

# Project Order

Proforma 2016

## 1. Short Project Title

Air, water and soil impacts of hydraulic fracturing

### Long Project Title

An intensive monitoring campaign to measure the air, surface water, groundwater and soil impacts of hydraulic fracturing of production wells in the Surat Basin

### GISERA Project Number

W.11

### Proposed Start Date

1 February 2017

### Proposed End Date

30 June 2017

### Project Leader

Melita Keywood

## 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 Keywood, Principal Research Scientist, CSIRO Oceans and Atmosphere

## 5. Background

The potential impact on air, surface water, groundwater and soil of hydraulic fracturing (HF) operations in coal seam gas production are of general concern to communities living in gas development regions. The Surat Basin is no different, and members of the Western Downs community want evidence that they will not be subjected to any adverse impacts as HF becomes increasingly used in that region. Community concerns center around disclosure of the nature and type of chemicals used in the HF operations; potential enhanced mobilization of geogenic contaminants (Rn, Hg, VOCs) from the coal seam; the possible environmental fate of HF chemicals and geogenic contaminants; and the potential for impacts on human health and the environment.

As a response to these concerns, GISERA is undertaking new projects in 2017 on health impacts of CSG development (initially in NSW but extending into Queensland subject to government funding outcomes). In order to accurately assess potential health impacts, it is necessary to know the environmental fate and concentration HF-related contaminants.

The objective of this study is to conduct a comprehensive study on the effects of HF on air, water and soil. This will involve measurements of contaminant concentrations before, during and after HF at selected sites in the Surat Basin. The project will also investigate contaminant sources, pathways and environmental fate.

The project comprises a Phase 1 Review and Monitoring/Sampling Design (5 months) and a Phase 2, Monitoring and Sampling Program (13 months). This Project Order concerns the approval of Phase 1 with a stage-gate 'Go/No-Go' decision step to be approved by the Queensland Regional Research Advisory Committee (RRAC) prior to commencement of Phase 2.

This project presents an important opportunity to generate a definitive account of the potential for environmental impacts from CSG production including hydraulic fracturing. The project presents a unique opportunity to access production wells during an extended HF program over 17 months in 2016 and 2017. Origin Energy will allow unrestricted access, where safe, to air, surface water, groundwater and soil in the vicinity of wells being hydraulically fractured for establishing instruments, sample collection and ongoing monitoring. Origin Energy will also liaise with researchers to maximize data collection during Phase 2.

There may be a perceived risk around conflict-of-interest which could present a risk to CSIRO independence associated with this project as Origin Energy will have involvement in enabling access to the well field. However, these risks will be mitigated through institution of the following oversight mechanisms:

- Establishment of an external Review Panel consisting of four independent external scientists of international reputation

- Peer review of the air, surface water, groundwater and soil sampling and measurement program by the Review Panel
- Opportunity for the external Review Panel to observe the implementation of measurements and to examine the field site during measurements if they so wish.
- Peer review of the final research report(s) by the Review Panel (and any other external and independent expert the Review Panel sees fit to invite to review documents)
- The convening of a Stakeholder Panel of local representatives engaged through a GISERA 'Knowledge Transfer' session to examine the design and implementation of the measurement program.

Significant work is already underway that will be incorporated into the project. In October 2016 Origin Energy secured the permission of landholders, and engaged SGS Leeder to undertake passive monitoring of VOCs and H<sub>2</sub>S at the proposed study site. In addition, Origin Energy is currently in final negotiations with Ecotech for the provision of a fixed air quality monitoring station (AQMS) also to be located at the study site. Surface and groundwater sampling by Origin and SGS Leeder is also underway in the vicinity of the proposed study site. CSIRO O&A visited the proposed study sites in October 2016 and provided advice and oversight on the selection of sites for the VOC monitoring and AQMS. In addition to providing important baseline air quality data for the proposed project, the AQMS and VOC monitoring will also provide significant additional data to the current GISERA Surat Basin Ambient Air Quality Study and vice versa.

Origin Energy will provide CSIRO with information on chemicals used during HF (including a sample of the HF fluid to be collected and analysed to confirm its composition) and provide information about the HF process; will provide access to the wells during the HF activities; and, ensure a safe work environment and necessary HSE training and PPE.

CSIRO will oversee program design and GISERA governance; audit procedures of third party air sampling and analysis providers; compile and analyse data; report data; and, make data/reports publically available on GISERA website with open public access to data.

## 6. Project Description

The project consists of two phases:

1. Phase 1 - Review, study design for a measurement program and establishment of baseline monitoring/sampling
2. Phase 2 - Implementation of measurement program designed in Phase 1. Approval of Phase 2 is NOT SOUGHT by the Queensland Regional Research Advisory Committee (RRAC) at this time.

**Phase 1: Impact of HF on air, surface water, groundwater and soil: Review of state of the knowledge, study design and review of baseline monitoring/sampling** (6 months, complete by July 2017, stage-gate 'Go/No-Go' decision by March/April 2017)

1. Review of state of the knowledge about the potential sources of air, surface water, groundwater and soil pollutants associated with CSG extraction using HF incorporating findings from the National Chemical Assessment. This will include the review of publically available industry reports and peer reviewed publications. In addition this study will request information from Origin/the hydraulic fracturing services company on chemical compounds that will be used in the proposed HF operations.
2. Establishment of external Review Panel.
3. Design of monitoring and sampling protocols for air, surface water, groundwater and soil observations).
4. Peer review of proposed air, surface water, groundwater and soil sampling and measurement programs by the Review Panel
5. Establishment of baseline observations for air, surface water, groundwater and soil measurements;.
  - a. CSIRO will oversee commissioning of AQMS including QA/QC audit checks (underway) and commissioning of passive VOC network including QA/QC audit checks (underway).
  - b. Baseline surface and groundwater measurements: data provided by Origin will be reviewed and gaps (if any) identified.
  - c. Baseline soil measurements: data provided by Origin will be reviewed and gaps (if any) identified.
6. Preliminary measurements:
  - a. Air- VOC passive monitoring and AQ station during HF at the Field Site
  - b. Supplementary baseline data (if required): water - surface and ground water quality samples from Site 1 and surrounds
  - c. Supplementary baseline data (if required): Soil quality samples from Site 1 and surrounds
7. Analyse preliminary data
8. Review Panel to peer review design and implementation of measurement program and to examine field site during first measurements. Review Panel to sign off on research quality.
9. Construct research reports on Phase 1 and undertake external project representation consistent with GISERA Communications and Engagement Strategy.
10. Stage-gate 'Go/No-Go' decision based on the developed measurement program plan to be made by March/April 2017

The outcomes of Phase 1 will include:

- A review of the state of knowledge from peer reviewed literature and reports to identify CSG and HF-specific sources of air, surface water, groundwater and soil pollutants.
- A study design for a measurement program to provide enhanced information of the impacts of HF on air, surface water, groundwater and soil quality to be carried out in Phase 2.
- Analysis of available baseline measurements of air (AQMS and VOC network installed in October 2016), surface water, groundwater and soil.

Air measurement program study design

**Phase 1 total cost \$194.4K**

CSIRO contribution: \$60.1K

GISERA contribution \$0k

Origin Energy cash contribution \$134.3K

Origin Energy will also provide in kind contribution \$400k

Surface water, groundwater and Soil measurement program study design

**Phase 1 total cost \$136.4k**

CSIRO contribution: \$25k

GISERA contribution \$0k

Origin Energy contribution \$111.4k

**Phase 2: Measurement Programs** (13 months, complete by June 2018)

Approval of Phase 2 is NOT SOUGHT by the Queensland RRAC at this time. Implementation of the approved measurement program following approval by the Review Panel and Go/No-Go decision by the Queensland RRAC will occur in February/March 2017.

Phase 2: Air Measurement Program

Intensive measurements of air pollutants at up to 6 wells during HF activities in mid-2017. CSIRO through GISERA will undertake community consultation, interpretation, reporting and Knowledge Transfer sessions to community, government and industry.

Precise details of the measurement program will be developed in Phase 1 and could include

1. A single fixed AQMS located within the field of wells to be hydraulically fractured. The AQMS will be equipped with standardised, high quality measurement systems for

measurements of criteria air pollutants and additional target species identified as part of the study design

2. Additional sensitive, high time resolution VOC and particle measurements in AQMS.
3. Portable fixed monitoring systems be deployed for fence-line monitoring at well sites with capability to measure a subset of target compounds including:
  - a. Methane
  - b. VOCs
  - c. Particulate matter including black carbon
  - d. CO
  - e. NOx
  - f. Ozone
  - g. Radon
  - h. Mercury
4. Mobile (vehicle mounted) monitoring equipment to measure well site and fugitive emissions of CSG and selected CSG trace species.
5. Well head gas sampling with subsequent composition analysis for methane, VOCs, Radon, Mercury, and other target compounds identified in Phase 1 measurement program.

Ambient air measurements of target compounds at the well sites and surrounding area will occur immediately prior to HF to determine pre-HF conditions. Source characterisation including well head gas and emissions from CSG extraction infrastructure and equipment will be undertaken by external contractors organised by Origin.

Milestone reporting over the duration of the Phase2-GISERA project will include a report of the data summary report of HF measurements (air), a data summary report of post-fracking measurements (air), a draft final report and a final report. In addition, CSIRO will make data/reports publically available on GISERA website with open public access to data. The final report and the final monitoring study design reports will undergo peer review as per oversight mechanism defined above.

#### Phase 2 Surface water, groundwater and Soil Measurement Program

Precise details of the surface water, groundwater and soil measurement program will be developed in Phase 1 and sampling could comprise the following methodology:

##### **1. Surface water sampling sites**

Samples will be collected at Dogwood Creek (3 sites) and 1 farm dam. There will be three sampling events: before, during and after HF.

##### **2. Groundwater bore samples**

Three bores will be sampled within the 5 km radius. Samples will be collected pre-, during and post HF.

### 3. Fracturing fluid

A recipe for the frack program will be provided by Origin Energy. A sample of the HF fluid will also be collected and analysed to confirm its composition.

### 4. Flow-back water

Three wells will be sampled at three time points over the duration of flow-back water collection. Based on previous experiences in this region this phase of the study last for less than one week at each well.

### 5. Produced water

The three wells that were sampled for flow-back waters will be sampled during the production phase for produced waters. Samples to be taken from the gas-liquid separator well head. It is proposed there are three sampling events per well. The exact timing of the sampling events is to be determined.

### 6. Water treatment facility water

The produced water treatment facility waters will be sampled pre-treatment and post-treatment on one occasions over the study period giving a total of two samples.

### 7. Soil samples

Five soil samples will be collected adjacent to one fracked well before and after HF activities. This will lead to a total of 10 soil samples, which will be subjected to the same chemical characterisation as the water samples following suitable sample preparation/extraction of the soil.

CSIRO staff will make one site visit during the course of Phase 1 to provide training on water and soil sample collection to contractors, oversight sampling operations and gain familiarity with the study sites.

#### Phase 2 Air measurement program total cost \$1166k (estimate)

CSIRO contribution: \$296k

GISERA contribution \$0k

Origin Energy contribution \$870k

Costs for external providers of air sampling and analytical services (including ANSTO and Macquarie University), \$150K included in price

#### Phase 2 Surface water, groundwater and soil measurement program total cost \$598K (estimate)

CSIRO contribution: \$119.6k

GISERA contribution \$0k

Origin Energy contribution \$478.4k

Costs for external providers \$150K (estimate) included in price

### Importance and necessity

- While the use of HF is currently not widespread in the Surat Basin HF is likely to be increasingly employed as CSG production from high permeability coal seams peaks and future reserves are dominated by lower permeability coal seams which necessitates HF for CSG extraction.
- With an increase in HF operations in the Surat Basin, the level of community concern about the impact of the CSG industry on human health and the environment is likely to persist or increase
- The independent study will provide detailed knowledge about the likely impact of HF for CSG extraction on air, surface water, groundwater and soil quality which will inform future management, regulatory and community actions
- Measurements of air, surface water, groundwater and soil quality at HF sites will be reported and made available to the public.

Community benefits -access to independent information on the potential impacts of HF

Industry benefits- social licence through acknowledgement of community concerns, engagement of independent scientific institutions, transparency in relation to chemicals and processes employed in HF and provision of access to industry sites.



## 7. Budget Summary

Expenditure	2016/17	2017/18	2018/19	Total
Labour	193,732	-	-	193,732
Operating	56,207	-	-	56,207
Subcontractors	80,857	-	-	80,857
<b>Total Expenditure</b>	<b>330,796</b>	-	-	<b>330,796</b>

Expenditure per Task	2016/17	2017/18	2018/19	Total
Task 1	50,614	-	-	50,614
Task 2	26,775	-	-	26,775
Task 3	9,798	-	-	9,798
Task 4	79,060	-	-	79,060
Task 5	14,697	-	-	14,697
Task 6	37,936	-	-	37,936
Task 7	111,916	-	-	111,916
<b>Total Expenditure</b>	<b>330,796</b>	-	-	<b>330,796</b>

Source of Cash Contributions	2016/17	2017/18	2018/19	Total
GISERA (0%)	-	-	-	-
Origin Energy (74%)	245,670	-	-	245,670
<b>Total Cash Contributions</b>	<b>245,670</b>	-	-	<b>245,670</b>

In-Kind Contribution from Partners	2016/17	2017/18	2018/19	Total
CSIRO (26%)	85,125	-	-	85,125
<b>Total In-Kind Contribution from Partners</b>	<b>85,125</b>	-	-	<b>85,125</b>

	<b>Total funding over all years</b>	<b>Percentage of Total Budget</b>
GISERA Investment	\$0	0%
Origin Energy Investment	\$245,670	74%
CSIRO Investment	\$85,125	26%
<b>TOTAL</b>	<b>\$330,795</b>	

Task	Milest one Number	Milest one Description	Funded by	Start Date (mm-yy)	Delivery Date (mm-yy)	Fiscal Year Completed	Payment \$ (excluding CSIRO contribution)
Task 1	1.1	Establishment of Review Panel	CSIRO / Origin	Feb 2017	Apr 2017	2016/17	\$37,589
Task 2	2.1	Report including: state of the knowledge about the potential sources of air pollutants associated with CSG extraction using hydraulic fracturing;	CSIRO / Origin	Feb 2017	Apr 2017	2016/17	\$19,885
Task 3	3.1	Report including: state of the knowledge about the potential sources of surface water, groundwater and soil contaminants associated with CSG extraction using hydraulic fracturing;	CSIRO / Origin	Feb 2017	Apr 2017	2016/17	\$7,277
Task 4	4.1	Peer reviewed report describing a suitable measurement program to provide enhanced information of the impacts of HF on air quality.	CSIRO / Origin	Feb 2017	Apr 2017	2016/17	\$58,715
Task 5	5.1	Peer reviewed report describing a suitable measurement program to provide enhanced information of the impacts of HF on surface water, groundwater and soil quality.	CSIRO / Origin	Feb 2017	Apr 2017	2016/17	\$10,915
Task 6	6.1	Report on measurements of air made before HF commenced (i.e. October 2016 to April 2017)	CSIRO / Origin	May 2017	June 2017	2016/17	\$28,174
Task 7	7.1	Report on measurements on surface water, groundwater and soil made before HF commenced (i.e. October 2016 to April 2017)	CSIRO / Origin	May 2017	June 2017	2016/17	\$83,116

## 8. Other Researchers (include organisations)

Researcher	Time Commitment (Phase 1)	Principle area of expertise	Years of experience	Organisation
Melita Keywood	30 days	Air quality science leader	20	CSIRO O&A
Erin Dunne	40 days	Air quality scientist and measurement techniques	7	CSIRO O&A
Jason Ward	10 days	Air quality measurement techniques	15	CSIRO O&A
James Harnwell	10 days	Air quality measurement techniques	25	CSIRO O&A
Simon Apte	10 days	Water quality	30	CSIRO L&W
Rai Kookana	12 days	Water & soil quality	30	CSIRO L&W
Mike Williams	22 days	Water & soil quality	6	CSIRO L&W

## 9. Subcontractors

Subcontractors (clause 9.5(a)(i))	Subcontractor	Role
	TBD	Peer reviewer 1 study design (Milestone 4.1 & 5.1)
	TBD	Peer reviewer 2 study design (Milestone 4.1 & 5.1)
	TBD	Peer reviewer 3 study design (Milestone 4.1 & 5.1)

## 10. Project Objectives and Outputs

### Objectives for phase 1

1. To summarise the current state of knowledge regarding sources of air, surface water, groundwater and soil pollutants associated with CSG extraction using HF.
2. To develop a suitable measurement program to provide state of the art information on the impacts of HF on air, surface water, groundwater and soil quality

### Outputs

1. Report summarising the current state of knowledge regarding sources of air, water and soil pollutants associated with CSG extraction using HF.
2. Peer Reviewed Report detailing the study design for a measurement program to provide enhanced information of the impacts on HF on air, surface water and groundwater and soil quality.

3. Report summarising data on air, surface water, groundwater and soil quality collected during the pre-fracturing period (i.e. baseline data).

## 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

This project was developed through consultation between Origin Energy and CSIRO O&A. Given the significant community concern associated with hydraulic fracturing, CSIRO O&A then approached GISERA to consider including the project in the GISERA umbrella.

A number of states have instigated moratoriums on HF. However gas is widely regarded as a transition energy source from coal to renewables. While the use of HF is currently not widespread in the Surat Basin, HF is likely to be increasingly employed as CSG production from high permeability coal seams peaks and future reserves are dominated by lower permeability coal seams which necessitates HF for CSG extraction. This study will provide much needed data on the impacts of HF on air, surface water, groundwater and soil to generate some evidential basis for future decisions around HF activity. These data will also be required to accurately assess potential health impacts in future health studies.

This project provides a world-first opportunity to investigate the air, surface water, groundwater and soil impacts before, during and after HF activities. The study will establish air, surface water, groundwater and soil baseline concentrations of various identified chemical species before HF; identify air, surface water, groundwater and soil pollutants present above background levels during and after hydraulic fracturing; and, investigate pollutant sources, pathways and environmental fate. This project presents a unique opportunity to access production wells during an extended HF program. Origin Energy will allow unrestricted access, where safe, to air, surface water, groundwater and soil in the vicinity of wells being hydraulically fractured and Origin Energy will also liaise with researchers to maximise data collection during Phase 2.

## 13. Project Plan

### 13.1 Project Schedule

ID	Task Title	Task Leader	Scheduled Start	Scheduled Finish	Predecessor
<b>Task 1</b>	Establishment of Review Panel	Melita Keywood	1 February 2017	30 April 2017	
<b>Task 2</b>	Review of state of the knowledge about the potential sources of air pollutants associated with CSG extraction using hydraulic fracturing	Melita Keywood	1 February 2017	30 April 2017	
<b>Task 3</b>	Review of state of the knowledge about the potential sources of surface water, groundwater and soil contaminants associated with CSG extraction using hydraulic fracturing	Simon Apte	1 February 2017	30 April 2017	
<b>Task 4</b>	Study design for a measurement program to provide enhanced information of the impacts of HF on air quality.	Erin Dunne	1 February 2017	30 April 2017	
<b>Task 5</b>	Study design for a measurement program to provide enhanced information of the impacts of HF on soil, surface water and groundwater quality.	Simon Apte	1 February 2017	30 April 2017	
<b>Task 6</b>	Analysis of measurements of air made before HF commenced ( i.e. October 2016 to April 2017)	Erin Dunne	1 May 2017	30 June 2017	
<b>Task 7</b>	Analysis of measurements of surface water, groundwater and soil made before HF commenced ( i.e. October 2016 to April 2017)	Simon Apte	1 May 2017	30 June 2017	

### 13.2 Australia Pacific LNG Payment Schedule

Invoice Number	Task Milestones	Date invoice to be issued to APLNG	Amount
1	Tasks 1 - 5	February 2017	\$134,380
2	Tasks 6 and 7	April 2017	\$111,290

It is important to note that:

- payment is to be received from APLNG prior to completion of milestones. Payment will reside in GISERA's Bank WBS until the GISERA Director is satisfied that each milestone has been completed.
- APLNG's financial contribution to this project is separate from their contribution for membership to GISERA.

## Task 1

**TASK NAME:** Establishment of peer review panel and community engagement

**TASK LEADER:** Melita Keywood

**OVERALL TIMEFRAME:** 1 February 2017 to 30 April 2017

**BACKGROUND:** There may be a perceived risk around conflict-of-interest associated with this project as Origin Energy will have involvement in enabling access to the well field. However, these risks will be managed through the establishment of an external Review Panel consisting of up to four independent external scientists of international reputation. The external Review Panel will

- Peer review the design of the of the air, surface water and groundwater and soil sampling and measurement program during Phase 1
- Peer review the final research report(s) and invite any other external and independent expert the Review Panel sees fit to invite to review documents during Phase 2
- In addition, a Stakeholder Panel of local representatives will be engaged through a GISERA 'Knowledge Transfer' session to examine the design and implementation of the measurement program during Phase 2 and provide feedback

**TASK OBJECTIVE:** to demonstrate independence in the design of the of the air, surface water, groundwater and soil sampling and measurement program

**TASK OUTPUTS:** Review panel members and terms of reference documented: summary of Knowledge Transfer Session

**SPECIFIC DELIVERABLES:** Short report documenting Review panel members and terms of reference and summary of Knowledge Transfer Session.

## Task 2

**TASK NAME:** Review of state of the knowledge about the potential sources of air pollutants associated with CSG extraction using HF

**TASK LEADER:** Melita Keywood

**OVERALL TIMEFRAME:** 1 February 2017 to 30 April 2017

### **BACKGROUND:**

The review will investigate the different processes involved in HF and for each process identify activities (e.g. use of chemicals, combustion etc) with the potential to release contaminants to the air.

The review will draw heavily on the previous work of the team including literature reviews (on Geogenic and Hydraulic fracturing Chemicals), Risk Assessment work (NICNAS) and existing air, water and gas composition data collected as part of GISERA Surat Basin ambient air quality study (CSIRO), where the project team has been involved over last three years. In addition, previous studies of community concerns around HF will be consulted in order to account for these aspects when designing a comprehensive air quality study.

Note that review of industry data pre-fracking air quality will be carried out as part of Task 6.



**TASK OBJECTIVE:** To review of state of the knowledge about the potential sources of air pollutants associated with CSG extraction using HF

**TASK OUTPUTS:** Report on state of the knowledge about the potential sources of air pollutants associated with CSG extraction using HF

**SPECIFIC DELIVERABLES:** Report on state of the knowledge about the potential sources of air pollutants associated with CSG extraction using HF

**This review will be used to inform the design of the monitoring program (Task 4).**

### Task 3

**TASK NAME:** Review of state of the knowledge about the potential sources of surface water, groundwater and soil pollutants associated with CSG extraction using HF

**TASK LEADER:** Simon Apte

**OVERALL TIMEFRAME:** 1 February 2017 to 30 April 2017

**BACKGROUND:**

The review will investigate the different processes involved in HF and for each process identify activities (e.g. use of chemicals, combustion etc) with the potential to release contaminants to the water or soil.

The review will draw heavily on the previous work of the team including literature reviews (on Geogenic and Hydraulic fracturing Chemicals), Risk Assessment work (NICNAS), Deep Groundwater (CSIRO) projects and existing air, water and gas composition data collected as part of GISERA Surat Basin ambient air quality study (CSIRO), where the project team has been involved over last three years. In addition, previous studies of community concerns around hydraulic fracturing will be consulted in order to account for these aspects when designing a comprehensive surface water, groundwater and soil quality study.

Note that review of industry data pre-fracking surface water, groundwater and soil quality will be carried out as part of Task 7.

**This review will be used to inform the design of the monitoring program (Task 5).**

**TASK OBJECTIVE:** To review of state of the knowledge about the potential sources of surface water, groundwater and soil contaminants associated with CSG extraction using HF

**TASK OUTPUTS:** Report on state of the knowledge about the potential sources of surface water, groundwater and soil contaminants associated with CSG extraction using HF

**SPECIFIC DELIVERABLES:** Report on state of the knowledge about the potential sources of surface water, groundwater and soil contaminants associated with CSG extraction using HF

### Task 4

**TASK NAME:** Study design for a measurement program to provide enhanced information of the impacts of HF on air quality.

**TASK LEADER:** Erin Dunne

**OVERALL TIMEFRAME:** 1 February 2017 to 30 April 2017

**BACKGROUND:**

Based on the occurrence, environmental fate, toxicity profiles of the chemicals described in the Review produced in Task 2, a suite of target compounds will be identified for the monitoring study. In doing so, the guiding principle will be to represent different classes of chemicals rather than covering every possible compound that may naturally be present in the air given the practicalities of being able to measure the compound.

The HF process and therefore the recipe of HF fluid is continuously changing. The suite of target compounds selected for the monitoring study will be guided by the current practices of the industry and will be finalised in consultation with the industry.

**The study design will be peer reviewed.**

**TASK OBJECTIVE:** To design a measurement program that will produced information of the impacts of HF on air quality.

**TASK OUTPUTS:** Report detailing the design of a measurement program that will produced information of the impacts of HF on air quality.

**SPECIFIC DELIVERABLES:** Report detailing the design of a measurement program that will produced information of the impacts of HF on air quality.

## Task 5

**TASK NAME:** Study design for a measurement program to provide enhanced information of the impacts of HF on water and soil quality.

**TASK LEADER:** Simon Apte

**OVERALL TIMEFRAME:** 1 February 2017 to 30 April 2017

**BACKGROUND:**

Based on the occurrence, environmental fate, toxicity profiles of the chemicals described in the Review produced in Task 2, a suite of target compounds will be identified for the monitoring study. In doing so, the guiding principle will be to represent different classes of chemicals rather than covering every possible compound that may naturally be present in the water and soil given the practicalities of being able to measure the compound.

The HF process and therefore the recipe of HF fluid is continuously changing. The suite of target compounds selected for the monitoring study will be guided by the current practices of the industry and will be finalised in consultation with the industry.

**The study design will be peer reviewed.**

**TASK OBJECTIVE:** To design a measurement program that will produced information of the impacts of HF on water and soil quality.

**TASK OUTPUTS:** Report detailing the design of a measurement program that will produced information of the impacts of HF on water and soil quality.

**SPECIFIC DELIVERABLES:** Report detailing the design of a measurement program that will produced information of the impacts of HF on water and soil quality.

## Task 6

**TASK NAME:** Analysis of measurements of air before HF commenced (October 2016 to April 2017)

**TASK LEADER:** Erin Dunne

**OVERALL TIMEFRAME:** 1 May 2017 to 30 June 2017

### **BACKGROUND:**

In October 2016 Origin Energy secured the permission of landholders, and engaged SGS Leeder to undertake passive monitoring of VOCs and H<sub>2</sub>S at the proposed study site. In addition, Origin Energy is currently in final negotiations with Ecotech for the provision of a fixed air quality monitoring station (AQMS) also to be located at the study site. CSIRO O & A visited the proposed study sites in October 2016 and provided advice and oversight on the selection of sites for the VOC monitoring and AQMS. In addition to providing important baseline air quality data for the project, the AQMS and VOC monitoring will also provide significant additional data to the current GISERA Surat Basin Ambient Air Quality Study and vice versa.

These data sets provide information on baseline air composition before the commencement of HF in the study region.

**TASK OBJECTIVE:** To analyse and summarise air quality data (passive and AQMS) measured near the study site before commencement of HF activity.

**TASK OUTPUTS:** Report summarising air quality data (passive and AQMS) measured near the study site before commencement of HF activity.

**SPECIFIC DELIVERABLES:** Report summarising air quality data (passive and AQMS) measured near the study site before commencement of HF activity.

## Task 7

**TASK NAME:** Analysis of measurements of water and soil made before HF commenced (October 2016 to April 2017)

**TASK LEADER:** Simon Apte

**OVERALL TIMEFRAME:** 1 May 2017 to 30 June 2017

### **BACKGROUND:**

In October 2016 Origin Energy secured the permission of landholders, and engaged SGS Leeder to undertake surface and groundwater sampling in the vicinity of the proposed study sites which will supplement previous data collected by Origin.

These data sets provide information on baseline water and soil composition before the commencement of HF in the study region.

**TASK OBJECTIVE:** To analyse and summarise water and soil data collected near the study site before commencements of HF activity.

**TASK OUTPUTS:** Report summarising water and soil data collected near the study site before commencement of HF activity.

**SPECIFIC DELIVERABLES:** Report summarising water and soil data collected near the study site before commencement of HF activity.

#### 14. Communications Plan

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 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. The final composition of the TRG will be determined during Phase 1 of the project.

#### 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 not confidential.			
Additional Commercialisation requirements (clause 13.1)	Not Applicable			
Distribution of Commercialisation Income (clause 13.4)	Not applicable			
Commercialisation Interest (clause 1.1)	<b>Party</b>		<b>Commercialisation Interest</b>	
	APLNG		NA	
	QGC		NA	
	CSIRO		NA	

## 16. Approval from Project Parties

In signing this document you are committing your organisation to provide the specified funds, personnel and the required in-kind contributions.

At date of signing, this Project Order approves Phase One only of this project and commits CSIRO and APLNG to completing milestones associated with Phase One, specifically Tasks 1 - 7 on page 14 of Item 13.1 'Project Schedule' and the 'Payment Schedule' set out in 13.2.

### Australia Pacific LNG

**SIGNED** for and on behalf of Australia Pacific LNG,

by

.....  
Signature of delegate

.....  
Name of delegate

in the presence of

.....  
Signature of witness

.....  
Name of witness

.....  
Date

### CSIRO

**SIGNED** for and on behalf of CSIRO

by

.....  
Signature of delegate

.....  
Name of delegate

in the presence of

.....  
Signature of witness

.....  
Name of witness

.....  
Date