Australia's National Science Agency

GISERA | Gas Industry Social and Environmental Research Alliance

Summary of CSIRO's GISERA Research Projects

Queensland

RESEARCH AREA	PROJECT
Surface and groundwater	• Geochemical response to re injection - understand and quantify aquifer reactions occurring due to re-injection of CSG water, and their impacts on water quality. • Re-injection of CSG water - understand, quantify and manage clogging of injection wells during re-injection of CSG water permeates, brines and blends. • High performance groundwater modelling - determine the feasibility of large-scale re-injection schemes. • Isotope and geochemical groundwater baseline study - characterise the baseline geochemistry of groundwater and formation water prior to and during initial stages of development to understand groundwater age and origin. • Hydrocarbons in groundwater, Surat and Bowen basins - review and assess the presence of organic compounds in groundwater found in the Surat and Bowen basins using existing open source and company held data. • Constraining water flows in the Surat Basin - measuring and modelling specific chemicals called environmental tracers to gain a better understanding of the speed and direction of groundwater flow. • Groundwater contamination risk assessment - assess the likelihood of groundwater contamination from hydraulic fracturing and wellbore damage. • Air, water and soil impacts of hydraulic fracturing (Phase 1) - design an intensive monitoring campaign that will measure the air, water and soil impacts of hydraulic fracturing of production wells in the Surat Basin. • Air, water and soil impacts of hydraulic fracturing (Phase 2) - undertake a comprehensive monitoring campaign to measure the air, surface water, groundwater and soil impacts of hydraulic fracturing of gas production wells in the Surat Basin. • Cooper Creek flood modelling scenarios - deliver outputs from targeted flood modelling scenarios developed in response to on-going engagement with stakeholders in the Cooper GBA region. • Microbial activity in the subsurface - understand controls and constraints of potential microbially influenced corrosion in onshore gas wells in the Surat and Bowen basins, Queensland. • Sources and mobility of gas in formations below the Walloon Coal Measures - investigate potential impacts of CSG production in the Surat Basin in southeast Queensland on important water supply aquifers that underlie the target coal seams in the Walloon Coal Measures. • Beneficial reuse and disposal options for brine in Queensland - review beneficial reuse and disposal options for brine produced from CSG operations in Queensland's Surat and Bowen basins.
Social and economic	• Monitoring regional transition - synthesise existing knowledge on the nature of rural socio-economic transitions occurring as a result of resource developments, and track the social impacts of regional economic change. • Economic assessment and forecasting project - understand future impacts on regional economies and how local businesses can respond. • Understanding community aspirations - identify community aspirations and their overlaps and/or disparities with existing resources, industry, and policy trajectories. Specifically, to understand how different community segments see the future of the region and how these reflect the economic and policy avenues for the region. • Community functioning and well-being - survey 1 - identify principal indicators of community function and well-being, the resources and strategies necessary for enabling and enhancing community responses, and how communities respond to major developments in their region. • Community function and well-being survey 2 - conduct a community well-being survey to measure the changes since the end of the construction and start of the operations phases and compare results with the Survey 1 in 2014. • Trends in community wellbeing and attitudes to CSG development – Survey 3 - monitor and communicate the changes and trends in community wellbeing, resilience and attitudes to CSG development across different phases of industry operation in south west Queensland, and identify how these vary between the construction, post-construction, and operations phases of development. • Community wellbeing and attitudes to CSG development - 2014 to 2024 – Survey 4 - identify trends in community wellbeing and attitudes to CSG development in south-west Queensland - from the construction phase to a fully operational phase. • Evaluating medium-term socio-economic impacts of onshore gas activity in Southern Queensland - study a range of potential positive and negative social, demographic and economic impacts that are commonly linked to onshore natural gas extraction activity, across the regions of the Surat and Bowen basins, in southern Queensland.
Greenhouse gases and air quality	• Methane seepage in the Surat Basin - detect and measure methane seeping from underground in the Surat Basin and identify sources of methane to provide a baseline of methane emissions on a regional scale. • Greenhouse gas emission assessment of the Surat Basin Gas Reserve - analysis of the whole of life cycle GHG emissions, including extraction, transportation and usage of CSG in the Surat Basin. • Ambient air quality in the Surat Basin - comprehensive assessment of air quality in the Surat Basin region in Queensland using air quality measurement network and modelling. • Methane contributions from holding ponds - desktop study to identify emissions potential and controls in CSG holding ponds and aquatic systems in Queensland. • Key controls or contributors to methane emissions from CSG water holding ponds in the Surat Basin, Queensland - the data will focus on the role that methane generating and eating microbes, algae, brine and sediment play in the methane emission contributions of water holding ponds. • Methane emissions from Queensland coal seam gas water holding ponds in the Surat Basin - select multiple representative CSG holding ponds to accurately quantify methane emissions, in both summer and winter, using rigorous sampling methods to minimise known methane measurement limitations. • Using carbon and hydrogen isotopes to fingerprint sources of methane emissions from the Western Downs Region in the Surat Basin - conduct isotopic fingerprinting of methane at various sites (including gas industry, agricultural, wastewater treatment, swamps, natural seeps, landfills).
Health	• Potential health impacts from CSG - establish processes and governance to ensure research quality, define the project boundary, conduct hazard identification and exposure pathways, and screen data. • Exposure assessment of identified chemicals used in CSG activities - screen and appraise the ~50 chemicals, and conduct microbial degradation trials to identify persistent chemicals requiring further in-depth assessment. Undertake a comprehensive sampling campaign at specific wells and surface water bodies to determine the presence or absence of these chemicals of potential concern. • Analysis of dust near CSG sites to assess potential for respirable crystalline silica - assess current composition of dust and size distributions of the different constituents in the study area to determine the abundance of RCS. Results will be compared against samples collected at the same time from reference sites which are not impacted by the CSG operation.

RESEARCH AREA	PROJECT
Agriculture	• Preserving agricultural productivity - assist in the preservation of agricultural productivity during land use change. • Shared space - understand how farmers from a range of production systems (extensive grazing to intensive cropping) perceive and value CSG developments on their and others' farms. • Gas farm design - understand how to design farms for a new mixed land use. • Making tracks, treading carefully - understand the direct and indirect impacts of tracks and traffic on invasive species and erosion in agricultural landscapes. • Without a trace - identify the nature and likely extent of damage to agricultural soils, and methods for avoiding and improving soils. • Telling the story - share understanding of changes on farms and in towns during CSG development in the Surat area. • CSG and Livestock – Inside the Herd - monitor grazing land with CSG infrastructure to better understand the impacts of CSG infrastructure, traffic and dust on animals and pastures.
Biodiversity	• Priority threat identification, management and appraisal - identify and understand the broad range of existing and new threats to biodiversity across a CSG development region. • Fire ecology of grassy woodlands - determine the sensitivity of the region's flora and fauna to changed fire regimes, and the thresholds at which changed fire regimes cause substantial ecological impact. • Habitat selection by two focal species - study two species, the Golden-tailed gecko and Glossy black-cockatoo, to assess the range of impacts from CSG development in south-west Queensland on their habitat. • Ensuring biodiversity offset success: the right kind of seed for a rare daisy - identify genetic and demographic factors that may limit the success of establishing a rare daisy (*Rutidosis lantana*) in a new location. • Guidelines for offset population sizes - improve the understanding of how ecological and biological traits of rare species of plants, commonly encountered in restoration projects, and different environmental factors determine viable population sizes by using computer models. • Sustaining turtles and their homes - understand how sediments from dredging and discharges affect seagrass and turtles. • Breeding response of focal threatened species to a resource pulse in the Cooper Basin - take advantage of recent major flooding in the Cooper Basin to capture information on important breeding sites of threatened or otherwise significant birds species.
Land and Infrastructure	• Review of cements, steels and microbial activity for Qld CSG wells - collate details on materials used in well casings and cements from information contained within Well Completion Reports. Review information on microbial activity in related geological formations from published papers and CSIRO studies. • Cement degradation processes in coal seam gas wells in Queensland - investigate the potential for cement degradation and their processes in CSG wells under conditions (pressure, temperature, groundwater chemistry) typically encountered in the Surat region.

New South Wales

RESEARCH AREA	PROJECT
Surface and groundwater	• Impacts of CSG depressurization on Great Artesian Basin flux - improve understanding of the GAB groundwater flow in the Pilliga region through integration of existing information from models, hydrochemical data and environmental tracers. • Spatial design of groundwater monitoring network in the Narrabri Gas Project area - analysis and design of groundwater bore networks for optimal groundwater monitoring and early detection of changes. • Improving groundwater models to better represent coal seam gas extraction impacts in the Namoi region - develop more representative models for estimating the groundwater impacts from coal seam gas well fields. • Groundwater contamination risk assessment - assess the likelihood of groundwater contamination from hydraulic fracturing and wellbore damage. • Assessment of faults as potential connectivity pathways - improve understanding of sub-surface structures and potential fault zones that may act as pathways between target coal seams and shallow aquifers or surface water systems, and by helping to further improve the accuracy of future groundwater models in the Narrabri region. • Microbial communities and their ability to degrade prospective chemicals used in coal seam gas activities - help improve understanding of the fate of chemical compounds used in coal seam gas activities in the region if these compounds were to come into contact with the environment. • Geochemical modelling and geophysical surveys to refine understanding of connectivity between coal seams and aquifers - improve our knowledge of groundwater systems in the Gunnedah and Surat Basins in the Narrabri region and refine the conceptual understanding of potential for hydrogeological connectivity pathways between shallow aquifers. • Groundwater modelling and predictive analysis to inform CSG impact assessment, monitoring and management - undertake independent groundwater modelling and predictive analyses to inform coal seam gas groundwater impact assessment and regulatory monitoring and management in the Narrabri Gas Project area. • Review of beneficial reuse or end-use options for brine from the Narrabri Gas Project region - collate existing data on brine and salt management in the region; review existing and emerging technologies and solutions; analyse the costs and benefits of brine reuse and end-use options.
Social and Economic	• Analysing economic and demographic trajectories in NSW regions experiencing CSG development and operations - identify current levels and trajectories of economic, social and demographic variables in CSG regions within NSW and analyse whether or not the CSG industry could change the trajectory of these variables. • Social baseline assessment of the Narrabri region of NSW in relation to CSG development - understand and measure attitudes, perceptions and expectations that exist within the community with respect to CSG development, and current levels of community wellbeing and community resilience. • Decommissioning pathways for CSG projects - review regulatory frameworks in relation to principles derived from international literature and consider social concerns with regard to decommissioning of wells and well pad infrastructure. • Assessing and projecting on-shore gas effects on regional economic activity - analyse the influence of the NSW on-shore gas industry on regional economic and social indicators, and use economic models to generate descriptions of potential future effects for NSW. • Monitoring community wellbeing and attitudes to CSG in Narrabri (pre-construction phase) - monitor any changes in local community wellbeing and attitudes to coal seam gas (CSG) during the pre-construction phase of the Santos Narrabri Gas Project in NSW.
Greenhouse gases and air quality	• Regional Methane Emissions in NSW CSG Basins - identify and quantify methane emission sources such as CSG infrastructure, feedlots, coal mining, legacy bore holes in the Pilliga region.
Health	• Potential human health effects of coal seam gas (study framework) - review current information to design a study on the health effects of CSG activities based on community stakeholder, governmental, expert consultation group, and industry input.
Biodiversity	• Remote sensing and threatened species surveys to better understand risks of forest fragmentation from the Narrabri Gas Project - determine how fragmentation resulting from Narrabri Gas Project land clearing activities will add to the existing impacts from prior land use fragmentation on biodiversity in the region.

Northern Territory

RESEARCH AREA	PROJECT
Surface and groundwater	• Baseline monitoring of groundwater properties in the Beetaloo Sub-basin, NT - understand the geochemical properties, recharge rates and recharge mechanisms of groundwater. • Environmental monitoring and microbial degradation of onshore shale gas activity chemicals and fluids - better understand how typical onshore gas chemicals biodegrade in relevant aquifers and soil types in the Northern Territory. • Improved approaches to long-term monitoring of decommissioned onshore gas wells - investigate options for long-term monitoring of well integrity in decommissioned onshore gas wells in the Northern Territory, including assessment of well decommissioning practices and monitoring techniques and technology, in the context of Northern Territory regulatory requirements • Onshore gas water lifecycle management options framework - design an options framework and decision criteria for water and wastewater management for Northern Territory onshore gas development. • Fate of hydraulic fracturing fluids/chemicals and geogenic hydrocarbons in surface facilities and in the subsurface - provide a systems-based approach to understanding chemicals and their lifecycle during hydraulic fracturing, in flow-back water produced after fracturing, and in tanks and ponds in industry facilities in the Northern Territory. • Characterisation of the stygofauna and microbial assemblages of the Beetaloo Sub-basin, NT - undertake a broad spatial pilot-scale survey of water bores in the Beetaloo Sub-basin, using direct sampling and DNA-based approaches to determine the distribution and abundance of stygofauna and characterise subterranean groundwater-dependent ecosystems. • Examination of stygofauna ecosystems of the Beetaloo Sub-basin - build an understanding of the extent to which stygofauna present in bores reflect their presence more widely within aquifers. It also aims to understand the physical and chemical drivers that may determine where stygofauna exist and how communities may be connected. • Environmental baseline characterisation of the springs in Hot Springs Valley, NT - conduct a field campaign to collect detailed data on the geology, hydrogeology and ecology of the Hot Springs Valley to augment data collected in previous surveys. • Groundwater connectivity in the eastern extension of the Beetaloo Sub-basin - investigate potential connectivity of groundwater systems between the Cambrian Limestone Aquifer and the surface in the eastern extension of the Beetaloo Sub-basin. • Review of potential environmental impacts of shale gas related wastewater disposal options - assess wastewater management and treatment options, including associated waste disposal requirements, and their potential for environmental harm.
Social and Economic	• Mapping future transport passages and volumes for improved planning and operation - using scenarios of both construction and operational phases of gas development, analyse road and rail freight costs, flows and impacts for identified sites and regions in the Beetaloo Sub-basin in the NT. Test a range of interventions that may increase road safety while reducing costs and impacts on the environment and local communities. • Pathways for Indigenous socio-economic development in the Beetaloo region of the Northern Territory - explore how economic opportunities from shale gas and other projects (agriculture, renewables, etc) can support the aspirations, values, and priorities of Aboriginal communities.
Greenhouse gases and air quality	• Baseline measurement and monitoring of methane emissions in the Beetaloo Sub-basin - understanding of the natural methane levels, over the various seasons, a baseline for accurately quantifying any future onshore gas impacts. • Mitigating Fugitive Gas Emissions from Well Casings - review current industry practice and conduct experimental investigations to evaluate techniques and assess new materials designed to minimise fugitive methane emissions leaking from microfractures and gaps in gas well cement casing. • Offsets for Life cycle Greenhouse Gas Emissions of Onshore Gas in the NT - seek feasible options to offset life cycle greenhouse gas emissions emitted in Australia associated with scenarios of new production and Australian consumption of onshore gas extracted from NT Beetaloo Sub-basin. • Methane emissions quantification of well drilling to completion processes in Beetaloo sub-basin - use autonomous emissions monitoring stations to quantify fugitive methane emissions from well construction and completion activities from unconventional shale petroleum exploration in the Beetaloo sub-basin. Results from this study will compare actual measured results with estimated results to verify the adequacy of existing calculated emission estimates.
Agriculture	• Putting land management knowledge into practice - develop high-quality spatial data to help landholders, regulators, and the gas industry evaluate design and placement of gas infrastructure, protect surface water and vegetation, and reduce erosion, soil damage and dust.
Biodiversity	• Understanding and managing impacts to biodiversity from roads and pipelines in the Beetaloo - investigate how roads, pipelines and other linear transport infrastructure may impact biodiversity in the Beetaloo Sub-basin during the development of an onshore gas industry. • UAV–LiDAR and spaceborne remote sensing for site survey and habitat condition monitoring in the Beetaloo - develop a scalable approach for monitoring the structural condition of vegetation in the Beetaloo Sub-basin.
Land and Infrastructure	• Background Seismicity of Beetaloo Sub-Basin and Seismic Hazard – establish long-term background seismic data to characterise the current natural seismic activity in the Beetaloo Sub-basin in the Northern Territory. This baseline data can then be used to distinguish any possible increases in seismic activity resulting from future gas development and operations in the region. • Beetaloo basin shale long-term competency after decommissioning – quantify the self-sealing competency of shales in the Beetaloo basin that sit between the target natural gas seams and the shallow Cambrian Limestone Aquifer.

Western Australia

RESEARCH AREA	PROJECT
Surface and groundwater	• Groundwater baseline study of the Canning Basin, Western Australia – explore and summarise the current state of knowledge of groundwater systems in the Canning Basin, Western Australia. • Baseline groundwater and seismicity, northern Perth Basin – improve understanding of seismic activity and groundwater in the northern Perth Basin in Western Australia.
Social and Economic	• Community wellbeing and attitudes to the energy transition in the North Perth Basin - provide an in-depth understanding of how energy infrastructure projects in the North Perth Basin region would affect the functioning and well-being of local communities.
Biodiversity	• Baseline assessment of the biodiversity of the Canning Basin, Western Australia - assess the current state of knowledge about the biodiversity of the Canning Basin in Western Australia.
Land and Infrastructure	• Baseline seismic monitoring of the Canning Basin, WA - establish a long-term baseline of seismic monitoring data that will characterise the current natural seismic activity and cultural seismic noise within the Canning Basin in Western Australia. • Northern Perth Basin subsurface resources conflicts - helping communities, government and industry understand and resolve potential resource conflicts in the northern Perth Basin in Western Australia.

South Australia

RESEARCH AREA	PROJECT
Surface and groundwater	• Onshore gas and water contamination: causes, pathways and risks - investigate potential groundwater contamination causes, pathways and vulnerability to understand onshore gas water quality impacts for south east South Australia. • Groundwater balance in gas development regions of south east South Australia - improve groundwater balance models in the onshore gas development regions of south east South Australia. • Microbial degradation of chemical compounds used in onshore gas production in the SE of South Australia - understand biodegradation of certain chemical compounds used in onshore gas production in the southeast of South Australia. • Microbial degradation of chemicals and fluids in aquifers of the Limestone Coast, South Australia - demonstrate the potential for microbial degradation of chemicals used by the onshore gas industry across the Tertiary Limestone Aquifer in the Limestone Coast region of south east South Australia. • Decision support framework for future groundwater development scenarios in the south east South Australia - develop and test a decision support framework to improve management of groundwater resources. Research outcomes will consider probable future groundwater use scenarios, taking account of climate change and various future water use patterns for irrigation, forestry, onshore gas and other industries in the south east of South Australia.
Social and Economic	• Community wellbeing and attitudes to conventional gas development in the south east of South Australia - measure levels of perceived risk, benefits, knowledge, and other underlying drivers of trust and social acceptance of conventional gas development in South Australia's south east, and develop baseline data on community values, well-being and future expectations. • Assessing the value of locally produced conventional gas in South Australia's south east - develop a profile of the gas industry and its role within the regional economy and develop scenarios for how the local gas industry may evolve. • The role of gas in South Australia - clarify the role of natural gas in meeting the state's renewable energy, security, emissions and energy pricing goals.
Agriculture	• Gas impacts and opportunities on primary industries - analyse possible impacts and opportunities from gas development for rural areas in South Australia's south east. • Perspectives on risk to local markets and industries - explore potential market impacts and associated concerns relating to the value of place of origin labelling and branding arising from conventional gas development in south east of SA.