

Groundwater dependent ecosystem mapping on the Queensland Globe frequently asked questions

Version 1.5

What are groundwater dependent ecosystems?

Groundwater dependent ecosystems (GDEs) are defined as "ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services" (Richardson et al. 2011).

What are the types of groundwater dependent ecosystems?

GDEs are grouped into types based on their groundwater access. The three types of GDEs are:

- Ecosystems dependent on the surface expression of groundwater (surface expression GDEs)
- Ecosystems dependent on the sub-surface presence of groundwater (terrestrial GDEs)
- Ecosystems dependent on the subterranean presence of groundwater (subterranean GDEs)

What are the subtypes of groundwater dependent ecosystems?

GDEs are grouped into sub-types based on their aquatic or terrestrial system. The sub-types of GDEs are:

- Ecosystems dependent on the surface expression of groundwater (surface expression GDEs)
 - Lacustrine wetland GDEs
 - Lacustrine wetlands are typically large, open water-dominated systems (e.g. lakes) outside river channels. They have less than 30% vegetation cover and are larger than 8 hectares or, if smaller than 8 hectares, are more than 2 metres deep (Environment Protection Agency 2005). Lacustrine wetland GDEs are those lacustrine wetlands that have connected gaining or connected variable gaining/losing groundwater connectivity.
 - Palustrine wetland GDEs
 - Palustrine wetlands are primarily vegetated non-channel environments. They include billabongs, swamps, bogs and have more than 30% emergent vegetation (Environment Protection Agency 2005). Palustrine wetland GDEs are those palustrine wetlands that have connected gaining or connected variable gaining/losing groundwater connectivity.

- Riverine water body GDEs
 - Riverine wetlands are all wetlands and deepwater habitats within a channel (Environment Protection Agency 2005). Riverine wetland GDEs are those riverine water bodies contained within a channel that have connected gaining or connected variable gaining/losing groundwater connectivity.
- Estuarine wetland GDEs
 - Estuarine wetlands are those with oceanic water sometimes diluted with freshwater run-off from the land (Environment Protection Agency 2005). Estuarine wetland GDEs are those estuarine wetlands that have either connected gaining or connected variable gaining/losing groundwater connectivity.
- Near-shore marine GDEs
 - Near-shore marine wetlands include the area of ocean from the coastline or estuary, extending to 6 meters below the low water mark (Environment Protection Agency 2005). Near-shore marine wetland GDEs are those near-shore marine wetlands that have connected gaining or connected variable gaining/losing groundwater connectivity.
- Ecosystems dependent on the sub-surface presence of groundwater (terrestrial GDEs)
 - Regional ecosystem GDEs
 - Regional ecosystems are vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil (Neldner et al. 2012). Regional ecosystem GDEs are those regional ecosystems where their components access groundwater within their root zone on at least an ephemeral basis.
 - Riverine wetland GDEs
 - Riverine wetlands are all wetlands and deepwater habitats within a channel (Environment Protection Agency 2005). Riverine regional ecosystem GDEs are those streamside regional ecosystems, associated with wetlands contained within a channel, which have connected gaining or connected variable gaining/losing groundwater connectivity.
- Ecosystems dependent on the subterranean presence of groundwater (subterranean GDEs)
 - Aquifers
 - Subterranean wetlands (aquifers) are wetlands occurring below the surface of the ground that are fed by groundwater. Aquifer ecosystems are innately GDEs. Aquifer GDEs provide habitat for specialised fauna (i.e. stygofauna).
 - Cave GDEs
 - Subterranean wetlands (caves) are wetlands occurring below the surface of the ground that are fed by groundwater. Cave ecosystem GDEs are those cave ecosystems that have either connected gaining or connected variable gaining/losing groundwater connectivity.

What sub-types of groundwater dependent ecosystems are mapped in the Queensland Groundwater Dependent Ecosystem Mapping?

The following sub-types of GDEs are included in the Queensland Groundwater Dependent Ecosystem Mapping:

- Ecosystems dependent on the surface expression of groundwater (surface expression GDEs)
 - Lacustrine wetland GDEs
 - Palustrine wetland GDEs
 - Riverine water body GDEs
 - Estuarine wetland GDEs – these GDEs are not comprehensively mapped in the Queensland Groundwater Dependent Ecosystem Mapping
- Ecosystems dependent on the sub-surface presence of groundwater (terrestrial GDEs)
 - Regional ecosystem GDEs
 - Riverine wetland GDEs
- Ecosystems dependent on the subterranean presence of groundwater (subterranean GDEs)
 - Cave GDEs

What is a spring?

Springs are hydrogeological features by which groundwater discharges naturally to the land surface or cave. This includes springs with:

- permanent and non-permanent (i.e. intermittent or ephemeral) saturation regimes
- dynamic or static spatial locations
- diffuse or point source spatial locations.

What is the difference between a spring and a groundwater dependent ecosystem?

A spring is a hydrogeological feature by which groundwater discharges naturally to the land surface or cave. An ecosystem occurring on the land surface may be dependent on this surface expression of groundwater from the spring and this ecosystem would be a GDE.

Are all groundwater dependent ecosystems associated with a spring?

Not all GDEs are associated with a spring. Ecosystems dependent on the sub-surface presence of groundwater will not be associated with a spring as the groundwater does not need to express at the surface for the ecosystem to access it.

How far does a spring extend on the surface?

The surface extent of the spring is limited to the spatial extent where groundwater discharges to the surface. Therefore a spring does not extend downslope despite the fact that the groundwater discharged by a spring might move downslope and support a surface expression GDE there.

How far does a groundwater dependent ecosystem extend from a spring?

There is no standard distance a GDE extends from a spring as they reflect local conditions. For example, a spring with diffuse discharge into a river can support riverine wetland GDEs for several hundred meters to kilometres depending on the spring flow rate, spring extent, and local hydrogeological characteristics. In contrast, a spring with a permanent saturation regime and a fixed spatial location in an arid environment may only support a palustrine wetland GDE (sometimes referred to as a 'spring wetland') extending just a few metres from the spring vent.

How is the Queensland Groundwater Dependent Ecosystem Mapping produced?

The Queensland Government employs a consultative process that integrates local, expert knowledge of landscapes (and the ecosystems within them) with detailed spatial data sets to map GDEs across catchments. The Queensland Groundwater Dependent Ecosystem Mapping Method capitalises on pre-existing ecosystem mapping data (e.g. regional ecosystem and wetlands mapping) available state wide for Queensland at 1:100,000 scale or better. The method overcomes one of the key criticisms often levelled at broader scale mapping methods – that information from local and regional experts, with significant understanding of landscape processes and ecosystems, is not incorporated into the data sets used by decision makers. The full method is detailed in 'Queensland Groundwater Dependent Ecosystem Mapping Method: A method for providing baseline mapping of groundwater dependent ecosystems in Queensland' (Department of Science, Information Technology and Innovation 2015).

What are the major data sets for the Queensland Groundwater Dependent Ecosystem Mapping?

The Queensland Groundwater Dependent Ecosystem Mapping utilises several major data sets to delineate GDEs:

- Biodiversity status of pre-clearing and remnant regional ecosystems
- Queensland Karst Mapping
- Queensland Springs Database
- Queensland Wetlands Data

Secondary data sets are used to implement mapping rule-sets to identify which ecosystems contained in the major data sets are GDEs or potential GDEs. Example secondary data sets include:

- Rainfall Isohyets
- Digital Elevation Models
- Geology mapping
- Groundwater Bore Data
- Soils Mapping

What are the groundwater dependent ecosystem pictorial conceptual models?

Pictorial conceptual models are representations of observed objects, phenomena and processes in a logical and objective way with the aim of constructing a formal system whose theoretical consequences are not contrary to what is observed in the real world (Department of Science, Information Technology, Innovation and the Arts 2012). GDE pictorial conceptual models capture the collective knowledge available on the key conditions, drivers and processes occurring in a landscape that control groundwater and ecosystem interaction.

Why are the groundwater dependent ecosystem pictorial conceptual models produced?

GDE pictorial conceptual models are produced to collate and communicate cross-disciplinary knowledge regarding the components, processes and interrelationships in a system that are critical to the presence, function and form of GDEs. GDE pictorial conceptual models are a tool that supports the communication of technical scientific concepts to end users to increase understanding and assist environmental managers in decision making.

Was field verification of Queensland Groundwater Dependent Ecosystem Mapping carried out?

Where possible, existing research (field research and desktop research) has been used to inform expert workshops held as part of the GDE mapping method. Field surveys, including either qualitative or detailed quantitative measurements of GDEs at specific locations, are not routinely undertaken to verify the Queensland Groundwater Dependent Ecosystem Mapping. Although such an assessment would significantly improve the accuracy of the mapping in some areas, this type of work would require significant funding and resourcing and is often not practical to complete over large areas. Field assessment techniques that may be useful to validate GDE mapping are outlined in the Australian groundwater-dependent ecosystems toolbox (Sinclair Knight Merz, 2011).

Will the Queensland Groundwater Dependent Ecosystem Mapping information be updated?

The intent is that the Queensland Groundwater Dependent Ecosystem Mapping will be updated in line with resources and needs. This will take the form of:

- improving the accuracy of the existing mapping
- extending mapping to other areas
- mapping additional GDE types and subtypes
- improving the source data sets used (e.g. wetland and regional ecosystem mapping)

What is the relationship between the National Atlas of Groundwater Dependent Ecosystems and the Queensland Groundwater Dependent Ecosystem Mapping?

The National Atlas of Groundwater Dependent Ecosystems combines nationwide layers of satellite remote sensing data with existing literature and mapping. Queensland GDE mapping is developed through consultation and integration of expert knowledge with detailed spatial data. The concepts and attributes used in the National Atlas of Groundwater Dependent Ecosystems and the Queensland Groundwater Dependent Ecosystem Mapping were developed collaboratively and are aligned.

How should the Queensland Groundwater Dependent Ecosystem Mapping be used?

The Queensland Groundwater Dependent Ecosystem Mapping products are tools to support natural resource management decision making. The mapping indicates the locations of potential GDEs at a catchment scale and provides descriptions and system understanding of the ecosystems where possible. The Queensland Groundwater Dependent Ecosystem Mapping should be used alongside other available information to assist environmental managers in making resource management decisions aimed at the sustainable management of environmental assets which may depend on groundwater. The Queensland Groundwater Dependent Ecosystem Mapping is most suitable for use at the catchment scale and can indicate where finer scale assessments may be necessary. While the mapping products may provide an input to policy and legislative processes they should not be used as statutory maps. Map users are advised to check the confidence rating in the Queensland Groundwater Dependent Ecosystem Mapping which is included as an attribute (GDE_CONF) and forms part of the recommended display symbology.

The Queensland Groundwater Dependent Ecosystem Mapping does not presently indicate the detailed level of ecosystem dependence on groundwater, the values of the ecosystem, and the condition of the ecosystem or their environmental water requirements. Rather these maps should be used to trigger and inform more detailed local-scale assessment of GDEs including field assessments.

What does the groundwater dependent ecosystem confidence rating mean?

Each ecosystem identified as potentially groundwater dependent has been assigned a confidence rating to indicate the level of confidence experts had in their prediction that the ecosystem is using groundwater as opposed to other water sources (e.g. soil water or surface water). Confidence is rated according to the level of confidence experts had in the mapping rule set that identified the specific ecosystem as potentially groundwater dependent. The confidence ratings of GDE mapping are:

- Known GDE
- Derived GDE–High confidence
- Derived GDE–Moderate confidence
- Derived GDE–Low confidence
- Unknown confidence

Does the Queensland Groundwater Dependent Ecosystem Mapping contain information on the level of groundwater use by an ecosystem?

The Queensland Groundwater Dependent Ecosystem Mapping does not currently contain information on the level of groundwater use by an ecosystem but does include a number of attributes describing the nature of an ecosystem's connection or potential connection with groundwater. Flora and fauna within an ecosystem may have different levels of groundwater use that can vary spatially and temporally. Factors that may affect groundwater use include flora physiology, availability of other water sources, existing hydrological regime and groundwater quality.

Does the Queensland Groundwater Dependent Ecosystem Mapping contain information on ecosystem condition?

The Queensland Groundwater Dependent Ecosystem Mapping contains limited information about ecosystem condition. The Queensland Groundwater Dependent Ecosystem Mapping contains a few attributes describing hydrological and salinity modification of GDEs based on wetland ecosystems, which is derived from the source Queensland Wetlands Data. The Queensland Groundwater Dependent Ecosystem Mapping contains attributes that link to the source ecosystem data sets and there may be attributes in these source ecosystem data sets that contain additional information on ecosystem condition.

Is the whole polygon shown in the Queensland Groundwater Dependent Ecosystem Mapping a groundwater dependent ecosystem?

Polygons in GDE mapping identify areas where groundwater and ecosystem interaction may be occurring. Not all ecosystems within that area may necessarily be groundwater dependent. For example, local experts may identify a specific regional ecosystem as potentially groundwater dependent but the regional ecosystem mapping may include polygons where that specific regional ecosystem occurs in a mosaic with other regional ecosystems (i.e. there are multiple regional ecosystems mapped within a single polygon). In such cases the GDE mapping generally shows the whole regional ecosystem mosaic polygon as a potential GDE even though only one component regional ecosystem was identified as potentially groundwater dependent. An estimate of the percentage of the polygon area that is potentially groundwater dependent is provided in the attribute 'GDE_PCT'. The values are as follows:

- Specific percentage
 - The specific percentage of the area estimated to be potentially groundwater dependent.
- 01-50_GDE
 - 1% to 50% of the polygon is estimated to be potentially groundwater dependent.
- 51-80_GDE
 - 51% to 80% of the polygon is estimated to be potentially groundwater dependent.
- 81-100_GDE
 - 81% to 100% of the polygon is estimated to be potentially groundwater dependent.

In addition, flora and fauna within an ecosystem may have different levels of groundwater use that can vary spatially and temporally. Factors that may affect groundwater use include flora physiology, availability of other water sources, existing hydrological regime and groundwater quality.

Are all groundwater dependent ecosystems shown in the Queensland Groundwater Dependent Ecosystem Mapping?

The Queensland GDE mapping does not include mapping of aquifer subterranean GDEs. Also, not all examples of the GDE types that are currently covered will be captured in the Queensland Groundwater Dependent Ecosystem Mapping. GDEs may not be captured where ecosystems are:

- not captured in source ecosystem data sets (e.g. because of errors or scale limits)
- not captured in the landscape scale analysis by local experts
- particular subtypes of GDEs (e.g. aquifer subterranean GDEs)
- located in areas outside the present mapping coverage

Why are there overlapping groundwater dependent ecosystems in the Queensland Groundwater Dependent Ecosystem Mapping?

Overlapping GDEs could indicate:

- the presence of multiple types of GDEs
 - For example, one ecosystem may be dependent on both the sub-surface presence of groundwater accessed through the capillary zone (e.g. a vegetation community fringing a river) and the surface expression of groundwater (e.g. a waterbody in the river channel).
- one type of GDE which may be identified through multiple mapping rule sets
 - One ecosystem may be identified as potentially groundwater dependent by two or more mapping rule sets capturing different combinations of attributes that indicate groundwater dependence. For example, one ecosystem may be captured in one mapping rule-set because of its position on permeable alluvia and this same ecosystem may also be captured by another mapping rule-set because of its position near to other permeable rocks.

What do blank and white spaces in the Queensland Groundwater Dependent Ecosystem Mapping mean?

Blank or white space on the map could indicate that the area:

- contains ecosystems that have been assessed as not groundwater dependent
- contains no mapped ecosystems (e.g. cleared areas)
- is outside the present mapping coverage for GDEs

A complementary data set is available alongside the Queensland Groundwater Dependent Ecosystem Mapping called 'Potential Groundwater Dependent Ecosystem Aquifer Mapping'. Where available, this data set can provide additional information on whether the blank or white spaces are due to the area not likely to be supporting GDEs (e.g. exclusion zones or recharge zones) or because the area contains no mapped ecosystems despite the potential to support GDEs.

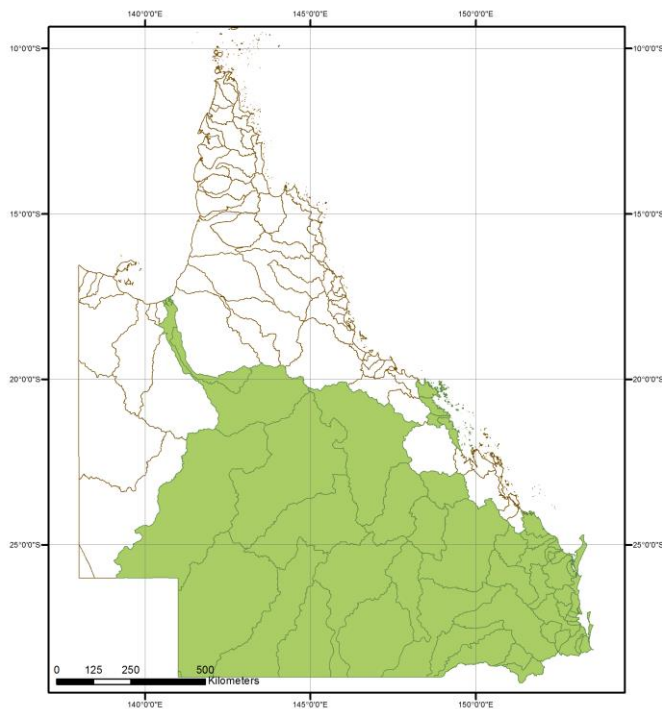
Why may borders be visible in the Queensland Groundwater Dependent Ecosystem Mapping?

Visible borders on the map could indicate:

- boundaries between the source data sets used to develop the Queensland Groundwater Dependent Ecosystem Mapping in different regions of Queensland. This may result from different available source data set scale, accuracy, currency or availability.
- application of different mapping rule-sets in different regions based on local, expert knowledge. Where possible, relevant information from adjoining regions has been incorporated into technical workshops to minimise the impact of different mapping rule-sets along borders between different regions.

What geographic area does the Queensland Groundwater Dependent Ecosystem Mapping cover?

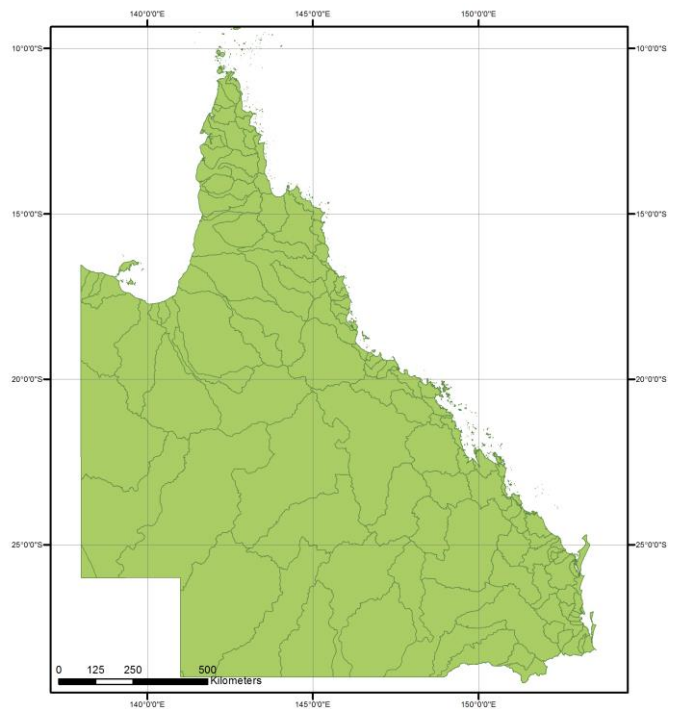
The Queensland Groundwater Dependent Ecosystem Mapping covers:



Ecosystems dependent on the surface expression of groundwater (line features)

Ecosystems dependent on the surface expression of groundwater (area features)

Ecosystems dependent on the sub-surface presence of groundwater (area features)



Ecosystems dependent on the surface expression of groundwater (point features)

Ecosystems dependent on the subterranean presence of groundwater – caves (area features)

What scale is the Queensland Groundwater Dependent Ecosystem Mapping?

The Queensland Groundwater Dependent Ecosystem Mapping has a scale of 1:100,000 or better (e.g. 1:50,000 in some coastal areas). Further information on the scale of mapping for each region of Queensland is available in the accompanying mapping metadata.

How accurate is the Queensland Groundwater Dependent Ecosystem Mapping?

The accuracy of the Queensland Groundwater Dependent Ecosystem Mapping is determined by the source data sets available during mapping development. Therefore, mapping for different regions of Queensland may have different accuracy. Further information on the accuracy of mapping for each region of Queensland is available in the accompanying mapping metadata.

How up-to-date is the Queensland Groundwater Dependent Ecosystem Mapping?

The currency of the Queensland Groundwater Dependent Ecosystem Mapping is determined by the source data sets available during mapping development. Therefore, mapping for different regions of Queensland may have different currencies. Further information on the currency of mapping for each region of Queensland is available in the accompanying mapping metadata.

Where can I find technical specifications for the Queensland Groundwater Dependent Ecosystem Mapping?

Detailed technical specifications for the Queensland Groundwater Dependent Ecosystem Mapping are available on request. The technical specifications document the processes used to implement mapping rule-sets in a geographic information system to develop the Queensland Groundwater Dependent Ecosystem Mapping. These documents are intended to facilitate the replication of Queensland Groundwater Dependent Ecosystem Mapping. The following technical specifications are available:

- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: General Application of the Queensland Groundwater Dependent Ecosystem Mapping and Classification Method
 - This document applies to the Wide Bay-Burnett region
- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: Module One — Eastern Murray-Darling Basin (as developed in version 1.0)
- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: Module Two — Wide Bay-Burnett
- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: Technical specifications for the general application of the Queensland Groundwater Dependent Ecosystem Mapping Method
 - This document applies to all regions (except for the Wide Bay-Burnett region)
- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: Module Three — Pumicestone Passage

- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: Module Four — Mackay–Whitsundays
- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: Module Five — South East Queensland
- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: Module Six — Lake Eyre Basin and surrounding drainage basin sub-areas
- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: Module Seven – Comet, Dawson and Mackenzie drainage basin sub-areas
- Queensland Groundwater Dependent Ecosystem Technical Mapping Specifications: Module Eight – Eastern Murray-Darling Basin (as revised in version 1.5)

References

Department of Science, Information Technology and Innovation 2015, *Queensland Groundwater Dependent Ecosystem Mapping Method: A method for providing baseline mapping of groundwater dependent ecosystems in Queensland*, Department of Science, Information Technology and Innovation, Brisbane.

Department of Science, Information Technology, Innovation and the Arts (2012), *Pictures worth a thousand words: a guide to pictorial conceptual modelling*, Queensland Government, Brisbane.

Environment Protection Agency (2005), *Wetland Mapping and Classification Methodology – Overall Framework – A Method to Provide Baseline Mapping and Classification for Wetlands in Queensland (Version 1.2)*, Queensland Government, Brisbane.

Neldner V, Wilson B, Thompson E, Dillewaard H (2012), *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Version 3.2)*, Queensland Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Richardson, E, Irvine, E, Froend, R, Book, P, Barber, S & Bonneville, B 2011, *Australian groundwater dependent ecosystems toolbox part 1: assessment framework*, National Water Commission, Canberra.

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