

‘Telling the Story’ project

Final report

Neil Huth, Andrea Walton and Brett Cocks

Report for Gas Industry Social and Environmental Research Alliance

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Part 1: Introduction

Background

The Western Downs region has experienced considerable CSG related development over the last five years since construction of the industry commenced in 2010.

This has resulted in changes to the landscape and potential changes to farming practices in a region with a long agricultural history. In addition, towns and communities have experienced changes that potentially impact their wellbeing within their local communities. A range of projects have investigated these changes over the last three years and created numerous reports, fact sheets, and scientific journal papers and are available on the GISERA website (see www.gisera.org.au).

Why is this research important?

GISERA phase one has seen a large amount of research undertaken in Queensland on a variety of topics and community members are keen to have this information. However, discussions at several agricultural research forums have raised the problem that farmers feel they do not have sufficient time to collate and interpret the large volume of information they receive from industry, community, and research groups. They have been requesting that a means of packaging and communicating relevant and useful information be developed.

This project has addressed this by developing a means of telling the story of changes in rural areas before CSG and during the development and production phases. This message was constructed through the development of detailed landscape change maps, survey findings, and a series of communication tools that were used at local agricultural shows. This community engagement was also used to gather feedback on our research to date, including its strengths and research gaps, and ways to improve the ways we communicate our findings.

Project aims

- To prepare story pieces that summarise changes to farming and community from CSG development using maps, surveys and other research to date.
- To understand the usefulness and relevance of our research.
- To identify gaps in our research.
- To understand trust in our research.
- To clarify information needs at this stage of the industry cycle.

Part 2: Developing the Story Pieces

The development of Story Pieces was a key part of this research project, which aimed to determine ways in which research findings can be better documented for landholders and members of the community. These pieces were not intended to replace the formal scientific peer reviewed publication processes which are necessary to ensure adequate scientific detail and rigour. However, discussions with rural folk from CSG development areas highlighted some deficiencies of the formal report-style documents for meeting their information needs.

Engagement with farmers, as part of GISERA's Agricultural Land Management Project 2 – *A Shared Space*, specifically asked stakeholders about preferred means of information transfer. Farmers were clear that they felt it was important they had access to information about the ongoing changes in the broader community and CSG companies. However, recent community forums conducted by the GISERA Agricultural Land Management Team have provided further feedback from landholders that they are struggling to deal with the amount of information that is being generated by industry, community, and research groups. Many farmers described the large number of documents they are having to read from researchers, government, and CSG companies in order to adequately understand the industry and the issues it brings. They are keen to learn about research findings but are also cognisant that they are time poor and struggling to grasp all information set before them. The community is asking researchers to find a way to present their information in a way that is accessible and useable without being “dumbed down”.

In this project, information is presented in a combination of photogrammetry, maps, 3D animation, and fact sheets. Previous research has demonstrated the value of modern digital datasets derived from aerial photogrammetry to demonstrate land use, but also to map surface water flows: an important issue for farmers in the region. Phase 1 of the GISERA projects has accumulated some detailed imagery of the Chinchilla-Miles area during the construction phase. Historical aerial imagery going back to the 1940's has also been collated for this area. A further detailed aerial survey demonstrating changes in the landscape, with subsequent mapping of changes in surface water flows, was undertaken within the project to assist discussions of landscape change. From these datasets, a time series of 3D virtual landscapes were created to allow people to navigate and explore interactively at local shows. The collection of imagery shows historical agricultural developments, and the recent changes brought about by CSG.

Finally, a series of fact sheets were developed to communicate the important issues raised by previous research results. Farmers are familiar with such fact sheets which are commonly developed by key agricultural research providers to assist farmers in understanding the latest agronomic research. A similar approach was used here to incorporate important messages into short fact sheets. Farmers could then determine whether to explore further detail in full scientific reports which are all publically available.

We provided ten story pieces to discuss our research which we have grouped into three domains: social, landscape change, and farming impacts. The research was all conducted in the Western Downs and Maranoa regions of southern Queensland, which house the gas fields of the Surat Basin. Both regions have experienced considerable CSG related development over the last five years with 10,000 wells in place by June 2016. The main towns and nearby areas involved in our research included: Dalby, Chinchilla, Miles,

Tara, Wandoan, Roma and Injune. Table 1 shows the broad story pieces used in each domain and the following factsheets exemplify the breadth of information in these story pieces.

Table 1 List of ‘Story pieces’ across the three research domains

SOCIAL	LANDSCAPE CHANGE	FARMING PRACTICES
Community wellbeing in the Western Downs: 2014 and 2016	Water Flow maps and 3D virtual landscapes	Understanding the way farmers see their farm
Community attitudes towards CSG development: 2014 and 2016	Spatial Data on CSG Footprint	Farm Machinery GPS Data around CSG wells
Responding to change: 2014 and 2016	Historical Aerial Photographs	Soil Compaction

Understanding the way farmers see their farm

A *Shared Space* was the title of one of the first projects within the Agricultural Land Management portfolio. This project investigated farmers' perceptions of coexistence with CSG in a shared space that was a CSG network, a farm business, and a family home. This fact sheet describes the methods used to explore this with farmers through the issue place identity, that is, the way in which farmers develop part of their own identity from their farm.

The key points are:

- Farmers feel that the issue of place identity is not well understood by many CSG workers from non-rural backgrounds.
- Landscape impacts can be difficult for farmers to communicate to CSG workers because of differing underlying value systems.
- Involving people from rural backgrounds as part of the CSG workforce could improve communication of the things that are important to farmers.

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Understanding the way farmers see their farm



Farmers and CSG workers may come from different backgrounds and this can impact on communications between them.

The CSIRO Shared Space project has shown that the aesthetics (visual aspects) of a farm is quite individualised and specific to the farmer and potentially a cause for a lack of understanding from others.

KEY POINTS

- Farmers feel that the issue of place identity is not well understood by many CSG workers from non-rural backgrounds.
- Landscape impacts can be difficult for farmers to communicate to CSG workers because of differing underlying value systems.
- Involving people from rural backgrounds as part of the CSG workforce could improve communication of the things that are important to farmers.

Example: Why do farmers like to keep things tidy?

"Tidy is healthy" (Crazier from Roma)

"Tidy is efficient" (Mixed cropping, Dalby)

There are often personal values that underpin the way a farmer sees a farm landscape. Others may not see the farm the same way.



Farmers can see efficiency in straight rows and level fields.

For the farmer, understanding the way in which he or she sees their farm is the first step to being able to communicate this to others.

There are two reasons why communication can be difficult.

Farmers identify with their farm

Farmers have a close relationship with their farm. Researchers refer to this as place identity. Four aspects to place identity have been suggested as being important:

Distinctiveness: A 'place' has symbolic meaning for people. It helps to describe someone and set them apart from others. Farms can be an expression of who we are.

Continuity: Memories of a place can link a person to their past or heritage. Farmers may have a long family history on a farm.

Self-esteem: A person gets positive feedback from a place with which they identify, just as gardeners feel best in their garden, many farmers get personal strength from their farm.

Self-efficacy: A place facilitates a person's lifestyle and personal goals. The farm is the basis for the farm business, the family and much of what farmers want to achieve from life.

Farmers see their farm in a different way

We all see and enjoy different landscapes in different ways and this also applies to farming landscapes. For example, a flat treeless paddock may look perfect to a farmer yet big and boring to someone from a non-farming background. Scientists refer to this as *Landscape Aesthetics*.

We often see things differently because of our different experiences and value systems. The way farmers see their farms has been studied across the globe. Many farmers like their fields to look "neat and tidy". Research has shown that this reflects the farmers understanding of what such tidiness means in different contexts. For example, straight, neat rows can indicate technical proficiency with farm machinery.



www.gisera.org.au

Figure 1 The farm coexistence fact sheet

Access Tracks and Soils Erosion

This fact sheet was developed to describe the techniques used to generate the 3D landscapes and high resolution water flow maps explored by the farmers during public engagement. These techniques were developed during the Agricultural Land Management Project 4–*Making Tracks* Project which investigated the impact of CSG access tracks on surface water flows. The fact sheet explains in simple terms the importance of unsealed rural roads for sediment export to water ways and ways in which the water flow maps could be used to make better decisions about the design of CSG access tracks.

Key points:

- Unsealed rural roads provide a disproportionate source of sediment into waterways.
- Aerial photogrammetry is being used to monitor changes in water flows from access tracks and other CSG infrastructure.
- Information on surface water flows should be used in planning for CSG infrastructure placement.

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Access tracks and soil erosion

Aerial photogrammetry is used to monitor and model the impact of access tracks on water flows and erosion.

KEY POINTS

- Unsealed rural roads provide a disproportionate source of sediment into waterways.
- Aerial photogrammetry is being used to monitor changes in water flows from access tracks and other CSG infrastructure.
- Information on surface water flows should be used in planning for CSG infrastructure placement.

Studies from around the world have shown that roadways provide a disproportionate source of sediment into waterways. Commonly, over 40% of the sediment can be shown to have its origin in unsealed rural roads even though these roads only make up about 1% of the total area of a catchment (see Table 1 overleaf).

With CSG development, the intensity of roadways in agricultural land will increase significantly and there is a risk that erosion losses will increase as well. Standard engineering methods for mitigating erosion threats are available if the location of problem areas can be identified. However, the scale of the CSG and hydrological systems are so large that monitoring for threat development using traditional methods is difficult.

Aerial photogrammetry

Aerial photography has been used for many decades to monitor land use and to generate the contour maps of the ground surface.

Modern high precision digital photography and computing techniques allow these procedures to be followed with high spatial resolution over larger areas than ever before.

How can this be used?

Information on the location and catchment area of water flows can be used by land holders and CSG staff during planning for CSG infrastructure placement. Furthermore, repeated surveys can show changes in water flow or soil surface elevation which may indicate diversion of water flows, soil loss or build-up of sediment within the survey area.

Land holders concerned about surface water flows can use a water flow map to help them communicate their concerns to CSG companies.

How does digital photogrammetry work?

A point 'A' in an agricultural field is identified in three overlapping images. If the position of the aircraft is known for locations 1, 2 and 3, the position of A can be calculated. Ground surface points within wooded areas (e.g. Point B) may need to be inferred from other nearby visible points if the view is obscured by foliage.

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Table 1: Data on roads as % of catchment and % of sediment source.

Country	% of area	% of Sediment
China	1	42.3
Indonesia	5	40
Brazil	1.5 to 2	28-69
USA	Less than 5	23-30
Australia (forest)	2.4	18-39
Australia (farm)	1	41-52

STEP 1: Visual image from aerial survey

STEP 2: Digital surface model including trees and buildings

STEP 3: Ground elevation model (trees and buildings removed)

STEP 4: Soil surface water flow model derived from Step 3

ABOUT GISERA

The Gas Industry Social and Environmental Research Alliance (GISERA) is a collaborative vehicle established to undertake publicly-reported independent research. The purpose of GISERA is to provide quality assured scientific research and information to industry, government and communities, focusing on social and environmental topics including: groundwater and surface water, biodiversity, land management, the marine environment, and socio-economic impacts. The governance structure for GISERA is designed to provide for and protect research independence and transparency of research. Visit www.gisera.org.au for more information about GISERA's governance structure, projects and research findings.

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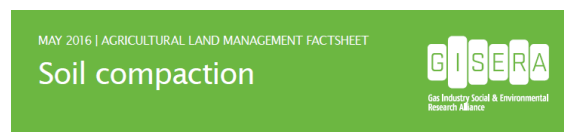
Figure 2 The erosion monitoring fact sheet

Soil Compaction

This fact sheet was developed to describe just some of the main findings from the Agricultural Land Management Project 5 – *Without A Trace* Project. This project provided research into the effect of CSG development on soils and likely means to mitigate or rehabilitate any soil damage. The fact sheet explains the key messages about soil compaction and demonstrates some measurements on common soils in CSG development areas.

Key points:

- Soil compaction has been found to be higher in areas around CSG wells than in neighbouring fields.
- The levels of compaction were similar to those tested in agronomic trials in Queensland which found yield impacts of up to 43% and 5 years for rehabilitation by natural processes.
- Simulation modelling suggests that rehabilitation of damage to the surface 30cm may remove most of the impact on crop production. Rehabilitation would need to be undertaken under suitable soil moisture conditions.



Heavy machinery from CSG operations can compact clay soils but rehabilitation should restore productivity.



An example of a CSG work-over rig in action on a cultivated field.

KEY POINTS

- Soil compaction has been found to be higher in areas around CSG wells than in neighbouring fields.
- The levels of compaction were similar to those tested in agronomic trials in Queensland which found yield impacts of up to 43% and 5 years for rehabilitation by natural processes.
- Simulation modelling suggests that rehabilitation of damage to the surface 30 cm may remove most of the impact on crop production. Rehabilitation would need to be undertaken under suitable soil moisture conditions.

What is "soil compaction"?

Soils can be compacted by movements of farm or CSG machinery across them. Compression of soils can cause reduction in soil volume and therefore soil pore space. This can decrease the rates at which rainfall can infiltrate into the soil. It can also make it more difficult for roots to penetrate. As a result, plant growth rates can be severely reduced under high levels of compactions.

The Darling Downs is well known for the high quality of its clay soils. As a result, state government legislation has been developed to protect areas of strategic value to agricultural production. Protection of such lands requires consideration of possible soil damage from CSG development, such as soil compaction.

Soil compaction has long been considered an important issue for soils of the region and modern farming methods have been developed to minimise damage to these soils from farm machinery. However, it has not been clear what damage may result from the large numbers of vehicles used along CSG pipelines and access tracks within lease areas.

Research findings

GISERA research has investigated the level of compaction related to CSG activities. Studies for wells on clay soils in the Darling Downs found that soil compaction was higher within areas of CSG activity and as a result water infiltration rates were lower. The level of compaction found at the study sites was comparable to previous compaction studies conducted on similar soil types in Queensland, and so these existing studies can provide information on the likely impacts on cropping.

These agronomic trials found that yields were reduced by up to 43% for similar levels of compaction and that rehabilitation of the soil through natural processes during subsequent minimum tillage took approximately five years.

Long term simulation modelling of these soils for the Chinchilla region found similar average reductions in yield (50%) due to reductions in wheat rooting depth (30%) and plant available moisture at sowing (50%). Modelling also suggested that, though existing damage appears to depths of up to 70 cm, careful rehabilitation of the surface 30 cm may be sufficient to overcome impacts on crop production.

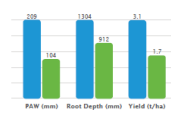
Such rehabilitation would need to be carefully undertaken during periods of suitable soil moisture conditions so as to not cause further damage to these soils.



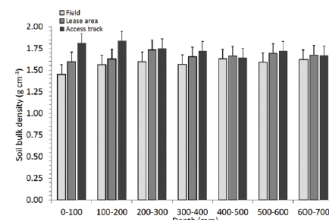
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What does this mean for me?

Heavy CSG machinery will be required to access lease areas several times during the lifetime of a CSG well. The level of compaction may need to be considered if farmers are looking to continually crop these areas. Though compaction can occur to depth, it may be that rehabilitation of the surface soil will be adequate for subsequent cropping. Deeper damage may be rehabilitated by natural processes, including shrink-swell cycles observed during wetting and drying. Further consideration of rehabilitation may be required when CSG infrastructure is decommissioned.



Estimated impacts of compaction on plant available water at sowing, wheat rooting depth and yield for 100 years of simulated wheat production for a grey clay soil at Chinchilla.



Example results from the study showing that soil bulk density is higher within lease areas and under access tracks. (Note: Compaction increases density).

FREQUENTLY ASKED QUESTIONS

How did you conduct the research?

In conjunction with USQ, we conducted a wide range of soil tests on well pads in the Miles and Cecil Plains districts. These tests were compared to other compaction studies in Queensland and the long term impacts evaluated using simulation modelling.

How did you determine the impact of CSG operations?

We compared soil properties within each lease area or access track with those in neighbouring unaffected soil.

What did you measure?

The surveys measured a range of soil properties including:

- Soil compaction (Bulk Density and Soil Strength)
- Soil structure (Soil and aggregate stability)
- Soil chemistry (pH, EC, ESP, Cations)
- Soil hydrology (Infiltration)

Where do I find more information?

A complete report of this project can be found at the GISERA website:

"The effects of coal seam gas infrastructure development on arable land, 2015" at gisera.org.au

Visible signs of vehicle movements over most of the lease area after well work-over.

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B001-18-0020

Figure 3 The soil compaction fact sheet

Community attitudes towards CSG development

This fact sheet was developed to display the results of recent surveys on community attitudes towards CSG for different areas of the western Darling Downs. It describes how community views varied between Dalby, Chinchilla, Miles-Wandoan and Tara districts, differences between people who live in or out of town, and changes in these perceptions between 2014 and 2016.

The key messages are:

- 13% of people rejected CSG
- 7% of people embraced CSG
- 80% of people tolerated, accepted or approved of CSG
 - 33% tolerated of gas
 - 35% accepted of gas
 - 12% approved of gas
- People's views differ based on where they live
 - Those who live 'out of town' felt negative on average towards CSG development
 - Those who live 'in town' felt neutral on average towards CSG development
- People's views differed between towns

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Community attitudes towards CSG development: 2014 and 2016

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Views towards CSG development in the Western Downs region differ within communities and also between communities.

On average, views towards CSG development became slightly more negative in 2016.

KEY POINTS

In 2016, residents of the Western Downs region were asked about their views towards CSG:

- 13% of people rejected CSG
- 7% of people embraced CSG
- 80% of people tolerated, accepted or approved CSG
 - 33% tolerated gas
 - 35% accepted gas
 - 12% approved of gas
- Peoples views differed based on where they live
 - Those who lived 'out-of-town' felt negative on average towards CSG development
 - Those who lived 'in town' felt neutral on average towards CSG development
- Peoples views differed between towns

What contributes to more positive attitudes towards CSG?

CSIRO research found that when people feel the following aspects of community life are strong then they have a more positive attitude towards CSG development:

- when they feel they are being listened to and can have a say
- trust is high
- the environment is being managed well for the future
- there are employment and business opportunities for their community
- there is good local planning and leadership
- people are getting access to information.

The 2016 CSIRO Community Wellbeing and Responding to Change Survey has shown that community attitudes vary across a wide spectrum but most people have moderate or 'like-warm' views towards CSG development.

The 2016 survey shows that on average these views are slightly more negative than 2014.

A range of community views

The CSIRO survey found that there was no single community view towards CSG development; rather there was a spread of attitudes that ranged from 'reject' CSG to 'embrace' CSG.

The survey showed that most people had moderate or like-warm views towards CSG - 33% of people 'tolerated' gas, 35 % accepted gas, and 12% approved of gas. There were 13% who rejected gas and 7% who embraced gas.

These differences can be attributed to people's previous experiences, current situations, individual needs and wants, and personal worldviews and beliefs around gas development.

CSG development covers extensive areas and affects many people, especially those residents who live out-of-town. In the case of the Surat Basin, thousands of wells are planned, impacting many different types of farms from broad acre cattle farming to more intensive agriculture. It also affects a range of town communities from smaller townships to larger regional centres. This amplifies differences in attitudes that CSG companies will potentially encounter as they intersect across the region.

For all stakeholders this requires an understanding of different perspectives that exist within communities and between communities. The research findings suggest that companies engage with communities in varied and nuanced ways, as it cannot be assumed that people's views are similar.





Figure 4 The community attitudes fact sheet

Community Wellbeing in the Western Downs

This fact sheet described results from community wellbeing surveys undertaken for people living in Dalby, Chinchilla, Tara and Miles regions, including those who lived in or out of town. The results describe the fifteen different dimensions of community wellbeing assessed by residents and how these changed between 2014 and 2016.

The key points were

- The biggest change in wellbeing in 2016 was the decrease in satisfaction in relation to jobs and employment opportunities
- The biggest improvements were in roads and the quality of the environment
- Overall community wellbeing in the Western Downs region was favourable

and remained relatively unchanged when measured in 2014 and 2016

- On average, people who live 'in town' reported higher levels of wellbeing than those who live 'out of town'

Drivers of community wellbeing in 2016

- Level of services and facilities,
- Social aspects of the community such as social interactions, community spirit, and feeling safe, and
- Satisfaction with jobs and business opportunities.

These were similar in 2014 although jobs and business opportunities were not key drivers of perceptions of quality of life in 2014.

Community Wellbeing in the Western Downs: 2014 and 2016

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Even though some aspects of wellbeing decreased and others improved, overall community wellbeing remains similar and robust over two years of CSG development.

The 2016 CSIRO Community Wellbeing and Responding to Change survey shows the biggest change in wellbeing from 2014 was the decrease in satisfaction in relation to jobs and employment opportunities, and the biggest improvements were in roads and the quality of the environment (e.g., dust and noise).

KEY POINTS

- The biggest change in wellbeing in 2016 was the decrease in satisfaction in relation to jobs and employment opportunities.
- The biggest improvements were in roads and the quality of the environment (e.g., dust and noise).
- Overall community wellbeing in the Western Downs region was favourable and remained relatively unchanged when measured in 2014 and 2016.
- On average, people who live in-town reported higher levels of wellbeing than those who live out-of-town.

What's most important for a sense of wellbeing within the community in 2016?

The 2016 CSIRO Community Wellbeing and Responding to Change survey shows that the key contributors to a sense of wellbeing in the Western Downs are:

- the level of services and facilities
- the social aspects of community life, such as community spirit and social interaction
- feelings of personal safety
- the opportunities for employment and businesses.

When people feel these aspects of their community are strong then they view their community as a great place to live, a place that offers a good quality of life to all ages.

Fifteen dimensions of community wellbeing assessed by residents

The survey measures 15 dimensions of community wellbeing across a wide range of topics, such as perceptions of community spirit, environmental quality, level of services and facilities, and employment and job opportunities.

In 2016, ten dimensions of community wellbeing were, on average, rated favourably. Five dimensions rated unfavourably including roads, community trust, environmental management for the future, decision making and having a say, and employment and business opportunities.

While some dimensions improved and others declined, overall community wellbeing remained virtually the same between 2014 and 2016 when the industry had slowed and was not yet in full operations phase.

Dimensions that improved from 2014

Perceptions of environmental quality relating to dust and noise improved significantly since 2014 to become the second most highly rated dimension in 2016.

Perceptions of roads and environmental management for the future also improved significantly since 2014, though residents were still not satisfied with these dimensions on average.

Dimensions that decreased from 2014

As may be expected, satisfaction with employment and business opportunities declined significantly between the construction phase in 2014 and the post-construction phase in 2016 to such an extent that residents were now dissatisfied on average.

Perhaps not as expected was that community cohesion also declined significantly. Other dimensions of community wellbeing did not change significantly between 2014 and 2016, as did overall community wellbeing.



Graph 1: Community wellbeing dimensions, 2014 and 2016.

FREQUENTLY ASKED QUESTIONS

How did you conduct the survey?

We used a telephone survey that took 30 minutes to complete. We asked 400 people approximately 120 questions about their views towards quality of life in their community. We also asked them about their attitudes towards CSG development in their area.

When did you conduct the survey?

We conducted the survey in Feb 2014 and again in Feb 2016.

Who completed the survey?

We contacted people who lived in the Western Downs region of southern Queensland to participate. All participants were randomly selected using public lists of telephone and mobile phone numbers.

The people who completed the survey were a representative sample of the region based on the ABS statistics for age, gender, and working status.

We made sure that our sample included:

- 100 people each from the areas of Dalby, Chinchilla, Tara, and Miles
- Half the people lived 'In Town' and half the people lived 'Out of Town'.

Where do I find more information?

A complete report of the 2014 and 2016 CSIRO Community Wellbeing and Responding to Change survey can be found at the GISERA website www.gisera.org.au

Note: the 2016 report is due for release in July 2016.

Source: CSIRO

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Source: CSIRO

Figure 5 The community wellbeing fact sheet

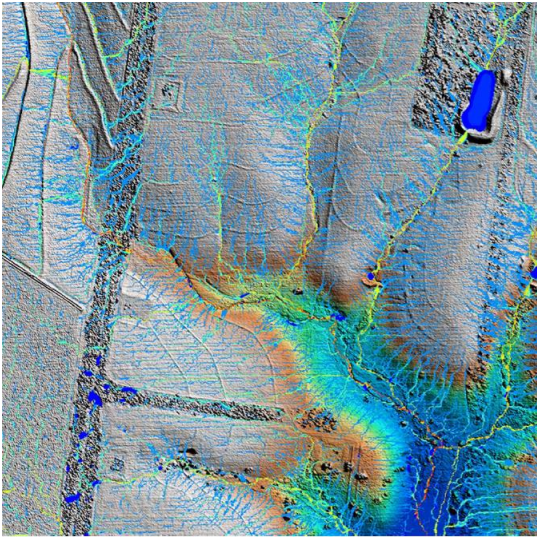
Landscape Change Imagery

Water is an important issue for all farmers, whether it is rainfall, irrigation, ground water, or surface water. Imagery showing changes in surface water flows within the Miles-Chinchilla-Condamine region were demonstrated at rural shows via interactive sessions with participants. Individuals were able to examine water flows across the terrain and develop a better understanding of issues of surface water flows and erosion processes. Farmers within the area were able to find their own fields and explore possible recent changes in water flows or the success of their farm management in addressing these important issues.

The images on the right are a simple example of the types of issues explored with

farmers. The top image shows a field in 2013 with water flows braking through the various old contour banks developed to minimise erosion losses many years earlier. The bottom image shows the same field in 2015 after the farmer had rebuilt the contour banks. The banks are now better defined and the water flows are more effectively managed.

2013



2015

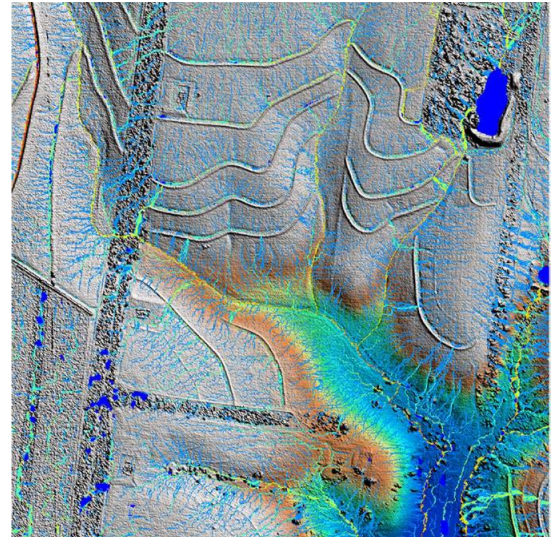


Figure 6 Imagery showing changes in ground elevation and water flow paths in 2013 (top) and 2015 (bottom).

3D Animations

The methods used to create the water flow maps can be difficult to explain. However, most people are familiar with 3D virtual reality constructions using modern computing methods. We created several animated 'fly-overs' from our aerial photography and digital surface models to demonstrate just how a virtual landscape can be modelled and then analysed to show where the water would flow.

The animations were effective in demonstrating the type of data developed during our aerial surveys and how they could be used to create the water flow maps used in other story pieces.

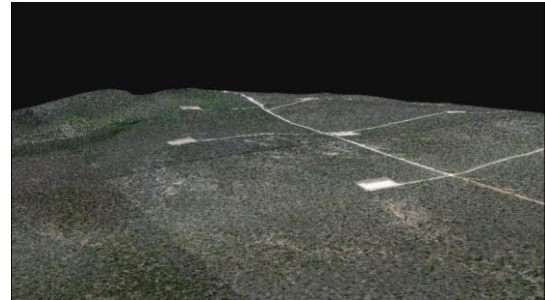


Figure 7 Image from 3D animation of well pads within a forest area

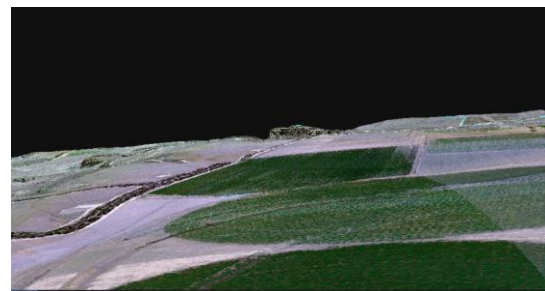


Figure 8 Image from 3D animation of a farming area

CSG Spatial Footprint

Most people are not aware of the exact nature of the CSG footprint within an agricultural field. We provided example data for monitored agricultural fields to show the footprint due to access tracks, well pads, pipelines, signs and vents. The areas of each, and any resultant loss of agricultural production area were described to enable informed discussions.

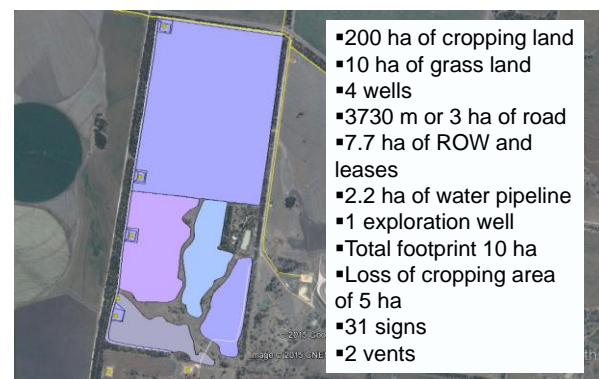


Figure 9 An example figure used to demonstrate the CSG footprint within a single agricultural field

Part 3: Engaging with the Community

This project undertook community engagement activities at the Miles District Agricultural Show and at Farmfest agricultural show held at Kingsthorpe near Toowoomba.

An ethics review of the project procedures was completed by CSIRO's ethics committee. Ethics approval was successfully granted (May 2016) for the research. The information sheet approved for use as part of the ethics procedure is attached in the Appendix.

What we wanted to find out

In seeking community feedback we wanted to understand four main aspects

1. How useful and relevant was our research?
2. What were the information gaps, and what about future research?
3. What is important for building trust in information?
4. How do information needs vary? What is needed when, and by whom?

Who participated in our research?

Over four days during May and June, our research team set up a research display at two rural events and collected feedback from local attendees.

- **Miles Rural Show** – a one-day local show held May 17, 2016.
- **Farmfest** –an annual three-day agricultural field day held in Toowoomba June 6-8, 2016.

Overall, we obtained feedback from 111 people:

- 79 men and 32 women
- Approximately **two thirds** were **farmers**
- Approximately **one third** comprised a mix of people including:
 - People working in rural areas,
 - People working in the CSG industry (e.g. pipeline construction),
 - Federal, state, and local politicians,
 - Government employees,
 - Local business owners,
 - Retirees, and visitors to the regions.

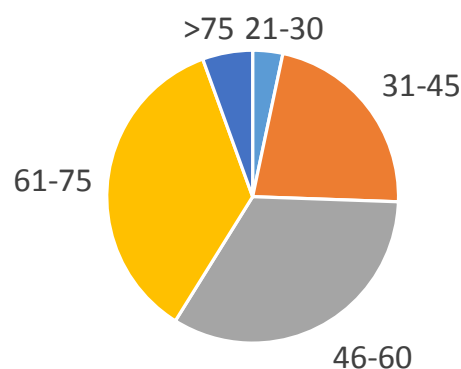


Figure 10 Age profile of participants

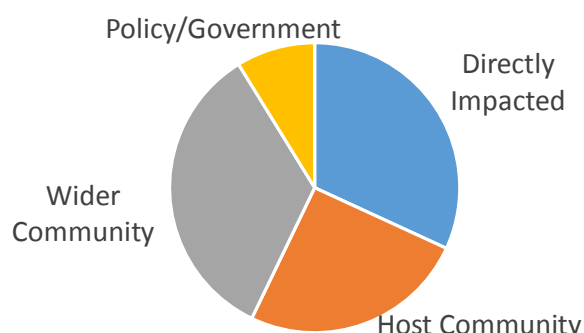


Figure 11 Type of engagement with CSG by participants

What we did

We explained our research findings using 'story pieces' and then followed this with short interviews and a brief questionnaire to gather our feedback. For approximately a third of the participants, we used longer interviews to gain a deeper understanding of information needs.

Information was provided to participants either verbally, hard copy, USB memory stick or via business card indicating the appropriate WWW address.

We collected our data using interview forms, field notes, and short survey questionnaires.

Analysing the Data

All interview data and fields notes were transcribed and questionnaire responses collated. We used inductive thematic analysis to identify common themes from the interview data and averaged the scores for each questionnaire item.

Types of story pieces

- ✓ Fact sheets
- ✓ Audio-visual presentations
- ✓ Journal publications
- ✓ 3-D imagery
- ✓ Interactive
- ✓ Aerial photography
- ✓ Reports

Different methods used to understand community feedback

Three researchers attended each of the four days that covered the Miles Show and the FarmFest events. We collected our feedback in two main ways

Short interviews discussing the relevance and usefulness of the research and research gaps, complemented by a short questionnaire

In-depth interviews covering information needs which canvassed the type of information people are interested in, trust in information and how they source information, a short questionnaire was also used to support our conclusions

Short questionnaires were also used to complement the interviews and support the interpretation of our findings. The questions used a 5- point Likert scale and covered topics related to trust in information and importance of different types of information and delivery modes.

Part 4: Findings

While it may be difficult to summarise information from over one hundred different conversations with stakeholders, a series of common themes emerged across the breadth of our community engagement. Five themes were identified in our discussions with community which revolved around relationships, uncertainty, trust, information needs, and science presentation.

1. **Farm-Gas relationships undermined by ongoing simple mistakes.** Recurring or unresolved mistakes are capable of undermining trust in a CSG company's capability to operate effectively, which then damages the relationship with the farmer and the reputation of the industry.
2. **Uncertainty persists within the community.** Farmers who are unsure of how the industry will unfold for them become unsure about CSG and question both local impacts and broader gas-related issues.
3. **Trust in information is linked to perceptions of bias.** People trust CSIRO but mechanisms to ensure independence are important. People are very mistrusting of information they perceive to be biased. They want to be given information and make judgements for themselves.
4. **Information needs vary according to a person's proximity to the issues.** This affects the type of information they are seeking and how they want it delivered. For some people dot points and key messages suffice and for others more in-depth and one-on-one communication is preferred.
5. **Visual presentation of our research works well.** Using maps and interactive output helps to make complex multi-dimensional information more tangible.

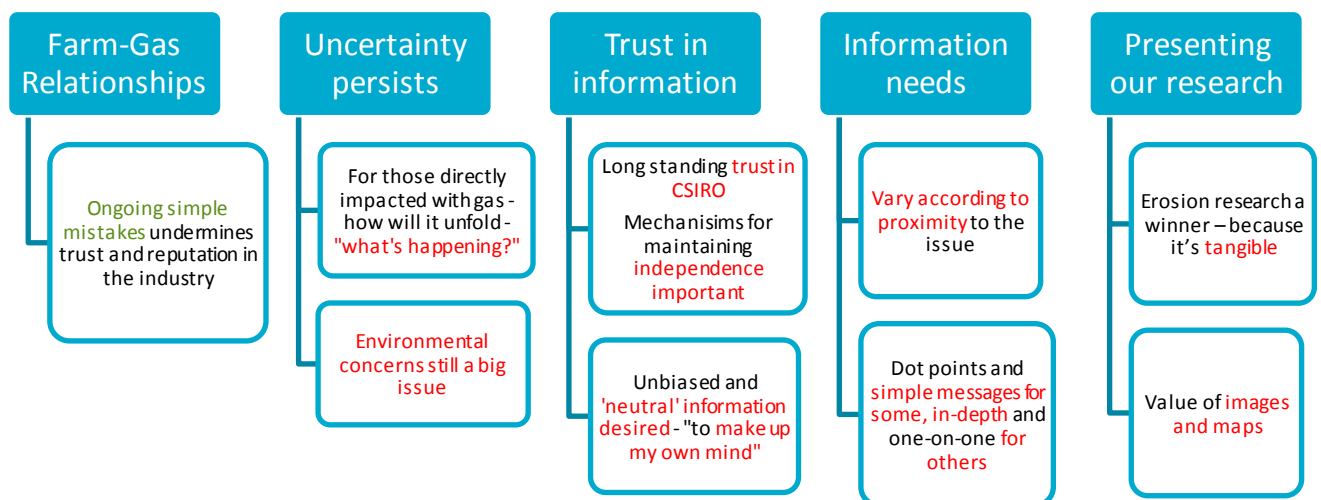


Figure 12 Five themes emerging from community discussions

Farmer relationships undermined by ongoing simple mistakes

Ongoing small mistakes by gas companies or their contractors that occur on farms undermine the reputation of the industry in the eyes of the farmer. Discussions with participants indicated ongoing frustrations for those farmers who were experiencing recurring mistakes by the gas industry. The farmers described disappointment and an emerging lack of patience with unresolved issues related to the CSG activity on their farms. These experiences undermined their trust in the industry as capable operators and supported a view that the CSG company is slow to learn from their mistakes.

"It seems very difficult - impossible for them to get it right - the pipeline company" (Farmer with pipeline)

"Companies are stupid they won't take advice - pipelines on my farm - They waste money and resources" (Farmer)

These stories can then spread by word of mouth throughout communities and potentially undermine the reputation of the industry more broadly. For example a farmer commenting on his next door neighbour's experiences with CSG

"My neighbour has wells and he's been badly affected, the CSG company has made simple mistakes and didn't care to fix them" (Farmer)

Discussions with participants indicated that farmers felt these problems could be easily avoided and thereby reduce the time wasted by both the farmer and the company in correcting problems. Many of these problems were described as relatively minor yet caused considerable inconvenience and wasted time in addressing them. Examples included misuse of farm gates by CSG workers or contractors, inappropriate surface soil management, administrative complexity and delays in payments to farmers for adverse impacts, inadequate communications, or obstruction of farm vehicles by incorrect placement of signs.

These findings suggest that what may seem as a small issue to a CSG company or contractor may matter much more considerably to a farmer. Overlooking these things may result in a disproportionate response from the farmer, especially if the issues are ongoing, which ultimately impacts upon trust in the company's ability to perform and follow through on commitments.

Uncertainty

Gas industry and uncertainty 'what's happening?'

Discussions indicated that uncertainty was an issue for farmers operating their farms in CSG developing areas. Participants with farms within gas tenements expressed concern that they were unsure how the CSG industry would unfold for them. This included for example, the timing of when wells or related infrastructure might commence on their properties, or when actual production of gas may occur, or when unconnected wells may be connected.

"My main issue is uncertainty – I've got nine wells that are not connected"
(Farmer with wells)

"We have wells half developed ...ten wells started ten years ago...we were initially interested and saw it as an opportunity" (Farmer with wells)

These types of uncertainty made planning difficult and created doubt about the industry and its viability. Information was seen as something that could help their situation by reducing insecurity and uncertainty. The need for information about the future was also expressed by people who live in small towns impacted by CSG development.

"What's most needed is to know what's ahead of us, to help the uncertainty so that we can make future decisions, ... information so that there is more control of where to go in the future" (Farmer with tenements)

Environmental concerns still a big issue

Uncertainty still prevailed about aspects of CSG extraction, particularly possible environmental effects and the impact on water. Participants described still feeling unsure about salt and brine management, the safety of well drilling, and the well's integrity over time. They also expressed feeling unsure about potential impacts on water quality and quantity; the meaning of methane bubbles in the Condamine; risk of fire for those living near a well; and possible health concerns.

"If the groundwater gets stuffed the rest is not important" (Farmer host community)

"What do I tell my friends who are cow cockies about the [safety] of the groundwater - I have pilot wells on my property" (Farmer with wells)

"The 'Make Good' – I don't believe it's going to happen....Is it Ag or CSG causing the decrease in water – people are getting confused" (Farmer wider community)

"My main concern is the longevity of the industry and the impact of infrastructure - look at LINC as an example" (Farmer with pipelines)

"My main worry is about seepage of gas - do I need to develop an evacuation plan?" (Farmer with well)

"I'm not a greenie - I just want to know this stuff - about water, gas, and health"
(Small business host community)

"I've never seen the river bubble as it is now" (Farmer with wells)

Trust in information

Long-standing trust in CSIRO but mechanisms for maintaining independence are important

Trust in CSIRO for information about gas was high and this has been built around a long standing tradition of trust in CSIRO, particularly by the farming community. This was also supported by the high trust scores measured in the questionnaires, which showed an average score of 4.22 out of 5 for trust in CSIRO research from 30 participants.

"good that you guys are doing this because we know it will be fair dinkum"
(Farmer host community)

"If there was a book on everything by CSIRO I'd buy it" (Farmer NSW)

Though some participants expressed interest and at times concern that CSIRO was involved with research funded by industry, their concerns were allayed once the governance arrangements regarding GISERA funding were explained.

"I hadn't heard of GISERA ...glad CSIRO involved" (Farmer wider community)

"if you have those systems in place...I would trust CSIRO's independence"
(Farmer with wells)

Participants indicated that independent research is very important to them. Universities and CSIRO were perceived to be the most trusted source of information on CSG. However, few people reported regular visits to a university or CSIRO website to source such information. Many people reported using 'Google' as a starting place for sourcing their information.

Unbiased and 'neutral' information please

The issue of biased information was a strong theme for information regarding CSG. Discussions indicated that people are wary of biased information and that a range of sources can be viewed as biased if they are perceived to be pushing a certain position or platform about CSG. People described feeling that the media was biased, and that the CSG companies and APPEA could not be trusted. They also felt that even friends and neighbours only provide information that is in line with their own views.

"just tell it as it really is -people always pushing their own barrow"
(Farmer wider community)

Participants described being mistrusting of any entity with a strong view or obvious self-benefit. They preferred a neutral and less emotive perspective, where the information is provided and they can explore it for themselves to make their own judgements.

"I want to make up my own mind based on the facts" (Farmer wider community)

Information needs vary

I don't need to know the detailnot yet

People who live in the vicinity of CSG but are not yet directly affected had relatively superficial information needs with respect to science. Discussions indicated that their information needs were to stay in touch with *"what's happening"* but not to get too engaged *"at this stage"*. Common feedback from farmers who lived near gas tenements but had no wells or other infrastructure on their properties was that they were not ready for the information. They indicated interest in our research but the interest was superficial. They were keen to be aware but were not interested in trying to understand more detailed information. However, they indicated that they would be making use of the research if things changed.

"We're not involved yet in gas so not looking into the science of things - only have a water monitoring bore" (Farmer host community)

"We're not really impacted, not yet thank goodness, but interested ...we follow it in the local newspaper and stories on TV ...don't really understand it all ...Wife would probably look up a few websites if we needed to know more" (Farmer host community)

"Not that interested in the information - CSG not affecting our farm - if it does then we'd want to find out more" (Farmer host community)

"I'm not directly affected but if I was I'd want to know everything" (Farmer wider community)

Others had a general interest in the topic for a variety of reasons. These participants described having a connection to family or friends on farms, or that they were just interested in the CSG debate more generally. Most people's interest is driven by their concern for possible impacts on groundwater.

These findings suggested that people's needs for information and preparedness to engage with the information vary depending on their proximity to the issue.

Simple messages for some and in-depth and one-on-one communication for others

We identified four types of audience for our research with differing needs, expectations, and preferences for interaction with the research.

Wider community

This group seemed to engage at a more superficial level. They were interested in the science but wanted simple messages that were easy to understand and not overly complex. This audience also involved children who were seeking information for school projects.

Host community

The information needs for this group include scientific information, information monitoring changes, and information on 'what's happening?' This is particularly in relation to the future for their region. They have an expectation that the science and monitoring research would be considered by government and would inform industry standards and government policy. The level of engagement from this group was heavily influenced on whether or not they were currently impacted.

Directly impacted

This group sought detailed information that could help them with planning, negotiating, and conducting their farm enterprise. Interactive information that was able to specifically highlight their own situation was found to be highly valuable. Delivering this information one-on-one or in a problem solving approach was valued by the farmer.

Policy makers, government and industry experts

This group was interested in the quality of the data, the sample used to collect the data, and the robustness of the science. They often identified other areas in which research may be relevant and they considered the wider impact of the science.

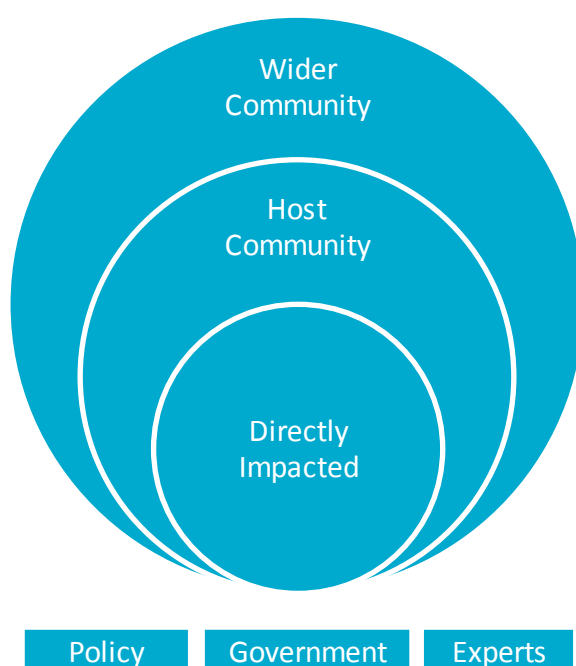


Figure 13 Diagram showing the four audience types showing different communication needs

Lessons for presenting our information

Erosion research is great – because it's tangible

The tangibility and visual appeal of the erosion research was useful in discussions with people from various audiences. Discussions with participants indicated considerable interest in and appreciation of the erosion research. Farmers who had experienced CSG infrastructure on their properties said that they understood the research and could see the benefits from this knowledge. They were also prepared to engage very deeply in understanding the erosion impacts for their own situation. They described these knowledge benefits as valuable for preventing erosion damage on their farms. These views were echoed by participants who were involved in the mining services sector such as contractors who lay pipeline.

"Water flow research great ...Great for seeing issues and highlighting where road design was wrong" (Worked in industry)

"the water flow maps are excellent" (Worked in industry)

"Water flow information is of great value ...You made the day worthwhile"
(Farmer with wells)

"You got it with the water flow - soil is too important to lose it" (Farmer wider community)

"Erosion mapping and well impacts on farms - excellent - extremely useful for negotiating and to understand full impacts, and to prevent impacts from poor decisions" (Farmer host community)

"The information will be useful for potential negotiations" (Farmer host community)

"Wish we'd known this research when we were putting in all those pipelines" –
(Worked in industry)

"Anything to do with erosion is useful ...the water flow maps show it how it really is" (Farmer with wells)

Understanding potential erosion impacts from CSG infrastructure can be difficult because of the time and spatial scales involved. However, the 3D virtual landscapes provided tangible representations of this problem and 'brought to life' erosion risk issues in an interactive way. Discussions and reactions from participants about the water flow maps suggested that those individuals who are directly involved with CSG activity require information that is relevant to their own situation, and benefit from face-to-face delivery where a problem solving approach can be undertaken. This finding further demonstrates how proximity to the issue influences the type of information needed and preferred methods for delivery.

Value of images and maps

The feedback about our aerial photogrammetry, the interactive water flow maps, and the on-farm CSG footprints were very positive. Moreover, having a scientist available to explain the results, to listen, and make sense of them for the individual was deemed valuable.

Most people indicated that they want information to be presented in a way that is easy to read and understand. The interpretation of complex scientific information is difficult for many people.

People want the science but it's got to be simple - "dot point information"

"Simple basic need to know information that's relevant to the farm - like if water levels drop - what caused it" (Farmer host community)

It became evident during discussions that maps were useful in addressing the need for neutral, or unbiased information. Participants were able to explore the maps individually, asking the researchers to navigate to on specific geographical areas, and then interpret the maps for themselves, process the information, and then ask questions or make assessments. The data could be explored and interpreted visually by the individual, with conversation arising between participants about what the data may mean. Information provided in this way is empowering for the individual. Empowerment brings confidence in both the data and the interpretation because the individual is involved directly, rather than having interpretation provided through a third party.

Finally, maps are well appreciated by rural people, many of whom are well adept at reading landscapes and landscape processes. When having a water flow map explained to him, one participant responded

"You don't need to explain it, I can see it the way it is" (Farmer with wells)

Research gaps and future needs

Whilst many participants were keen to highlight the importance of research that had been conducted to date, several research gaps and emerging research needs were identified.

- The need for research in other areas of the CSG development, in particular, the Wandoan region. Many farmers were keen on research into the issues facing graziers in this region.
- Many participants reiterated the need for research findings to be provided in a timely manner before key decisions need to be made. This can be difficult when industry development occurs rapidly.
- Participants see the need for research into the next stages of the CSG industry now that the construction phase is complete. This includes issues regarding possible regional decline during the production phase after the initial CSG boom period, and consideration of the eventual closure and decommissioning phases.

Ongoing uncertainties about gas

People expressed a range of ongoing concerns related to the industry that still required further research or better communication of existing knowledge. These included social, environmental, and economic issues. These issues represent potential areas of continued research or research communication to address on-going uncertainties or to identify ways of improving outcomes in communities yet to experience CSG development. Addressing this may not require large investments in time or resources. In many cases, a review of existing research findings written for a range of audiences, especially those directly impacted or from the host community, could help to address uncertainty that significantly impacts people's understanding and acceptance of changes in their community.

Issues for which people expressed ongoing uncertainty

- Water – potential impacts to groundwater quantity and quality; make good provisions
- Salt and brine management
- Capability of CSG companies
- Safe drilling and well integrity
- Bubbles in the Condamine River
- Scale of the development
- Impacts on housing and businesses in towns
- Dust on pastures
- Forests – long term impacts from disturbance - access tracks, weeds, erosion
- Compensation – adequate compensation to cover the actual cost to farmers such as time managing the ongoing relationship
- Fairness issues – CSG companies seem to have more rights to water than farmers; compensation amounts relative to other farmers
- Impacts on future farm valuations

Part 5: Conclusions and Key Messages

Consider differing communications needs

Farmers value in-depth information with a problem solving focus, often conveyed in direct consultation with scientists. Members of the host community value information about changes or developments in their local area, and are keen to see this information influencing key decision makers for their community. The wider public is interested in simple message addressing important topical questions (e.g. is the ground water safe?). Government, policy or subject matter experts are keen to understand the reliability of the data and the relevancy of the information to other related problem domains (e.g. use of erosion risk mapping for Great Barrier Reef catchments).

Help people to engage with information on their own terms

People will not readily trust information that appears to come from a party that is biased in their assessments. Information presented in a neutral way builds confidence in the information provider, and allows the person to engage in the discussion and come to their own judgement.

Visual aids to help people to interpret and process the problem

Visual aids help to address the previous issue. The use of animations, maps, visual aids help to include the participant within the process of interpreting the data directly, empowering the individual to make their own judgements, and helping them to communicate their thoughts with others.

Little things help a sustainable long term relationship

Trust in CSG companies as capable operators is undermined if CSG companies or their operators/contractors continue to make simple mistakes. Taking advantage of local knowledge from farmers not only supports a better outcome but also enriches the relationship, indicating to the farmer a mutual respect and a preparedness to learn.

CSIRO is a trusted advisor in this industry

CSIRO continues to enjoy the trust of community. However, community members have reiterated the need to continue ensuring that mechanisms are maintained safeguarding research independence.

Future research opportunities in new regions and industry phases

Community members are keen for research to be extended into new geographical areas such as the CSG development areas around Wandoan. The community is also keen for research to commence sooner rather than later to address new issues arising from the operations phase, and future issues regarding eventual decommissioning of the industry.

Continue to address the uncertainty

There is a need to focus research efforts and communication on helping to address the uncertainty around CSG and its impacts. Research updates that collate the latest research on key areas of uncertainty such as well integrity and ground water connectivity would help to address the more widely held concerns of communities. Such review papers could help to dispel myths that may develop to fill knowledge gaps, and which create anxiety within CSG communities.

A valuable touchpoint with the community

The researchers have found such a level of community engagement to be of great benefit in understanding issues arising from their research, and methods for better communicating with important sectors of the community. Similarly, many participants expressed their gratitude for

being able to speak with the researchers directly. Such interactions should become a regular part of GISERA's research communications agenda.

Appendix: Ethics Information Sheet

AGRICULTURE
www.csiro.au



Project: Community feedback on CSG research

The purpose of this study is to collect community feedback about GISERA CSG research that has been conducted by CSIRO in the Surat Basin over the last 4 years. We are interested in understanding the relevance of our research and how best to communicate our research findings. Results from the project will inform future decisions and activities related to CSG research and improve the way researchers communicate the results of their science.

Who is funding this research?

The study is being conducted by the CSIRO and is funded by the Gas Industry Social and Environmental Research Alliance (GISERA). CSIRO conducts independent and publicly available research for GISERA, which is co-funded by the CSIRO and gas companies APLNG and QGC. The purpose of GISERA is to provide quality assured scientific research to industry and government, focusing on social and environment topics including: groundwater and surface water, biodiversity, land management, the marine environment, and socio-economic impacts. More information about GISERA is available at www.gisera.org.au

Who is participating in the study?

Land owners, local town residents, and business operators of the Western Downs region will be invited to participate. You were invited through your attendance at a local community event, for example a rural show.

What is involved?

You will be invited to partake in:

- a short interview or a short questionnaire.

The **interview** takes approximately 15 minutes run by a CSIRO researcher. We will ask questions about your views regarding CSG related research.

The **questionnaire** takes approximately 5 minutes to complete and asks for your feedback on CSG research.

We will also gather some demographic information about the people who participated (e.g. gender, occupation). This information will remain anonymous.

What happens with the information?

A report from this study will be used to develop future CSG related research and to improve the way we explain our research findings. Results may also be used in scientific publications.

What are the risks to you?

Participation in this study involves no risks beyond those of everyday living. You are free to withdraw at any time.

Confidentiality

All information collected in this study remains **confidential** and **anonymous**. Although interviews will be recorded and analysed by a researcher, it will only be available to members of our research team. The data will be securely stored, and used only for research purposes.

Participation and withdrawal

Participation in this study is voluntary and you are free to withdraw at any time.

How can I find out more about the study?

A summary of the findings will be available on the GISERA website. More information about the project can be found on the website or by contacting the CSIRO researchers.

Ethical clearance and contacts

This study has been cleared in accordance with the ethical review processes of CSIRO and falls within the guidelines of the National Statement on Ethical Conduct in Human Research. If you have any questions concerning your participation in the study feel free to contact the researchers involved. Alternatively, any concerns or complaints about the conduct of this study can be raised with the Manager of Social Responsibility and Ethics on (07) 3833 5693 or by email at csshrec@csiro.au

For further information

Project Lead: Dr Neil Huth: t 07 3327 4064, e neil.huth@csiro.au
Dr Andrea Walton: t 07 3833 5675, e andrea.walton@csiro.au

CONTACT US

t 1300 363 400
+61 3 9545 2176
e csiroenquiries@csiro.au
w www.csiro.au

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FOR FURTHER INFORMATION

**Gas Industry Social and Environmental Research Alliance
(GISERA)**
e gisera@gisera.org.au
w www.gisera.org.au