596.3	55.7	0.41	0.138	0.070	0.027	id	20.76	0.724	0.082
		90th	1618	97	159	24	241	46	876	76	2978	82	260.0	12	10.28	1	4380	1288	8.7	737.4	69.1	0.50	0.220	0.400	0.088	id	24.32	2.235	0.082
Fractured rock	4 - Curtis Island Trap Rocks	Samples	290	290	290	290	289	289	276	275	289	289	279	278	233	233	555	290	308	287	229	266	203	187	108	107	289	233	3
		10th	34	29	4	4	4	9	29	7	44	27	3.0	1	0.00	0	290	27	6.3	14.0	24.0	0.10	0.000	0.000	0.010	0.000	1.57	0.000	id
		20th	51	42	8	7	6	13	64	12	59	41	5.2	2	0.00	0	418	51	6.6	42.9	32.3	0.14	0.000	0.000	0.010	0.000	2.29	0.000	id
		40th	97	57	25	11	21	17	128	21	122	61	11.0	3	0.37	0	838	143	7.2	100.9	45.1	0.22	0.000	0.010	0.020	0.010	3.60	0.080	id
		50th	146	65	34	14	30	20	158	28	238	69	13.8	3	0.60	0	1150	222	7.4	125.0	50.0	0.29	0.000	0.020	0.030	0.010	4.43	0.130	id
		70th	250	75	63	21	56	28	278	46	459	83	24.7	4	1.86	0	1950	404	7.8	225.8	59.0	0.40	0.020	0.104	0.060	0.030	7.58	0.404	id
		80th	324	79	83	24	79	33	403	53	714	86	36.4	5	2.79	0	2840	511	8.0	322.0	66.0	0.52	0.039	0.241	0.139	0.040	8.95	0.607	id
		90th	530	86	118	31	118	40	530	68	1068	93	78.7	6	6.30	1	4100	808	8.1	442.4	76.8	0.70	0.160	0.596	0.351	0.102	11.88	1.370	id

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Fractured rock	5 - Ravenswood Granites and Volcanics	Samples	780	780	779	779	779	779	779	779	780	780	774	774	702	702	4158	781	781	780	659	773	556	554	128	128	778	702	38
		10th	74	35	24	5	18	12	184	13	61	25	5.0	1	0.00	0	782	162	7.5	153.0	31.0	0.12	0.000	0.000	0.000	0.000	2.02	0.000	0.000
		20th	116	41	36	7	36	20	314	19	183	37	11.5	1	0.50	0	1300	265	7.7	260.0	40.0	0.20	0.000	0.000	0.000	0.000	2.78	0.109	0.000
		40th	246	48	60	11	70	28	470	27	443	58	23.0	2	1.30	0	2350	454	7.9	395.0	47.0	0.40	0.010	0.010	0.010	0.010	4.54	0.283	0.000
		50th	320	53	73	14	94	30	528	31	635	64	32.0	2	2.35	0	2865	568	8.0	439.5	50.0	0.40	0.020	0.020	0.010	0.010	5.34	0.511	0.000
		70th	580	62	105	22	160	34	640	44	1100	73	61.0	4	3.80	0	4373	927	8.2	535.5	60.0	0.60	0.040	0.020	0.020	0.020	8.96	0.826	0.000
		80th	730	67	130	26	200	37	701	55	1469	78	86.3	5	6.41	0	5800	1143	8.2	596.0	65.0	0.70	0.050	0.040	0.030	0.048	11.14	1.393	0.000
		90th	1004	79	175	33	285	42	810	70	1990	82	132.2	7	14.00	1	8070	1528	8.4	687.5	71.6	1.00	0.100	0.051	0.100	0.050	17.31	3.043	0.011
Fractured rock	7 - Main Range Volcanics	Samples	881	881	881	881	880	880	870	869	879	879	853	845	626	623	1105	882	957	880	510	718	504	481	208	204	880	626	31
		10th	50	27	7	4	4	4	219	34	20	8	2.0	0	0.00	0	480	36	7.3	175.0	18.0	0.10	0.000	0.000	0.000	0.000	1.35	0.000	0.000
		20th	72	30	15	6	13	12	302	48	35	12	4.0	1	0.40	0	688	104	7.5	247.5	25.0	0.12	0.000	0.000	0.005	0.001	1.69	0.087	0.000
		40th	103	39	30	12	32	28	419	65	64	18	8.6	2	1.50	0	921	210	7.9	349.5	41.0	0.20	0.010	0.005	0.010	0.005	2.62	0.326	0.075
		50th	122	46	38	15	44	33	460	72	80	23	12.0	3	2.55	0	1032	291	8.0	383.0	45.0	0.26	0.020	0.010	0.010	0.005	3.20	0.554	0.082
		70th	181	68	58	24	64	40	550	81	175	34	26.1	5	8.20	1	1450	413	8.2	455.0	54.0	0.39	0.030	0.010	0.020	0.010	6.17	1.783	0.082
		80th	237	78	68	28	80	44	602	85	245	43	45.9	7	20.12	2	1866	489	8.3	500.0	61.0	0.49	0.050	0.020	0.040	0.015	9.04	4.374	0.082
		90th	348	91	84	32	118	50	758	89	484	56	125.0	12	38.93	4	2800	667	8.5	624.5	73.0	0.60	0.192	0.050	0.107	0.021	13.90	8.463	0.261
Fractured rock	8 - Central Cratonic Basement	Samples	173	173	173	173	173	173	172	172	173	173	172	172	151	151	195	173	177	173	111	135	100	98	12	12	173	151	9
		10th	106	37	20	3	17	15	268	6	85	26	9.8	2	0.00	0	934	175	7.3	223.0	20.2	0.18	0.000	0.000	0.000	0.004	2.50	0.000	0.000
		20th	152	43	32	5	47	21	360	13	176	31	24.0	3	0.04	0	1369	344	7.5	298.1	28.0	0.24	0.005	0.010	0.009	0.005	3.44	0.008	0.000
		40th	335	52	51	9	85	28	530	30	356	48	69.2	5	1.00	0	2500	491	7.8	440.0	38.9	0.40	0.020	0.020	0.010	0.007	5.44	0.217	0.000
		50th	380	56	69	11	125	30	628	38	610	53	101.9	6	1.10	0	3335	692	7.9	530.0	42.0	0.50	0.035	0.020	**0.015**	**0.010**	6.73	0.239	**0.000**
		70th	730	64	100	16	217	38	874	55	1200	67	179.5	9	4.36	0	4832	1145	8.0	728.0	50.2	0.70	0.105	0.082	0.029	0.010	10.01	0.948	0.082
		80th	1124	70	183	23	352	40	938	63	1946	76	294.2	11	7.43	0	7565	1708	8.1	780.0	58.0	0.85	0.200	0.395	0.056	0.020	15.49	1.615	0.082
		90th	2839	76	334	26	890	46	1059	70	5060	84	819.0	15	16.40	1	17838	4622	8.3	927.0	65.4	1.20	1.450	1.100	0.212	0.026	19.46	3.565	0.082

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Fractured rock	9 - Serpentinite Belt	Samples	260	260	260	260	260	260	260	260	260	260	255	255	215	215	543	260	264	260	205	255	168	167	85	84	260	215	6
		10th	49	17	10	4	30	21	227	9	65	14	8.8	1	0.00	0	869	270	7.3	196.0	30.0	0.05	0.000	0.000	0.005	0.000	0.99	0.000	id
		20th	70	26	31	8	49	26	381	18	102	24	14.6	2	0.10	0	1110	377	7.5	316.0	37.0	0.10	0.000	0.000	0.005	0.010	1.51	0.022	id
		40th	126	34	60	15	78	33	512	35	219	42	34.3	4	1.00	0	1547	542	7.7	429.0	45.0	0.20	0.000	0.000	0.020	0.015	2.70	0.217	id
		50th	170	38	76	18	101	37	551	45	318	48	46.0	5	1.80	0	1800	632	7.8	457.5	50.0	0.28	0.000	0.010	0.030	0.020	3.19	0.391	id
		70th	299	47	132	25	169	44	651	62	663	63	87.0	7	4.60	0	2976	888	8.1	554.0	65.0	0.44	0.010	0.020	0.070	0.020	5.07	1.000	id
		80th	391	54	165	29	205	50	741	72	932	68	166.0	9	8.15	1	4018	1224	8.2	620.0	77.0	0.60	0.020	0.040	0.100	0.030	6.21	1.772	id
		90th	1083	65	240	40	360	65	820	81	1840	82	395.0	11	16.00	1	6608	2054	8.4	698.0	86.0	0.77	0.057	0.120	0.200	0.060	9.73	3.478	id
Fractured rock	10 - Eastern Fitzroy Trap Rocks	Samples	948	948	949	948	948	947	944	944	949	949	939	939	860	860	1747	947	945	941	820	903	733	715	296	296	947	860	47
		10th	77	26	36	11	28	20	278	15	79	23	20.0	3	0.00	0	800	228	7.3	230.0	29.0	0.14	0.000	0.000	0.000	0.000	1.77	0.000	0.000
		20th	102	33	52	15	37	24	351	24	129	29	29.2	4	0.50	0	1000	307	7.5	290.0	40.0	0.22	0.000	0.000	0.010	0.010	2.23	0.109	0.000
		40th	155	41	73	21	56	28	425	37	236	43	47.0	5	2.30	0	1445	430	7.7	355.0	58.5	0.30	0.000	0.000	0.020	0.010	3.10	0.500	0.000
		50th	180	44	85	24	68	30	465	42	302	49	56.0	6	3.50	0	1680	501	7.9	387.0	70.0	0.39	0.000	0.000	0.030	0.020	3.51	0.761	0.000
		70th	277	52	113	29	100	35	545	52	534	61	80.4	8	9.35	1	2450	671	8.1	454.0	80.0	0.50	0.020	0.010	0.070	0.030	4.93	2.033	0.000
		80th	360	57	138	31	128	39	615	59	757	66	107.2	9	16.20	1	3191	878	8.2	510.0	85.0	0.60	0.030	0.020	0.110	0.050	6.24	3.522	0.000
		90th	553	65	203	35	201	44	710	68	1294	76	198.0	13	28.75	2	4884	1246	8.3	592.0	90.0	0.80	0.060	0.060	0.259	0.080	8.73	6.250	0.000
Fractured rock	11 -Callide Headwaters	Samples	44	44	44	44	43	43	44	44	44	44	40	40	30	30	56	44	46	44	22	42	27	20	2	2	43	30	10
		10th	82	22	16	6	33	22	415	14	55	13	8.1	1	0.00	0	953	236	7.4	344.5	19.7	0.19	0.000	0.000	id	id	1.76	0.000	0.000
		20th	86	27	28	8	64	33	450	27	72	16	19.5	2	0.50	0	1050	356	7.7	380.0	24.9	0.21	0.000	0.000	id	id	1.90	0.109	0.000
		40th	138	34	51	14	80	42	480	48	135	28	37.2	4	2.65	0	1400	422	8.0	427.4	49.3	0.33	0.000	0.010	id	id	2.50	0.576	0.000
		50th	164	38	55	16	87	45	528	59	210	36	41.8	5	3.25	0	1663	503	8.1	480.0	52.0	0.41	0.010	**0.010**	id	id	2.78	0.707	**0.008**
		70th	242	49	91	20	119	51	641	77	378	48	86.7	7	4.80	0	2700	719	8.3	562.6	58.9	0.60	0.020	0.035	id	id	4.94	1.043	0.016
		80th	403	53	116	24	171	54	778	80	951	60	135.0	9	7.40	1	3767	1143	8.4	650.0	60.0	0.71	0.031	0.050	id	id	6.12	1.609	0.025
		90th	522	67	240	28	543	59	796	84	2150	80	551.0	24	13.55	1	9390	2354	8.6	677.5	61.6	0.92	0.064	0.120	id	id	7.47	2.946	0.033

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Fractured rock	12 - Mount Alma Trap Rocks with Limestones and Volcanics	Samples	2151	2151	2146	2145	2132	2131	2090	2089	2149	2149	2118	2115	1568	1566	11836	2152	5147	2093	939	2037	1481	370	77	78	2125	1568	62
		10th	75	32	30	9	14	9	171	15	61	17	9.4	1	0.00	0	855	201	6.7	140.0	7.0	0.10	0.000	0.000	0.010	0.000	1.99	0.000	0.000
		20th	115	38	50	14	25	13	305	22	115	27	23.2	3	0.00	0	1240	290	6.9	257.0	20.0	0.10	0.010	0.000	0.010	0.000	2.64	0.000	0.000
		40th	180	46	84	22	40	18	462	36	235	41	51.0	6	2.10	0	1770	428	7.2	384.0	24.0	0.20	0.100	0.000	0.020	0.010	3.63	0.457	0.000
		50th	222	50	104	26	51	20	520	43	300	46	68.0	7	5.30	1	2015	494	7.4	432.0	26.0	0.30	0.200	0.010	0.030	0.010	4.46	1.152	0.000
		70th	350	59	147	35	72	26	637	56	560	62	110.0	10	14.00	1	2930	646	7.7	537.0	29.0	0.44	0.772	0.010	0.070	0.020	6.45	3.043	0.000
		80th	455	65	182	40	90	30	728	64	790	71	140.0	12	22.00	2	3608	778	7.9	614.0	31.0	0.60	1.700	0.020	0.091	0.030	7.93	4.783	0.000
		90th	620	71	243	47	125	35	878	75	1153	79	200.0	15	51.00	6	5269	993	8.1	761.0	35.6	0.89	4.100	0.070	0.242	0.050	10.60	11.087	0.000
	CAINOZOIC DEPOSITS (including deposits overlying the GAB)																												
Cainozoic deposits	2 - Eastern Weathered Cainozoic Remnants	Samples	39	39	39	39	39	39	39	38	38	38	39	38	33	33	131	39	44	39	23	39	17	15	4	4	39	33	10
		10th	29	30	20	4	14	14	23	1	44	27	5.0	2	0.00	0	464	134	6.1	46.4	14.8	0.01	0.000	0.000	id	id	1.04	0.000	0.000
		20th	33	31	32	8	15	15	100	2	51	31	7.3	2	0.00	0	1007	142	7.2	85.3	16.5	0.10	0.009	0.000	id	id	1.12	0.000	0.041
		40th	171	62	41	11	21	17	172	23	164	41	21.8	4	0.05	0	1429	177	7.6	150.8	23.7	0.14	0.010	0.000	id	id	3.88	0.011	0.082
		50th	188	66	45	14	30	20	195	39	289	58	35.8	4	0.10	0	1760	203	7.7	165.0	25.0	0.19	**0.010**	**0.010**	id	id	6.70	0.022	**0.082**
		70th	436	75	64	23	72	27	280	62	835	73	142.6	7	1.50	0	3060	617	7.9	264.0	36.2	0.30	0.034	0.010	id	id	10.84	0.326	0.082
		80th	1502	76	99	41	200	28	368	64	2817	83	172.8	10	2.55	0	9519	1084	8.1	448.1	48.6	0.43	0.074	0.075	id	id	16.55	0.554	0.082
		90th	1705	77	146	42	230	29	708	67	3247	91	445.4	13	4.92	0	10364	1232	8.3	686.0	62.4	0.60	0.488	0.160	id	id	21.67	1.070	0.082
Cainozoic deposits	3 - Southern Callide	Samples	371	371	371	371	371	371	371	371	371	371	370	370	354	354	480	386	405	371	335	370	297	292	20	20	371	354	86
		10th	185	36	47	5	40	15	168	3	410	56	13.3	1	0.00	0	1950	318	7.0	139.2	14.0	0.00	0.000	0.000	0.005	0.000	2.96	0.000	0.000
		20th	300	45	66	10	69	18	239	5	504	63	40.5	2	0.50	0	2285	504	7.4	198.0	20.0	0.10	0.000	0.000	0.005	0.005	4.63	0.109	0.000
		40th	493	57	106	14	110	23	365	13	1000	74	71.0	4	1.80	0	3750	799	7.7	301.9	32.0	0.10	0.020	0.000	0.010	0.015	8.10	0.391	0.000
		50th	586	59	130	16	130	25	415	16	1250	77	93.0	5	2.50	0	4895	994	7.8	350.0	37.0	0.20	0.040	0.010	**0.020**	**0.015**	9.51	0.543	0.000
		70th	1050	64	231	20	233	32	520	24	2250	83	217.5	7	6.00	0	7325	1550	8.0	439.0	46.0	0.30	0.100	0.050	0.040	0.015	12.32	1.304	0.000
		80th	1198	67	325	23	326	36	630	29	2550	89	303.7	9	9.55	0	8405	1897	8.1	531.2	50.0	0.39	0.150	0.100	0.065	0.020	13.49	2.076	0.000
		90th	1950	72	439	29	497	39	761	39	4008	93	435.0	11	19.10	1	13000	2825	8.3	744.0	56.0	0.50	0.220	0.600	0.190	0.045	18.05	4.152	0.000

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Cainozoic deposits	4 - Central Moderately Saline Weathered Remnants	Samples	308	308	307	307	307	307	301	301	307	307	321	301	264	262	398	307	337	308	200	255	228	222	84	74	307	264	7
		10th	54	34	14	6	8	11	146	17	43	18	4.2	1	0.10	0	643	85	6.8	123.6	15.0	0.10	0.000	0.000	0.005	0.000	1.73	0.022	id
		20th	96	42	23	9	17	16	170	20	75	24	12.0	2	0.83	0	880	135	7.1	140.0	25.5	0.20	0.010	0.005	0.010	0.000	2.47	0.180	id
		40th	174	61	33	12	32	19	230	26	206	48	26.0	5	4.00	0	1200	210	7.5	189.0	47.0	0.20	0.020	0.010	0.020	0.005	5.42	0.870	id
		50th	215	65	37	13	35	21	256	33	303	56	32.0	5	7.00	1	1410	241	7.7	218.0	60.0	0.30	0.025	0.010	0.025	0.005	6.04	1.522	id
		70th	260	72	48	16	47	29	384	56	392	68	46.0	7	27.09	3	1700	320	8.0	318.0	70.0	0.40	0.050	0.020	0.050	0.020	7.35	5.889	id
		80th	286	74	59	22	64	34	511	68	430	71	52.0	8	46.00	5	1953	411	8.1	425.6	78.0	0.40	0.090	0.040	0.117	0.030	7.97	10.000	id
		90th	507	80	86	28	140	43	653	76	711	74	106.0	12	71.20	8	3067	813	8.3	545.4	85.0	0.50	0.334	0.090	0.190	0.050	13.57	15.478	id
Cainozoic deposits	5 - Tertiary Sediments Overlying The GAB and Bowen Basin	Samples	155	155	155	155	155	155	155	155	155	155	153	153	118	118	182	155	162	155	45	104	123	116	35	35	154	118	63
		10th	73	30	26	12	40	27	237	30	100	21	3.2	1	0.00	0	770	232	6.7	196.0	11.0	0.10	0.000	0.000	0.010	0.010	1.81	0.000	0.000
		20th	78	36	27	14	42	31	273	42	113	31	9.0	2	0.01	0	820	241	6.8	224.0	17.0	0.20	0.010	0.000	0.035	0.010	2.00	0.001	0.000
		40th	94	41	30	16	47	38	310	54	126	39	16.5	3	0.37	0	972	268	7.3	254.0	23.5	0.30	0.020	0.020	0.140	0.010	2.31	0.080	0.016
		50th	98	42	32	16	52	40	353	56	135	40	20.0	4	0.50	0	1186	322	7.6	296.0	29.0	0.35	0.040	0.030	0.370	0.020	2.49	0.109	0.033
		70th	144	47	59	18	81	42	580	59	200	44	34.3	5	1.22	0	1797	491	8.0	480.0	38.0	0.50	0.162	0.057	0.720	0.020	3.07	0.265	0.183
		80th	242	49	72	21	95	45	682	65	339	48	50.0	7	2.20	0	2305	560	8.2	571.0	40.5	0.59	0.467	0.106	0.950	0.035	4.23	0.478	0.324
		90th	335	59	110	27	109	51	760	75	490	59	128.4	11	6.74	1	3765	667	8.4	640.0	45.0	0.70	3.660	0.685	1.200	0.050	5.89	1.465	0.458
Cainozoic deposits	6 - Saline Tertiary Sediments	Samples	159	159	158	158	158	158	145	145	159	159	153	153	109	109	252	159	176	158	78	143	87	80	35	36	157	109	19
		10th	150	57	6	2	5	3	56	2	146	55	0.1	0	0.00	0	577	34	6.8	6.3	14.0	0.01	0.000	0.000	0.000	0.000	6.42	0.000	0.000
		20th	257	64	10	3	11	6	132	4	326	63	7.1	1	0.00	0	1019	81	7.1	58.4	15.0	0.10	0.000	0.010	0.000	0.000	7.89	0.000	0.021
		40th	585	74	31	5	36	11	239	8	730	82	29.7	3	0.05	0	2951	224	7.7	181.5	19.7	0.20	0.010	0.015	0.010	0.001	12.60	0.011	0.082
		50th	690	78	54	7	70	14	290	10	1000	85	51.0	4	0.50	0	3760	458	7.8	224.5	25.5	0.30	0.020	0.020	0.010	0.001	15.69	0.109	**0.082**
		70th	1322	85	144	10	168	19	409	21	2329	90	141.1	6	1.46	0	7425	1123	8.1	322.3	42.3	0.40	0.100	0.050	0.030	0.010	24.00	0.317	0.082
		80th	1800	91	202	13	220	23	508	34	3596	92	192.3	7	2.47	0	12306	1458	8.2	406.8	56.0	0.60	0.190	0.100	0.050	0.022	28.27	0.537	0.082
		90th	2888	94	355	17	319	30	690	44	5424	94	542.4	9	5.96	0	16160	2113	8.3	575.0	76.5	0.91	0.486	0.310	0.170	0.030	33.65	1.296	0.082

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
	MID GAB																												
Mid GAB	1 Upper Dawson Uncertain Area	Samples	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0
			Insufficient data																										
	*3 Bungil and Mooga Outcrops' (merged with QMDB '6 North Wallumbilla Bungil and Mooga')	Samples	153	153	153	153	151	151	146	146	153	153	145	145	59	59	119	149	130	152	38	131	50	43	6	6	150	59	11
		10th	344	82	2	1	0	0	0	2	160	31	0.5	0	0.00	0	1566	8	7.1	114.1	12.3	0.12	0.000	0.000	id	id	20.84	0.000	0.000
		20th	425	89	4	1	1	0	0	4	283	46	5.9	0	0.00	0	1983	17	7.4	143.0	13.0	0.20	0.000	0.000	id	id	28.95	0.000	0.000
		40th	617	94	11	2	3	1	106	8	615	66	59.0	5	0.10	0	2815	46	7.8	248.8	14.0	0.30	0.010	0.010	id	id	39.36	0.021	0.015
		50th	770	96	19	2	5	1	200	14	921	76	115.2	8	0.50	0	3867	81	8.1	300.5	15.0	0.40	0.025	0.010	id	id	44.80	0.109	**0.016**
		70th	1380	98	51	5	14	3	378	33	1937	82	301.7	15	2.18	0	6172	231	8.4	412.9	16.0	0.51	0.145	0.030	id	id	57.49	0.474	0.163
		80th	1796	99	110	7	40	5	462	50	2599	87	571.3	17	3.41	0	8893	395	8.6	506.6	16.0	0.67	0.575	0.040	id	id	63.32	0.741	0.163
		90th	2293	99	187	12	93	9	603	63	3736	94	1111.1	21	6.70	0	11260	992	8.8	604.9	20.8	0.90	2.000	0.092	id	id	71.94	1.457	0.163
	LOWER GAB																												
Lower GAB	*1 Central Surat Springbok Area continued (Continues as Zone1 in the QMDB)	Samples	467	467	461	461	443	443	459	459	467	467	434	434	302	302	496	453	474	466	267	422	255	237	71	70	435	302	83
		10th	195	89	1	0	0	0	134	24	66	15	0.0	0	0.00	0	841	5	7.7	204.6	12.0	0.27	0.000	0.000	0.000	0.000	17.18	0.000	0.000
		20th	235	96	2	1	0	0	346	48	80	19	0.5	0	0.00	0	1042	6	7.9	316.7	14.0	0.40	0.000	0.000	0.000	0.003	27.76	0.000	0.000
		40th	300	98	2	1	1	0	480	67	106	24	5.1	1	0.20	0	1229	9	8.2	444.7	16.0	0.60	0.005	0.000	0.005	0.015	39.37	0.043	0.000
		50th	319	99	3	1	1	0	540	71	125	26	10.0	2	0.50	0	1300	12	8.3	472.5	18.0	0.70	0.010	0.005	0.005	0.015	45.00	0.109	0.000
		70th	436	99	5	2	2	1	663	76	207	36	20.2	4	0.70	0	1767	22	8.5	578.7	23.0	1.30	0.070	0.010	0.005	0.015	56.91	0.152	0.000
		80th	546	99	10	2	4	2	749	79	407	50	33.6	5	1.20	0	2100	40	8.6	661.0	28.1	1.80	0.165	0.015	0.010	0.020	64.00	0.261	0.000
		90th	800	99	27	6	12	6	907	83	900	78	57.0	8	2.23	0	3409	125	8.8	790.0	40.8	2.52	0.460	0.030	0.020	0.085	79.39	0.485	0.020
Lower GAB	3 - Hutton Outcrop West Dawson Headwaters	Samples	125	125	124	124	122	122	124	124	125	125	118	118	88	88	137	123	129	125	78	119	73	68	13	13	120	88	17
		10th	180	90	2	1	0	0	204	45	110	24	0.0	0	0.00	0	708	6	7.6	213.0	9.6	0.10	0.000	0.000	0.000	0.000	11.77	0.000	0.000
		20th	208	96	2	1	0	0	270	52	120	25	0.0	0	0.00	0	910	6	7.9	253.5	13.0	0.25	0.000	0.000	0.000	0.001	23.30	0.000	0.000
		40th	275	98	3	1	0	0	470	65	131	27	0.5	0	0.00	0	1143	9	8.3	439.0	15.0	0.70	0.000	0.010	0.000	0.010	33.47	0.000	0.000
		50th	305	98	3	1	1	0	539	70	140	29	2.0	0	0.00	0	1250	12	8.4	465.0	15.0	0.86	0.010	0.010	**0.005**	**0.015**	39.63	0.000	**0.000**
		70th	350	99	4	2	1	1	598	73	154	40	4.8	1	0.50	0	1484	18	8.6	519.0	16.0	1.08	0.036	0.021	0.014	0.015	47.39	0.109	0.016
		80th	364	99	6	2	3	2	655	74	183	44	11.9	2	0.50	0	1546	26	8.6	572.0	17.0	1.29	0.049	0.030	0.020	0.015	54.97	0.109	0.016
		90th	469	99	31	8	7	3	700	75	330	54	29.0	6	1.20	0	1650	113	8.8	602.0	22.5	1.57	0.184	0.047	0.050	0.015	62.45	0.261	0.016

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																											
		%ile[2]	Na^3		Ca^3		Mg^3		$HCO_3{}^3$		Cl^3		$SO_4{}^3$		$NO_3{}^3$		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Lower GAB	*4 Northern Walloons (Continues into QMDB as Zone 7)	Samples	76	76	76	76	75	75	74	74	76	76	72	72	40	40	83	76	67	76	31	64	26	23	3	3	74	40	4
		10th	198	83	2	1	0	0	0	6	129	41	0.0	0	0.00	0	910	8	7.5	172.3	11.6	0.11	0.000	0.000	id	id	17.07	0.000	id
		20th	239	91	3	1	1	0	162	8	175	42	0.0	0	0.00	0	1100	11	7.9	217.1	12.0	0.20	0.000	0.000	id	id	23.20	0.000	id
		40th	378	97	6	1	2	1	281	21	377	63	2.4	0	0.50	0	1442	26	8.1	275.2	14.0	0.40	0.000	0.005	id	id	33.76	0.109	id
		50th	510	97	9	2	3	1	323	29	580	69	6.0	0	0.60	0	2200	32	8.2	308.0	15.0	0.69	0.000	0.010	id	id	39.46	0.130	id
		70th	986	98	22	3	7	2	431	46	1362	83	20.0	3	1.95	0	3946	93	8.4	392.1	18.2	1.20	0.047	0.016	id	id	58.27	0.424	id
		80th	1361	99	56	5	15	2	497	52	2003	91	42.0	4	3.10	0	5696	190	8.6	438.6	20.0	1.30	0.163	0.020	id	id	64.04	0.674	id
		90th	2195	99	145	10	44	7	554	59	3572	95	86.0	5	5.10	0	8940	561	8.9	498.5	25.2	1.70	0.665	0.066	id	id	76.97	1.109	id
Lower GAB	*5 Northeastern Hutton Outcrop (Continues into the QMDB as Zone 5)	Samples	195	195	195	195	194	194	192	191	194	194	181	180	76	75	159	194	183	195	71	175	57	52	11	11	194	76	11
		10th	200	67	6	1	1	0	0	4	268	55	0.0	0	0.00	0	1050	21	7.2	115.0	7.0	0.10	0.000	0.000	0.000	0.000	7.71	0.000	0.000
		20th	421	76	7	1	1	0	64	8	468	67	0.0	0	0.00	0	2000	26	7.5	149.5	11.7	0.10	0.000	0.000	0.004	0.000	11.61	0.000	0.000
		40th	600	89	12	2	5	1	200	14	801	78	10.0	1	0.50	0	2610	76	7.8	212.5	14.0	0.20	0.010	0.020	0.010	0.010	24.24	0.109	0.000
		50th	674	93	24	3	8	2	243	16	923	80	19.0	1	0.50	0	3050	119	7.9	236.0	15.0	0.30	0.020	0.025	**0.020**	**0.010**	35.63	0.109	**0.000**
		70th	940	97	52	6	42	9	384	23	1346	87	55.8	4	2.00	0	4452	318	8.2	390.0	18.2	0.50	0.040	0.059	0.034	0.015	49.52	0.435	0.016
		80th	1250	98	81	8	75	13	522	27	1882	91	85.1	5	3.19	0	5670	532	8.4	482.0	41.2	0.66	0.120	0.110	0.135	0.015	53.71	0.693	0.016
		90th	2220	98	134	14	118	21	659	43	3605	96	120.2	7	5.49	0	9060	832	8.6	641.0	57.8	1.20	0.200	0.240	0.432	0.021	67.25	1.193	0.023
Lower GAB	6 -Upper Dawson Walloons	Samples	48	48	48	48	46	46	48	48	48	48	45	45	13	13	54	48	37	48	9	39	12	10	0	0	46	13	7
		10th	544	90	8	1	3	0	0	3	667	73	0.0	0	0.00	0	2514	30	7.2	256.6	12.0	0.24	0.000	0.000	id	id	28.13	0.000	id
		20th	1169	93	14	1	5	1	0	6	1431	81	0.0	0	0.00	0	2883	55	7.4	310.5	12.0	0.50	0.000	0.000	id	id	59.02	0.000	id
		40th	1816	97	23	2	8	1	237	10	2477	87	1.4	0	0.00	0	5165	98	7.8	363.6	12.1	0.66	0.000	0.000	id	id	73.57	0.000	id
		50th	1945	97	28	2	10	1	363	12	2610	88	2.9	0	**0.20**	**0**	6460	106	8.0	402.5	**13.0**	0.75	0.025	0.000	id	id	78.90	**0.043**	id
		70th	2287	98	40	3	15	1	520	15	3281	91	5.7	0	0.92	0	8320	146	8.3	500.1	13.0	0.97	0.099	0.000	id	id	86.00	0.200	id
		80th	2460	98	63	4	19	2	608	18	3682	94	9.3	0	1.27	0	8945	262	8.4	557.0	17.2	1.26	0.771	0.000	id	id	89.98	0.276	id
		90th	4329	98	175	6	67	4	720	25	6891	97	22.0	1	5.20	0	10220	699	8.7	628.1	31.0	1.59	29.100	0.025	id	id	106.14	1.130	id

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Lower GAB	7 - Hutton Outcrop Palm Tree Creek Area	Samples	92	92	92	92	90	90	91	91	92	92	85	85	59	59	98	92	90	89	46	87	40	30	4	4	90	59	5
		10th	96	61	1	1	0	0	85	5	56	26	0.0	0	0.00	0	289	4	7.0	93.2	12.0	0.00	0.000	0.000	id	id	4.31	0.000	id
		20th	144	71	2	1	0	0	119	16	100	39	0.0	0	0.00	0	612	5	7.5	110.9	12.0	0.02	0.000	0.000	id	id	8.62	0.000	id
		40th	216	95	5	2	0	0	171	26	236	64	2.6	1	0.00	0	994	15	7.8	152.1	13.0	0.10	0.010	0.008	id	id	21.69	0.000	id
		50th	235	96	7	3	1	1	194	31	263	68	5.3	1	0.00	0	1100	24	7.9	185.0	13.0	0.11	0.015	0.010	id	id	25.46	0.000	id
		70th	304	97	22	8	5	3	229	39	376	73	11.4	2	0.45	0	1486	66	8.0	212.9	14.0	0.17	0.043	0.022	id	id	30.85	0.098	id
		80th	443	99	53	16	14	7	298	56	603	82	23.7	5	1.35	0	2259	151	8.3	268.7	16.0	0.30	0.100	0.045	id	id	41.63	0.293	id
		90th	669	99	83	29	28	14	390	67	1023	91	70.0	8	6.30	1	3464	407	8.8	345.4	23.9	0.40	3.050	0.095	id	id	46.53	1.370	id
Lower GAB	8 - Huttons Eurombah Creek Area	Samples	47	47	46	46	47	47	45	45	47	47	43	43	22	22	43	45	44	47	17	46	12	9	1	1	46	22	3
		10th	271	95	2	0	0	0	0	5	127	25	0.0	0	0.00	0	1147	5	7.7	216.0	11.2	0.16	0.000	0.000	id	id	34.52	0.000	id
		20th	295	97	2	1	0	0	258	11	133	30	0.0	0	0.00	0	1229	8	7.8	282.8	12.9	0.35	0.027	0.003	id	id	37.77	0.000	id
		40th	452	98	3	1	1	1	393	30	310	45	0.0	0	0.00	0	1764	12	8.2	396.1	17.0	0.80	0.063	0.010	id	id	57.06	0.000	id
		50th	594	98	5	1	3	1	500	41	510	66	1.6	0	0.00	0	2010	17	8.3	435.0	**18.0**	0.90	**0.080**	**0.010**	id	id	62.95	0.000	id
		70th	1525	99	20	1	8	1	618	61	1994	86	4.6	0	0.95	0	6340	74	8.6	528.2	18.0	1.03	0.156	0.020	id	id	77.64	0.207	id
		80th	1894	99	36	2	13	2	810	70	2810	94	8.4	0	1.11	0	8577	118	8.7	691.9	19.2	1.12	0.342	0.034	id	id	82.79	0.241	id
		90th	2703	99	69	4	27	2	1046	75	5153	97	19.8	1	2.56	0	14494	328	8.8	904.0	21.0	1.84	1.590	0.046	id	id	88.94	0.557	id
Lower GAB	*9 Northern Hutton Outcrop (Composed of disconnected western portions of Hutton outcrop which were merged with QMDB '6 Northern Hutton Outcrop')	Samples	49	48	49	48	49	48	49	48	49	48	49	48	25	24	55	49	44	48	24	48	30	21	10	10	48	25	3
		10th	30	31	12	11	1	1	0	8	18	14	4.4	1	0.00	0	334	41	6.8	98.0	9.0	0.01	0.000	0.000	0.000	0.000	1.15	0.000	id
		20th	39	38	20	20	5	3	0	37	40	20	9.3	3	0.00	0	437	91	7.0	134.2	12.0	0.05	0.000	0.000	0.003	0.000	1.63	0.000	id
		40th	73	47	32	29	13	13	166	49	50	27	22.9	6	0.13	0	532	154	7.8	157.1	13.1	0.10	0.000	0.000	0.008	0.000	2.28	0.027	id
		50th	78	50	36	31	15	18	213	55	65	33	26.0	7	0.25	0	570	162	8.0	185.0	19.5	0.13	0.000	0.005	**0.010**	**0.005**	2.49	0.054	id
		70th	97	57	45	32	19	22	230	61	108	41	38.7	9	0.40	0	768	194	8.1	196.0	25.1	0.18	0.007	0.017	0.015	0.008	4.09	0.087	id
		80th	135	69	63	35	27	29	264	71	194	56	64.1	13	0.70	0	934	259	8.3	218.0	36.4	0.30	0.020	0.040	0.025	0.015	7.28	0.152	id
		90th	235	88	79	39	28	38	290	81	1673	88	88.0	15	1.00	0	1186	286	8.5	241.1	44.1	0.57	2.350	0.142	0.040	0.015	11.97	0.217	id

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
	BASAL GAB																												
Basal GAB	1 - Eastern Precipice	Samples	210	210	210	210	207	207	210	206	210	210	187	187	152	152	219	210	218	213	138	207	118	115	36	36	207	152	26
		10th	31	75	1	3	0	0	74	74	7	8	0.0	0	0.00	0	149	3	6.7	63.0	11.0	0.10	0.000	0.000	0.000	0.010	5.00	0.000	0.000
		20th	34	89	1	3	0	1	79	80	8	11	0.0	0	0.00	0	163	4	7.0	70.0	12.0	0.13	0.005	0.000	0.005	0.014	6.14	0.000	0.000
		40th	43	94	2	4	0	1	102	84	9	12	0.0	0	0.00	0	200	6	7.3	90.7	12.0	0.20	0.010	0.010	0.010	0.015	7.55	0.000	0.000
		50th	47	94	2	4	0	1	118	85	10	13	0.5	0	0.00	0	220	6	7.5	99.0	13.0	0.20	0.030	0.010	0.020	0.015	8.02	0.000	0.000
		70th	59	95	3	6	1	2	134	88	13	16	2.0	1	0.25	0	245	10	7.7	116.6	14.0	0.30	0.100	0.020	0.030	0.015	9.24	0.054	0.000
		80th	69	96	4	8	1	3	159	89	15	20	2.0	2	0.50	0	302	14	7.9	149.0	14.0	0.35	0.190	0.020	0.033	0.015	10.25	0.109	0.000
		90th	83	96	15	17	2	4	190	91	33	35	3.0	3	0.50	0	350	43	8.1	174.2	15.0	0.50	0.449	0.050	0.068	0.015	11.46	0.109	0.000
Basal GAB	*2 South Eastern Evergreen Outcrop continued (merged with '3 Northeastern Evergreen Outcrop' QMDB')	Samples	56	56	56	56	55	55	56	56	56	56	54	54	25	25	55	51	53	56	22	51	25	22	5	5	55	25	0
		10th	74	66	3	1	1	1	76	5	39	23	0.0	0	0.00	0	494	22	7.0	101.7	12.8	0.21	0.000	0.000	id	id	7.53	0.000	id
		20th	175	77	6	1	1	1	126	8	130	28	0.5	0	0.00	0	1225	33	7.3	150.0	14.0	0.37	0.020	0.010	id	id	10.69	0.000	id
		40th	481	89	13	3	4	2	295	30	444	55	4.6	0	0.50	0	2175	73	7.5	260.9	15.0	0.60	0.045	0.020	id	id	16.56	0.109	id
		50th	629	91	17	4	7	2	377	34	542	66	8.4	1	0.80	0	2950	85	7.8	342.5	17.0	0.70	0.070	0.025	id	id	19.08	0.174	id
		70th	979	97	47	8	15	6	528	56	1026	76	20.0	2	2.30	0	4600	281	8.2	443.4	20.0	0.91	0.150	0.040	id	id	53.42	0.500	id
		80th	1386	98	106	14	70	8	576	66	1499	89	28.0	3	3.00	0	5465	595	8.4	487.7	20.0	1.40	0.755	0.051	id	id	60.08	0.652	id
		90th	2099	98	338	16	157	18	1097	75	4015	94	101.8	5	3.40	0	10750	2001	8.6	1042.5	26.1	3.05	2.500	0.069	id	id	64.91	0.739	id
Basal GAB	*3 Precipice Outcrop continued in Upper Dawson (merged with '1 Precipice Outcrop QMDB')	Samples	71	71	71	71	71	71	71	71	71	71	70	70	56	56	83	71	78	71	52	68	40	40	17	17	71	56	11
		10th	15	25	8	14	4	8	52	51	14	12	2.2	1	0.00	0	179	39	6.8	67.6	11.0	0.05	0.000	0.000	0.000	0.000	0.61	0.000	0.000
		20th	16	27	14	19	6	17	101	64	16	15	4.3	3	0.00	0	247	75	7.0	89.4	11.0	0.10	0.000	0.010	0.000	0.000	0.70	0.000	0.000
		40th	21	31	23	33	10	26	121	69	24	20	7.0	5	0.00	0	297	99	7.3	105.4	12.0	0.10	0.005	0.030	0.000	0.010	0.80	0.000	0.000
		50th	23	34	24	35	12	28	136	71	25	22	9.7	6	0.00	0	340	110	7.5	133.0	13.0	0.10	0.010	0.040	**0.005**	**0.015**	0.88	0.000	**0.000**
		70th	27	43	29	37	14	31	155	74	28	23	11.1	6	0.17	0	373	126	7.7	151.7	15.7	0.12	0.013	0.050	0.015	0.017	1.21	0.036	0.005
		80th	34	63	38	40	18	36	194	81	35	27	14.0	8	0.50	0	440	157	8.1	189.2	21.2	0.15	0.020	0.070	0.034	0.020	1.88	0.109	0.016
		90th	64	75	41	44	19	40	240	83	52	39	26.0	10	0.59	0	461	192	8.4	205.6	25.3	0.24	0.295	0.125	0.118	0.020	3.08	0.128	0.075

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Basal GAB	4 -Ruined Castle Evergreens	Samples	24	24	24	24	23	23	23	23	24	24	23	23	4	4	23	8	21	24	4	23	21	19	17	17	23	4	1
		10th	19	38	5	10	2	3	46	26	12	14	0.4	1	id	id	138	15	6.1	66.3	id	0.03	0.018	0.030	0.005	0.001	1.07	id	id
		20th	22	41	7	14	4	9	68	57	12	15	0.7	1	id	id	169	17	6.1	71.0	id	0.09	0.186	0.041	0.005	0.001	1.10	id	id
		40th	23	55	8	22	5	21	72	70	15	25	1.0	1	id	id	185	45	6.3	73.1	id	0.10	0.279	0.044	0.005	0.001	1.50	id	id
		50th	23	56	8	22	5	23	73	71	16	27	1.6	1	id	id	191	**127**	6.4	90.5	id	0.10	0.360	**0.045**	**0.005**	**0.001**	1.57	id	id
		70th	26	59	18	27	9	25	123	77	17	29	2.9	2	id	id	272	270	6.6	125.9	id	0.16	1.978	0.057	0.005	0.001	2.24	id	id
		80th	102	79	18	32	10	27	128	84	72	54	16.4	4	id	id	865	280	7.4	226.4	id	0.20	2.191	0.060	0.006	0.001	2.94	id	id
		90th	335	85	62	34	21	30	322	85	335	87	22.9	5	id	id	1644	450	7.8	347.8	id	0.24	2.446	0.060	0.007	0.001	17.63	id	id
Basal GAB	*5 Eastern Central Area continued (merged with 2 Eastern Central Area QMDB)	Samples	98	98	96	96	94	94	97	97	98	98	93	93	66	66	92	96	89	98	45	86	46	41	6	6	91	66	20
		10th	37	69	1	1	0	0	76	45	16	13	0.0	0	0.00	0	157	4	6.9	67.6	12.0	0.10	0.000	0.000	id	id	3.70	0.000	0.000
		20th	87	92	2	1	0	0	150	57	36	17	0.0	0	0.00	0	185	6	7.5	162.2	14.0	0.15	0.000	0.000	id	id	8.48	0.000	0.000
		40th	197	96	2	1	1	1	319	68	77	22	3.0	1	0.00	0	884	10	8.0	289.7	17.5	0.30	0.005	0.005	id	id	23.77	0.000	0.000
		50th	255	97	3	2	1	1	420	72	99	26	5.0	2	0.25	0	1040	11	8.2	347.0	19.0	0.53	0.008	0.010	id	id	27.56	0.054	**0.000**
		70th	284	98	5	3	2	2	505	75	121	30	13.2	3	0.50	0	1181	18	8.3	421.2	21.3	1.08	0.065	0.017	id	id	34.53	0.109	0.005
		80th	342	99	8	5	5	4	674	82	165	37	29.6	5	1.00	0	1463	33	8.6	569.6	26.0	2.20	0.180	0.030	id	id	48.45	0.217	0.016
		90th	404	99	26	20	9	12	743	83	205	45	41.7	8	1.89	0	1700	97	8.8	632.7	31.0	4.00	0.427	0.084	id	id	59.98	0.411	0.016
Basal GAB	6 - Palm Tree Evergreens	Samples	63	63	63	63	63	63	64	63	63	63	58	58	41	41	65	63	64	64	36	61	32	23	8	8	63	41	5
		10th	24	32	4	7	1	1	6	14	31	18	0.0	0	0.00	0	157	14	6.0	24.9	10.0	0.00	0.000	0.000	0.020	0.010	1.41	0.000	id
		20th	26	47	5	11	1	3	30	26	34	35	0.0	0	0.00	0	168	16	6.4	26.0	11.0	0.00	0.000	0.001	0.021	0.010	1.80	0.000	id
		40th	36	64	10	16	2	6	44	35	52	53	1.9	1	0.00	0	273	36	6.7	48.0	12.0	0.05	0.020	0.040	0.044	0.010	2.73	0.000	id
		50th	45	72	13	18	3	6	64	36	56	57	3.0	1	0.00	0	305	44	7.0	57.5	13.0	0.10	0.020	0.050	**0.060**	**0.010**	2.96	0.000	id
		70th	70	78	21	26	6	11	131	51	68	63	10.0	4	0.50	0	510	114	7.5	167.5	17.7	0.20	0.093	0.126	0.113	0.015	3.80	0.109	id
		80th	115	81	42	32	17	20	194	59	114	69	14.8	7	0.53	0	820	194	7.8	284.7	24.2	0.27	0.312	0.207	0.137	0.015	6.62	0.115	id
		90th	290	89	80	39	44	33	406	80	377	74	25.1	11	1.60	0	3300	396	8.3	350.0	46.7	0.50	2.000	0.280	0.147	0.047	9.70	0.348	id

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
	EARLIER BASINS PARTIALLY UNDERLYING GAB																												
Earlier basins partially underlying GAB	1 - Central Galilee Coal Measures	Samples	59	59	59	59	58	58	57	57	58	58	59	58	50	49	90	59	68	56	29	51	32	24	8	6	58	50	3
		10th	64	44	4	2	3	2	43	2	89	32	1.0	0	0.00	0	517	25	6.7	36.4	11.4	0.14	0.000	0.000	0.000	id	2.66	0.000	id
		20th	121	66	8	4	4	3	83	5	120	41	5.4	2	0.00	0	780	47	7.2	76.4	13.0	0.20	0.000	0.000	0.001	id	5.13	0.000	id
		40th	240	74	27	6	9	8	129	13	245	65	34.5	5	0.00	0	1290	120	7.5	121.4	15.0	0.30	0.013	0.040	0.010	id	9.86	0.000	id
		50th	293	83	32	9	22	10	191	17	370	73	73.0	6	0.00	0	1555	174	7.7	174.5	17.0	0.40	0.045	0.040	**0.020**	id	11.83	0.000	id
		70th	557	87	65	13	56	15	327	30	893	84	156.8	10	1.35	0	2932	318	7.9	277.0	20.8	0.95	0.184	0.086	0.110	id	18.60	0.293	id
		80th	1032	90	122	18	105	21	406	37	1666	86	248.8	16	3.00	0	4600	753	8.0	333.6	25.7	1.20	0.310	0.193	0.110	id	21.89	0.652	id
		90th	1844	94	170	29	188	26	659	52	3285	89	468.0	24	5.75	1	7855	1479	8.2	542.0	48.2	2.12	0.527	0.369	2.308	id	34.79	1.250	id
Earlier basins partially underlying GAB	2 - Southern Galilee Clematis (merged with '3 Galilee Basin' QMDB')	Samples	22	22	22	22	22	22	21	21	22	22	21	21	17	17	31	22	23	22	16	21	1	1	0	0	22	17	0
		10th	51	62	3	3	1	1	0	23	25	14	0.0	0	0.00	0	74	11	6.8	98.4	10.0	0.10	id	id	id	id	2.29	0.000	id
		20th	104	86	3	3	1	1	16	48	30	15	0.0	0	0.63	0	450	13	7.2	179.3	10.0	0.30	id	id	id	id	8.78	0.137	id
		40th	120	93	4	4	2	2	228	70	35	25	0.0	0	1.00	0	550	16	7.9	211.3	12.0	0.59	id	id	id	id	12.49	0.217	id
		50th	124	94	5	4	2	2	253	72	50	27	0.0	0	**1.00**	**0**	571	17	8.0	218.0	**13.0**	0.60	id	id	id	id	12.99	**0.217**	id
		70th	138	95	9	6	3	4	287	82	76	33	2.4	1	2.00	0	756	35	8.1	244.5	13.0	0.60	id	id	id	id	14.83	0.435	id
		80th	145	95	10	7	4	6	301	84	92	44	8.9	2	2.00	0	1252	44	8.2	250.5	14.3	0.60	id	id	id	id	15.05	0.435	id
		90th	213	96	23	19	13	22	320	85	228	67	28.0	7	2.00	1	1488	99	8.2	266.7	15.9	0.60	id	id	id	id	15.78	0.435	id
Earlier basins partially underlying GAB	3 - Western Galilee Clematis	Samples	19	19	18	18	18	18	19	19	19	19	19	19	13	13	27	18	22	18	11	17	12	12	3	0	18	13	1
		10th	33	73	1	1	2	2	7	4	48	59	1.4	1	0.00	0	174	9	6.4	17.9	7.6	0.10	0.024	0.007	id	id	3.76	0.000	id
		20th	40	77	1	1	2	4	22	7	55	66	2.3	2	0.20	0	210	11	6.9	26.4	10.0	0.10	0.030	0.010	id	id	4.24	0.043	id
		40th	68	81	2	3	4	10	37	13	95	77	4.1	3	0.50	0	382	18	7.1	38.7	11.9	0.20	0.053	0.013	id	id	6.60	0.109	id
		50th	**122**	**83**	**3**	**3**	**6**	**13**	**51**	**15**	**115**	**79**	**5.3**	**3**	**0.50**	**0**	470	**34**	**7.4**	**66.0**	**14.0**	**0.20**	**0.080**	**0.020**	id	id	**10.81**	**0.109**	id
		70th	574	91	36	7	23	15	122	25	864	83	43.8	6	0.68	0	1464	184	7.8	101.5	17.2	0.30	0.160	0.039	id	id	15.83	0.148	id
		80th	630	94	68	9	51	16	150	31	1085	91	60.8	7	1.16	1	3375	400	7.8	125.8	23.2	0.50	0.477	0.237	id	id	17.17	0.252	id
		90th	1031	96	143	13	122	17	164	39	1964	92	129.0	8	1.92	1	5950	767	8.0	136.4	45.2	0.74	0.930	5.373	id	id	18.28	0.417	id

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																									
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Earlier basins partially underlying GAB	4 - Confluence of Bowen and Galilee	Samples	118	118	118	118	118	118	110	110	118	118	110	110	80	80	165	116	134	112	73	102	45	42	20	20	116	80	8
		10th	48	27	9	3	6	5	117	20	37	11	3.4	1	0.00	0	450	58	7.0	71.4	10.8	0.10	0.000	0.000	0.000	0.000	1.27	0.000	0.000
		20th	64	34	15	7	17	15	211	31	52	15	14.0	3	0.00	0	744	136	7.6	158.6	13.0	0.20	0.000	0.000	0.005	0.000	1.75	0.000	0.005
		40th	111	47	30	14	36	28	402	51	85	22	26.8	5	0.25	0	981	248	7.9	325.2	18.7	0.30	0.010	0.010	0.010	0.001	2.76	0.054	0.072
		50th	138	50	37	15	45	32	463	59	107	27	45.5	7	0.50	0	1080	285	8.0	380.0	23.0	0.30	0.010	0.020	**0.010**	**0.005**	3.47	0.109	**0.082**
		70th	205	66	52	20	61	39	543	74	180	41	95.5	14	1.65	0	1400	384	8.2	454.7	34.2	0.44	0.025	0.059	0.035	0.018	5.37	0.359	0.163
		80th	268	79	59	23	76	42	619	79	280	57	139.0	24	2.75	0	1700	462	8.4	520.5	38.9	0.50	0.050	0.082	0.140	0.033	8.70	0.598	0.163
		90th	451	89	82	28	96	49	746	83	537	79	254.2	36	5.25	1	2550	617	8.5	624.3	50.4	0.67	0.100	0.286	0.420	0.060	14.45	1.141	0.209
Earlier basins partially underlying GAB	5 - Central Bowen Saline Zone	Samples	94	94	93	93	93	93	89	89	94	94	88	88	51	51	151	95	102	94	39	78	52	43	14	14	92	51	7
		10th	249	46	17	2	36	5	240	3	323	39	2.2	0	0.00	0	1740	215	7.2	111.5	9.0	0.11	0.000	0.000	0.000	0.001	5.37	0.000	id
		20th	415	59	35	3	46	7	302	4	417	50	11.5	0	0.00	0	2500	292	7.5	237.9	14.0	0.20	0.000	0.000	0.000	0.001	7.33	0.000	id
		40th	660	69	61	7	72	14	459	13	894	68	37.8	2	0.37	0	4430	461	7.7	371.4	17.0	0.30	0.003	0.017	0.001	0.010	13.10	0.080	id
		50th	805	75	78	8	87	17	545	16	1305	78	60.0	3	0.60	0	5690	541	7.8	434.0	18.0	0.31	0.020	0.020	**0.010**	**0.010**	15.36	0.130	id
		70th	1838	82	153	12	160	23	747	31	2851	90	129.1	7	2.06	0	11090	1133	8.1	610.0	25.0	0.50	0.049	0.040	0.083	0.020	27.55	0.448	id
		80th	2355	90	270	15	286	28	906	43	5316	95	278.0	9	3.00	0	14730	1704	8.2	749.2	33.4	0.70	0.103	0.059	0.482	0.027	48.08	0.652	id
		90th	3852	93	482	21	730	34	1177	55	7317	97	757.2	14	5.30	0	21060	4409	8.6	972.3	54.0	0.99	0.343	0.234	1.083	0.031	56.93	1.152	id
Earlier basins partially underlying GAB	7 - Callide Coal	Samples	49	49	49	49	49	49	49	49	49	49	49	49	49	49	50	49	50	49	0	0	49	49	49	49	49	49	37
		10th	79	40	11	8	18	22	55	14	116	34	0.1	0	0.00	0	750	106	5.9	45.6	id	id	0.010	0.064	0.038	0.005	2.21	0.000	0.016
		20th	87	41	13	9	20	23	110	27	121	35	1.0	0	0.05	0	789	120	6.1	91.3	id	id	0.040	0.103	0.076	0.010	2.28	0.011	0.033
		40th	96	45	17	12	27	27	146	32	131	39	2.9	1	0.11	0	864	151	6.4	120.0	id	id	0.073	0.240	0.224	0.020	2.59	0.024	0.163
		50th	99	47	28	15	33	30	277	45	140	41	6.0	1	0.20	0	939	261	6.5	228.0	id	id	0.210	0.260	0.290	0.020	2.79	0.043	0.163
		70th	106	65	34	18	45	39	339	61	169	67	16.5	3	0.50	0	1023	278	6.8	279.0	id	id	1.000	0.294	0.516	0.040	4.10	0.109	0.261
		80th	110	66	40	20	49	40	378	63	172	69	17.0	4	1.30	0	1055	299	6.8	310.6	id	id	1.567	0.378	0.818	0.050	4.22	0.283	0.343
		90th	111	68	43	21	52	43	400	64	189	73	20.6	5	5.30	1	1138	309	7.2	327.6	id	id	2.312	0.566	1.220	0.086	4.46	1.152	0.588

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Earlier basins partially underlying GAB	*8 Lower Bowen continued (Merged with QMDB '1 Bowen Basin' and '2 Upper Bowen Basin')	Samples	162	162	157	157	155	155	157	157	157	157	129	129	111	111	160	134	158	158	92	150	125	116	35	35	155	111	15
		10th	38	93	1	0	0	0	94	45	9	7	0.0	0	0.00	0	177	4	7.1	79.0	11.0	0.16	0.000	0.000	0.005	0.001	6.73	0.000	0.000
		20th	51	96	2	0	0	0	113	56	14	9	0.0	0	0.00	0	218	5	7.4	105.0	13.0	0.20	0.010	0.000	0.005	0.001	9.57	0.000	0.000
		40th	346	98	2	1	0	0	584	75	87	14	0.0	0	0.00	0	1410	7	8.1	520.0	15.0	1.19	0.020	0.002	0.005	0.001	42.79	0.000	0.000
		50th	440	99	2	1	1	0	685	78	109	19	0.0	0	0.00	0	1700	7	8.3	611.0	17.0	1.65	0.040	0.005	0.005	0.001	50.82	0.000	0.000
		70th	586	99	4	2	1	1	935	87	176	28	2.0	0	0.50	0	2300	13	8.5	890.6	20.0	2.70	0.090	0.010	0.005	0.001	77.67	0.109	0.000
		80th	853	99	5	3	1	1	1217	90	316	42	2.9	1	0.50	0	3001	19	8.6	1080.9	22.0	5.46	0.150	0.010	0.010	0.015	109.14	0.109	0.000
		90th	882	100	11	5	3	2	1861	92	684	55	5.9	2	0.94	0	3318	34	8.8	1696.3	24.0	10.34	0.310	0.020	0.010	0.015	142.62	0.204	0.016
Earlier basins partially underlying GAB	9 -Bowen Non Coal Bearing	Samples	121	121	121	121	119	119	121	121	121	121	109	109	70	70	133	119	108	117	45	104	41	33	5	5	117	70	15
		10th	59	63	5	3	1	1	31	1	42	20	0.0	0	0.00	0	168	17	6.9	48.0	11.0	0.10	0.000	0.000	id	id	2.95	0.000	0.000
		20th	111	69	7	5	2	2	101	3	75	38	0.0	0	0.00	0	702	29	7.3	106.8	13.0	0.10	0.000	0.000	id	id	5.34	0.000	0.000
		40th	182	76	19	8	10	6	191	11	165	57	2.0	0	0.00	0	1170	82	7.6	165.6	17.0	0.20	0.010	0.010	id	id	8.87	0.000	0.033
		50th	275	81	26	10	22	8	215	18	355	75	4.0	1	0.15	0	2400	170	7.7	190.0	18.0	0.30	0.020	0.010	id	id	15.74	0.033	**0.065**
		70th	1196	85	121	12	68	15	364	46	2162	91	20.0	2	0.50	0	8280	626	8.0	307.8	23.0	0.40	0.090	0.020	id	id	24.80	0.109	0.098
		80th	1739	89	172	16	97	19	442	60	3211	95	47.7	3	0.85	0	11370	1092	8.1	401.5	27.0	0.56	0.163	0.020	id	id	27.31	0.185	0.131
		90th	2614	95	345	20	265	28	686	77	5290	98	120.4	6	2.75	0	19060	2157	8.3	574.8	42.0	0.80	0.426	0.074	id	id	34.83	0.598	0.163
Earlier basins partially underlying GAB	10 - Upper Dawson Coal Measures	Samples	20	20	20	20	20	20	20	20	20	20	20	20	6	6	38	20	10	20	0	4	7	4	0	0	20	6	6
		10th	401	57	73	3	0	0	0	2	649	51	6.5	0	id	id	3758	242	6.6	136.5	id	id	id	id	id	id	7.91	id	id
		20th	809	66	104	5	0	0	0	3	1339	53	12.0	1	id	id	6496	315	6.9	229.5	id	id	id	id	id	id	10.61	id	id
		40th	1263	71	150	12	0	0	0	8	1865	62	66.5	2	id	id	7502	523	7.2	379.5	id	id	id	id	id	id	16.60	id	id
		50th	**1495**	**77**	**189**	**13**	**0**	**0**	**0**	**12**	**2104**	**70**	**93.3**	**2**	id	id	8170	**629**	**7.2**	**493.5**	id	id	id	id	id	id	**19.88**	id	id
		70th	2268	89	299	21	32	7	347	22	3280	79	1314.2	27	id	id	9392	1085	7.2	575.0	id	id	id	id	id	id	40.14	id	id
		80th	2812	95	434	25	69	20	599	25	4138	94	1900.5	33	id	id	10663	1166	7.3	737.5	id	id	id	id	id	id	71.35	id	id
		90th	4835	97	552	31	156	21	857	33	5237	95	3181.8	38	id	id	12360	1463	7.5	971.5	id	id	id	id	id	id	139.59	id	id

Aquifer class and chemistry zone		%ile[2]	Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
			Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Earlier basins partially underlying GAB	11 - Eastern Bowen Coal Measures	Samples	276	276	276	276	275	275	270	270	276	276	274	274	233	233	389	277	307	276	207	265	169	165	14	10	274	233	36
		10th	142	31	19	2	36	10	175	3	215	40	24.1	4	0.00	0	1170	249	7.2	140.0	4.0	0.10	0.000	0.000	0.005	0.000	2.65	0.000	0.000
		20th	283	41	38	5	72	21	277	7	444	49	69.8	5	0.05	0	2005	459	7.5	207.7	7.9	0.10	0.010	0.000	0.010	0.000	3.60	0.011	0.000
		40th	409	50	70	10	145	29	540	19	934	63	140.0	7	1.00	0	3313	796	7.7	439.9	18.0	0.40	0.040	0.010	0.010	0.000	6.34	0.217	0.000
		50th	536	54	90	12	182	32	610	22	1115	67	172.5	8	1.90	0	4200	1000	7.8	502.5	23.0	0.50	0.050	0.010	**0.010**	**0.005**	8.00	0.413	0.000
		70th	1235	61	150	15	355	38	774	32	2400	76	470.0	11	5.00	0	7200	1745	8.1	646.2	39.4	0.70	0.120	0.020	0.070	0.018	13.43	1.087	0.000
		80th	1965	71	248	19	433	44	850	40	4500	84	896.1	13	7.47	0	10670	2327	8.2	705.4	50.0	0.80	0.197	0.040	0.161	0.025	17.79	1.624	0.082
		90th	3200	87	455	24	769	56	1015	51	6995	89	1224.4	19	16.00	1	18800	4242	8.6	836.9	57.8	1.10	0.326	0.100	1.989	0.055	25.90	3.478	0.082
Earlier basins partially underlying GAB	12 - Bowen Clematis Outcrop	Samples	385	385	384	384	382	382	377	375	384	382	366	364	326	324	398	374	374	384	286	370	211	206	30	30	381	326	20
		10th	24	39	3	4	2	3	62	45	28	12	0.0	0	0.00	0	251	18	6.8	58.7	11.0	0.10	0.000	0.000	0.003	0.005	1.61	0.000	0.000
		20th	44	42	6	7	3	7	134	54	35	19	0.9	0	0.00	0	356	31	7.3	133.2	12.0	0.10	0.005	0.010	0.005	0.015	1.87	0.000	0.000
		40th	73	61	10	12	6	14	210	68	48	25	2.3	1	0.25	0	540	53	7.7	178.1	14.0	0.12	0.010	0.010	0.005	0.015	2.23	0.054	0.000
		50th	80	68	15	14	9	19	240	70	52	28	4.0	2	0.50	0	610	63	7.8	210.0	15.0	0.20	0.010	0.010	0.008	0.015	2.86	0.109	**0.000**
		70th	105	79	30	20	29	30	360	76	66	39	9.0	3	0.50	0	750	191	8.1	309.3	16.0	0.20	0.020	0.030	0.020	0.015	5.14	0.109	0.000
		80th	125	85	39	23	38	36	444	79	78	44	14.0	4	0.50	0	850	245	8.2	378.7	17.0	0.24	0.030	0.070	0.020	0.015	6.93	0.109	0.000
		90th	146	91	49	25	47	38	520	85	100	56	19.5	6	1.00	0	969	296	8.3	453.2	19.0	0.30	0.108	0.280	0.055	0.035	10.42	0.217	0.172
Earlier basins partially underlying GAB	13 - Northwestern Bowen Coal Measures	Samples	35	35	35	35	35	35	35	34	34	34	32	31	9	8	119	35	101	35	5	24	16	18	11	3	35	9	1
		10th	209	55	29	5	4	1	1	0	295	49	19.7	1	0.00	0	1264	125	7.5	1.0	id	0.10	0.001	0.013	0.006	id	7.69	0.000	id
		20th	360	65	37	6	12	7	195	4	391	56	29.9	2	0.00	0	1836	199	7.7	160.0	id	0.10	0.101	0.061	0.010	id	8.13	0.000	id
		40th	590	71	124	8	45	15	408	7	1055	73	116.0	4	0.06	0	4464	822	7.9	342.5	id	0.20	0.458	0.144	0.010	id	12.82	0.012	id
		50th	1000	74	175	10	105	16	534	10	1810	82	160.0	4	**0.10**	**0**	6640	1021	8.1	444.0	id	0.20	**1.075**	**0.160**	**0.010**	id	18.02	**0.022**	id
		70th	2260	78	284	14	276	20	686	22	5067	90	381.4	9	1.76	0	13736	1685	8.3	565.0	id	0.28	2.194	0.307	0.024	id	23.20	0.383	id
		80th	3115	79	335	19	553	24	727	25	6422	93	529.0	13	1.97	0	18453	3081	8.4	601.0	id	0.40	3.506	0.460	0.055	id	25.35	0.428	id
		90th	3600	81	414	20	657	27	814	51	7610	98	1009.0	25	3.80	0	24016	3508	8.6	670.0	id	0.41	6.258	0.907	0.350	id	33.25	0.826	id

Aquifer class and chemistry zone			Fitzroy and Capricorn-Curtis Coast - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Earlier basins partially underlying GAB	14 - Bowen Basin Basalt Area	Samples	67	67	67	67	67	67	67	67	68	68	67	67	44	44	76	68	68	68	21	57	31	29	12	12	67	44	3
		10th	81	28	14	4	6	6	305	26	53	13	11.4	2	0.00	0	750	63	7.3	255.3	13.6	0.10	0.000	0.000	0.005	0.005	1.74	0.000	id
		20th	100	35	15	7	8	8	331	44	63	20	15.9	3	0.00	0	840	76	7.5	274.0	19.1	0.18	0.017	0.010	0.005	0.005	2.23	0.000	id
		40th	147	58	29	10	33	17	463	57	104	25	23.0	4	0.01	0	1300	244	7.9	383.2	24.9	0.26	0.025	0.011	0.005	0.005	4.81	0.001	id
		50th	152	64	46	11	46	23	505	64	134	27	33.0	5	0.30	0	1565	288	8.0	419.0	33.0	0.30	0.025	0.020	**0.005**	**0.005**	7.33	0.065	id
		70th	388	79	61	19	73	34	609	72	259	44	70.8	8	1.00	0	2918	500	8.2	507.9	48.0	0.40	0.168	0.040	0.028	0.005	9.01	0.217	id
		80th	516	82	65	22	87	39	698	74	611	49	117.3	10	1.40	0	3707	551	8.3	578.5	51.3	0.51	0.381	0.060	0.114	0.005	11.27	0.304	id
		90th	640	84	97	29	134	43	1018	80	720	58	189.0	22	8.84	0	4507	684	8.4	859.1	61.6	1.06	0.780	0.112	0.150	0.016	14.06	1.922	id

Notes

1. Abbreviations: Na: Sodium, Ca: Calcium, Mg: Magnesium, HCO_3: Bicarbonate, Cl: Chloride, SO_4: Sulfate, NO_3: Nitrate, EC: Electrical conductivity, Hard: hardness, Alk: alkalinity, SiO_2: Silica, F: Fluoride, Fe: Iron, Mn: Manganese, Zn: Zinc, Cu: Copper, SAR: Sodium adsorption ratio, TN: total nitrogen, TP: total phosphorus, mg/L: milligrams per Litre, µS/cm: microsiemens/centimetre

2. Percentiles are provided in most cells where samples are available for a particular indicator. The Queensland Water Quality Guidelines (section 4) contains information on recommended minimum sample size when deriving percentiles for use in deriving water quality guidelines. For this table, where less than 8 samples were available, cell shows insufficient data ('id'); where 8–20 samples were available, 50^{th} percentile values are provided (in bold). Where greater than 20 samples were available, the full percentile ranges are provided. The intent is to maintain current water quality (20^{th}, 50^{th} and 80^{th} percentile ranges) where water quality is in natural condition. Where there is evidence of anthropogenic disturbance in groundwater quality, a long term goal to improve water quality may be established and reflected by adoption of an alternative (e.g. 40^{th} percentile) value.

3. Na, Ca and other ion % columns: The percentages of major cations (Na, Ca and Mg) were evaluated for each sample, as were the major anions (Cl, HCO_3, SO_4 and NO_3). Then the ion % columns were compiled by calculating the percentiles of these percentages independently of each other. For instance, in Alluvium zone 6 – Curtis Coast, the 50th percentile of Na is 57, while the 20th–80th percentile range is 43–73. This means that half of the samples contain at least 57% of dissolved Na, with the balance being made up of Ca and Mg in any proportions. Because of this, the sum of the 50th percentiles in Alluvium zone 6 – Curtis coast is near to 100%, with Ca contributing 27% and Mg contributing 16%. However, the 20th and 80th percentiles of each of the major cations are based on ranges of that cation, and add up to less or more than 100% respectively.

4. Low TP values (e.g. recordings of zero) may be due to concentrations below detection limits. Concentrations of TP are usually low in Queensland groundwaters, because most of the phosphorus binds to particles in the soil and unsaturated zone, restricting its movement to the aquifer (Holman et al. 2008).

5. Refer to accompanying figures (maps) for locations of chemistry zone. In some locations (mainly within the alluvial aquifer class) a chemistry zone is identified by entire zone and the 'near stream' (within 1.5km of stream channel) component of the zone, where near stream water quality characteristics may be different from overall zone. Percentiles are provided in each case. Overall zone includes near stream and other areas. Near stream zone is shown on large scale plans accompanying this report, available on the department's website.

Reference: Holman, IP, Whelan, MJ, Howden, NJK, Bellamy, PH, Willby, NJ, Rivas-Casado, M & McConvey, P. 2008, 'Phosphorus in groundwater – an overlooked contributor to eutrophication?'. Hydrological Processes, vol. 22, no: 5121–5127.

Table 6: Burdekin, Don-Haughton: Statistical summaries of water chemistry by groundwater zone

Refer to notes after table.

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																										
		%ile[2]	Na^3		Ca^3		Mg^3		$HCO_3{}^3$		Cl^3		$SO_4{}^3$		$NO_3{}^3$		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
	ALLUVIUM																												
Alluvium	1 – Don and Southern Burdekin Delta	Samples	3469	3469	3467	3467	3467	3467	3463	3463	3476	3476	3464	3464	3309	3309	19610	3470	3520	3467	3269	3452	2150	2132	431	431	3465	3309	481
		10th	61	36	21	3	14	9	177	2	68	30	10.0	2	0.00	0	565	126	7.4	150.0	21.0	0.19	0.000	0.000	0.000	0.000	1.92	0.000	0.000
		20th	94	41	33	4	22	13	225	8	110	37	19.0	3	0.10	0	770	187	7.6	190.0	27.0	0.20	0.010	0.000	0.005	0.015	2.39	0.022	0.000
		40th	205	50	55	12	49	20	309	21	370	55	44.0	4	0.90	0	1510	350	7.9	260.0	35.0	0.30	0.020	0.010	0.005	0.015	4.34	0.196	0.000
		50th	300	57	73	17	68	24	340	26	570	65	60.0	6	1.70	0	2200	489	8.0	288.0	39.0	0.31	0.020	0.010	0.010	0.015	5.88	0.370	0.000
		70th	755	77	130	26	125	28	420	43	1300	76	190.0	11	4.90	0	3760	837	8.2	355.0	50.0	0.50	0.050	0.020	0.020	0.050	14.59	1.065	0.000
		80th	1742	81	180	30	195	31	471	53	2750	82	781.0	14	8.20	1	6400	1278	8.3	399.0	58.0	0.60	0.100	0.050	0.020	0.050	28.13	1.783	0.000
		90th	5800	87	370	34	590	34	561	63	9490	88	2453.0	20	16.50	2	14595	3154	8.5	479.0	65.0	1.10	0.250	0.300	0.050	0.050	53.22	3.587	0.000
Alluvium	1 - Don and Southern Burdekin Delta near stream	Samples	1421	1421	1420	1420	1420	1420	1416	1416	1426	1426	1417	1417	1333	1333	7661	1421	1438	1420	1327	1419	814	809	132	132	1419	1333	228
		10th	51	38	18	2	12	7	158	1	53	24	9.3	2	0.00	0	460	108	7.5	135.0	18.0	0.20	0.000	0.000	0.005	0.015	1.74	0.000	0.000
		20th	66	42	27	3	17	10	200	3	70	31	15.0	4	0.10	0	600	151	7.7	169.0	23.0	0.20	0.005	0.000	0.005	0.015	2.12	0.022	0.000
		40th	140	54	40	6	24	15	270	23	150	42	44.0	8	0.97	0	842	210	7.9	230.0	28.0	0.30	0.020	0.010	0.005	0.015	3.92	0.211	0.000
		50th	228	69	46	14	33	18	305	33	343	50	64.0	9	2.00	0	1125	273	8.0	260.0	30.0	0.40	0.020	0.010	0.010	0.015	6.83	0.435	0.000
		70th	1860	82	97	26	100	25	380	53	2400	75	730.0	13	5.50	0	2950	717	8.3	320.0	35.0	0.60	0.060	0.020	0.020	0.050	31.39	1.196	0.000
		80th	3900	86	170	30	293	27	430	60	5737	81	1500.0	17	9.59	1	9106	1691	8.4	365.0	39.0	0.72	0.130	0.100	0.040	0.050	49.54	2.085	0.000
		90th	9100	89	345	35	655	29	520	67	15000	88	3290.0	21	18.00	2	24600	3895	8.5	452.5	48.0	1.13	0.380	0.622	0.100	0.100	67.50	3.913	0.000
Alluvium	2 - Haughton	Samples	822	822	822	822	821	821	821	821	822	822	817	817	795	794	7298	822	825	822	788	819	670	668	153	153	821	795	17
		10th	42	37	15	9	9	13	130	1	32	22	1.7	0	0.00	0	355	76	7.1	108.0	39.0	0.10	0.000	0.000	0.000	0.000	1.66	0.000	0.000
		20th	55	42	20	14	12	17	145	16	56	28	2.0	1	0.20	0	485	104	7.3	120.0	49.0	0.10	0.000	0.010	0.000	0.000	1.97	0.043	0.000
		40th	77	48	31	19	18	22	175	40	100	41	3.4	1	0.50	0	780	155	7.7	145.0	60.0	0.20	0.010	0.010	0.000	0.000	2.56	0.109	0.000
		50th	95	53	40	24	22	23	203	48	140	49	5.0	1	0.60	0	974	191	7.8	169.0	63.0	0.20	0.020	0.020	0.005	0.010	3.21	0.130	**0.000**
		70th	210	63	65	30	35	25	250	62	326	67	23.0	4	2.43	0	2280	302	8.1	207.0	70.0	0.20	0.020	0.020	0.010	0.010	6.85	0.528	0.000
		80th	509	68	102	33	66	26	287	69	754	81	50.0	6	5.87	1	6059	517	8.2	240.1	75.0	0.30	0.050	0.220	0.020	0.015	11.53	1.276	0.000
		90th	2625	76	762	36	714	28	390	75	6660	90	817.6	10	12.00	2	31400	4744	8.4	330.0	80.0	0.50	0.200	5.446	0.040	0.020	17.29	2.609	0.000

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	2 - Haughton near stream	Samples	218	218	218	218	218	218	217	217	218	218	214	214	209	208	2095	218	218	218	208	216	145	144	57	57	218	209	6
		10th	24	34	11	4	7	7	123	19	25	20	2.0	0	0.00	0	282	64	7.2	103.0	24.0	0.10	0.000	0.000	0.000	0.000	1.12	0.000	id
		20th	40	38	15	5	11	9	189	44	40	23	2.5	1	0.21	0	440	95	7.6	156.3	35.0	0.20	0.000	0.000	0.000	0.000	1.40	0.046	id
		40th	94	52	24	14	16	16	309	57	66	28	4.9	1	0.50	0	723	132	8.0	258.0	50.0	0.24	0.005	0.010	0.000	0.000	2.93	0.109	id
		50th	132	63	30	17	18	18	340	63	92	34	9.0	2	1.00	0	850	152	8.1	284.5	55.0	0.30	0.010	0.010	0.005	0.010	5.08	0.217	id
		70th	302	77	43	31	26	24	427	71	276	46	20.5	3	4.51	1	1480	210	8.3	360.9	70.0	0.50	0.020	0.010	0.010	0.010	11.38	0.980	id
		80th	396	85	55	37	31	25	541	74	350	53	28.0	5	8.44	1	1990	251	8.4	473.1	79.9	0.60	0.035	0.020	0.010	0.015	12.95	1.835	id
		90th	576	89	75	42	46	28	608	77	740	72	46.4	8	11.75	2	2840	355	8.6	520.7	84.7	0.69	0.070	0.021	0.020	0.015	16.68	2.554	id
Alluvium	3 - Suttor	Samples	67	67	67	67	66	66	64	63	66	66	64	63	56	55	153	67	70	64	48	67	23	19	9	8	66	56	5
		10th	101	63	6	2	3	4	29	0	43	17	11.0	2	0.00	0	638	28	6.9	25.0	17.0	0.10	0.000	0.002	0.002	0.000	4.57	0.000	id
		20th	142	65	11	4	6	5	49	1	94	32	23.2	3	0.00	0	821	45	7.1	40.0	19.2	0.14	0.000	0.010	0.010	0.000	8.39	0.000	id
		40th	440	68	30	8	25	13	82	5	470	78	43.2	5	0.39	0	3785	174	7.4	87.4	26.0	0.30	0.020	0.022	0.051	0.011	12.29	0.085	id
		50th	838	71	48	12	71	16	142	8	1180	85	99.1	6	0.50	0	6500	462	7.6	129.0	32.0	0.38	0.020	**0.070**	**0.060**	**0.033**	15.10	0.109	id
		70th	1642	88	222	16	160	17	293	32	2420	92	220.5	7	1.00	0	17767	1270	7.9	283.7	45.0	0.60	0.272	0.262	0.198	0.196	26.09	0.217	id
		80th	3170	90	443	17	410	19	399	55	6354	93	629.3	9	1.77	0	21380	2646	8.1	352.6	49.8	0.80	0.803	0.585	0.433	0.324	29.68	0.385	id
		90th	5222	94	826	19	848	21	562	72	11097	94	855.0	11	6.57	1	31000	5510	8.3	550.9	59.4	2.72	2.900	2.684	0.520	0.585	33.32	1.428	id
Alluvium	4 - Lower Burdekin with Bowen	Samples	104	104	104	104	104	104	104	104	104	104	104	104	94	94	855	104	110	104	91	104	60	60	26	26	104	94	1
		10th	64	39	8	5	5	6	162	9	28	12	2.0	1	0.50	0	459	40	7.3	132.4	35.0	0.15	0.000	0.000	0.000	0.001	2.16	0.109	id
		20th	80	46	20	11	13	12	222	32	41	20	4.7	1	1.10	0	583	118	7.6	189.3	45.0	0.20	0.010	0.010	0.000	0.010	2.60	0.239	id
		40th	99	53	35	19	18	18	270	57	82	32	7.9	2	2.51	0	736	157	8.0	229.2	53.0	0.20	0.020	0.010	0.018	0.020	3.44	0.546	id
		50th	110	57	39	22	20	21	285	60	110	36	10.0	2	4.70	0	790	185	8.1	240.5	55.0	0.28	0.020	0.020	0.020	0.040	4.09	1.022	id
		70th	158	62	55	27	32	23	343	69	250	55	18.3	3	11.00	2	1250	312	8.3	285.0	62.0	0.40	0.050	0.020	0.020	0.050	5.58	2.391	id
		80th	415	74	107	31	70	27	386	76	447	65	24.7	4	15.70	2	2250	562	8.5	340.8	65.0	0.50	0.100	0.020	0.020	0.050	8.91	3.413	id
		90th	506	89	166	38	130	32	552	80	1387	87	46.7	5	24.16	5	4300	1021	8.6	457.6	70.0	0.81	0.210	0.060	0.047	0.050	10.66	5.252	id

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																									
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	4 - Lower Burdekin with Bowen near stream	Samples	27	27	27	27	27	27	27	27	27	27	27	27	26	26	239	27	29	27	25	27	15	15	6	6	27	26	1
		10th	61	38	20	11	12	14	229	42	19	8	0.2	0	0.85	0	485	101	7.1	192.2	45.0	0.20	0.000	0.000	id	id	2.16	0.185	id
		20th	69	46	24	18	15	18	260	54	25	11	2.4	1	2.42	1	554	132	7.3	216.0	52.5	0.30	0.005	0.005	id	id	2.57	0.526	id
		40th	87	52	31	21	17	22	287	71	33	15	5.5	1	6.66	1	646	149	7.9	243.0	59.0	0.40	0.020	0.010	id	id	2.84	1.448	id
		50th	92	54	36	22	19	22	323	75	45	18	7.7	2	9.15	2	682	161	8.0	266.0	62.0	0.50	**0.030**	**0.010**	id	id	3.00	1.989	id
		70th	119	59	40	27	23	23	358	79	91	33	9.4	3	19.70	5	810	202	8.3	299.4	70.0	0.77	0.030	0.020	id	id	4.20	4.283	id
		80th	129	63	45	28	26	24	377	82	151	41	14.1	3	25.72	6	886	231	8.3	313.5	72.5	1.00	0.040	0.020	id	id	4.83	5.591	id
		90th	186	71	75	34	50	28	441	86	332	54	23.6	3	30.15	7	1112	379	8.6	373.4	92.0	1.08	0.060	0.020	id	id	4.97	6.554	id
Alluvium	5 - Upper Burdekin	Samples	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	1	2	0	2	0	0	0	0	2	2	0
		10th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id
		20th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id
		40th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id
		50th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id
		70th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id
		80th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id
		90th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id	id
Alluvium	17 - Burdekin Delta Coastal Area	Samples	2783	2783	2783	2783	2783	2783	2767	2767	2813	2813	2798	2798	2698	2698	27503	2782	2906	2743	2704	2736	1493	1476	447	447	2783	2698	214
		10th	120	53	15	4	12	9	73	0	120	39	33.0	3	0.00	0	670	94	7.0	65.0	20.0	0.05	0.000	0.000	0.000	0.000	4.02	0.000	0.000
		20th	200	61	26	5	23	12	115	0	270	52	67.0	6	0.20	0	1240	169	7.3	97.0	26.0	0.10	0.010	0.010	0.005	0.000	6.33	0.043	0.000
		40th	550	70	60	7	61	17	170	2	780	73	200.0	9	0.60	0	2650	396	7.6	141.0	34.0	0.10	0.030	0.040	0.020	0.015	13.53	0.130	0.000
		50th	1158	73	97	9	110	19	201	6	1910	83	330.0	9	1.00	0	4480	690	7.7	170.0	38.0	0.20	0.050	0.200	0.030	0.025	20.23	0.217	0.000
		70th	6100	77	560	13	956	21	279	20	12800	90	1800.0	12	4.00	0	17060	5597	8.0	233.0	46.0	0.30	0.250	1.437	0.100	0.110	36.47	0.870	0.000
		80th	10500	80	1050	17	1800	23	339	28	22723	91	2920.0	17	7.50	0	42900	10362	8.1	283.0	50.0	0.40	0.598	5.393	0.250	0.250	46.76	1.630	0.000
		90th	14500	86	1650	23	2500	27	435	39	29800	93	3800.0	27	16.00	0	63000	15320	8.3	368.0	59.1	0.70	1.300	19.000	0.500	0.500	57.71	3.478	0.000

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																											
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	17 - Burdekin Delta Coastal Area near stream	Samples	999	999	999	999	999	999	997	997	1009	1009	1004	1004	967	967	9909	999	1023	998	964	983	515	512	146	146	999	967	68
		10th	112	60	14	3	12	8	79	0	130	45	32.0	4	0.00	0	612	93	7.2	67.0	20.0	0.05	0.000	0.000	0.000	0.000	4.52	0.000	0.000
		20th	234	65	21	4	23	11	112	1	296	56	62.6	6	0.20	0	1150	160	7.4	95.0	27.0	0.10	0.010	0.010	0.000	0.000	7.32	0.043	0.000
		40th	651	72	48	7	60	16	174	4	880	70	167.6	9	0.60	0	2950	356	7.6	144.7	34.0	0.20	0.030	0.020	0.010	0.010	15.53	0.130	0.000
		50th	1150	75	72	8	94	18	210	7	1690	80	260.0	9	1.00	0	4370	553	7.8	176.0	37.0	0.20	0.050	0.050	0.025	0.050	22.00	0.217	0.000
		70th	4116	78	400	11	630	20	286	20	8904	89	1660.0	12	3.00	0	10838	3688	8.1	240.0	44.0	0.40	0.190	0.700	0.100	0.150	34.08	0.652	0.000
		80th	9114	83	857	14	1500	22	370	29	19500	91	2700.0	16	5.82	0	22200	7816	8.2	311.8	50.0	0.50	0.400	2.710	0.210	0.250	43.68	1.265	0.000
		90th	11260	88	1372	18	1972	24	595	39	23500	92	3700.0	24	12.50	0	53000	11753	8.4	517.3	58.0	0.70	1.000	8.760	0.409	0.500	49.90	2.717	0.000
Alluvium	18 - West Barratta	Samples	647	647	647	647	647	647	647	646	646	646	629	628	624	624	5721	647	657	646	627	645	524	522	295	295	647	624	20
		10th	17	41	6	8	3	7	70	40	10	14	0.0	0	0.00	0	186	28	7.1	59.1	33.0	0.10	0.000	0.000	0.000	0.000	1.05	0.000	0.000
		20th	21	46	9	11	4	11	91	55	13	16	0.6	0	0.00	0	226	41	7.4	75.0	38.0	0.10	0.000	0.005	0.000	0.000	1.28	0.000	0.000
		40th	33	56	13	18	7	16	118	66	26	24	2.0	1	0.25	0	311	60	7.7	97.9	48.0	0.15	0.010	0.010	0.000	0.010	1.88	0.054	0.000
		50th	45	61	14	20	8	18	129	69	35	27	2.0	1	0.50	0	390	68	7.8	107.0	51.0	0.20	0.020	0.020	0.005	0.010	2.44	0.109	**0.000**
		70th	88	72	18	27	10	22	194	77	66	35	4.2	2	0.50	0	738	85	8.1	161.0	57.0	0.22	0.030	0.070	0.010	0.015	4.50	0.109	0.000
		80th	145	77	23	30	14	25	335	81	95	40	6.2	3	0.80	0	986	114	8.2	281.0	60.0	0.30	0.060	0.231	0.020	0.020	5.93	0.174	0.000
		90th	216	85	33	34	22	28	434	84	198	53	16.0	6	2.00	1	1582	174	8.4	362.9	65.0	0.60	0.191	0.783	0.030	0.030	10.28	0.435	0.000
Alluvium	18 - West Barratta near stream	Samples	316	316	316	316	316	316	316	315	315	315	308	307	303	303	2446	316	318	315	304	315	229	229	113	113	316	303	11
		10th	15	38	6	11	3	10	55	41	10	14	0.0	0	0.00	0	154	25	7.0	48.0	28.0	0.08	0.000	0.000	0.000	0.000	0.92	0.000	0.000
		20th	17	42	7	14	3	13	82	52	12	16	0.4	0	0.00	0	196	33	7.2	68.0	36.0	0.10	0.005	0.010	0.000	0.000	1.07	0.000	0.000
		40th	23	51	11	22	5	17	100	68	15	21	2.0	1	0.25	0	239	49	7.5	82.0	42.0	0.10	0.010	0.020	0.005	0.009	1.37	0.054	0.000
		50th	26	55	12	24	6	19	111	72	19	24	2.0	2	0.50	0	268	56	7.7	92.0	46.5	0.14	0.020	0.020	0.010	0.010	1.66	0.109	**0.000**
		70th	40	66	15	30	8	24	124	80	33	32	4.0	3	0.50	0	410	70	7.9	103.0	53.0	0.20	0.058	0.250	0.010	0.010	2.46	0.109	0.000
		80th	67	73	17	33	9	27	134	82	49	40	6.3	5	0.80	1	576	78	8.1	112.0	55.0	0.24	0.120	0.567	0.020	0.015	4.05	0.174	0.000
		90th	93	79	21	36	11	30	195	84	97	51	14.9	7	1.60	1	1080	93	8.3	160.0	60.0	0.30	0.296	1.206	0.030	0.020	4.80	0.348	0.000

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	19 - Mid Burdekin Delta	Samples	1537	1535	1537	1535	1537	1535	1537	1534	1549	1546	1537	1534	1507	1504	16563	1535	1614	1534	1471	1519	915	902	349	349	1535	1507	86
		10th	19	30	9	5	5	10	79	2	14	13	3.0	2	0.00	0	219	46	7.1	67.0	23.0	0.05	0.000	0.000	0.000	0.000	0.93	0.000	0.000
		20th	25	36	14	9	7	16	100	28	18	16	5.3	3	0.25	0	275	64	7.4	85.0	28.0	0.10	0.000	0.000	0.005	0.000	1.17	0.054	0.000
		40th	41	45	21	22	11	21	144	55	30	23	12.0	4	1.00	0	400	102	7.7	120.0	35.0	0.10	0.010	0.010	0.010	0.010	1.71	0.217	0.000
		50th	58	50	26	26	15	23	174	60	46	26	17.5	6	2.40	0	505	133	7.8	148.0	39.0	0.19	0.010	0.010	0.020	0.010	2.22	0.522	0.000
		70th	135	64	48	32	33	27	265	70	140	39	40.5	9	9.38	2	962	250	8.1	225.0	46.0	0.23	0.030	0.030	0.100	0.015	4.59	2.039	0.000
		80th	250	72	72	35	51	30	349	74	328	59	90.0	12	17.00	4	1415	381	8.2	294.4	49.0	0.30	0.050	0.080	0.217	0.020	9.53	3.696	0.000
		90th	3220	83	233	39	329	34	447	79	7630	89	1000.0	22	30.00	7	3010	1928	8.4	375.3	55.0	0.50	0.270	0.303	0.706	0.040	33.71	6.522	0.000
Alluvium	19 - Mid Burdekin Delta near stream	Samples	436	436	436	436	436	436	436	436	442	442	437	437	424	424	4978	436	457	436	419	433	281	278	110	110	436	424	14
		10th	18	25	14	19	7	20	91	46	13	11	2.6	1	0.20	0	213	64	7.2	76.1	24.4	0.10	0.000	0.000	0.000	0.000	0.81	0.043	0.000
		20th	22	27	17	25	9	24	116	58	16	14	4.8	2	0.60	0	267	82	7.5	99.0	29.3	0.10	0.000	0.000	0.005	0.000	0.94	0.130	0.000
		40th	35	34	28	31	15	27	195	68	25	18	8.6	3	4.10	1	376	133	7.8	164.0	38.0	0.20	0.010	0.010	0.020	0.000	1.19	0.891	0.000
		50th	41	36	34	33	19	29	240	71	36	21	10.0	3	7.60	2	450	171	7.9	203.0	40.0	0.20	0.010	0.010	0.050	0.010	1.32	1.652	**0.000**
		70th	67	44	54	37	31	31	367	76	84	29	15.0	5	18.15	4	715	267	8.1	308.7	49.0	0.30	0.020	0.010	0.165	0.010	2.05	3.946	0.000
		80th	98	48	66	40	44	34	405	79	128	35	20.0	6	25.85	6	970	342	8.2	343.2	55.0	0.33	0.030	0.020	0.285	0.015	2.71	5.620	0.000
		90th	144	57	83	43	58	39	501	82	178	47	30.3	10	45.25	8	1358	436	8.4	415.0	62.0	0.50	0.060	0.080	1.405	0.020	3.49	9.837	0.000
Alluvium	20 - East Barratta	Samples	1160	1160	1160	1160	1160	1160	1159	1159	1160	1160	1145	1145	1132	1132	8161	1160	1172	1160	1119	1140	949	945	382	382	1160	1132	29
		10th	47	37	13	11	8	13	110	20	43	27	2.2	1	0.00	0	396	68	7.2	92.0	35.0	0.10	0.000	0.000	0.000	0.000	1.77	0.000	0.000
		20th	70	43	21	14	13	16	150	28	80	35	4.0	1	0.30	0	650	112	7.5	124.0	43.0	0.10	0.000	0.000	0.000	0.000	2.27	0.065	0.000
		40th	105	51	43	19	25	21	270	41	146	45	8.0	1	0.60	0	970	216	7.8	226.0	50.0	0.10	0.010	0.010	0.000	0.010	3.04	0.130	0.000
		50th	122	55	51	22	29	22	306	47	180	49	10.0	2	1.10	0	1100	251	8.0	256.0	54.0	0.15	0.010	0.010	0.010	0.010	3.52	0.239	0.000
		70th	182	63	71	28	43	25	370	56	315	62	15.0	2	5.00	1	1523	352	8.1	310.0	60.0	0.20	0.020	0.020	0.010	0.020	5.04	1.087	0.000
		80th	246	68	88	31	55	27	412	62	456	69	20.0	3	9.00	1	1950	447	8.2	345.0	62.0	0.20	0.020	0.040	0.030	0.030	6.73	1.957	0.000
		90th	425	75	120	34	82	32	475	69	758	78	29.0	7	15.70	2	2800	616	8.4	398.0	68.0	0.30	0.040	0.170	0.093	0.040	8.62	3.413	0.000

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	20 - East Barratta near stream	Samples	23	23	23	23	23	23	23	23	23	23	19	19	19	19	169	23	19	23	19	19	14	14	2	2	23	19	0
		10th	112	51	30	11	22	16	202	17	175	53	4.4	0	0.00	0	384	172	7.7	167.8	38.2	0.10	0.000	0.000	id	id	3.96	0.000	id
		20th	153	54	37	15	25	19	242	18	233	55	5.9	0	0.13	0	529	204	7.8	204.2	45.0	0.10	0.000	0.010	id	id	4.17	0.028	id
		40th	250	56	61	18	48	22	284	24	500	68	7.6	1	1.00	0	1500	345	8.0	237.2	50.4	0.10	0.020	0.020	id	id	5.35	0.217	id
		50th	268	59	71	19	55	23	300	26	540	73	**9.0**	**1**	**1.00**	**0**	2100	369	**8.0**	250.0	**54.0**	**0.10**	**0.020**	**0.020**	id	id	5.69	**0.217**	id
		70th	353	62	99	21	74	25	354	37	678	79	13.2	1	1.28	0	3008	549	8.1	298.4	56.8	0.12	0.020	0.063	id	id	6.61	0.278	id
		80th	402	65	115	22	85	26	388	44	818	81	15.4	1	2.52	0	3702	638	8.2	322.6	59.1	0.13	0.027	0.084	id	id	7.58	0.548	id
		90th	464	69	140	23	105	27	478	46	1008	82	31.5	3	6.42	0	4308	782	8.3	395.4	60.0	0.20	0.061	0.142	id	id	8.61	1.396	id
Alluvium	21 - Native Companion Creek	Samples	73	73	65	65	65	65	65	65	73	73	65	65	71	71	81	65	76	65	53	65	48	50	20	13	65	71	0
		10th	35	48	13	10	9	18	95	14	20	16	6.0	3	0.62	0	327	71	6.8	78.0	47.4	0.12	0.000	0.000	0.010	0.000	1.19	0.135	id
		20th	42	56	20	11	20	19	126	18	65	53	11.0	4	1.60	0	642	134	6.9	103.0	57.1	0.20	0.000	0.005	0.010	0.001	2.17	0.348	id
		40th	183	63	31	12	31	22	169	21	290	66	28.8	4	7.92	1	1357	206	7.1	140.0	67.7	0.21	0.020	0.010	0.030	0.010	5.27	1.722	id
		50th	210	65	35	13	34	23	195	23	330	69	34.5	5	15.00	2	1560	228	7.3	160.0	70.0	0.30	0.035	0.010	**0.055**	**0.010**	5.91	3.261	id
		70th	258	70	41	15	46	26	220	33	441	74	45.0	6	31.00	4	1750	289	7.4	181.0	75.0	0.30	0.050	0.015	0.150	0.020	6.80	6.739	id
		80th	270	71	48	17	51	28	246	42	474	79	47.7	6	39.05	4	1930	329	7.6	202.0	80.0	0.31	0.050	0.020	0.205	0.020	7.18	8.489	id
		90th	288	100	56	27	68	31	346	79	509	88	58.0	8	52.40	7	2196	392	8.1	284.0	80.2	0.49	0.100	0.140	0.395	0.030	7.43	11.391	id
Alluvium	22 - Cape River Alluvium	Samples	26	26	26	26	26	26	26	26	26	26	19	19	19	19	98	26	26	26	15	25	5	5	5	5	26	19	0
		10th	17	35	11	25	5	20	95	58	13	12	5.4	4	0.00	0	158	46	7.1	78.0	5.0	0.12	id	id	id	id	0.87	0.000	id
		20th	29	38	18	28	8	20	117	63	19	16	7.3	5	0.00	0	236	79	7.5	96.0	23.0	0.15	id	id	id	id	1.28	0.000	id
		40th	32	44	20	30	10	23	140	71	23	19	8.3	5	0.00	0	320	87	7.8	115.9	41.0	0.26	id	id	id	id	1.41	0.000	id
		50th	33	44	20	30	10	25	140	72	24	20	**8.4**	**5**	**0.00**	**0**	330	93	7.9	116.0	**52.0**	0.30	id	id	id	id	1.51	**0.000**	id
		70th	38	49	27	32	12	27	154	75	34	23	16.0	10	0.46	0	340	117	8.0	128.1	55.0	0.37	id	id	id	id	1.87	0.100	id
		80th	50	50	32	35	17	27	175	76	48	29	23.8	13	0.91	1	350	152	8.1	142.9	56.0	0.40	id	id	id	id	2.25	0.198	id
		90th	98	53	44	36	24	28	389	81	79	37	33.8	18	10.32	2	384	197	8.1	323.5	58.0	0.42	id	id	id	id	2.59	2.243	id

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	23 - Campaspe River Alluvium	Samples	226	226	226	226	225	225	222	222	226	226	223	223	177	177	294	226	252	226	152	223	151	136	79	78	225	177	1
		10th	31	29	18	6	10	13	125	32	26	16	4.9	2	0.00	0	360	93	6.8	96.1	18.0	0.12	0.000	0.000	0.005	0.000	1.19	0.000	id
		20th	41	35	23	10	13	18	155	38	37	20	12.5	4	0.30	0	466	124	7.1	124.7	23.0	0.18	0.000	0.000	0.010	0.000	1.38	0.064	id
		40th	65	42	32	17	28	25	222	44	85	31	31.0	7	1.40	0	760	195	7.5	176.0	32.0	0.22	0.010	0.010	0.030	0.010	2.01	0.304	id
		50th	87	44	40	20	37	28	317	51	109	36	39.3	8	2.20	0	962	268	7.6	256.5	34.0	0.27	0.010	0.010	0.040	0.010	2.32	0.478	id
		70th	160	58	60	32	51	34	470	65	238	49	69.2	12	5.00	1	1603	369	7.9	383.5	46.0	0.40	0.042	0.020	0.080	0.015	4.27	1.087	id
		80th	379	68	71	36	71	36	669	70	423	52	114.8	13	10.60	2	2457	456	8.1	535.7	58.2	0.49	0.083	0.043	0.100	0.020	7.53	2.304	id
		90th	748	77	92	40	95	40	912	78	841	57	178.9	17	20.00	5	4205	572	8.2	764.1	66.3	0.60	0.348	0.483	0.158	0.030	14.01	4.348	id
Alluvium	23 - Campaspe River Alluvium near stream	Samples	30	30	30	30	30	30	30	30	31	31	25	25	25	25	73	30	31	30	18	30	15	15	15	15	30	25	0
		10th	11	57	2	6	1	5	29	21	11	29	0.0	0	0.00	0	134	9	6.9	24.0	28.9	0.00	0.000	0.000	0.000	0.000	1.32	0.000	id
		20th	15	61	4	8	2	7	37	38	16	32	0.0	0	0.00	0	375	15	7.1	30.0	32.0	0.00	0.000	0.000	0.000	0.000	1.51	0.000	id
		40th	24	73	7	11	3	10	79	47	22	37	3.8	2	0.00	0	610	29	7.5	65.0	44.8	0.17	0.000	0.005	0.010	0.005	2.38	0.000	id
		50th	87	75	9	12	4	12	127	56	70	39	5.9	3	0.00	0	760	38	7.6	103.5	**56.0**	0.20	**0.000**	**0.010**	**0.020**	**0.010**	4.17	0.000	id
		70th	146	82	16	16	10	16	202	64	172	52	16.4	5	0.20	0	1452	83	7.8	168.0	83.3	0.31	0.000	0.020	0.180	0.020	8.78	0.043	id
		80th	288	86	36	21	36	18	273	67	300	60	32.2	6	0.35	0	2263	237	7.9	227.0	93.2	0.43	0.020	0.140	0.475	0.035	10.03	0.076	id
		90th	664	88	74	25	60	18	718	71	786	83	83.6	8	4.70	1	2615	432	8.0	591.5	110.8	0.85	0.090	0.360	0.800	0.070	13.57	1.022	id
Alluvium	24 - Upper Barratta	Samples	424	424	424	424	424	424	423	423	424	424	423	423	424	424	3827	424	448	422	422	424	386	386	174	173	424	424	32
		10th	104	39	22	3	20	7	281	8	140	31	8.9	1	0.00	0	1080	146	7.3	239.7	23.7	0.12	0.000	0.000	0.000	0.000	2.45	0.000	0.000
		20th	175	49	34	5	33	10	375	14	265	46	16.0	2	0.50	0	1863	228	7.6	314.0	32.0	0.20	0.000	0.000	0.000	0.000	3.70	0.109	0.000
		40th	435	65	59	8	61	15	499	23	580	61	36.0	2	1.60	0	3223	392	7.9	423.3	45.0	0.30	0.005	0.010	0.000	0.010	10.61	0.348	0.000
		50th	668	73	70	11	72	17	580	27	817	68	52.8	3	2.50	0	3930	478	8.0	486.0	50.0	0.40	0.010	0.010	0.008	0.010	13.25	0.543	0.000
		70th	980	80	110	18	104	24	703	40	1500	77	116.9	4	4.93	0	6354	701	8.2	590.9	62.0	0.53	0.020	0.020	0.010	0.030	19.30	1.072	0.000
		80th	1400	84	140	22	150	28	759	50	2184	82	150.0	5	6.47	0	8152	987	8.3	639.0	68.0	0.73	0.050	0.050	0.020	0.040	24.87	1.407	0.000
		90th	1830	90	196	30	205	33	978	67	3302	87	223.9	6	10.00	1	11000	1341	8.4	832.5	75.0	1.06	0.090	0.100	0.030	0.092	30.03	2.174	0.000

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Alluvium	24 - Upper Barratta near stream	Samples	149	149	149	149	149	149	148	148	149	149	148	148	149	149	1187	149	151	147	147	149	127	127	24	24	149	149	7
		10th	67	33	22	3	15	6	164	9	69	20	5.0	1	0.50	0	733	121	7.4	137.8	18.2	0.10	0.000	0.000	0.000	0.000	1.83	0.109	id
		20th	107	39	32	5	28	10	315	17	162	41	9.9	2	1.00	0	920	219	7.6	264.5	25.0	0.15	0.010	0.010	0.000	0.000	2.43	0.217	id
		40th	266	53	51	9	51	16	435	27	311	56	20.6	2	2.80	0	1748	341	7.9	362.3	36.0	0.20	0.010	0.010	0.001	0.000	4.95	0.609	id
		50th	315	61	61	16	63	22	498	36	423	59	33.0	3	3.20	0	2350	392	8.0	418.0	41.0	0.30	0.020	0.010	0.010	0.010	6.37	0.696	id
		70th	703	80	87	23	81	29	603	47	1117	74	87.1	4	6.36	0	3938	506	8.2	515.8	49.4	0.50	0.030	0.020	0.013	0.036	18.73	1.383	id
		80th	1050	85	129	29	103	32	679	55	1450	80	138.4	5	8.27	1	5799	737	8.3	579.5	53.0	0.80	0.051	0.050	0.020	0.050	24.91	1.798	id
		90th	1800	91	174	33	165	36	854	76	2680	86	188.5	7	12.60	2	8604	1093	8.4	725.6	70.0	1.10	0.100	0.128	0.061	0.080	31.32	2.739	id
	FRACTURED ROCK																												
Fractured rock	1 - Drummond Basin Sediments	Samples	105	105	105	105	104	104	105	105	105	105	98	98	62	62	192	105	113	105	46	100	51	43	15	15	104	62	7
		10th	140	50	10	4	5	2	62	2	120	18	5.3	0	0.00	0	1250	58	7.1	51.0	15.1	0.10	0.000	0.000	0.000	0.000	4.14	0.000	id
		20th	235	59	19	5	13	6	133	5	220	30	19.4	2	0.00	0	1700	152	7.4	109.5	21.0	0.19	0.000	0.010	0.005	0.000	6.61	0.000	id
		40th	435	70	60	10	29	12	270	11	420	70	83.3	6	0.50	0	3473	322	7.7	224.5	28.0	0.37	0.010	0.017	0.020	0.010	10.75	0.109	id
		50th	650	72	85	12	45	13	370	15	860	74	135.0	7	0.55	0	4500	450	7.8	306.0	32.5	0.49	0.020	0.020	**0.050**	**0.010**	13.25	0.120	id
		70th	942	77	156	15	87	16	491	26	1517	79	266.3	10	1.42	0	7505	759	7.9	407.0	37.0	0.82	0.040	0.080	0.100	0.016	16.95	0.308	id
		80th	1527	87	299	21	171	21	734	48	2830	88	528.8	16	3.15	0	13514	1377	8.2	609.0	46.0	1.50	0.079	0.200	0.200	0.028	24.35	0.685	id
		90th	2480	91	444	33	290	27	880	69	4240	93	779.1	22	5.93	0	24500	2155	8.3	733.0	60.0	2.52	0.240	0.626	0.400	0.050	29.94	1.289	id
Fractured rock	2 - Greenvale Craton	Samples	4	4	4	4	4	4	4	4	4	4	3	3	3	3	11	4	9	4	2	4	2	2	0	0	4	3	0
		10th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	341	id	7.2	id	id	id	id	id	id	id	id	id	id
		20th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	842	id	7.5	id	id	id	id	id	id	id	id	id	id
		40th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	1570	id	7.8	id	id	id	id	id	id	id	id	id	id
		50th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	**1582**	id	**7.9**	id	id	id	id	id	id	id	id	id	id
		70th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	1918	id	8.1	id	id	id	id	id	id	id	id	id	id
		80th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	1943	id	8.2	id	id	id	id	id	id	id	id	id	id
		90th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	5280	id	8.4	id	id	id	id	id	id	id	id	id	id

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Fractured rock	5 - Ravenswood Granites and Volcanics	Samples	780	780	779	779	779	779	779	779	780	780	774	774	702	702	4158	781	781	780	659	773	556	554	128	128	778	702	38
		10th	74	35	24	5	18	12	184	13	61	25	5.0	1	0.00	0	782	162	7.5	153.0	31.0	0.12	0.000	0.000	0.000	0.000	2.02	0.000	0.000
		20th	116	41	36	7	36	20	314	19	183	37	11.5	1	0.50	0	1300	265	7.7	260.0	40.0	0.20	0.000	0.000	0.000	0.000	2.78	0.109	0.000
		40th	246	48	60	11	70	28	470	27	443	58	23.0	2	1.30	0	2350	454	7.9	395.0	47.0	0.40	0.010	0.010	0.010	0.010	4.54	0.283	0.000
		50th	320	53	73	14	94	30	528	31	635	64	32.0	2	2.35	0	2865	568	8.0	439.5	50.0	0.40	0.020	0.020	0.010	0.010	5.34	0.511	0.000
		70th	580	62	105	22	160	34	640	44	1100	73	61.0	4	3.80	0	4373	927	8.2	535.5	60.0	0.60	0.040	0.020	0.020	0.020	8.96	0.826	0.000
		80th	730	67	130	26	200	37	701	55	1469	78	86.3	5	6.41	0	5800	1143	8.2	596.0	65.0	0.70	0.050	0.040	0.030	0.048	11.14	1.393	0.000
		90th	1004	79	175	33	285	42	810	70	1990	82	132.2	7	14.00	1	8070	1528	8.4	687.5	71.6	1.00	0.100	0.051	0.100	0.050	17.31	3.043	0.011
Fractured rock	6 - Northern Basalt	Samples	8	8	8	8	8	8	8	8	8	8	7	7	8	8	57	8	10	8	6	8	4	4	2	2	8	8	0
		10th	30	17	20	11	41	35	381	73	19	7	id	id	0.00	0	779	261	7.2	317.5	id	0.00	id	id	id	id	0.73	0.000	id
		20th	34	21	37	21	44	37	411	73	25	8	id	id	0.00	0	804	271	7.4	342.3	id	0.01	id	id	id	id	0.83	0.000	id
		40th	66	25	45	25	54	49	489	79	43	12	id	id	0.00	0	983	332	7.8	405.2	id	0.06	id	id	id	id	1.34	0.000	id
		50th	**72**	**27**	**51**	**26**	**57**	**52**	**522**	**83**	**52**	**16**	id	id	**0.00**	**0**	1050	357	7.8	431.5	id	**0.09**	id	id	id	id	**1.50**	**0.000**	id
		70th	75	31	56	28	60	54	536	92	88	24	id	id	0.35	0	1308	390	7.8	440.1	id	0.10	id	id	id	id	1.66	0.075	id
		80th	76	35	60	28	64	54	548	92	99	26	id	id	1.11	0	1442	426	7.8	448.9	id	0.10	id	id	id	id	1.90	0.240	id
		90th	77	38	81	35	81	57	561	93	114	26	id	id	3.86	1	1550	487	8.1	462.6	id	0.11	id	id	id	id	1.98	0.839	id
Fractured rock	7 - Main Range Volcanics	Samples	881	881	881	881	880	880	870	869	879	879	853	845	626	623	1105	882	957	880	510	718	504	481	208	204	880	626	31
		10th	50	27	7	4	4	4	219	34	20	8	2.0	0	0.00	0	480	36	7.3	175.0	18.0	0.10	0.000	0.000	0.000	0.000	1.35	0.000	0.000
		20th	72	30	15	6	13	12	302	48	35	12	4.0	1	0.40	0	688	104	7.5	247.5	25.0	0.12	0.000	0.000	0.005	0.001	1.69	0.087	0.000
		40th	103	39	30	12	32	28	419	65	64	18	8.6	2	1.50	0	921	210	7.9	349.5	41.0	0.20	0.010	0.005	0.010	0.005	2.62	0.326	0.075
		50th	122	46	38	15	44	33	460	72	80	23	12.0	3	2.55	0	1032	291	8.0	383.0	45.0	0.26	0.020	0.010	0.010	0.005	3.20	0.554	0.082
		70th	181	68	58	24	64	40	550	81	175	34	26.1	5	8.20	1	1450	413	8.2	455.0	54.0	0.39	0.030	0.010	0.020	0.010	6.17	1.783	0.082
		80th	237	78	68	28	80	44	602	85	245	43	45.9	7	20.12	2	1866	489	8.3	500.0	61.0	0.49	0.050	0.020	0.040	0.015	9.04	4.374	0.082
		90th	348	91	84	32	118	50	758	89	484	56	125.0	12	38.93	4	2800	667	8.5	624.5	73.0	0.60	0.192	0.050	0.107	0.021	13.90	8.463	0.261

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																									
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Fractured rock	8 - Central Cratonic Basement	Samples	173	173	173	173	173	173	172	172	173	173	172	172	151	151	195	173	177	173	111	135	100	98	12	12	173	151	9
		10th	106	37	20	3	17	15	268	6	85	26	9.8	2	0.00	0	934	175	7.3	223.0	20.2	0.18	0.000	0.000	0.000	0.004	2.50	0.000	0.000
		20th	152	43	32	5	47	21	360	13	176	31	24.0	3	0.04	0	1369	344	7.5	298.1	28.0	0.24	0.005	0.010	0.009	0.005	3.44	0.008	0.000
		40th	335	52	51	9	85	28	530	30	356	48	69.2	5	1.00	0	2500	491	7.8	440.0	38.9	0.40	0.020	0.020	0.010	0.007	5.44	0.217	0.000
		50th	380	56	69	11	125	30	628	38	610	53	101.9	6	1.10	0	3335	692	7.9	530.0	42.0	0.50	0.035	0.020	**0.015**	**0.010**	6.73	0.239	**0.000**
		70th	730	64	100	16	217	38	874	55	1200	67	179.5	9	4.36	0	4832	1145	8.0	728.0	50.2	0.70	0.105	0.082	0.029	0.010	10.01	0.948	0.082
		80th	1124	70	183	23	352	40	938	63	1946	76	294.2	11	7.43	0	7565	1708	8.1	780.0	58.0	0.85	0.200	0.395	0.056	0.020	15.49	1.615	0.082
		90th	2839	76	334	26	890	46	1059	70	5060	84	819.0	15	16.40	1	17838	4622	8.3	927.0	65.4	1.20	1.450	1.100	0.212	0.026	19.46	3.565	0.082
	CAINOZOIC DEPOSITS (including deposits overlying the GAB)																												
Cainozoic deposits	1 - Scattered Remnants Northern Burdekin Headwaters	Samples	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	3	1	1	1	1	1	0	0	1	1	0
		Insufficient data																											
Cainozoic deposits	2 - Eastern Weathered Cainozoic Remnants	Samples	39	39	39	39	39	39	39	38	38	38	39	38	33	33	131	39	44	39	23	39	17	15	4	4	39	33	10
		10th	29	30	20	4	14	14	23	1	44	27	5.0	2	0.00	0	464	134	6.1	46.4	14.8	0.01	0.000	0.000	id	id	1.04	0.000	0.000
		20th	33	31	32	8	15	15	100	2	51	31	7.3	2	0.00	0	1007	142	7.2	85.3	16.5	0.10	0.009	0.000	id	id	1.12	0.000	0.041
		40th	171	62	41	11	21	17	172	23	164	41	21.8	4	0.05	0	1429	177	7.6	150.8	23.7	0.14	0.010	0.000	id	id	3.88	0.011	0.082
		50th	188	66	45	14	30	20	195	39	289	58	35.8	4	0.10	0	1760	203	7.7	165.0	25.0	0.19	**0.010**	**0.010**	id	id	6.70	0.022	**0.082**
		70th	436	75	64	23	72	27	280	62	835	73	142.6	7	1.50	0	3060	617	7.9	264.0	36.2	0.30	0.034	0.010	id	id	10.84	0.326	0.082
		80th	1502	76	99	41	200	28	368	64	2817	83	172.8	10	2.55	0	9519	1084	8.1	448.1	48.6	0.43	0.074	0.075	id	id	16.55	0.554	0.082
		90th	1705	77	146	42	230	29	708	67	3247	91	445.4	13	4.92	0	10364	1232	8.3	686.0	62.4	0.60	0.488	0.160	id	id	21.67	1.070	0.082
Cainozoic deposits	4 - Central Moderately Saline Weathered Remnants	Samples	308	308	307	307	307	307	301	301	307	307	321	301	264	262	398	307	337	308	200	255	228	222	84	74	307	264	7
		10th	54	34	14	6	8	11	146	17	43	18	4.2	1	0.10	0	643	85	6.8	123.6	15.0	0.10	0.000	0.000	0.005	0.000	1.73	0.022	id
		20th	96	42	23	9	17	16	170	20	75	24	12.0	2	0.83	0	880	135	7.1	140.0	25.5	0.20	0.010	0.005	0.010	0.000	2.47	0.180	id
		40th	174	61	33	12	32	19	230	26	206	48	26.0	5	4.00	0	1200	210	7.5	189.0	47.0	0.20	0.020	0.010	0.020	0.005	5.42	0.870	id
		50th	215	65	37	13	35	21	256	33	303	56	32.0	5	7.00	1	1410	241	7.7	218.0	60.0	0.30	0.025	0.010	0.025	0.005	6.04	1.522	id
		70th	260	72	48	16	47	29	384	56	392	68	46.0	7	27.09	3	1700	320	8.0	318.0	70.0	0.40	0.050	0.020	0.050	0.020	7.35	5.889	id
		80th	286	74	59	22	64	34	511	68	430	71	52.0	8	46.00	5	1953	411	8.1	425.6	78.0	0.40	0.090	0.040	0.117	0.030	7.97	10.000	id
		90th	507	80	86	28	140	43	653	76	711	74	106.0	12	71.20	8	3067	813	8.3	545.4	85.0	0.50	0.334	0.090	0.190	0.050	13.57	15.478	id

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																									
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	**Chemistry zone[5]**		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Cainozoic deposits	6 - Saline Tertiary Sediments	Samples	159	159	158	158	158	158	145	145	159	159	153	153	109	109	252	159	176	158	78	143	87	80	35	36	157	109	19
		10th	150	57	6	2	5	3	56	2	146	55	0.1	0	0.00	0	577	34	6.8	6.3	14.0	0.01	0.000	0.000	0.000	0.000	6.42	0.000	0.000
		20th	257	64	10	3	11	6	132	4	326	63	7.1	1	0.00	0	1019	81	7.1	58.4	15.0	0.10	0.000	0.010	0.000	0.000	7.89	0.000	0.021
		40th	585	74	31	5	36	11	239	8	730	82	29.7	3	0.05	0	2951	224	7.7	181.5	19.7	0.20	0.010	0.015	0.010	0.001	12.60	0.011	0.082
		50th	690	78	54	7	70	14	290	10	1000	85	51.0	4	0.50	0	3760	458	7.8	224.5	25.5	0.30	0.020	0.020	0.010	0.001	15.69	0.109	**0.082**
		70th	1322	85	144	10	168	19	409	21	2329	90	141.1	6	1.46	0	7425	1123	8.1	322.3	42.3	0.40	0.100	0.050	0.030	0.010	24.00	0.317	0.082
		80th	1800	91	202	13	220	23	508	34	3596	92	192.3	7	2.47	0	12306	1458	8.2	406.8	56.0	0.60	0.190	0.100	0.050	0.022	28.27	0.537	0.082
		90th	2888	94	355	17	319	30	690	44	5424	94	542.4	9	5.96	0	16160	2113	8.3	575.0	76.5	0.91	0.486	0.310	0.170	0.030	33.65	1.296	0.082
Cainozoic deposits	7- North West Suttor Catchment	Samples	128	128	128	128	128	128	128	128	128	128	127	127	112	112	197	128	130	128	96	127	91	89	87	87	128	112	1
		10th	35	59	4	4	3	7	51	7	21	25	0.5	0	0.00	0	243	25	6.9	42.3	31.3	0.14	0.000	0.000	0.000	0.000	2.52	0.000	id
		20th	56	65	8	6	5	9	87	12	50	33	3.0	2	0.00	0	276	36	7.1	71.1	49.5	0.20	0.000	0.000	0.010	0.010	3.59	0.000	id
		40th	155	72	19	9	15	12	156	27	162	54	16.2	3	0.50	0	700	106	7.3	129.0	73.0	0.27	0.000	0.000	0.030	0.010	5.82	0.109	id
		50th	208	75	24	11	23	13	211	33	300	63	29.7	4	0.70	0	940	158	7.4	173.5	79.5	0.31	0.010	0.010	0.040	0.010	7.54	0.152	id
		70th	433	80	55	14	48	16	366	46	642	76	56.3	5	1.70	0	1858	324	7.7	300.0	93.1	0.40	0.030	0.038	0.110	0.030	10.58	0.370	id
		80th	605	83	83	17	70	21	476	62	885	82	84.7	6	3.08	1	2585	495	7.8	392.9	99.3	0.49	0.083	0.067	0.160	0.030	13.79	0.670	id
		90th	893	86	120	21	124	23	591	71	1664	88	174.8	8	8.02	2	4264	758	8.1	485.5	104.9	0.72	0.170	0.228	0.208	0.040	19.08	1.743	id
Cainozoic deposits	8 - Don and Bogie Coastal Area	Samples	1276	1276	1275	1275	1275	1275	1275	1275	1275	1275	1273	1273	1272	1272	7162	1275	1275	1275	1222	1274	1226	1226	364	364	1275	1272	23
		10th	135	34	33	4	42	15	350	10	245	41	12.0	1	0.50	0	1500	283	7.7	290.0	35.0	0.23	0.000	0.000	0.000	0.000	2.62	0.109	0.000
		20th	205	41	51	7	74	22	420	15	385	55	20.5	2	0.50	0	2100	475	7.8	352.0	43.0	0.30	0.000	0.000	0.000	0.000	3.63	0.109	0.000
		40th	345	50	81	11	123	30	516	23	712	64	37.5	3	1.50	0	3320	733	7.9	431.0	52.0	0.40	0.010	0.010	0.000	0.010	5.76	0.326	0.000
		50th	435	54	95	13	145	32	559	27	870	68	50.0	3	2.35	0	3950	859	8.0	467.0	55.0	0.46	0.020	0.010	0.000	0.015	6.89	0.511	0.000
		70th	727	61	131	18	198	37	660	36	1400	75	100.0	4	3.70	0	5750	1132	8.2	553.0	62.0	0.60	0.020	0.020	0.010	0.030	9.76	0.804	0.000
		80th	916	67	160	22	236	40	742	42	1788	79	175.0	6	5.40	0	7250	1300	8.3	628.0	67.0	0.70	0.040	0.020	0.020	0.040	11.80	1.174	0.000
		90th	1250	78	200	27	290	43	845	56	2400	83	305.0	9	9.10	0	9823	1670	8.4	714.0	72.0	0.96	0.080	0.040	0.020	0.050	18.25	1.978	15.359

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																									
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
	MID GAB																												
Mid GAB	2 Northeastern GAB Border, Ronlow and Gilbert River	No data																											
	LOWER GAB																												
Lower GAB	2 - Northeastern Eromanga (This zone probably extends into the adjoining Thompson Sub-basin)	Samples	5	5	5	5	5	5	5	5	5	5	5	5	2	2	8	5	5	5	1	5	3	1	1	1	5	2	0
		10th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	659	id	id	id	id	id	id	id	id	id	id	id	id
		20th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	822	id	id	id	id	id	id	id	id	id	id	id	id
		40th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	929	id	id	id	id	id	id	id	id	id	id	id	id
		50th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	**1050**	id	id	id	id	id	id	id	id	id	id	id	id
		70th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	1767	id	id	id	id	id	id	id	id	id	id	id	id
		80th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	3200	id	id	id	id	id	id	id	id	id	id	id	id
		90th	id	id	id	id	id	id	id	id	id	id	id	id	id	id	3900	id	id	id	id	id	id	id	id	id	id	id	id
Lower GAB	*9 Northern Hutton Outcrop (Composed of disconected western portions of Hutton outcrop which were merged with QMDB '6 Northern Hutton Outcrop')	Samples	49	48	49	48	49	48	49	48	49	48	49	48	25	24	55	49	44	48	24	48	30	21	10	10	48	25	3
		10th	30	31	12	11	1	1	0	8	18	14	4.4	1	0.00	0	334	41	6.8	98.0	9.0	0.01	0.000	0.000	0.000	0.000	1.15	0.000	id
		20th	39	38	20	20	5	3	0	37	40	20	9.3	3	0.00	0	437	91	7.0	134.2	12.0	0.05	0.000	0.000	0.003	0.000	1.63	0.000	id
		40th	73	47	32	29	13	13	166	49	50	27	22.9	6	0.13	0	532	154	7.8	157.1	13.1	0.10	0.000	0.000	0.008	0.000	2.28	0.027	id
		50th	78	50	36	31	15	18	213	55	65	33	26.0	7	0.25	0	570	162	8.0	185.0	19.5	0.13	0.000	0.005	**0.010**	**0.005**	2.49	0.054	id
		70th	97	57	45	32	19	22	230	61	108	41	38.7	9	0.40	0	768	194	8.1	196.0	25.1	0.18	0.007	0.017	0.015	0.008	4.09	0.087	id
		80th	135	69	63	35	27	29	264	71	194	56	64.1	13	0.70	0	934	259	8.3	218.0	36.4	0.30	0.020	0.040	0.025	0.015	7.28	0.152	id
		90th	235	88	79	39	28	38	290	81	1673	88	88.0	15	1.00	0	1186	286	8.5	241.1	44.1	0.57	2.350	0.142	0.040	0.015	11.97	0.217	id

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																												
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
	BASAL GAB																												
Basal GAB	*3 Precipice Outcrop continued in Upper Dawson (merged with '1 Precipice Outcrop QMDB')	Samples	71	71	71	71	71	71	71	71	71	71	70	70	56	56	83	71	78	71	52	68	40	40	17	17	71	56	11
		10th	15	25	8	14	4	8	52	51	14	12	2.2	1	0.00	0	179	39	6.8	67.6	11.0	0.05	0.000	0.000	0.000	0.000	0.61	0.000	0.000
		20th	16	27	14	19	6	17	101	64	16	15	4.3	3	0.00	0	247	75	7.0	89.4	11.0	0.10	0.000	0.010	0.000	0.000	0.70	0.000	0.000
		40th	21	31	23	33	10	26	121	69	24	20	7.0	5	0.00	0	297	99	7.3	105.4	12.0	0.10	0.005	0.030	0.000	0.010	0.80	0.000	0.000
		50th	23	34	24	35	12	28	136	71	25	22	9.7	6	0.00	0	340	110	7.5	133.0	13.0	0.10	0.010	0.040	**0.005**	**0.015**	0.88	0.000	**0.000**
		70th	27	43	29	37	14	31	155	74	28	23	11.1	6	0.17	0	373	126	7.7	151.7	15.7	0.12	0.013	0.050	0.015	0.017	1.21	0.04	0.005
		80th	34	63	38	40	18	36	194	81	35	27	14.0	8	0.50	0	440	157	8.1	189.2	21.2	0.15	0.020	0.070	0.034	0.020	1.88	0.109	0.016
		90th	64	75	41	44	19	40	240	83	52	39	26.0	10	0.59	0	461	192	8.4	205.6	25.3	0.24	0.295	0.125	0.118	0.020	3.08	0.128	0.075
	EARLIER BASINS PARTIALLY UNDERLYING GAB																												
Earlier basins partially underlying GAB	1 - Central Galilee Coal Measures	Samples	59	59	59	59	58	58	57	57	58	58	59	58	50	49	90	59	68	56	29	51	32	24	8	6	58	50	3
		10th	64	44	4	2	3	2	43	2	89	32	1.0	0	0.00	0	517	25	6.7	36.4	11.4	0.14	0.000	0.000	0.000	id	2.66	0.000	id
		20th	121	66	8	4	4	3	83	5	120	41	5.4	2	0.00	0	780	47	7.2	76.4	13.0	0.20	0.000	0.000	0.001	id	5.13	0.000	id
		40th	240	74	27	6	9	8	129	13	245	65	34.5	5	0.00	0	1290	120	7.5	121.4	15.0	0.30	0.013	0.040	0.010	id	9.86	0.000	id
		50th	293	83	32	9	22	10	191	17	370	73	73.0	6	0.00	0	1555	174	7.7	174.5	17.0	0.40	0.045	0.040	**0.020**	id	11.83	0.000	id
		70th	557	87	65	13	56	15	327	30	893	84	156.8	10	1.35	0	2932	318	7.9	277.0	20.8	0.95	0.184	0.086	0.110	id	18.60	0.293	id
		80th	1032	90	122	18	105	21	406	37	1666	86	248.8	16	3.00	0	4600	753	8.0	333.6	25.7	1.20	0.310	0.193	0.110	id	21.89	0.652	id
		90th	1844	94	170	29	188	26	659	52	3285	89	468.0	24	5.75	1	7855	1479	8.2	542.0	48.2	2.12	0.527	0.369	2.308	id	34.79	1.250	id
Earlier basins partially underlying GAB	2 - Southern Galilee Clematis (merged with '3 Galilee Basin' QMDB')	Samples	22	22	22	22	22	22	21	21	22	22	21	21	17	17	31	22	23	22	16	21	1	1	0	0	22	17	0
		10th	51	62	3	3	1	1	0	23	25	14	0.0	0	0.00	0	74	11	6.8	98.4	10.0	0.10	id	id	id	id	2.29	0.000	id
		20th	104	86	3	3	1	1	16	48	30	15	0.0	0	0.63	0	450	13	7.2	179.3	10.0	0.30	id	id	id	id	8.78	0.137	id
		40th	120	93	4	4	2	2	228	70	35	25	0.0	0	1.00	0	550	16	7.9	211.3	12.0	0.59	id	id	id	id	12.49	0.217	id
		50th	124	94	5	4	2	2	253	72	50	27	0.0	0	**1.00**	**0**	571	17	8.0	218.0	13.0	0.60	id	id	id	id	12.99	**0.217**	id
		70th	138	95	9	6	3	4	287	82	76	33	2.4	1	2.00	0	756	35	8.1	244.5	13.0	0.60	id	id	id	id	14.83	0.435	id
		80th	145	95	10	7	4	6	301	84	92	44	8.9	2	2.00	0	1252	44	8.2	250.5	14.3	0.60	id	id	id	id	15.05	0.435	id
		90th	213	96	23	19	13	22	320	85	228	67	28.0	7	2.00	1	1488	99	8.2	266.7	15.9	0.60	id	id	id	id	15.78	0.435	id

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																									
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Earlier basins partially underlying GAB	3 - Western Galilee Clematis	Samples	19	19	18	18	18	18	19	19	19	19	19	19	13	13	27	18	22	18	11	17	12	12	3	0	18	13	1
		10th	33	73	1	1	2	2	7	4	48	59	1.4	1	0.00	0	174	9	6.4	17.9	7.6	0.10	0.024	0.007	id	id	3.76	0.000	id
		20th	40	77	1	1	2	4	22	7	55	66	2.3	2	0.20	0	210	11	6.9	26.4	10.0	0.10	0.030	0.010	id	id	4.24	0.043	id
		40th	68	81	2	3	4	10	37	13	95	77	4.1	3	0.50	0	382	18	7.1	38.7	11.9	0.20	0.053	0.013	id	id	6.60	0.109	id
		50th	**122**	**83**	**3**	**3**	**6**	**13**	**51**	**15**	**115**	**79**	**5.3**	**3**	**0.50**	**0**	470	**34**	7.4	**66.0**	**14.0**	**0.20**	**0.080**	**0.020**	id	id	**10.81**	**0.109**	id
		70th	574	91	36	7	23	15	122	25	864	83	43.8	6	0.68	0	1464	184	7.8	101.5	17.2	0.30	0.160	0.039	id	id	15.83	0.148	id
		80th	630	94	68	9	51	16	150	31	1085	91	60.8	7	1.16	1	3375	400	7.8	125.8	23.2	0.50	0.477	0.237	id	id	17.17	0.252	id
		90th	1031	96	143	13	122	17	164	39	1964	92	129.0	8	1.92	1	5950	767	8.0	136.4	45.2	0.74	0.930	5.373	id	id	18.28	0.417	id
Earlier basins partially underlying GAB	6 - Northern Galilee Clematis	Samples	25	25	25	25	25	25	25	25	25	25	24	24	17	17	40	25	24	25	15	25	12	11	9	9	25	17	1
		10th	50	67	1	1	1	2	43	7	62	51	0.0	0	0.00	0	325	7	7.2	40.0	21.0	0.16	0.000	0.000	0.010	0.000	4.11	0.000	id
		20th	54	80	3	3	3	4	65	12	70	53	1.6	1	0.00	0	415	25	7.5	58.5	21.0	0.20	0.000	0.007	0.013	0.000	4.39	0.000	id
		40th	69	83	5	6	4	8	99	28	82	56	6.4	2	0.00	0	494	29	7.8	83.0	48.5	0.30	0.010	0.029	0.020	0.010	5.77	0.000	id
		50th	88	84	6	7	4	9	100	35	85	59	7.7	3	**0.00**	**0**	690	29	7.8	90.0	**50.0**	0.30	**0.015**	**0.030**	**0.020**	**0.010**	6.27	**0.000**	id
		70th	135	86	14	8	13	12	122	41	151	73	12.0	4	0.50	0	765	89	8.0	104.0	64.0	0.50	0.020	0.042	0.142	0.050	15.88	0.109	id
		80th	492	92	24	9	23	14	170	45	650	82	25.3	5	0.52	0	790	155	8.1	190.0	66.5	0.65	0.024	0.053	0.170	0.050	18.03	0.113	id
		90th	1000	97	33	17	93	22	300	46	2200	92	104.1	6	2.54	0	3270	460	8.2	280.0	86.0	3.20	0.063	0.060	2.510	0.050	25.40	0.552	id
Earlier basins partially underlying GAB	11 - Eastern Bowen Coal Measures	Samples	276	276	276	276	275	275	270	270	276	276	274	274	233	233	389	277	307	276	207	265	169	165	14	10	274	233	36
		10th	142	31	19	2	36	10	175	3	215	40	24.1	4	0.00	0	1170	249	7.2	140.0	4.0	0.10	0.000	0.000	0.005	0.000	2.65	0.000	0.000
		20th	283	41	38	5	72	21	277	7	444	49	69.8	5	0.05	0	2005	459	7.5	207.7	7.9	0.10	0.010	0.000	0.010	0.000	3.60	0.011	0.000
		40th	409	50	70	10	145	29	540	19	934	63	140.0	7	1.00	0	3313	796	7.7	439.9	18.0	0.40	0.040	0.010	0.010	0.000	6.34	0.217	0.000
		50th	536	54	90	12	182	32	610	22	1115	67	172.5	8	1.90	0	4200	1000	7.8	502.5	23.0	0.50	0.050	0.010	**0.010**	**0.005**	8.00	0.413	0.000
		70th	1235	61	150	15	355	38	774	32	2400	76	470.0	11	5.00	0	7200	1745	8.1	646.2	39.4	0.70	0.120	0.020	0.070	0.018	13.43	1.087	0.000
		80th	1965	71	248	19	433	44	850	40	4500	84	896.1	13	7.47	0	10670	2327	8.2	705.4	50.0	0.80	0.197	0.040	0.161	0.025	17.79	1.624	0.082
		90th	3200	87	455	24	769	56	1015	51	6995	89	1224.4	19	16.00	1	18800	4242	8.6	836.9	57.8	1.10	0.326	0.100	1.989	0.055	25.90	3.478	0.082

Aquifer class and chemistry zone			Burdekin, Haughton-Don - Indicator[1]																										
		%ile[2]	Na[3]		Ca[3]		Mg[3]		HCO_3[3]		Cl[3]		SO_4[3]		NO_3[3]		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP[4]
Class	Chemistry zone[5]		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Earlier basins partially underlying GAB	14 - Bowen Basin Basalt Area	Samples	67	67	67	67	67	67	67	67	68	68	67	67	44	44	76	68	68	68	21	57	31	29	12	12	67	44	3
		10th	81	28	14	4	6	6	305	26	53	13	11.4	2	0.00	0	750	63	7.3	255.3	13.6	0.10	0.000	0.000	0.005	0.005	1.74	0.000	id
		20th	100	35	15	7	8	8	331	44	63	20	15.9	3	0.00	0	840	76	7.5	274.0	19.1	0.18	0.017	0.010	0.005	0.005	2.23	0.000	id
		40th	147	58	29	10	33	17	463	57	104	25	23.0	4	0.01	0	1300	244	7.9	383.2	24.9	0.26	0.025	0.011	0.005	0.005	4.81	0.001	id
		50th	152	64	46	11	46	23	505	64	134	27	33.0	5	0.30	0	1565	288	8.0	419.0	33.0	0.30	0.025	0.020	**0.005**	**0.005**	7.33	0.065	id
		70th	388	79	61	19	73	34	609	72	259	44	70.8	8	1.00	0	2918	500	8.2	507.9	48.0	0.40	0.168	0.040	0.028	0.005	9.01	0.217	id
		80th	516	82	65	22	87	39	698	74	611	49	117.3	10	1.40	0	3707	551	8.3	578.5	51.3	0.51	0.381	0.060	0.114	0.005	11.27	0.304	id
		90th	640	84	97	29	134	43	1018	80	720	58	189.0	22	8.84	0	4507	684	8.4	859.1	61.6	1.06	0.780	0.112	0.150	0.016	14.06	1.922	id

Notes

1. Abbreviations: Na: Sodium, Ca: Calcium, Mg: Magnesium, HCO_3: Bicarbonate, Cl: Chloride, SO_4: Sulfate, NO_3: Nitrate, EC: Electrical conductivity, Hard: hardness, Alk: alkalinity, SiO_2: Silica, F: Fluoride, Fe: Iron, Mn: Manganese, Zn: Zinc, Cu: Copper, SAR: Sodium adsorption ratio, TN: total nitrogen, TP: total phosphorus, mg/L: milligrams per Litre, µS/cm: microsiemens/centimetre

2. Percentiles are provided in most cells where samples are available for a particular indicator. The Queensland Water Quality Guidelines (section 4) contains information on recommended minimum sample size when deriving percentiles for use in deriving water quality guidelines. For this table, where less than 8 samples were available, cell shows insufficient data ('id'); where 8–20 samples were available, 50th percentile values are provided (in bold). Where greater than 20 samples were available, the full percentile ranges are provided. The intent is to maintain current water quality (20th, 50th and 80th percentile ranges) where water quality is in natural condition. Where there is evidence of anthropogenic disturbance in groundwater quality, a long term goal to improve water quality may be established and reflected by adoption of an alternative (e.g. 40th percentile) value.

3. Na, Ca and other ion % columns: The percentages of major cations (Na, Ca and Mg) were evaluated for each sample, as were the major anions (Cl, HCO_3, SO_4 and NO_3). Then the ion % columns were compiled by calculating the percentiles of these percentages independently of each other. For instance, in Burdekin Alluvium zone 1 – Don and Southern Burdekin Delta, the 50th percentile of Na is 57, while the 20th – 80th percentile range is 41–81. This means that half of the samples contain at least 57% of dissolved Na, with the balance being made up of Ca and Mg in any proportions. Because of this, the sum of the 50th percentiles in Alluvium zone 1 – Don and Southern Burdekin Delta – is near to 100%, with Ca contributing 17% and Mg contributing 24%. However, the 20th and 80th percentiles of each of the major cation are based on ranges of that cation, and add up to less or more than 100% respectively.

4. Low TP values (e.g. recordings of zero) may be due to concentrations below detection limits. Concentrations of TP are usually low in Queensland groundwaters, because most of the phosphorus binds to particles in the soil and unsaturated zone, restricting its movement to the aquifer (Holman et al. 2008).

5. Refer to accompanying figures (maps) for locations of chemistry zone. In some locations (mainly within the alluvial aquifer class) a chemistry zone is identified by entire zone and the 'near stream' (within 1.5km of stream channel) component of the zone, where near stream water quality characteristics may be different from overall zone. Percentiles are provided in each case. Overall zone includes near stream and other areas. Near stream zone is shown on large scale plans accompanying this report, available on the department's website.

Reference: Holman, IP, Whelan, MJ, Howden, NJK, Bellamy, PH, Willby, NJ, Rivas-Casado, M & McConvey, P. 2008, 'Phosphorus in groundwater – an overlooked contributor to eutrophication?'. Hydrological Processes, vol. 22, no: 5121–5127.

10 Glossary

Terms as used in this document

Al – Aluminium

Alkalinity – ability to neutralize acids to the equivalence point of carbonate or bicarbonate

Alluvium – loose, friable material eroded and reshaped by water

Anion – a negatively charged ion (e.g. Cl^-).

Aquiclude – An aquiclude or confining layer is a bed of rock or sediment which, although porous and capable of storing water, can only transmit it at negligible rates. If a confined aquifer is penetrated by a bore, the water will rise to the potentiometric surface, which is an elevation related to the height of the recharge source and hydraulic gradient. This may be above the local water table or even the ground surface.

Aquifer – permeable underground water-bearing material, from which groundwater can be extracted. There are two main aquifer types, confined and unconfined. In an unconfined aquifer, the groundwater surface is a water table, which rises or falls freely according to recharge and discharge. On the other hand, a confined aquifer is overlain by an impermeable layer, which confines the water below the elevation of the recharge beds. If the pressure is released, as in a bore, the water level rises above the aquifer to its natural level in relation to recharge.

Aquifer class – a classification system for major aquifer types, including division of large systems such as the GAB, to avoid difficulties in mapping overlapping units. The aquifer types occurring in Queensland have been subdivided into nine major classes for mapping purposes. Seven of these classes occur in the Fitzroy/Burdekin region. Each aquifer class is subdivided into chemistry zones, with boundaries mapped around distributions of similar water chemistry and a consistent suite of aquifers.

Aquitard – a relatively impermeable layer which retards but does not prevent the flow of water to or from an underlying aquifer. The aquifer underlying the aquitard may be referred to as a semi-confined, or leaky aquifer.

Artesian (or confined) – groundwater at a lower elevation than its recharge source, which is confined under pressure by overlying impervious beds. Water level will rise when a bore penetrates the impervious layer. Aquifer may be 'semi-confined' if overlying material allows some leakage.

Basin – Australia was divided into drainage divisions through the work of The Australia's River Basins 1997 project by the Australian Water Resources Management Committee (1997). The drainage divisions are further sub-divided into water regions and then into river basins, which represent discrete catchments such as the Fitzroy or Pioneer, which have outlets to either the sea, or an inland drainage area. Larger basins such as the Fitzroy or Murray Darling are divided into **Sub-basins**, based on the catchments of major tributaries.

B – Boron

Basalt – extrusive volcanic rock formed from rapid cooling of lava

Baseflow – stream flow derived from deep subsurface flow and delayed shallow subsurface flow

Baseline quality – the most common water quality across a zone, under present conditions

Bedrock – native consolidated rock underlying the surface, usually overlain by weathered material. Sometimes referred to as **Basement**.

Bore – A bore or well is described by USGS (2018) and (NUDLC 2012) as an artificial excavation, constructed by any method, to abstract, observe or explore groundwater or other resources. The depth of the excavation is greater than the largest surface dimension, and it may be an open hole, or more usually lined with a casing containing slots or screens to allow for the entry of water from the desired aquifer level. Some bores contain more than one pipe, to access groundwater at different levels. Bores in Queensland are issued with a unique Registration Number (RN) with separate pipes being referred to alphabetically. Information and data for these bores can be accessed through the QDNRME Groundwater Database via the RN.

Ca – Calcium ion (major cation)

Carbonates – dissolved calcium and magnesium bicarbonates, or rocks such as limestone or dolomite which were formed or cemented by their precipitation.

Catchment – A catchment, as used here, is a less formal term than basin. It can refer to any area of land where all run-off flows through a common network of rivers and creeks to the main stream which has a terminal outlet such as a larger body of water or the ocean. Catchments are bordered and separated by elevated and often hilly areas known as watersheds.

Cation – a positively charged ion (e.g. Na^+).

Chemical type – chemistry of a groundwater, characterised by particular ionic equivalence; the major chemical types identified for Fitzroy and Burdekin regions groundwater are:

1. Sodium bicarbonate
2. Sodium chloride

3. Sodium magnesium chloride, becoming more saline and closer to seawater composition as EC increases
4. Lower sodium
5. Sulphate rich
6. Analogous to surface water

Chemistry zone (groundwater) – a section of an aquifer class where the baseline water chemistry is reasonably consistent, and the bores access one or more major aquifers or other geological formations which are related in space, time and origin.

Ck – Creek

Cl – Chloride ion (major anion)

CO_3 – Carbonate (anion)

Consolidated – Aquifers composed of solid rocks such as granite, sandstone, basalt or limestone. Ground water enters, flows and is stored in fractured or weathered zones, pore spaces, or voids caused by solution, as in limestone. Such aquifers have limited porosity or storage capacity, and may be hydrologically discontinuous.

Craton – The surface of the earth is divided into a series of tectonic plates. The term craton or shield refers to an ancient, stable continent land mass, usually in the interiors of a tectonic plate, as opposed to the more geologically active regions near the edges.

Cu – Copper

Deformed (rocks) – rocks which have become deformed into folds and faults when the Earth's crust is compressed or stretched.

DNRME – Department of Natural Resources Mines and Energy, the Queensland Government Department which is custodian of the states, ground and surface water data bases. The department was referred to as **DNRM** from 2015 to 2018, and **DERM** or other titles prior to 2012.

D/S – downstream of

DO – dissolved oxygen. Usually given in mg/L, but at times as percent saturation.

EC – electrical conductivity, a measure of salinity measured in µS/cm

EH –redox potential

Equivalence – amount of a substance which will either – react with or supply one mole of hydrogen ions (H^+) in an acid–base reaction; or react with or supply one mole of electrons in a redox reaction

Evenly proportioned cations – water chemistry where the major cations (Na, Ca and Mg) are in roughly even proportions in terms of equivalents, although in Queensland groundwaters sodium is usually slightly in excess of each of the others.

F – Fluoride ion

Fe – dissolved iron, either ionic or in other chemical combinations.

Formation – or **geological formation** is the fundamental geological unit. It consists of a body of rock with comparable lithology, and is usually named, e.g. ‘Hooray Sandstone’.

GAB – Great Artesian Basin

GAB Cap – relatively impermeable layer of shallow marine sediments overlying the GAB

GDE – groundwater dependent ecosystem

Geological Time Scale – divides the time from formation of the Earth to the present, into a series of units that are useful for comparing geological formations of space and time. These units are measured in millions of years (MYA), but defined according to significant geological changes or events on a world wide scale, and therefore vary greatly in length. Those most relevant to this study are summarized here.

Period		MYA before present	Description
Precambrian		4600–541	Began with formation of the Earth. Divided into several units, the most recent being the Proterozoic, which represents the oldest surface rocks in Queensland.
	Proterozoic	2,500–541	When the Proterozoic began, the Earth had liquid water, oxygen in the atmosphere, and single celled organisms, with soft bodied multicellular forms evolving later. The early geology consists of heavily metamorphosed rocks and granites, which were followed in Queensland by relatively un-deformed sediments.

Period		**MYA before present**	**Description**
Paleozoic		541–252	Divided into the Cambrian, Ordovician, Silurian, Devonian, Carboniferous, and lastly the Permian. The Paleozoic in Queensland is dominated by a **subduction zone** which formed offshore of the Precambrian craton towards the end of the Proterozoic. The subduction trench became filled with deep water marine sediments and volcanics. It remained active throughout the Paleozoic, but with compression intervals where the sediments were folded into stable continental crust. The new crust was eroded to form shallow marine or terrestrial basins while the trench reopened further to the east. The Great Dividing Range (GDR) is formed from the trench sediments and associated granites. An 'explosion' in biodiversity on land and water during the Paleozoic allowed the formation of coal and oil in the shallow marine and terrestrial basins.
Mesozoic		252–66	Divided into the Triassic, Permian and Cretaceous. It began with the final phases of the Paleozoic subduction-compression cycles, referred to as the Hunter-Bowen Orogeny, which had greatly extended the landmass. Changing patterns of subsidence and uplift caused the Palaeozoic sedimentary basins such as the Bowen and Galilee to be uplifted, eroded, and be replaced by newer drainage patterns including the Great Artesian Basin (GAB). The formation of the GAB was completed by a relatively impermeable cap of marine sediments laid down by the Eromanga Sea. The end of the Mesozoic saw the breakup of Gondwanaland, and the Hunter-Bowen Orogeny landmass being split by the opening of the Tasman and Coral Seas. The landward side rose, while the eastern bloc sank, with remnants now in New Zealand and the Solomon and nearby Islands.
Cainozoic		66–0	Most recent, divided into the Tertiary and Quaternary.
	Tertiary	66–2.6	The first and longest period of the Cainozoic, divided into the Paleocene, Eocene, Oligocene, Miocene and Pliocene. It saw many changes in Queensland that affected present groundwaters. At the end of the Mesozoic, Queensland was mainly flat lying, and the GAB was a subartesian aquifer system with exposures in the east providing recharge. The rising of the east coast, associated with the opening of the Tasman Sea, created the GDR and tilted the GAB to the west, creating artesian conditions. The opening of the sea also stretched the crust, leading to floods of basaltic lava, potential aquifer systems, but covering much of the GAB recharge areas. The modern drainage pattern was formed by the rise of the GDR, with short, steep, coastal basins and drier, low gradient, westerly basins with extensive floodplains. The headwaters of the western streams were progressively 'captured' by the greater erosive power of the coastal streams, leading to greatly reduced inland discharge. After separating from Antarctica, Australia drifted north to its present location, changing to a drier climate with extensive weathering and duricrust formation.
	Quaternary	2.6–0	The Quaternary may be further subdivided into the **Pleistocene**, which covers the Ice Age (2.6 MYA-11,700 thousand years ago), and the **Holocene**, or **Recent**, which is the current period, in which most active floodplains were deposited. The most significant feature of the Quaternary was the Ice Age, which caused large water level fluctuations along the Queensland coast, as well as episodic climate change. This is the age when human impacts occurred. The modern alluvial systems of Queensland developed, within the more extensive Tertiary systems, particularly in inland basins. The GBR also formed during this period, while sand dunes were built in the southwest, as well as on the coast. These included the large sand deposits of North Stradbroke, Moreton and Fraser Islands. Several major deltas were formed by large rivers, and acid sulphate soils were deposited in low lying coastal areas.

GDR – Great Dividing Range

GIS – geographic information system

GMU – groundwater management unit

Granitic Rock – an **igneous** rock formed from the molten state at depth, where slow cooling gave it a coarse granular texture. True **granites** have a narrow range of chemical composition, but the term is used broadly here to include all rocks of similar appearance and origin.

Groundwater – water that is stored below the plant root zone in soil pore spaces or in porous or fractured rocks. The **water table** is the depth at which all available space is saturated.

Group – groundwaters with similar types of chemistry.

GW – groundwater

GWDB – the DNRME Groundwater Database, which contains most of the chemical and hydrological data for groundwater in Queensland.

Hardness – Hardness is a water quality parameter caused primarily by calcium and magnesium ions in solution. It is expressed as $CaCO_3$ in mg/Ll. Hard water increases the amount of soap or detergent required for washing, and also deposits mineral scale or incrustation on kettles, boilers and pumping equipment. Harder water can, however, reduce the toxicity to the ecosystem of certain trace substances. In terms of guidelines, ANZECC and ARMCANZ (2000) advise that <60 is possibly corrosive, 60–200 can be considered good quality, 200–500 requires softening with an increasing likelihood of scale, and >500 can cause severe scaling.

HCO_3 – Bicarbonate ion (anion)

Igneous – rocks such as basalt or granite that were formed from solidified lava or magma

Intrusion – an igneous rock formed where molten magma was **intruded** under pressure into the overlying rocks, and subsequently cooled.

Ion – an atom or molecule which has either an excess or shortage of electrons, giving it a negative charge (anion) or positive charge (cation) respectively. Dissolved salts are generally in ionic form, with cations being metallic (i.e. Na, Ca, Mg) and anions non-metallic (i.e. Cl, SO_4, HCO_3).

K – Potassium (cation)

Lithology – the term ‘lithology’ is used loosely in this document to comment on the origin, formation, mineral composition and classification of rock or stratigraphic unit. The primary lithological division is into igneous, metamorphic and sedimentary rocks.

Magma – molten rock, from deep in the earth's crust, which forms igneous rock on cooling, and **lava** if it reaches the surface through volcanoes.

Metamorphic – rocks where minerals and structure have been altered after emplacement, due to the heat and pressure exerted by deep burial or earth movements. The rock are then said to be **metamorphosed**

Mg – Magnesium ion (cation)

Mn – Manganese (cation)

Na – Sodium ion (cation)

NaCl – Sodium chloride

NO_3 – Nitrate (anion)

NTU – Nephelometric turbidity units

Orogeny – a mountain building process that occurs when deep, oceanic trenches, formed in **subduction zone**s, become filled by sediments. These sediments are deformed by continuing compressional forces within the subduction zone, becoming folded, faulted and squeezed upward to form mountain ranges. **Metamorphism** and **Igneous** rocks are usually associated with orogenies.

pH – measure of how acidic or alkaline a water is by the concentration free hydrogen ions in solution. The pH scale ranges from 0 to 14, with a pH of 7 being neutral, values lower than 7 being acidic, and pH values higher than 7 being alkaline (basic). For instance, approximate pH values are orange juice 3, coffee 5, rainwater 6, freshly distilled water 7, seawater 8, and a baking soda solution 9 (Decelles 2002).

PO_4 – Ortho-phosphate (anion)

QWQG – Queensland Water Quality Guidelines (2009, as amended)

R – river

RAH – residual alkali hazard

Recharge – hydrologic process where water moves downward from surface water to groundwater

Salinity – the dissolved salt content in water. In most Queensland natural waters this includes the cations Na, Ca, Mg, and to a lesser extent K, and the anions Cl and HCO_3, with usually smaller amounts of SO_4 and NO_3. These are known as the major ions. Salinity can be measured in several ways, although these are not exactly comparable: Total Dissolved Ions (TDI) is a measure of the major ions in solution expressed in mg/L. This is most needed by catchment managers because it can be used to measure mass transport of salts. An alternative measure is Electrical Conductivity (EC) which is the ability of the solution to conduct an electric current. Although EC is influenced by the type as well as quantity of salts, as well as by factors such as temperature, pressure and suspended matter, it is often used as a substitute for TDI because it is easily measured. Salinity categories in this document are based on median EC in µS/cm:

- EC <200 very low
- EC <200–500 low
- EC >500–1500 moderate
- EC >1500–5000 high
- EC >5000 very high
- Salinity is classified variable if the range is more than twice the median.

SAR – Sodium adsorption ratio is used to measure the dominance of sodium (Na) in the water chemistry, and to determine whether Na levels in irrigation water will cause soil structure to deteriorate.

Sediments – or **Sedimentary rocks**, are those formed when the weathered, fragmented, or dissolved remains of previous rocks or biological materials are accumulated in layers, often having been transported there by wind or water. They may be **unconsolidated**, but become hardened if compressed by subsequent layers, or cemented by solutions of dissolved **silica** or **carbonates.** Examples are sandstone, shale, alluvium, limestone, coal.

SiO_2 – Silicon dioxide (or **silica**)

SO_4. – Sulphate ion (anion)

Sodic – waters where sodium dominates the cations in terms of proportion.

Subduction zone – The surface of the earth (crust) is broken into a series of **tectonic** plates, and a subduction zone occurs where two collide, forming a deep trench where one is thrusting under the other. The trench is filled with deep water sediments, and an **Orogeny** occurs when these are later deformed by compressional forces, resulting in folding, faulting, metamorphosis and uplifting to form mountain ranges.

Surface water – water collecting on the ground or in a stream, river, lake, wetland, or ocean

SW – surface water

SWDB – surface water database

SYSTAT – a statistical and graphical software package.

TDI – total dissolved ions

TDS – total dissolved solids

Tectonics – The surface of the earth (crust) is broken into a series of plates. Tectonics describes the very large-scale processes through which these plates interact to reshape continental or oceanic features, for instance through **Subduction zones**.

Unconsolidated – sedimentary rocks with a loose, friable structure, because they have not been significantly compressed by subsequent layers, or cemented.

U/S – upstream of

UA – unincorporated (groundwater) areas, not included in a GMU

Volcanics – rocks of volcanic origin, consisting of lava flows, volcanic ash, and sometimes layers of sediment composed mostly of volcanic materials. Examples are basalt and andesite.

Water table – the surface where the groundwater pressure head equals atmospheric pressure

Zn – Zinc (cation)

Zone – geographically delineated area that is likely to contain groundwater of a particular type at one or more individual depth classes.

References:

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USGS 2018, '*Water Science Glossary of Terms*', https://water.usgs.gov/edu/dictionary.html#W, accessed: 17/10/2018.