GISERA | Gas Industry Social and Environmental Research Alliance

Progress report

Baseline seismic monitoring of the Canning Basin

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: <u>Traffic light reports</u> and descriptive <u>Project schedule reports</u>.

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
Task 1	Identification of Potential Seismic Sources	1 Jul-21	31 Aug-21	Completed
Task 2	Establishing a CSIRO data centre with appropriate data workflows	1 Sept-21	31 Aug-24	Completed
Task 3	1st Interim Report	1 Apr-22	30 Jun-22	Completed
Task 4	Publication platform development	1 Nov-22	28 Feb-25	
Task 5	Refining geological models	1 Nov-22	31 Oct-24	Completed
Task 6	2nd Interim Report	1 Apr-23	30 Dec-23	This task will be delivered in Dec 2024.
Task 7	3rd Interim Report	1 Apr-24	30 Dec-24	This task will be delivered in Feb 2025
Task 8	Final Report	1 Mar-24	30 Apr-25	
Task 9	Communicate findings to stakeholders	1 May-25	30 Jun-25	

Project schedule report

TASK 1: Identification of Potential Seismic Sources

BACKGROUND

The identification of existing seismic sources including man-made ones prior to the installation of the network is critical in discrimination in later stages.

TASK OBJECTIVES

Conduct desktop study to identify and map existing seismic sources from legacy data.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

2D maps of seismic sources and their potential impact on the planned seismic array. It will provide input to the fine tuning on the location of the planned seismic array.

PROGRESS REPORT

This task is complete.
- The shapefiles of the locations of the road network, petroleum licenses, mines (both historical and operating ones) and proposed seismic monitoring station locations have been obtained from the Geological Survey of Western Australia and Landgate (Government of Western Australia).
- Historical seismic event information has been sourced from Geoscience Australia and IRIS earthquake catalogues.
- Reproducible python-based 2D mapping scripts have been developed to map this information.
- The mapped spatial information of road network, petroleum licenses and mine locations are assessed as potential source generators with respect to the station locations.

TASK 2: Establishing a CSIRO data centre with appropriate data workflows to detect and locate seismic activity.

BACKGROUND

It is vital to establish a fully operational data centre that will capture near real-time data from seismic stations, apply several workflows in an automated fashion to streamline the detection and location of seismic activity within the Canning Basin. Several workflows will be tested and fine-tuned over time with the inclusion of inputs from other tasks.

TASK OBJECTIVES

To develop and maintain system that is operational within the restrictions of the GSWA IT security, that can receive and process seismic data and produce a location and magnitude for each event using the state of the art detection and location algorithms and workflows.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

The system should be able to:
   a) Retrieve data from the GA open access repository including the GSWA new stations, and from the Seismometers in Schools server (and possibly any other local real-time network) into a temporary CSIRO data centre.

b) Set up and refine triggering algorithms specific to the stations in this study with the aim of capturing magnitude 1.5 events and larger
c) To automate location and magnitude calculations of seismic activity from the triggered events
d) Incorporate outputs from Task 4 to refine the depth and magnitude estimates. Consider relocation of historic events using the refined velocity model
e) To allow operator review and intervention into the automation on an ad hoc basis
f) Produce a listing of the seismic activity details suitable for publication

PROGRESS REPORT

This task is now completed. We have developed workflows that automatically retrieve continuous data from the data centre and designed algorithms to detect, locate, and calculate the magnitudes of seismic activity. The seismic velocity model is also incorporated into the location workflow. As a result, we can create a list of earthquakes within the study region, including timing, spatial, and magnitude information.

TASK 3: 1ˢᵗ Interim Report

BACKGROUND

The desktop study regarding the potential seismic sources aims to determine the location of existing sources, classify them, and provide input to the network design. The data centre will automatically retrieve the data from Geoscience Australia and will apply many processing steps in the background to the raw data to detect and locate earthquakes.

TASK OBJECTIVES

Provide a general outline of the potential seismic sources and provide input to the seismic network design (GSWA Task). Provide a preliminary assessment of the data centre's capabilities and core functions.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

A detailed report showing the results of the desktop study of seismic sources through maps and digital datasets. Assessment of the capabilities of the data centre with the first batch of the data coming from the seismic network.

PROGRESS REPORT

This task is complete. The current progress of the project is captured in the first interim report which is publicly available on the GISERA website via this link.

TASK 4: Publication platform development

BACKGROUND

The whole aim of this task is to make publicly available the baseline seismicity of the Canning Basin as outlined in Task 2. The information produced in the previous step need to be shared with the public in a transparent and accessible way. Ideally the information portal will regularly publish a

daily listing and map of the seismic activity of the Canning Basin and follows the format and standards of the other international published seismic event catalogues as well as maintaining an easy-to-understand interface for the public. This activity will proceed through the following stages:

Stage 1 - Determine the minimum viable product in collab with GSWA**.**

Stage 2 - Development / Implementation of information portal

Stage 3 - Deliver the information portal software and processing workflows to GSWA.

TASK OBJECTIVES

Publish locations and magnitudes of seismic activity in the Canning Basin

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

a) Identify and document and agreement between GSWA and CSIRO on minimum viable product
b) Delivery of beta information portal for acceptance testing by CSIRO and GSWA on GSWA IT infrastructure
c) Completion of acceptance testing and formal handover of information platform to GSWA by CSIRO.
d) CSIRO staff to train GSWA staff in the operation and maintenance of the software

PROGRESS REPORT

This task is due for completion February 2025.

TASK 5: Refining geological models

BACKGROUND

The science of seismic activity location strongly relies on having earth models with strong a priori knowledge. In general, for 'poor' earth models, the estimated depths and location of events can be off by several km, which will bias baseline monitoring operations. The same data collected in the array can be used to improve the Earth models to refine the spatial location of the detected seismic events.

TASK OBJECTIVES

To conduct advanced seismological research using the seismic data to investigate the geological structure of the Canning Basin. The results will contribute to new geological information to discriminate natural and man-made seismic events.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

Methods such as receiver function analysis and ambient noise tomography will be used to gain a better geological insight into the structure of the Canning Basin. Geological models will be published via open access platforms including social media and academic publications. Implementation of updated velocity models into GSWA information portal by CSIRO.

This task is now completed. With the publication of Chen, Saygin et al. (2023), we have produced a continent-wide seismic velocity model. This model has been incorporated into the process of locating seismic events.

TASK 6: 2nd Interim Report

BACKGROUND

The data centre will automatically retrieve the data from Geoscience Australia and will apply a number of processing steps in the background to the raw data to detect and locate seismic activity. The publication platform is for disseminating information about detected seismic events to the public.

TASK OBJECTIVES

Provide an update of the data centre functionality supported with real data examples. Initial assessment of the publication platform.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

Examples of detected local seismic activity: location maps, magnitude information. Demonstration of the publication platform through screenshots as given in the report.

PROGRESS REPORT

This task will be complete in November 2024.

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
23/06/23	Delays have been experienced in data transmission from the seismic network, as a result of Cyclone Ellie in early 2023	Milestone 6 extended from June 2023 to September 2023	
20/10/23	Several seismic stations are down due to telecommunication problems, firmware issues and floods	Milestone 6 extended from September 2023 to December 2023	

26/04/24	Delays in delivery of 1st Interim report have resulted in delayed delivery of the 2nd and 3rd Interim reports.	Milestone 7 extended from June 2024 to December 2024.	

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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.