Australia's National
Science Agency

GISERA | Gas Industry Social and Environmental Research Alliance

Progress report

Groundwater baseline study of the Canning Basin

CSIRO | Australia Pacific LNG | QGC | origin | Santos | NSW Government | Australian Government Department of Industry, Science, Energy and Resources | Supported by Government of South Australia | Queensland Government | Northern Territory Government

Progress against project milestones

Progress against milestones/tasks are approved by the GISERA Director, acting with authority in accordance with the GISERA Alliance Agreement.

Progress against project milestones/tasks is indicated by two methods: Traffic light reports and descriptive Project schedule reports.

1. Traffic light reports in the Project Schedule Table below show progress using a simple colour code:

- **Green**:
  - Milestone fully met according to schedule.
  - Project is expected to continue to deliver according to plan.
  - Milestone payment is approved.
- **Amber**:
  - Milestone largely met according to schedule.
  - Project has experienced delays or difficulties that will be overcome by next milestone, enabling project to return to delivery according to plan by next milestone.
  - Milestone payment is withheld.
  - Milestone payment withheld for second of two successive amber lights; project review initiated and undertaken by GISERA Director.
- **Red**:
  - Milestone not met according to schedule.
  - Problems in meeting milestone are likely to impact subsequent project delivery, such that revisions to project timing, scope or budget must be considered.
  - Milestone payment is withheld.
  - Project review initiated by GISERA Director.

2. Progress Schedule Reports outline task objectives and outputs and describe, in the 'progress report' section, the means and extent to which progress towards tasks has been made.

Project schedule table

TASK NUMBER	TASK DESCRIPTION	SCHEDULED START	SCHEDULED FINISH	COMMENT
1	Framework development	Jul-20	Sept-20	
2	Data collation	Jul-20	Feb-21	
3	Reporting	Jan-21	Apr-21	

Project schedule report

TASK 1: Framework development

BACKGROUND

The aim of the project is to explore and summarise the current state of knowledge related to groundwater systems in the Canning Basin and to identify needs for future groundwater systems investigations, characterisation and monitoring.

TASK OBJECTIVES

Develop a framework to guide data collation

TASK OUTPUTS AND SPECIFIC DELIVERABLES

The framework for the groundwater baseline characterisation will be developed, based on the regulators' requirements and best practice. The framework will define the data requirement for the effective baseline characterisation and assist in data collection process as well as data gap analysis.

PROGRESS REPORT

This milestone is complete.

The Technical Reference Group (TRG) has been established with representatives from:

- Energy & Groundwater Division, Geoscience Australia
- Science and Planning, Department of Water and Environmental Regulation (DWER) (also represented WA EPA)
- Water Science, Department of Primary Industries and Regional Development
- Geological Survey and Resource Strategy Division, Department of Mines, Industry Regulation and Safety
- Geoscience Mapping Through Cover, Department of Mines, Industry Regulation and Safety
- Theia Energy
- Members of the CSIRO project team

The project team developed the framework for the groundwater baseline characterisation and introduced it to the TRG at their first meeting which was held on 23 September 2020. The

framework aims to define the data requirements for the effective baseline characterisation and assist in the data collection process as well as data gap analysis. The TRG members generally agreed with the proposed approach, summarised as a framework, and commented on the data availability and their respective organisations interests in this project. The TRG did express some concerns about the very short timelines for the project as well as the ability of the project and staff members to undertake the significant tasks of stakeholder engagement as well as collate, review and summarise key datasets for a basin of 400,000 km2 in six months. This followed with additional comments that perhaps the project should focus on key areas in the basin where competition for water resources associated with regional development (energy, minerals and irrigated agriculture) will be greatest. The project team is currently following up with the individual TRG members (instead of initially proposed a second TRG meeting), further exploring potential contribution from the relevant organisations to data collation and groundwater baseline characterisation across the Canning Basin as well as better capturing their key interests. The project team is currently summarising the outcomes of these individual meetings and closely monitoring both the time spent on the project and the progress towards delivering future milestones. Given this milestone is one month overdue it is likely that both the data collation and reporting timelines will need to be adjusted to better account for: (i) the longer than expected time required to form the TRG, (ii) the significant stakeholder engagement process, and (iii) appropriate Christmas/New Year leave arrangements for project staff.

A summary of the framework is provided below:

	Baseline characterisation should address the following objectives	**Data requirement to achieve stated objectives (and likely data custodian)**	**Important considerations**
Hydrogeological systems	• Geological framework of the basin including the extent and type of geological units • Hydrogeological characteristics including aquifer properties, degree of confinement and hydrological interconnectivity • Characteristics of the superficial cover in the basin via which the basins aquifers receive recharge (i.e. thickness, porosity and hydraulic conductivity)	• Known aquifer maps: top and bottom (DPIRD, DWER, GA?) • Geological formation, likely to be aquifers: top and bottom (GSWA) • Major tectonic features (GSWA) • Geophysical data (GeoView, GA EftF, other National Data) • Petroleum exploration data, including porosity/permeability data (WA DMP, industry)	• *Depth of aquifers and hydraulic head* • *Reporting Basin's elements* • *Usefulness of GSWA geological model* • *Sources of porosity/permeability data for the less known aquifers (WA DMP, industry)*

	Baseline characterisation should address the following objectives	Data requirement to achieve stated objectives (and likely data custodian)	Important considerations
		• Water bore data (DWER, DPIRD, others) • Depth to regolith (sources?) • Palleovalley map (GA)	
Groundwater Processes	• Baseline is representative of the climatic cycles of the area and of the geological and geomorphological variation across the region • An inventory of associated surface systems, including terrestrial ecosystems and bodies of surface water, with which the groundwater body is dynamically linked • Estimates of the directions and rates of exchanges of water between the aquifers and associated surface systems • Estimate the long term annual average rate of overall recharge (where possible, recharge zones)	• Climate data (BoM) • Surface water features (streamlines, lakes) (BoM) • Surface water monitoring data (DWER, industry) • Runoff data (AWLA, BoM) • GW discharge zone associated with GDEs locations (GDE Atlas, WA DBCA, DPIRD, DWER, GISERA projects) • Groundwater motoring data (DWER, DPIRD, industry, others) • Environmental tracers and chemistry data and interpretation (DWER, CSIRO, DPIRD, industry) • National recharge assessment data (CSIRO)	• *Spatial distribution of existing monitoring infrastructure* • *Spatial and temporal data sufficiency to address historical variability* • *Unknown water balance components*

	Baseline characterisation should address the following objectives	Data requirement to achieve stated objectives (and likely data custodian)	Important considerations
Groundwater Quality	• Chemical composition of the groundwater, including specification of the contributions from human activity • Key water quality indicators, specific for regional development (irrigation, gas, mining, tourism, town water supply)	• Surface water quality (WA DBCA, DPIRD, DWER, industry, others) • Groundwater quality (DWER, DPIRD, CSIRO, industry, others)	• The most important water quality parameters for individual stakeholders
Groundwater dependencies	• Determine locations of ecologically important perennial and temporary waterbodies and dry season aquatic refugia • Characterise the wet season surface water flow regime • Characterise the dependency or degree of influence on ecosystems by groundwater, and their likely sensitivity to new water extraction • Characterise inter-annual and seasonal water quality variability, with particular focus on dry season aquatic refugia. • Determine locations of culturally important assets or groundwater services • Characterise the dependency or degree of influence of groundwater availability on local economy and their likely sensitivity to new water extraction	• National and state important environmental assets • GDEs Atlas (BoM) • Other sources for GDEs locations (WA DBCA, DPIRD, DWER, WABSI, GISERA projects) • Surface/groundwater monitoring data in the proximity of the GDEs (WA DPIRD, DWER) • Culturally significant assets (WA DBCA, DPIRD, DWER, KLC) • Current groundwater use (WA DPIRD, DWER) • Characterisation of groundwater dependencies (WA DBCA, DPIRD, DWER, WABSI)	• Data source for culturally significant dependencies • Groundwater dependency measurements, as defined by stakeholders

TASK 2: Data collation

BACKGROUND

Within the framework, the project team will source, systematically review and evaluate data, currently available to directly or indirectly characterise groundwater systems in the Basin. It is anticipated that the data are available from various sources, at various scales and uncertain quality and will require quality control and further data integration.

TASK OBJECTIVES

Collate available data suitable for the groundwater characterisation in the Basin

TASK OUTPUTS AND SPECIFIC DELIVERABLES

Review and collation of the available data, suitable for groundwater resource characterisation.

PROGRESS REPORT

This milestone is 100% complete.

Between October 2020 and February 2021, the project team has extensively engaged with the following key stakeholders to collate the data required to assess the groundwater baseline for the Canning Basin:

- Department of Water and Environmental Regulation (DWER)
- Geological Survey and Resource Strategy Division, Department of Mines, Industry Regulation and Safety (DMIRS)
- Theia Energy
- Buru Energy
- Department of Primary Industries and Regional Development (DPIRD)
- Geoscience Australia (GA)
- Energy business unit, Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Innovative Groundwater Solutions (IGS)

This engagement has resulted in the acquisition of 7.5 GB of spatial data and 2.0 GB of scientific literature which includes interpretation of some of the datasets. This data and literature is currently being systematically reviewed and evaluated in regard to its quality and therefore benefit for characterising and understanding groundwater systems across the basin.

TASK 3: Reporting

BACKGROUND

The project will produce a report as well as data, gathered during the project life

TASK OBJECTIVES

Summarise the data availability and gaps

TASK OUTPUTS AND SPECIFIC DELIVERABLES

The report will summarise the main finding, critical gaps in current knowledge and provide initial recommendations for future work.

PROGRESS REPORT

This milestone is complete.

The final report titled *Groundwater baseline review of the Canning Basin, Western Australia* has been publicly released and is available on the GISERA website.

Executive Summary

This project conducted a groundwater baseline review of the Canning Basin, located in north-west Western Australia. It is the first ever collation, review, and summary of groundwater information for the entire Canning Basin. The baseline review was considered important given that the current basin-scale understanding of groundwater is fragmented and sparse in some areas, despite ongoing interest in regional development for irrigated agriculture and mineral and energy resources. That is, reports and data from regional and local-scale groundwater resource assessments are dispersed across the internet, in different libraries and databases; much of these data are not digitally accessible, and in addition, private-sector data remain confidential. It was therefore timely to take stock of groundwater knowledge across the entire basin, to identify where new, higher resolution or improved hydrogeological information would support increased groundwater demand and provide a suite of potential options for future work before any further development occurs.

The review was based on a framework agreed upon with the key stakeholders forming the Technical Reference Group (Section 1.1). The framework, described in Section 3, identified four groundwater baseline assessment components: hydrogeological systems, groundwater processes, groundwater quality and groundwater dependencies. We explored, collated, reviewed, and summarised the available data for each of the four components in sections 4 to 7, respectively. Note that this project was limited to collating, reviewing, and summarising the available data with minor data integration to support the review. Due to a limited timeframe and budget, new data analysis, detailed data integration and interpretation of data were out of the project scope.

The Canning Basin has an onshore extent of about 530,000 square kilometres. It hosts significantly thick and regionally stacked sandstone, shale, and mudstone strata, offering highly prospective resources of groundwater, minerals, oil, and gas. Groundwater resources across the basin have been progressively developed to support irrigated agriculture, town and community water supplies, mineral and energy operations, and the basin's road network. These resources are one of the primary pillars of the basin's economy and support a thriving tourism industry and a diverse range of ecologically and culturally significant water-dependent assets.

The basin's groundwater resources, and water-dependant assets are relatively well understood in areas with the highest demand for groundwater, but other areas remain poorly characterised. However, the current level of characterisation and monitoring is commensurate for the current level of water demand across the basin. Recent investigations into the potential for expanding irrigation and developing unconventional gas resources have also sparked further interest in regional development. In addition, significant interest has also been raised in further protecting

the basin's ecologically and culturally important water-dependant assets as well as some of its unique geological features.

We identified several areas where hydrogeological data and information could be improved: (see Section 8.4):

- existing aquifer attribution to key hydrogeological data is unavailable in the Water Information Reporting (WIR) online data portal and this hinders groundwater resource identification, exploration, and characterisation
- the spatial variability in aquifer and aquitard properties is poorly understood for key hydrogeological systems where water demand is highest or where potential future demand for water is anticipated but is fundamental for accurate water balance estimates
- the majority of existing groundwater quality data is not available for digital download in the WIR database which makes it difficult to either characterise groundwater processes or evaluate the groundwater suitability for different uses in different parts of the basin
- the existing level of characterisation of ecologically and culturally important water-dependant assets is commensurate for the current demand for water across the basin but may need to consider the potential risk of contamination
- a paucity of stratigraphic and hydrogeologic information about the extensive veneer of unconsolidated-to-consolidated sediments and large unsaturated zones in the Great Sandy Desert hampers groundwater exploration and access in an area identified as prospective for unconventional oil and gas resources
- many parts of the study area remain underexplored or unexplored as most previous projects have focused on specific areas of the basin, however, further analysis and integration of previous geophysical data together with regional airborne electromagnetic (AEM) data would improve the understanding of the stratigraphy of the entire basin.

As a result of our research, we have provided a suite of potential options for future work (see Section 8.5). These suggested options have been provided for consideration should there be an increase in demand for groundwater in specific parts of the study area or development of unconventional oil and gas resources proceeds.

- Consider updating the WIR database to include: (i) publicly available aquifer attribution and hydrogeochemical data, and (ii) private hydrogeological data, when and if current water legislation is modernised.
- Consider undertaking additional recharge investigations on the Broome, Wallal and Erskine sandstones and consider the potential development of a stochastic water balance model for the Broome and Wallal sandstones in the west Canning Basin groundwater allocation sub-area.
- Consider applying an integrated geophysical approach to improve the understanding of the basin's stratigraphy and hydrogeology.
- Consider developing a basin-scale geological model to define: (i) the thickness and geometry of Cenozoic cover, (ii) the depth to the top and geometry of key hydrogeological units, and (iii) the occurrence, spatial extent, and thickness of aquitards and aquicludes between Ordovician geological units prospective for unconventional oil and gas and Permian to Cretaceous hydrogeological units important for fresh groundwater supplies.

- Consider further evaluating potential contamination risks to groundwater, including characterising the spatial integrity of the Ordovician to Carboniferous aquitard and aquiclude sequences in the north-west of the study area, particularly as to their physical properties and the presence of structural faults.

Variations to Project Order

Changes to research Project Orders are approved by the GISERA Director, acting with authority, in accordance with the GISERA Alliance Agreement. Any variations above the GISERA Director's delegation require the approval of the relevant GISERA Research Advisory Committee.

The table below details variations to research Project Order.

Register of changes to Research Project Order

DATE	ISSUE	ACTION	AUTHORISATION
16/11/2020	There were delays in establishing the TRG and greater consultation being undertaken than anticipated, this impacted the delivery of milestones 2 & 3.	Milestone 2 extended from December 2020 to end February 2021 & milestone 3 extended from February 2021 to end May 2021.	

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GISERA is a collaboration between CSIRO, Commonwealth and state governments and industry established to undertake publicly-reported independent research. The purpose of GISERA is to provide quality assured scientific research and information to communities living in gas development regions focusing on social and environmental topics including: groundwater and surface water, greenhouse gas emissions, biodiversity, land management, the marine environment, and socio-economic impacts. The governance structure for GISERA is designed to provide for and protect research independence and transparency of research.