



GISERA
Gas Industry Social and
Environmental Research Alliance

Project Order, Variations and Research Progress

Project Title: Human health effects of Coal Seam Gas Activity- scrutinizing emission pathways for harmful exposure levels using novel risk assessment techniques

This document contains three sections. Click on the relevant section for more information.

- Section 1: [Research Project Order as approved by the GISERA Research Advisory Committee and GISERA Management Committee before project commencement](#)
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GISERA
Gas Industry Social and
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1 Original Project Order



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South Australia**



Project Order

Proforma 2016

1. Short Project Title

Human Health effects of Coal Seam Gas Activity Study Design

Long Project Title

Human Health effects of Coal Seam Gas Activity: scrutinizing emission pathways for harmful exposure levels using novel risk assessment techniques

GISERA Project Number

H.1

Proposed Start Date

1 February 2017

Proposed End Date

31 August 2017

Project Leader

Melita Keyword

2. GISERA Region

Queensland

New South Wales

Northern Territory

3. GISERA Research Program

Water Research

GHG Research

Social & Economic Research

Biodiversity Research

Agricultural Land Management Research

Health

4. Research Leader, Title and Organisation

Melita Keyword, Principal Research Scientist, CSIRO Oceans and Atmosphere 30%

5. Background

The NSW Chief Scientist CSG Review included a report on managing environmental and human health risks from CSG activities (OCSE 2014). It identified potential risks to the environment (air, soil, water) by four major CSG activities

- drilling, well integrity and fracture stimulation;
- seam depressurisation;
- spills and leaks;
- produced water and solids.

Exposure pathways of risk to human health were identified as water, soil and air, and indirectly in food. The report suggested that exposure pathways can be understood through the modelling of water and air movement, or ecological webs, which requires knowledge of the local environment and potential contaminants.

While the report identified many risks and uncertainties around human health from emissions arising from CSG activities, the report concluded that the risks can be managed through regulation and monitoring. Subsequently, the report has been accused of leaving concerns about CSG and health unanswered.

Potential human health risks from CSG activities are consistently raised as an issue of concern to the community (OCS 2014). Directly measuring human health effects through epidemiological studies of such communities is difficult or perhaps impossible for several reasons. The CSG industry in NSW is relatively small. The small population exposed to activities means that epidemiological studies do not have sufficient statistical power to clearly distinguish disease states or health outcomes that may be caused or aggravated by exposures related to CSG activities from background occurrence of these conditions. Furthermore, some potential health effects of concern may not manifest over shorter time periods but rather emerge after longer periods (many years or decades) of exposure or latency. Thus, direct studies of health outcomes may not provide meaningful conclusions about the impacts of CSG activity on human health. Published peer-reviewed studies on this issue are limited (Vaneckova and Baylis 2014; Stearman et al., 2014; Navi et al., 2014; Werner et al., 2015). However, human health risk assessment techniques can provide qualitative, semi-quantitative, or quantitative estimates of potential human health risks. The level of quantitative evaluation depends on the type and degree of data that is available regarding the possible chemical exposures.

This work complements existing Surat Basin CSG site and community investigations:

- Air quality work and water quality research- data sets collected from these studies will underpin health investigations;
- Social survey- data sets and experience will be valuable for designing health survey questionnaires and community engagement.

6. Project Description

The research described here is **Phase 1** of a study to address the question: does CSG activity in the NSW region influence human health, and if so, how and to what degree?

Phase 1 focuses on a review of the state of knowledge about health impacts of CSG activity and identification of gaps in the knowledge base and the design of a study to address these gaps. The study design produced in **Phase 1** will be used to develop proposals for the implementation of the study that would be carried out in **Phase 2**.

The study that would be carried out in **Phase 2** will be a follow up project to the work detailed here. **Phase 2** will generate information required to investigate the health impacts of CSG activities. **Phase 2** is not included in the work described in this document.

CSIRO will lead **Phase 1** and, working together with the Queensland Alliance for Environmental Health Sciences (QAEHS, UQ), will draw upon a pool of subject experts in environmental monitoring, exposure assessments, (eco)toxicology, epidemiology, human health risk assessments, risk communication and community engagement.

This project will begin to address the community interest in a more explicit evaluation of potential human health risks and impacts from CSG.

Importance and necessity

This project is important because of community concern about the influence of CSG activity on health. Comprehensive CSG health studies have not been carried out in Australia, and the few studies reporting health impacts that have been undertaken (Werner et al., 2016), have been opportunistic and inconclusive and generally led to heightened community concern). This concern is a significant driver for opposition to CSG activity and thus a source of revenue loss for industry. In this project, we plan to involve community in the design of the study and to make all information open and transparent e.g. publish data sets, community presentations etc.

Methodology

The methodology will involve two phases:

- **Phase 1**- This phase will consist of four main tasks:
 - Update the previously conducted literature reviews from the NSW Chief Scientist to provide a current picture of the state of knowledge and identification of gaps in the knowledge base related to potential contaminants and human health risks.
 - Establish a community stakeholder group to contribute to understanding of the local site and an expert consultation group to guide study design and implementation. The community consultation will occur in NSW.
 - Build an initial conceptual site model of the community and the CSG activities in this community based on community stakeholder, governmental, expert consultation group, and industry input. This conceptual site model will provide an initial picture of the potential contaminants and exposure pathways. Evaluation of alternative health risk assessment approaches will be undertaken in parallel with and be informed by the conceptual site model.
 - Design a study to address the general and local knowledge gaps based on the conceptual site model and the community stakeholder perspectives. The study design could apply to NSW or Queensland.
- **Phase 2**- This phase would include the implementation of the study and is not part of the scope of this document.

Phase 1

Task 1

Update the previously conducted literature reviews from the NSW Chief Scientist to provide a current picture of the state of knowledge and identification of gaps in the knowledge base related to potential contaminants and human health risks:

The review will compile and critically assess literature, reports and other information sources since 2013 (or an earlier date as necessary) on the following:

1. Datasets (physical environment and human health) available for the study region;
2. Health studies carried out in other CSG regions;
3. Potential CSG-related emission sources in the study area, including fugitive emissions of CSG, CSG flaring and combustion, as well as other emission sources linked to CSG extraction processes but not directly linked to CSG such as diesel exhaust emissions;
4. Chemicals likely to be used during CSG extraction activities;
5. Behaviour of these chemicals in the environment i.e. how they are introduced, how they move through the environment, how they are removed, how populations are exposed (exposure routes);

6. Mechanisms of toxicity of the above chemicals to populations, communities, and ecosystems;
7. Exposure risks to pollutants from CSG extraction activities;
8. Life style factors such as cigarette smoking and diet that could contribute to adverse health outcomes;
9. Community perception to the risk and perceived risk.

The results of this review will be used to inform the conceptual site model (Task 3). Importantly the review will identify the scope of what should be included in Phase 2 by eliminating from the study design factors with no risk and highlighting knowledge gaps related to potential contaminants and human health risks.

Task 2

Establish a community stakeholder group to contribute to understanding of the local site and an expert consultation group to guide study design and implementation:

Questions regarding health concerns will be incorporated into surveys planned for distribution during November 2016 as part of the “Social baseline assessment of the Narrabri region of New South Wales in relation to CSG development”. Based on the outcome of these survey questions, a further engagement plan focused on a study of potential human health risks and impacts from CSG will be designed and implemented in March 2017. Parallel to this, a community stakeholder group will be established to contribute to the development of the conceptual site model (see Task 3).

An expert consultation group will be established early in Phase 1. It is envisaged that the group would include, but not be limited to, the following individuals and/or organisations:

1. Air quality science: CSIRO and QAEHS
2. Water quality science: CSIRO and QAEHS
3. Toxicology (human) and ecotoxicology (ecosystems): Lesa Aylward (UQ), Peter Sly (UQ, specialist in respiratory toxicology), Beate Escher (UFZ Leipzig/UQ, specialist in ecotoxicology)
4. Exposure and risk assessments: QAEHS, Leisa-Marie Toms (QUT)
5. Human health, mental health and epidemiology: Lesa Aylward (UQ), Peter Sly (UQ), Geoffrey Morgan and Bin Jalaludin (CRE Energy transitions, air pollution and health in Australia) Melissa Haswell (QUT), NSW Health (tbd)
6. Psychology, risk communication and community engagement: Andrea Walton (CSIRO), Kelly Fielding (UQ), GISERA
7. Statisticians (tbd)

The expert consultation group will meet face-to-face on at least one occasion as well as by video conferencing. A facilitator will be engaged to manage the face-to-face meeting. We will hold a 1-2 day meeting for community groups and work with a community survey consultant to undertake a community survey to determine issues of concern to the community regarding health. This could be carried out in NSW or Queensland. The recommendation of the expert consultation group and outcomes of the community survey will be summarized for inclusion in final report developed in Task 4.

Task 3

Build an initial conceptual site model of the community and the CSG activities in this community based on community stakeholder, governmental, expert consultation group, and industry input:

This conceptual site model will provide an initial picture of the potential contaminants and exposure pathways. Identification of exposure pathways will be informed by inspection of the CSG activities, discussion with industry and experts from the expert consultation group, consultation with government representatives, and consultation with the community stakeholder groups. In particular, the community stakeholder groups will be critical to identifying the possible exposure pathways that most concern residents and the basis of those concerns. Identification of potential contaminants will be particularly informed by the literature review and expert consultation group, as well as data or perspectives from the governmental and industry representatives.

Information on hazards of identified potential contaminants and the possible exposure pathways will be combined into a conceptual site model that allows a qualitative assessment of potential risks (Figure 1) and will guide the design of a more detailed study (see Task 4). Alternative risk assessment approaches, including consideration of the statistical representation of particular events/exposures occurring along the causal pathway will be evaluated by the expert consultation group and a recommended approach, appropriate to the study site(s) and the expected availability/quality of data, will be proposed. Additional relevant information including identification of lifestyle or social factors that may indicate vulnerable populations or modify response to possible chemical exposures will also be collected during this task.

We also expect that these consultations will identify aesthetic and environmental or ecological concerns as well -- these will be noted and incorporated as an arm of the conceptual model for further consideration in addressing community concerns and perception of acceptability of CSG activities, even when they do not directly relate to possible human health impacts.

The conceptual model will be developed for NSW but be applied in Queensland.

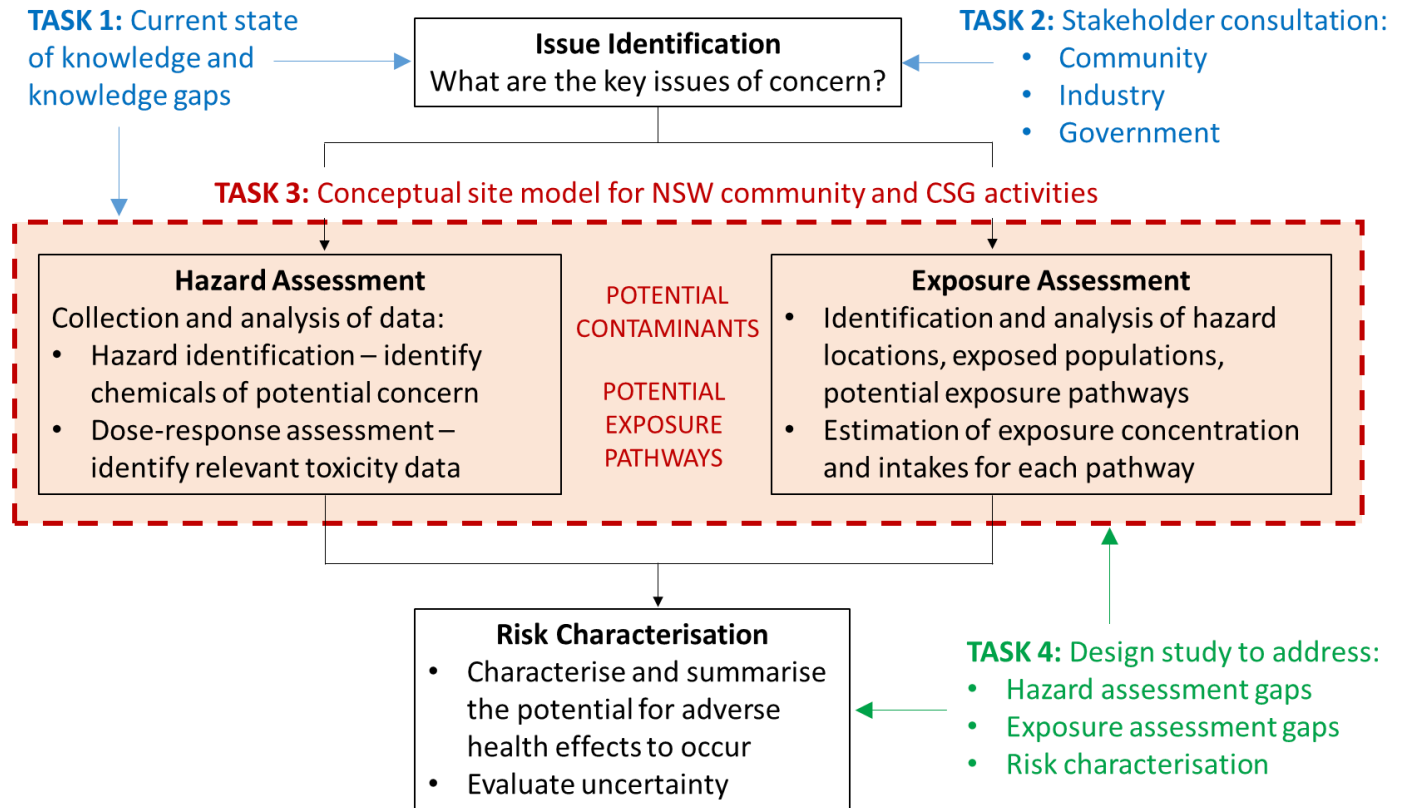


Figure 1: The environmental health risk assessment process (black boxes; adapted from enHealth , 2012) showing the information that Tasks 1-4 will deliver to enable the health risk assessment process (Phase 2)

Task 4

Design a study to address the general and local knowledge gaps based on the conceptual site model and the community stakeholder perspectives:

The outcomes of Tasks 1-3 will provide the basis for developing a study design to deliver an evaluation of potential human health risks and impacts of CSG activities. The intention is to provide an approach based on best practice that can be readily adapted to other CSG sites and communities at a regional or national level.

Based on the overall health risk assessment framework, the various parties (community stakeholders, expert consulting group, etc.) will identify the items of most concern for the specific site using information from the conceptual model and then design sampling methods and other data collection that will provide the necessary site-specific information to complete the assessment. This will be achieved through workshops and other consultation forums held throughout Phase 1. It is anticipated that an important component of the study design is the identification of potentially useful longitudinal monitoring components, both with respect to environmental media sampling and analysis and potentially with respect to markers of health outcomes. The result of Task 4 will be a report outlining the proposed best practice approach for the Phase 2 study design, as well as an implementation plan and associated costings.

Note that the report will include the details of how the quantitative health risk assessment will be carried out. However, a detailed health risk assessment itself will not be carried out as part of the work proposed here and will instead be carried out during Phase 2 which will be the subject of a future proposal.

The study design report will be peer reviewed.

Deliverables

- A current picture of the state of knowledge and identification of gaps in the knowledge base related to potential contaminants and human health risks
- An initial conceptual model for the NSW community and CSG activities
- A fully costed, peer reviewed design for a health study that has industry and community endorsement

Community and industry benefits

Community benefit- Community will receive information about chemicals emitted by CSG activities in the air, water and soil and a more explicit evaluation of potential human health risks and impacts from CSG

Industry benefit- Industry will demonstrate willingness to be transparent about environmental information (i.e. Social license to operate (Williams and Walton, 2013)).

7. Budget Summary

Expenditure	2016/17	2017/18	2018/19	Total
Labour	102,916	22,134	-	125,050
Operating	30,000	-	-	30,000
Subcontractors	91,508	25,966	-	117,474
Total Expenditure	224,424	48,100	-	272,524

Expenditure per Task	2016/17	2017/18	2018/19	Total
Task 1	28,193	-	-	28,193
Task 2	117,752	-	-	117,752
Task 3	41,279	-	-	41,279
Task 4	37,200	48,100	-	85,300
Total Expenditure	224,424	48,100	-	272,524

Source of Cash	2016/17	2017/18	2018/19	Total
Contributions				
GISERA Industry Partners (25%)	56,106	12,025	-	68,131
- Santos (12.5%)	28,053	6,012.50	-	34,065.50
- AGL (12.5%)	28,053	6,012.50	-	34,065.50
NSW Government (25%)	56,106	12,025	-	68,131
Federal Government (25%)	56,106	12,025	-	68,131
Total Cash Contributions	168,318	36,075	-	204,393



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In-Kind Contribution from Partners	2016/17	2017/18	2018/19	Total
CSIRO (25%)	56,106	12,025	-	68,131
Total In-Kind Contribution from Partners	56,106	12,025	-	68,131

	Total funding over all years	Percentage of Total Budget
GISERA Investment	\$68,131	25%
NSW Government Investment	\$68,131	25%
Federal Government Investment	\$68,131	25%
CSIRO Investment	\$68,131	25%
Total Other Investment	-	
TOTAL	\$272,524	

Task	Milestone Number	Milestone Description	Funded by	Start Date	Delivery Date	Fiscal Year Completed	Payment \$ (excluding CSIRO contribution)
Task 1	1.1	Update the NSW Chief Scientist literature reviews to provide a current picture of the state of knowledge and identification of knowledge gaps regarding potential contaminants and human health risks. Includes project team labour and travel costs	GISERA	02-17	04-17	16/17	\$21,144
Task 2	2.1	<p>Establish a community stakeholder group and an expert consultation group; includes project team labour and travel costs</p> <p>Hold 3 day meeting of expert consultation group (or 2x 2 day meetings depending on schedules); includes engagement of a workshop facilitator, travel and accommodation costs for experts; project team labour</p> <p>Hold a 1-2 day meeting of the community stakeholder group and undertake community survey, includes engagement of a community survey consultant; travel for project team and project team labour</p> <p>Summarize recommendations from expert consultation group and the community survey; includes project team labour and travel costs</p>	GISERA	02-17	06-17	16/17	<p>\$18,000</p> <p>\$34,318</p> <p>\$18,000</p> <p>\$18,000</p>
Task 3	3.1	Build an initial conceptual site model of the community and the CSG activities in this community. Includes project team labour costs	GISERA	02-17	06-17	16/17	\$30,959



Task 4	4.1	Provide a study design to address the general and local knowledge gaps, an implementation plan and associated costings. Includes project team labour costs	GISERA	5-17	8-17	17/18	\$63,974
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8. Other Researchers (include organisations)

Researcher	Time Commitment (project as a whole)	Principle area of expertise	Years of experience	Organization
Andrea Walton	40 days	Community wellbeing, resilience and social acceptance	7	CSIRO
Anu Kumar	20 days	Water and Environmental Toxicology		CSIRO

9. Subcontractors

Subcontractors (clause 9.5(a)(i))	Subcontractor	Role
	Lesa Aylward, UQ	Human health risk assessments and toxicology
	Jochen Mueller, UQ	Environmental monitoring, exposure and risk assessment
	Sharon Grant, UQ	Environmental monitoring, exposure and risk assessment
	Leisa-Marie Toms, QUT	Epidemiology and exposure and risk assessment
	TBD	Workshop facilitator
	TBD	Community Survey Consultant

10. Project Objectives and Outputs

Objectives

1. To provide the current state of knowledge regarding potential contaminants and health effects of CSG activities
2. To identify knowledge gaps regarding health effects of CSG activities
3. To design a study to address these knowledge gaps and answer the question “Does CSG activity in the NSW region influence human health, and if so, how and to what degree?”

Outputs

1. Report summarising the current state of knowledge and knowledge gaps regarding potential contaminants and health effects of CSG activities.
2. Conceptual model for the NSW community and CSG activities, including the identification of hazards and a qualitative assessment of the risk of the hazard.
3. Peer reviewed report detailing the study design for a health study to investigate health effects of CSG Activity. Included in the report will be recommendations for the environmental and health data required to carry out the health study.

11. GISERA Objectives Addressed

Carrying out of research and improving and extending knowledge of social and environmental impacts and opportunities of unconventional gas projects for the benefit of the Gas Industry, the relevant community and the broader public.

Informing government, regulators and policy-makers on key issues regarding policy and legislative framework for the Gas Industry.

12. Project Development

The NSW Chief Scientist identified that potential human health risks from CSG activities are consistently raised as an issue of concern to the community (OCS 2014), and while the NSW Chief Scientist identified many risks and uncertainties around human health from emissions arising from CSG activities, the NSW Chief Scientist has been accused of leaving concerns about CSG and health unanswered. Hence there is interest from NSW Government to address these concerns.

Concern over the potential health effects of CSG activities will be a national issue as CSG exploration occurs in other states around Australia. The value of this work is that the systematic review of information, identification of knowledge gaps and design of a study to address these health concerns could, with caveats, be tailored for any CSG exploration area. Thus effectively this study could develop a tool for the design of health studies to investigate the impact of CSG activities on health.

Input for project development

- Discussion with Andrea Walton project leader of Social baseline assessment of the Narrabri region of New South Wales in relation to CSG Development- who shared insights regarding community consultation
- NSW Office of Chief Scientist- information in reports
- Discussions with GISERA management team who shared their insights from recent field trips to Narrabri and the discussions they have had with community, government, industry, local farmers, and indigenous stakeholders
- Discussion with Sarah Lawson project leader for Ambient Air Quality, Surat Basin, Queensland who shared insights from recent trips to Surat Basin around the communities concerns over health impacts.

13. Project Plan

The work will review the state of knowledge of the health impacts of CSG activities and will identify gaps in the knowledge base. Using this information and the expertise of an expert panel a study will be designed to address these gaps and answer the question “Does CSG activity in the NSW region influence human health, and if so, how and to what degree?”

13.1 Project Schedule

ID	Task Title	Task Leader	Scheduled Start	Scheduled Finish	Predecessor
Task 1	Update the NSW Chief Scientist literature reviews to provide a current picture of the state of knowledge and identification of knowledge gaps regarding potential contaminants and human health risks	Melita Keywood	1 February 2017	30 April 2017	None
Task 2	Establish a community stakeholder group and an expert consultation group Hold 3 day meeting of Expert Working Group (or 2x 2 day meetings depending on schedules) Hold a ½ day meeting for community groups and undertake community survey Summarize recommendations from Expert Working Group	Andrea Walton (community) Melita Keywood (expert group)	1 February 2017	30 June 2017	None
Task 3	Build an initial conceptual site model of the community and the CSG activities in this community	Melita Keywood	1 February 2017	30 June 2017	None
Task 4	Provide a study design to address the general and local knowledge gaps, an implementation plan and associated costings	Melita Keywood	1 May 2017	31 August 2017	1, 2 & 3

Task 1

TASK NAME: Update CSG literature review

TASK LEADER: Melita Keywood

OVERALL TIMEFRAME: 3 months

BACKGROUND: The NSW Chief Scientist CSG Review included a report on managing environmental and human health risks from CSG activities. It identified potential risks to the environment (air, soil, water) by four major CSG activities:

- drilling, well integrity and fracture stimulation;
- seam depressurisation;
- spills and leaks;
- produced water and solids.

Exposure pathways of risk to human health were identified as water, soil and air, and indirectly in food. The report suggested that exposure pathways can be understood through the modelling of water and air movement, or ecological webs, which requires knowledge of the local environment and the potential contaminants.

While the report identified many risks and uncertainties around human health from emissions arising from CSG activities, the report concluded that the risks can be managed through regulation and monitoring. Subsequently, the report has been accused of leaving concerns about CSG and health unanswered. Potential human health risks from CSG activities are consistently raised as an issue of concern to the community (OCS 2014).

TASK OBJECTIVE: Update the NSW Chief Scientist literature reviews to provide a current picture of the state of knowledge and identification of knowledge gaps regarding potential contaminants and human health risks

TASK OUTPUTS: Report summarising the current state of knowledge and knowledge gaps

SPECIFIC DELIVERABLES: Report summarising the current state of knowledge and knowledge gaps.

Task 2

TASK NAME: Establish a community stakeholder group and an expert consultation group

TASK LEADER: Andrea Walton (community) and Melita Keywood (expert group)

OVERALL TIMEFRAME: 5 months

BACKGROUND: Potential human health risks from CSG activities are consistently raised as an issue of concern to the community. It will be important for these concerns to be addressed by the study design hence consultation with the community is an important part of the project. Similarly an investigation of health effects will require capability from a range of disciplines, which lie outside of the core project team. Thus engaging a group of experts with diverse but relevant capabilities to provide input to the study design will ensure a robust design.

TASK OBJECTIVE: Establish a community stakeholder group to contribute to understanding of the local site and an expert consultation group to guide study design and implementation.

Hold a 3 day meeting of Expert Working Group (or 2x 2 day meetings depending on schedules).

Hold a 1-2 day meeting for community groups and undertake community survey.

Summarize recommendations from Expert Working Group and results of the community survey.

TASK OUTPUTS: Report summarising recommendations of the community survey.

SPECIFIC DELIVERABLES: Outcomes from the workshop will be incorporated into the Peer reviewed report detailing the study design.

Task 3

TASK NAME: Conceptual Model of potential contaminants and exposure pathways

We also expect that these consultations will identify aesthetic and environmental or ecological concerns as well -- these will be noted and incorporated as an arm of the conceptual model for further consideration in addressing community concerns and perception of acceptability of CSG activities, even when they do not directly relate to possible human health impacts.

TASK LEADER: Melita Keywood

OVERALL TIMEFRAME: 5 months

BACKGROUND: This conceptual site model will provide an initial picture of the potential contaminants and exposure pathways. Identification of exposure pathways will be informed by inspection of the CSG activities, discussion with industry and expert consultation experts, consultation with government representatives, and consultation with the community stakeholder groups. In particular, the community stakeholder groups will be critical to identifying the possible exposure pathways that most concern residents and the basis of those concerns (for example, perceived odour). Identification of potential contaminants will be particularly informed by the literature review and expert consultation group, as well as data or perspectives from the governmental and industry representatives. Information on hazards of identified potential contaminants and the possible exposure pathways will be combined into a conceptual site model that allows a qualitative assessment of potential risks

and will guide the design of a more detailed study (see Task 4). Additional relevant information including identification of lifestyle or social factors that may indicate vulnerable populations or modify response to possible chemical exposures will also be collected during this task.

TASK OBJECTIVE: To build a conceptual model of potential contaminants and exposure pathways

TASK OUTPUTS: A conceptual model of potential contaminants and exposure pathways

SPECIFIC DELIVERABLES: The conceptual model will be incorporated into the Peer reviewed report detailing the study design.

Task 4

TASK NAME: Study design

TASK LEADER: Melita Keywood

OVERALL TIMEFRAME: 4 months

BACKGROUND: The outcomes of Tasks 1-3 will provide the basis for developing a study design to deliver an evaluation of potential human health risks and impacts of CSG activities. The intention is to provide an approach based on best practice that can be readily adapted to other CSG sites and communities at a regional or national level.

Based on the overall health risk assessment framework, the various parties (community stakeholders, expert consulting group, etc.) will identify the items of most concern for the specific site using information from the conceptual model and then design sampling methods and other data collection that will provide the necessary site-specific information to complete the assessment. This will be achieved through workshops and other consultation forums held throughout Phase 1. An important component of the study design will most likely be the identification of potentially useful longitudinal monitoring components, both with respect to environmental media sampling and analysis and potentially with respect to markers of health outcomes.

TASK OBJECTIVE: To produce a fully costed, peer reviewed design for a health study that has industry and community endorsement.

TASK OUTPUTS: Peer reviewed report detailing the study design.

References

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- Navi, M., C. Skelly, et al. (2014). "Coal seam gas water : potential hazards and exposure pathways in Queensland" <http://eprints.qut.edu.au/72270>." International Journal of Environmental Health Research 25(2): 162-183.
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- Werner, A. K., S. Vink, et al. (2015). "Environmental health impacts of unconventional natural gas development: A review of the current strength of evidence." Science of the Total Environment 505: 1127-1141.
- Werner, A. K., K. Watt, et al. (2016). "All-age hospitalization rates in coal seam gas areas in Queensland, Australia, 1995-2011." Bmc Public Health 16.
- Williams, R. and A. Walton (2013). The Social Licence to Operate and Coal Seam Gas Development. A literature review report to the Gas Industry Social and Environmental Research Alliance (GISERA). March 2013. CSIRO, Canberra. <https://gisera.org.au/wp-content/uploads/2016/04/socioeco-proj-5-lit-review.pdf>.

Communication of the results of the project will be managed in accordance with GISERA’s communication strategy. This may include presentations at community and industry meetings, conferences and publication of reports, scientific articles and factsheets. In addition, communication with relevant state and federal government departments including Department of the Environment, NSW Health, NSW EPA and NSW Chief Scientist’s office will be maintained to ensure that they are aware of the outcomes of the research and possible policy implications.

The project will establish a Technical Reference Group (TRG) aimed at seeking peer-to-peer technical advice on contextual matters and to discuss research needs as well as outputs as the project progresses. The TRG will include the project leader and a group of different stakeholders as appropriate (noting NSW Chief Scientist Office have been approached and declined).

15. Intellectual Property and Confidentiality

Background IP (clause 11.1, 11.2)	Party	Description of Background IP	Restrictions on use (if any)	Value
				\$
				\$
Ownership of Non-Derivative IP (clause 12.3)	CSIRO			
Confidentiality of Project Results (clause 15.6)	Project Results are confidential.			
Additional Commercialisation requirements (clause 13.1)	Not Applicable			
Distribution of Commercialisation Income (clause 13.4)	Not applicable			
Commercialisation Interest (clause 1.1)	Party		Commercialisation Interest	
	Santos		N/A	
	AGL		N/A	
	CSIRO		N/A	





2 Variations to Project Order

Changes to research Project Orders are approved by the GISERA Director, acting with authority provided by the GISERA National Research Management Committee, in accordance with the [National GISERA Alliance Agreement](#).

The table below details variations to research Project Order.

Register of changes to Research Project Order

Date	Issue	Action	Authorisation
29/6/17	Delays due to the extensive feedback and information received from the expert workshop panel, milestones 1, 2, 3 and 4 were pushed back.	Milestone 1 pushed back to Jul 17, milestone 2 pushed back to Jul 17, milestone 3 pushed back to Jul 17, milestone 4 pushed back to Sept 17.	
27/9/17	Extensive stakeholder feedback has resulted in delays.	Milestone 4 pushed back to Nov 17.	



3 Progress against project milestones

Progress against milestones are approved by the GISERA Director, acting with authority provided by the GISERA National Research Management Committee, in accordance with the [National GISERA Alliance Agreement](#).

Progress against project milestones/tasks is indicated by two methods: Traffic Light Reports and descriptive Project Schedule Reports.

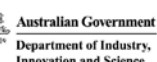
1. Traffic light reports in the Project Schedule Table below show progress using a simple colour code:
 - **Green:**
 - Milestone fully met according to schedule.
 - Project is expected to continue to deliver according to plan.
 - Milestone payment is approved.
 - **Amber:**
 - Milestone largely met 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 approved for one amber light.
 - 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 and undertaken by GISERA Research Advisory Committee.
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

ID	Task Title	Task Leader	Scheduled Start	Scheduled Finish	Predecessor
Task 1	Update the NSW Chief Scientist literature reviews to provide a current picture of the state of knowledge and identification of knowledge gaps regarding potential contaminants and human health risks	Melita Keywood	Feb-17	Jul-17	None
Task 2	<p>Establish a community stakeholder group and an expert consultation group</p> <p>Hold 3 day meeting of Expert Working Group (or 2x 2 day meetings depending on schedules)</p> <p>Hold a ½ day meeting for community groups and undertake community survey</p> <p>Summarize recommendations from Expert Working Group</p>	<p>Andrea Walton (community)</p> <p>Melita Keywood (expert group)</p>	Feb-17	Jul-17	None
Task 3	Build an initial conceptual site model of the community and the CSG activities in this community	Melita Keywood	Feb-17	Jul-17	None
Task 4	Provide a study design to address the general and local knowledge gaps, an implementation plan and associated costings	Melita Keywood	May-17	Nov-17	1, 2 & 3





Project Schedule Report

Task 1

TASK NAME: Update CSG literature review

TASK LEADER: Melita Keywood

OVERALL TIMEFRAME: 3 months

BACKGROUND: The NSW Chief Scientist CSG Review included a report on managing environmental and human health risks from CSG activities. It identified potential risks to the environment (air, soil, water) by four major CSG activities:

- drilling, well integrity and fracture stimulation;
- seam depressurisation;
- spills and leaks;
- produced water and solids.

Exposure pathways of risk to human health were identified as water, soil and air, and indirectly in food. The report suggested that exposure pathways can be understood through the modelling of water and air movement, or ecological webs, which requires knowledge of the local environment and the potential contaminants.

While the report identified many risks and uncertainties around human health from emissions arising from CSG activities, the report concluded that the risks can be managed through regulation and monitoring. Subsequently, the report has been accused of leaving concerns about CSG and health unanswered. Potential human health risks from CSG activities are consistently raised as an issue of concern to the community (OCS 2014).

TASK OBJECTIVE: Update the NSW Chief Scientist literature reviews to provide a current picture of the state of knowledge and identification of knowledge gaps regarding potential contaminants and human health risks

TASK OUTPUTS: Report summarising the current state of knowledge and knowledge gaps

SPECIFIC DELIVERABLES: Report summarising the current state of knowledge and knowledge gaps.

PROGRESS REPORT:

Unconventional natural gas (UNG) development, including coal seam gas (CSG), has increased in many areas of the world as technological advances have made extraction of natural gas from a variety of geologic formations more economical. Such development has prioritised the need for evaluation of potential environmental hazards – as well as potential exposures and risks to human health due to chemical or non-chemical hazards – associated with UNG development. This review seeks to provide an overview of potential hazards and available health effect studies related to UNG development. The review is an update covering the time period since 2014, when the NSW



Chief Scientist & Engineer issued the report, managing environmental and human health risks from CSG activities.

Results and conclusions of the review can be summarised as: potential hazards; risk assessment frameworks and recent risk assessments studies in UNG regions; recent epidemiological studies on human health outcomes; and the role of non-chemical stressors. Although the focus is on CSG, the limited number of studies related to CSG activities, particularly in the Australian context, meant that studies related to other types of UNG and surrogate industries were heavily relied on. Major gaps in data or understanding related to the environmental and public health hazards of UNG and CSG development are identified.

Task 2

TASK NAME: Establish a community stakeholder group and an expert consultation group

TASK LEADER: Andrea Walton (community) and Melita Keywood (expert group)

OVERALL TIMEFRAME: 5 months

BACKGROUND: Potential human health risks from CSG activities are consistently raised as an issue of concern to the community. It will be important for these concerns to be addressed by the study design hence consultation with the community is an important part of the project. Similarly an investigation of health effects will require capability from a range of disciplines, which lie outside of the core project team. Thus engaging a group of experts with diverse but relevant capabilities to provide input to the study design will ensure a robust design.

TASK OBJECTIVE: Establish a community stakeholder group to contribute to understanding of the local site and an expert consultation group to guide study design and implementation.

Hold a 3 day meeting of Expert Working Group (or 2x 2 day meetings depending on schedules).

Hold a 1-2 day meeting for community groups and undertake community survey.

Summarize recommendations from Expert Working Group and results of the community survey.

TASK OUTPUTS: Report summarising recommendations of the community survey.

SPECIFIC DELIVERABLES: Outcomes from the workshop will be incorporated into the Peer reviewed report detailing the study design.

PROGRESS REPORT:

This report includes a summary of the community perspectives, the expert workshop and the conceptual model (Task 3).

Community Perspectives:

Semi-structured in-depth interviews were used to explore and understand the issues related to health, CSG development, and the design of a health study. In addition, previous research findings on the Surat Basin were helped us to interpret and understand the issues. Goals of the community consultation were to



1. To identify the main issues of concern for community stakeholders in relation to health and CSG development
2. To understand where community stakeholders consider a future study should be undertaken
3. To develop guiding principles that reflected community expectations about how a health study should be conducted

The main issues identified during the consultation were concerns related to direct physical hazards, concerns related to mental health impacts and identification of benefits that improve health in the region.

Three different study areas were discussed in relation to a future health study; Narrabri (new development), the Surat Basin (extensive and ongoing development) and Camden (historic development) and participants identified pros and cons associated with each potential area. Each context was seen as having unique characteristics that would make a study at that site useful. In general, addressing places that were at different stages of CSG development was considered as worthy.

The key guiding principles and expectations identified were around trust and independence, with community perceiving these factors to be paramount to the success of any health study.

Expert Workshop:

The “CSIRO/UQ Coal Seam Gas health effects study” Workshop took place on the Monday 22 – Wednesday 24 May in Brisbane. The purpose of the workshop was to share information and insights from a range of health and technical experts on the elements needed in a study of the potential human exposures, health risks and potential health effects of CSG activities.

The workshop was attended by 36 participants from research and government organisations including CSIRO, Queensland Government, NSW Government and several universities. The dynamic agenda for the workshop saw a mixture of plenary and group discussions on various topics including: exploring stakeholder perspectives; factors to be consider to ensure study outcomes are relevant to and accepted by community and other stakeholders; hazard Identification; non-chemical stressors; risk assessment and health study approaches and methodologies.

Key outcomes from the workshop include the importance of stakeholder engagement in co-design of a study and that health assessments are highly site specific. This means that while we cannot define a ‘one size fits all’ study, we can provide recommendations for the best options for given situations. The health impact assessment framework (HIA) was seen as a useful tool for carrying out health assessments. The Health Assessment Framework for Natural Gas (HAF4NG), is adapted from the HIA to allow the fact that many CSG sites already established, that CSG is highly complex and that the key values identified by both community and the expert workshop of transparency, independence and real engagement are incorporated.





Task 3

TASK NAME: Conceptual Model of potential contaminants and exposure pathways

We also expect that these consultations will identify aesthetic and environmental or ecological concerns as well -- these will be noted and incorporated as an arm of the conceptual model for further consideration in addressing community concerns and perception of acceptability of CSG activities, even when they do not directly relate to possible human health impacts.

TASK LEADER: Melita Keywood

OVERALL TIMEFRAME: 5 months

BACKGROUND: This conceptual site model will provide an initial picture of the potential contaminants and exposure pathways. Identification of exposure pathways will be informed by inspection of the CSG activities, discussion with industry and expert consultation experts, consultation with government representatives, and consultation with the community stakeholder groups. In particular, the community stakeholder groups will be critical to identifying the possible exposure pathways that most concern residents and the basis of those concerns (for example, perceived odour). Identification of potential contaminants will be particularly informed by the literature review and expert consultation group, as well as data or perspectives from the governmental and industry representatives. Information on hazards of identified potential contaminants and the possible exposure pathways will be combined into a conceptual site model that allows a qualitative assessment of potential risks and will guide the design of a more detailed study (see Task 4). Additional relevant information including identification of lifestyle or social factors that may indicate vulnerable populations or modify response to possible chemical exposures will also be collected during this task.

TASK OBJECTIVE: To build a conceptual model of potential contaminants and exposure pathways

TASK OUTPUTS: A conceptual model of potential contaminants and exposure pathways

SPECIFIC DELIVERABLES: The conceptual model will be incorporated into the Peer reviewed report detailing the study design.

PROGRESS:

This milestone is complete.

The report for Task 2 includes a description of the conceptual models that could be used in a health assessment. The conceptual model would be used as part of the scoping and planning stage of the HAF4NG to identify hazards and their pathways to exposure. The report includes examples of conceptual models for the construction phase, the operational phase without hydraulic fracturing, the operational phase with hydraulic fracturing activities and the decommissioning/well abandonment phase.





Task 4

TASK NAME: Study design

TASK LEADER: Melita Keywood

OVERALL TIMEFRAME: 4 months

BACKGROUND: The outcomes of Tasks 1-3 will provide the basis for developing a study design to deliver an evaluation of potential human health risks and impacts of CSG activities. The intention is to provide an approach based on best practice that can be readily adapted to other CSG sites and communities at a regional or national level.

Based on the overall health risk assessment framework, the various parties (community stakeholders, expert consulting group, etc.) will identify the items of most concern for the specific site using information from the conceptual model and then design sampling methods and other data collection that will provide the necessary site-specific information to complete the assessment. This will be achieved through workshops and other consultation forums held throughout Phase 1. An important component of the study design will most likely be the identification of potentially useful longitudinal monitoring components, both with respect to environmental media sampling and analysis and potentially with respect to markers of health outcomes.

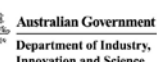
TASK OBJECTIVE: To produce a fully costed, peer reviewed design for a health study that has industry and community endorsement.

TASK OUTPUTS: Peer reviewed report detailing the study design.

PROGRESS REPORT:

This milestone is now complete. The final report for the project Human Health Effects of Coal Seam Gas Activities - A Study Design Framework describes the methodology used to develop a framework that can be applied to study the health effects of coal seam gas activities. Included in this methodology is a literature review, consultation with the community and an Expert Workshop during which conceptual models of the hazards associated with CSG activities were identified. The literature review, community consultation perspectives, a summary of the Expert Workshop and a description of the conceptual models have been the subject of previous reports (Aylward et al., 2017 and Keywood et al., 2017).

The final report presents a framework that could be used to design studies to investigate the influence of CSG activity on human health that would be carried out in Phase 2. The proposed study framework uses the core tenets of the Health Impact Assessment (HIA) framework, to identify potential health impacts on a population from a development. HIAs generally apply existing knowledge and evidence about health impacts to develop evidence-based recommendations. The framework proposed here is aimed toward generating new, foundational evidence on the possible exposures on residents living in the vicinity of CSG activities in Australia and any associated health impacts.





The framework being offered here has two parallel streams of research:

1. Conducting exposure and health impact assessments for chemical and physical stressors
2. Identifying CSG activities contributing to social stress and defining effective intervention and mitigation strategies to reduce exposure to these stressors, while maximizing benefits in the context of the community's overall resilience

A series of staged steps are the essence of the framework, with consultation and decision points at each step:

1. A Scoping and Planning phase defines the overall structure for a study in a given location, including strategies for involving stakeholders, communicating findings, and meeting research ethics requirements. This phase establishes processes to support the quality and legitimacy of the research.
2. The Identification and Screening phases establish the potential sources of chemical and physical hazards (air, water, soil, noise, and light) and other stressors, such as social stressors. It also defines how community members near CSG activities might be exposed. These phases compile existing data, assess the data for quality and validity, and establish a data archive. Through these processes, gaps in knowledge are identified.
3. The Further Assessment phase involves in-depth assessments of exposures and risks as well as health outcome assessments. This phase addresses gaps in data in relation to relevant chemical and physical stressors. This phase also identifies social stress status as well as needs and mitigation opportunities to minimise social stress impact.
4. The Recommendations phase is the final stage in the framework and integrates findings, draws conclusions, and makes recommendations, including identifying needs for ongoing monitoring.

The final report will be available on the GISERA website in March 2018.

