



GISERA
Gas Industry Social and
Environmental Research Alliance

Project Order, Variations and Research Progress

Project Title: Understanding the impacts of CSG on pastures and livestock through on-farm monitoring

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

- Section 1: [Research Project Order as approved by the GISERA Research Advisory Committee and GISERA Management Committee before project commencement](#)
- Section 2: [Variations to Project Order](#)
- Section 3: [Progress against project milestones](#)



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GISERA
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1 Original Project Order



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Project Order

Proforma 2016

1. Short Project Title

CSG and Livestock – Inside the herd

Long Project Title Understanding the impacts of CSG on pastures and livestock through intensive on-farm monitoring.

GISERA Project Number L.7

Proposed Start Date 1-Jan-2017

Proposed End Date 30-Jun-2018

Project Leader Dr Neil Huth

2. GISERA Region

Queensland New South Wales Northern Territory

3. GISERA Research Program

Water Research GHG Research Social & Economic Research
 Biodiversity Research Marine Agricultural Land
Management Research

4. Research Leader, Title and Organisation

Dr Neil Huth
Research Scientist and Team Leader
CSIRO Agriculture and Food, Toowoomba
25 years' experience
(29 days on this project)

5. Background

Much of the land within current and prospective CSG development areas is used for grazing or mixed cropping and grazing enterprises. Most of the research within the Agricultural Land Management Portfolio has targeted cropping systems and the soils, management and issues relevant to them. This includes studies of soil compaction and erosion, production and machinery impacts, and social and economic considerations. Recent landholder engagement activities as part of the “Telling the Story” project highlighted the research gaps that remain, particularly with respect to grazing systems. Landholders raised issues of impacts on animal behavior and pastures through factors such as dust or changed water flows. These included concerns about decreased pasture palatability for livestock due to dust, changes to pasture production with changed water flows or dust deposition, livestock avoidance of, or attraction to CSG vehicles or infrastructure leading to changing use of watering points or shelter, or livestock damage of fragile soils after disturbance. Similar concerns were raised during workshops held as part of the “A Shared Space” project. We suggest that these issues should now be addressed.

Studies of the grazing-related issues listed above can be difficult, especially when studies will need to be conducted in “on-farm”. Recent technological advances now provide new opportunities for monitoring such things at remote locations. Furthermore, several new initiatives within the CSIRO Agriculture and Food Business Unit are evaluating new digital technologies for agricultural applications. Previous projects, such as the “Making Tracks, Treading Carefully” which studied CSG impacts on surface hydrology using digital photogrammetry for 3D mapping and water flow modelling, have found modern spatial data approaches very useful for not only studying complex issues, but also for communicating them to rural audiences. Farmers understand landscapes and therefore read and understand maps very well. Farmers could interpret complex hydrological data when applied to aerial photography of their region and communicate lessons arising from it. GISERA’s water flow maps for the CSG development area between Chinchilla and Miles have gathered much interest with landholders at local agricultural shows and communications forums.

6. Project Description

This project will provide information for graziers through the detailed monitoring of grazing land with CSG infrastructure. Research will address questions about the impacts of CSG infrastructure, traffic and dust on animals and pastures. The research team will discuss these data with landholders at a relevant rural industry event using maps and animations worked into story pieces.

As stated above, most GISERA agricultural research has been undertaken in cropping lands. The research gap lies within the grazing landscapes, which are a large component of CSG development areas in both Queensland and New South Wales. Dust and impacts on livestock, surface water flows, and pastures have been raised as important issues by landholders in various landholder engagement forums. Furthermore, landholders have also been outspoken about the need for science to be communicated in meaningful ways. Those negotiating with CSG companies regularly feel information overload and request information to be not “dumbed down” but communicated clearly to farmers.

We would identify a suitable property for intensive study. The property should be large enough and include a suitable set of CSG infrastructure to provide several study sites for this project. The preference will be for a property containing operational wells. If possible, the site would be chosen within our existing study area east of Miles. The level of site monitoring will depend on paddock/livestock availability. We would then undertake an intensive monitoring exercise of the property to provide where possible:

- 1) 24 hour monitoring of individual animal movement and behaviour (walking, grazing, ruminating, camping) using GPS monitoring collars and locally installed wireless sensor networks.
- 2) High resolution mapping of pasture type and condition using remote sensing (e.g. NRM Spatial Hub) to identify possible impacts of CSG on pastures, and of pastures on grazing behaviour.
- 3) Use of existing high resolution water flow mapping created during previous GISERA projects.
- 4) Soil mapping using CSIRO “Soil and Landscape Grid” with on-ground verification.
- 5) Local soil and meteorological conditions which may affect dust generation and dispersion. Exact numbers and types of meteorological stations will be determined according to site characteristics.
- 6) Dust deposition on pastures (e.g. Dust Deposition Gauges) to determine impacts on pastures and livestock.
- 7) Video and photography of activities and the site for use in communications (e.g. time lapse photography, drone flights).
- 8) Where possible, herd attributes (e.g. live weights) will be monitored before and after the experiment.

These data, when analysed and combined, will be studied to determine any impacts of CSG operations on pasture and livestock, hydrological processes, and productivity. Spatial analyses of livestock movements and behavior (inc walking, grazing, ruminating, resting) will be undertaken incorporating spatial datasets on relevant site variables which may influence animal behavior. Data requirements will be determined after site selection, but may include pasture condition, soils, microclimate, remnant vegetation and farm infrastructure. Statistical relationships between livestock movement and soil, pasture, microclimate covariates will be established. These will be combined with information on CSG infrastructure and operations to determine the key associations between animal movements, gas infrastructure and behavior.

We would aim to use the data to create story pieces for use in communication activities. This may include animations of livestock movements and behaviour over the study period for farmers to follow and interpret, maps of pasture condition and water flows, and possibly virtual landscapes for people to view.

This project will conduct a field day at the site and will invite important stakeholders (CSG (e.g. gas companies, gasfields commission), Government (e.g. compliance), Agriculture (e.g. local farmer groups), NRM (e.g. catchment groups), Research (e.g. CCSG, USQ), Community (e.g. local government), Industry (e.g. Meat and Livestock Australia)) to observe and ask questions about the research. Finally, the project would be concluded with a communications activity in the local area, similar to those employed as part of the “Telling the Story” project. CSIRO staff would attend a

local agricultural show and would present these results with those from previous projects on cropping systems.

This project will negotiate collaborative approaches with existing technology-based projects to provide synergies required to mount an exercise of this size with reduced costs. These projects may include CSIRO's "Digital Homestead" grazing project and "Soil and Landscape Grid of Australia" or others identified during subsequent project development (e.g. other GISERA projects). Collaboration will be used to reduce overall costs.

7. Budget Summary

Expenditure	2016/17	2017/18	2018/19	Total
Labour	54,862	134,471	-	189,333
Operating	18,000	26,000	-	44,000
Subcontractors	-	-	-	-
Total Expenditure	72,862	160,471	-	233,333

Expenditure per Task	2016/17	2017/18	2018/19	Total
Task 1	9,268	-	-	9,268
Task 2	15,686	-	-	15,687
Task 3	47,908	66,433	-	114,341
Task 4	-	56,779	-	56,779
Task 5	-	29,029	-	29,029
Task 6	-	8,230	-	8,230
Total Expenditure	72,862	160,471	-	233,333

Source of Cash Contributions	2016/17	2017/18	2018/19	Total
GISERA Industry Partners (70%)	51,003.40	112,329.70	-	163,333.10
- APLNG (35%)	25,501.70	56,164.85	-	81,666.55
- QGC (35%)	25,501.70	56,164.85	-	81,666.55
Total Cash Contributions	51,003.40	112,329.70	-	163,333.10

In-Kind Contribution from Partners	2016/17	2017/18	2018/19	Total
CSIRO (30%)	21,858.60	48,141.30	-	69,999.90
Total In-Kind Contribution from Partners	21,858.60	48,141.30	-	69,999.90

	Total funding over all years	Percentage of Total Budget
GISERA Investment	\$163,333.10	70%
CSIRO Investment	\$69,999.90	30%
Total Other Investment		
TOTAL	\$233,333	

Task	Milest one Number	Milest one Description	Funded by	St art Date	Delivery Date	Fiscal Year Completed	Payment \$ (excluding CSIRO cont ribution)
Task 1	1.1	Project Team Meeting	GISERA	Jan-17	Jan-17	2016/17	\$6,488
Task 2	2.1	Negotiation of Field Site(s)	GISERA	Feb-17	Jun-17	2016/17	\$10,981
Task 3	3.1	On-farm monitoring	GISERA	Feb-17	Sep-17	2017/18	\$80,039
Task 4	4.1	Data processing	GISERA	Sep-17	Dec-17	2017/18	\$39,745
Task 5	5.1	Public engagement	GISERA	Dec-17	Mar-18	2017/18	\$20,320
Task 6	6.1	Draft Scientific Publication	GISERA	Mar-18	Jun-18	2017/18	\$5,760

8. Other Researchers (include organisations)

Researcher	Time Commitment (project as a whole)	Principle area of expertise	Years of experience	Organisation
Brett Cocks	49 days	Farmer engagement and on-farm technician	20 years	CSIRO
Greg Bishop-Hurley	28 days	Animal Sensor Technologies	20 years	CSIRO
Brett Abbott	25 days	Remote sensing/ GIS/Rangeland condition	20 years	CSIRO

9. Subcontractors

Subcontractors (clause 9.5(a)(i))	Subcontractor	Role
	None	

10. Project Objectives and Outputs

Outputs will include:

1. A detailed study of livestock behaviour, pastures, soil processes, and dust deposition for a real CSG property that is used to generate information that is suitable not only for scientific study of issues of importance for farmers, but also for communication to the general community.
2. A report and conference articles about the research and technologies employed.
3. A series of engagement activities designed for rural communities.

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

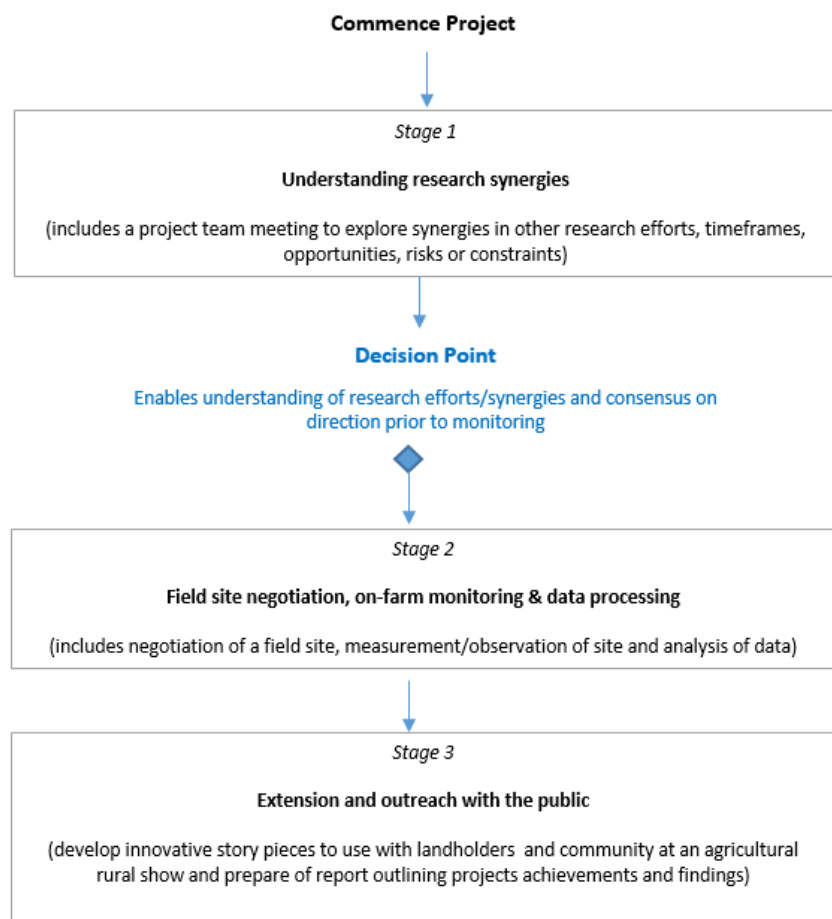
This project concept was developed after consultation with local landholders in previous GISERA Agricultural Land Management Projects (*A Shared Space, Making Tracks – Treading Carefully*,

Telling the Story). This involves direct discussions with farmers in workshops in Roma, Chinchilla and Dalby, Research Forums in Chinchilla and Roma, and science communications efforts are rural shows in Miles and Toowoomba. Furthermore, the project leader has held ongoing discussions with other agricultural researchers (e.g. CCSG) working within this area about such issues. Issues involving water, pasture and livestock impacts, vehicular traffic and dust have been raised by numerous farmers as issues important to them. The majority of GISERA Agricultural research to date has been undertaken on cropping lands. This project will address this research gap.

Previous communications of GISERA findings have highlighted the need for research to be communicated in appropriate ways for farmers. Proposed methods in this project would build upon lessons gained in previous communications efforts.

The use of spatial data approaches within the project is deliberate, not only because of the nature of the problem domain, but because of the communicative power with the farming community. For this reason, links with existing CSIRO projects for soil and livestock data systems have been sought to provide required levels of expertise. Technical support for these emerging technologies will be provided through internal CSIRO collaboration.

13. Project Plan



13.1 Project Schedule

ID	Task Title	Task Leader	Scheduled Start	Scheduled Finish	Predecessor
Task 1	Project Team Meeting	Neil Huth	1 Jan-17	31 Mar-17	
Task 2	Negotiation of Field Site(s)	Neil Huth	1 Feb-17	30 Jun-17	Task 1
Task 3	On-farm monitoring	Neil Huth	1 Feb-17	30 Sep-17	Task 2
Task 4	Data processing	Neil Huth	1 Sep-17	31 Dec-17	Task 3
Task 5	Public engagement	Neil Huth	1 Dec-17	31 Mar-18	Task 4
Task 6	Draft Scientific Publication	Neil Huth	1 Mar-18	30 Jun-18	Task 5

Task 1

TASK NAME: Project Team Meeting

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: January 2017

BACKGROUND: This project team includes staff from several business units and scientific disciplines and seeks to explore synergies in several other research efforts. That being the case, a significant level of communication and organisation is required in establishing the project.

TASK OBJECTIVE: A team meeting to organise project requirements from the various teams within the projects and to outline timeframes and staff commitments for each task.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report outlining the project planning including timeframes, opportunities and any risks or constraints for the project.

Task 2

TASK NAME: Negotiation of Field Site

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: February-June 2017

BACKGROUND: This project will seek to undertake intensive measurements of grazing land with CSG. Access to site and livestock will need to be negotiated with landholders in a manner that is appropriate for on-farm research. CSIRO Toowoomba has a long history of collaborative on-farm research.

TASK OBJECTIVE: To communicate this research opportunity and negotiate an on-farm monitoring approach that is acceptable and of interest to landholders and in accordance with CSIRO operating and human and animal ethics research procedures.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report outlining the sites to be used in this project and any research approvals undertaken.

Task 3

TASK NAME: On-farm monitoring

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: February-September 2017

BACKGROUND: This project will seek to undertake intensive measurements of grazing lands with CSG. The level of site monitoring will depend on the level of resourcing and paddock/livestock availability.

TASK OBJECTIVE: To generate spatial data on site conditions, CSG infrastructure, animal behaviour, pasture condition, surface water flow, dust deposition, and documentation of the research for use in future communications activities. Further and more detailed data analysis will be undertaken after the given measurement window. If possible, a field day will be conducted during the field campaign to highlight the research being undertaken with key stakeholders.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report outlining the type of measurements undertaken and outcomes from the field day. Where possible, summary data or graphical representation of results will be provided.

Task 4

TASK NAME: Data processing

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: September-December 2017

BACKGROUND: A large amount of data will be generated during the intensive field measurement period. These data will need significant processing and synthesis to prepare them for interpretation and discussion with landholders, and for further publication.

TASK OBJECTIVE: To synthesis the wide range of data gathered within the field in a form suitable for analysis, communication and publication.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report summarising the results obtained to date. Analysis will continue until communications are complete, but preliminary results will be available at this time.

Task 5

TASK NAME: Public engagement

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: December 2017- March 2018

BACKGROUND: Previous research efforts have found direct communications with interested landholders as an effective means of information transfer. This project will undertake a communications activity in the local area similar to those employed as part of the “Telling the Story” project. CSIRO staff would attend a local agricultural show and would present these results with those from previous projects on cropping systems.

TASK OBJECTIVE: To develop and use innovative story pieces based on the spatial analyses within this project to explore this research with landholders.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report outlining the outcomes of the public engagement activity.

Task 6

TASK NAME: Final Report

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: March-June 2018

BACKGROUND: This project will integrate a range of novel monitoring approaches in a way that has not been undertaken previously. This will provide an opportunity to report on the application of novel emerging technologies applied to a research question of regional importance.

TASK OBJECTIVE: To produce a report outlining the projects achievements and findings.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report available via GISERA website.

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.

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)	Party		Commercialisation Interest	
	APLNG		N/A	
	QGC		N/A	
	CSIRO		N/A	




2 Variations to Project Order

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

The table below details variations to research Project Order.

Register of changes to Research Project Order

Date	Issue	Action	Authorisation
2/11/17	Delays experienced from the dry weather resulting in the collaring of the cattle being pushed back and dependant on the landowners availability.	Milestone 3 pushed back to December 2017 and milestone 4 pushed back until March 2018.	



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3 Progress against project milestones

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

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

1. Traffic light reports in the Project Schedule Table below show progress using a simple colour code:
 - **Green:**
 - Milestone fully met according to schedule.
 - Project is expected to continue to deliver according to plan.
 - Milestone payment is approved.
 - **Amber:**
 - Milestone largely met according to schedule.
 - Project has experienced delays or difficulties that will be overcome by next milestone, enabling project to return to delivery according to plan by next milestone.
 - Milestone payment approved for one amber light.
 - Milestone payment withheld for second of two successive amber lights; project review initiated and undertaken by GISERA Director.
 - **Red:**
 - Milestone not met according to schedule.
 - Problems in meeting milestone are likely to impact subsequent project delivery, such that revisions to project timing, scope or budget must be considered.
 - Milestone payment is withheld.
 - Project review initiated and undertaken by GISERA Research Advisory Committee.
2. Progress Schedule Reports outline task objectives and outputs and describe, in the 'progress report' section, the means and extent to which progress towards tasks has been made.



Project Schedule Table

ID	Task Title	Task Leader	Scheduled Start	Scheduled Finish
Task 1	Project Team Meeting	Neil Huth	Jan-17	Jan-17
Task 2	Negotiation of Field Site(s)	Neil Huth	Feb-17	Jun-17
Task 3	On-farm monitoring	Neil Huth	Feb-17	Dec-17
Task 4	Data processing	Neil Huth	Sep-17	Mar-18
Task 5	Public engagement	Neil Huth	Dec-17	Mar-18
Task 6	Draft Scientific Publication	Neil Huth	Mar-18	Jun-18





Project Schedule Report

Task 1

TASK NAME: Project Team Meeting

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: January 2017

BACKGROUND: This project team includes staff from several business units and scientific disciplines and seeks to explore synergies in several other research efforts. That being the case, a significant level of communication and organisation is required in establishing the project.

TASK OBJECTIVE: A team meeting to organise project requirements from the various teams within the projects and to outline timeframes and staff commitments for each task.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report outlining the project planning including timeframes, opportunities and any risks or constraints for the project.

PROGRESS REPORT:

A series of discussions have been held by team members to determine overall project workflow and the timeframes for critical tasks. The project includes GPS monitoring of farm livestock as a significant component of the study. Therefore, approval via the CSIRO Animal Ethics procedures will be a key determinant for field work schedules. Issues of availability for key staff mean that animal ethics approval is likely by June 2017. This is within the window provided with the project proposal, but does constrain field operations to a shorter period. This may have implications for access to appropriate farm sites as the team will need to identify grazing properties with adequate CSG infrastructure and appropriate livestock and mustering capability available within that smaller time window. Progress on this will be documented in the next project milestone. The duration of the animal monitoring is more likely to be dependent upon the availability of the landholder to assist with mustering. Similarly, timing of the field day will be dependent upon negotiations with the landholder and the site availability described above. It is most likely that the field day may need to be conducted after, rather than during, the survey period. That timing may then be outside the originally documented timeframe. However, this provides added benefits in enabling the team to present preliminary results to stakeholders when they visit the site. Whilst site negotiations and animal ethics approvals are being sought, the team will undertake development and testing of technologies used to monitor traffic, pastures, climate and dust to ensure all operations are ready when sites and approvals are available. These testing efforts will be complete before June. There is some interest from other research teams within CSIRO to demonstrate other novel remote monitoring or modelling tools currently under development. Where possible, these opportunities may be used to provide extra data for the statistical evaluation of the animal behavioural data. A Landscape Preference Index approach is likely to be employed to the livestock GPS data to determine areas of statistically different grazing performance. These will be further explored using the spatial data obtained within the project to find explanations for any differences in animal behaviour.

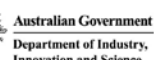
Task 2

TASK NAME: Negotiation of Field Site

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: February-June 2017

BACKGROUND: This project will seek to undertake intensive measurements of grazing land with CSG. Access to site and livestock will need to negotiate with landholders in a manner that is appropriate for on-farm research. CSIRO Toowoomba has a long history of collaborative on-farm research.





TASK OBJECTIVE: To communicate this research opportunity and negotiate an on-farm monitoring approach that is acceptable and of interest to landholders and in accordance with CSIRO operating and human and animal ethics research procedures.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report outlining the sites to be used in this project and any research approvals undertaken.

PROGRESS REPORT:

A field site has been chosen for the purposes of this project. The site is located near the town of Miles and includes 20 CSG wells on a property used for breeding and fattening of composite cattle. The site has cattle yards and infrastructure for animal handling and the manager is very supportive of our research. The site also lies within the region previously studied using aerial photogrammetry which provide further spatial data for the final analysis. Animal Ethics Approval has been obtained (18th August, AEC number 2017-29) through the CSIRO Queensland Animal Ethics committee.

Task 3

TASK NAME: On-farm monitoring

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: February-December 2017

BACKGROUND: This project will seek to undertake intensive measurements of grazing lands with CSG. The level of site monitoring will depend on the level of resourcing and paddock/livestock availability.

TASK OBJECTIVE: To generate spatial data on site conditions, CSG infrastructure, animal behaviour, pasture condition, surface water flow, dust deposition, and documentation of the research for use in future communications activities. Further and more detailed data analysis will be undertaken after the given measurement window. If possible, a field day will be conducted during the field campaign to highlight the research being undertaken with key stakeholders.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report outlining the type of measurements undertaken and outcomes from the field day. Where possible, summary data or graphical representation of results will be provided.

PROGRESS REPORT:

Field monitoring is complete, however installed devices will continue to log remotely to provide a longer time series of information. The following efforts have been undertaken:

1. Initial mapping of fence lines and infrastructure is complete with final stages to be completed using detailed imagery already obtained.
2. Eleven cameras have been recording numbers and types of vehicles travelling along various access tracks and some of these have already been processed. The failure of some cameras, and the decision to replicate measurements at important sites, has reduced the number of locations currently monitored. However, this level of sampling will be adequate to provide information on the total number of vehicles and variation in traffic pressure across the property.
3. Estimates of spatial variation of pasture condition have been prepared using long term satellite data for the case study farm (20 years of data including periods before and after CSG development). Detailed pasture mapping has been undertaken (22nd to 23rd November) using Patchkey software (CSIRO Land and Water). Information was obtained for a series of transects across the property to sample the various pasture and land types with records of pasture composition, pasture condition, grazing pressure and soil condition. These will be used to further calibrate and test the pasture data obtained via remote sensing.
4. Transects of pasture condition and grazing pressure (Patchkey) have been undertaken at various distances from roadways to detect possible impacts of traffic and roads on





- pastures and livestock. This approach was chosen to provide a large sample size over large areas for targeted areas.
5. Animal exclusion cages have been installed at varying distances next to roadways to monitor pasture growth rates in the absence of grazing to determine any possible impact of roadway on pasture growth or grazing.
 6. Animal ethics approval for GPS monitoring of cattle was obtained in August but rainfall had been exceptionally low (47mm between April and September) and pasture levels were low mid-year. The research team decided that animal studies under these conditions were unlikely to provide useful results as animals are likely to congregate near water and feed supply, especially if supplementary feeding was commenced. Therefore the GPS collars were fitted to livestock on the 24th of November after a suitable period of rainfall and the return of pasture condition. These collars will be removed in early January to allow for an extended period of monitoring, but to also comply with animal research requirements.
 7. Three weather stations have been installed across the property to assist in interpretation of pasture and livestock data. These will remain on site to provide ongoing weather data until the project is complete.
 8. Task 4 (Data Processing) has already commenced on the available data.

There are two changes to what was outlined in the project plan:

- a) The team has not conducted a field day on the site as outlined in the project plan. Low stocking rates and vegetation on site would make demonstrations of livestock monitoring equipment difficult. The delay of some measurements has also meant that much information is still being processed. Furthermore, we could not ensure availability of staff and stakeholders over the holiday season. A decision was made to delay the field day and to incorporate it toward the end of the project in conjunction with our knowledge transfer procedures. It is anticipated that this will also increase the effectiveness of our outreach activities.
- b) No direct measures of dust emissions have been undertaken. Initial site inspection and observation of local dust emission processes highlighted the localised and variable nature of the issue. Furthermore, variability in vegetation, climate and vehicle movements would likely make upscaling of measurements (space and time) very difficult. The project team has decided to focus on quantifying impacts of dust and some mechanisms behind these. These are described in the list of measurements above. Simple models will be developed and used, in conjunction with long term climate records and data on vehicle movements, to provide long term assessments of the frequency and timing of dust risks.

Task 4

TASK NAME: Data processing

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: September-March 2018

BACKGROUND: A large amount of data will be generated during the intensive field measurement period. These data will need significant processing and synthesis to prepare them for interpretation and discussion with landholders, and for further publication.

TASK OBJECTIVE: To synthesis the wide range of data gathered within the field in a form suitable for analysis, communication and publication.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report summarising the results obtained to date. Analysis will continue until communications are complete, but preliminary results will be available at this time.





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PROGRESS REPORT:

Data processing is now complete after earlier delays to the previous task brought about due to dry weather conditions during 2017 (See Task 3). Data from the livestock GPS collars has been downloaded and processed to provide animal locations at a one minute temporal resolution. Data from vehicle monitoring has been processed to provide information on the number and type of vehicles entering the property over a 3 to 6 month period. Sample of road surface materials have been processed using suitable methods to parameterisation of statistical models of dust emissions. Characterisation of four main soil types within the property is complete. CSG and Farm infrastructure, vegetation, livestock behaviour (movement, camping and grazing) has been mapped. Land and pasture condition models have been calibrated using on-ground measurements. Tests for identifiable impacts of infrastructure on animal behaviour are now complete. All data have been formatted for display during public engagement (see Task 5).

Task 5

TASK NAME: Public engagement

TASK LEADER: Neil Huth

OVERALL TIMEFRAME: December 2017- March 2018

BACKGROUND: Previous research efforts have found direct communications with interested landholders as an effective means of information transfer. This project will undertake a communications activity in the local area similar to those employed as part of the “Telling the Story” project. CSIRO staff would attend a local agricultural show and would present these results with those from previous projects on cropping systems.

TASK OBJECTIVE: To develop and use innovative story pieces based on the spatial analyses within this project to explore this research with landholders.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Short report outlining the outcomes of the public engagement activity.

PROGRESS REPORT:

Community engagement is now complete after delays to the previous tasks brought about due to dry weather conditions during 2017. CSIRO staff presented information and gathered feedback at the Chinchilla Show on 25th and 26th of May. Materials presented included video of the study location and methods used, maps of livestock behaviour, information on traffic levels, basic statistics on impacts of CSG on livestock and pastures. Discussions were held with over 100 people with backgrounds ranging from Agriculture, regional development, state government, CSG, Coal mining, solar energy, engineering, and local business. Response from participants was positive. Feedback will be used to improve communications materials prior to future knowledge transfer.



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