Project Order, Variations and Research Progress

Project Title: A study into potential soil damage and its management during CSG development

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

1 Original Project Order

Project Order

Proforma 2011

1. Short Project Title (less than 15 words)

Project 5 – Without a trace

Long Project Title	A study into potential soil damage and its management during CSG development.
GISERA Project Number	A5 1214
Proposed Start Date	July 2012
Proposed End Date	June 2014
Project Leader	Neil Huth

2. GISERA Research Program

☐ Biodiversity Research ☐ Marine Research ☒ Land Research

☐ Water Research ☐ Social & Economic Research

3. Research Leader, Title and Organisation

Dr Neil Huth
Research Scientist
CSIRO Ecosystem Sciences

4. Summary (less than 300 words)

The establishment of coal seam gas infrastructure will see the development of an extensive network of access tracks, pipes and thousands of wells on agricultural land, requiring the use of heavy equipment. A primary goal of rehabilitation following disturbance of this type is the return of land to its original condition. Disturbance during establishment, operation and removal of gas infrastructure will result in changes in the physical, chemical and structural properties of soil. Changes in the biological properties of soil are also anticipated (e.g. grass/weed seed banks). Designs for coal seam gas infrastructure should account for these

risks and seek to minimise damage, both by avoiding damage and minimising it where it is unavoidable. Processes for rehabilitating unavoidable damage have yet to be fully described. This research will provide insight into these issues via literature review and on-farm case studies.

5. Budget Summary (From Excel Budget Pack worksheet "Project Plan Summary")

Expenditure	2012/13 Year 1	2013/14 Year 2	2014/15 Year 3	2015/16 Year 4	2016/17 Year 5	Total
Labour	118,458	172,532				290,990
Operating	17,000	32,000				49,000
Total Costs	**135,458**	**204,532**				**339,990**
University of Southern Queensland (USQ)	135,458	204,532				
Total Expenditure	**135,458**	**204,532**				**339,990**

Expenditure per Task	2012/13 Year 1	2013/14 Year 2	2014/15 Year 3	2015/16 Year 4	2016/17 Year 5	Total
Task 1 Task 2 Task 3 Task 4 Task 5	135,458	204,532				339,990
Total Expenditure	**135,458**	**204,532**				**339,990**

Cash Funds to Project Partners	2012/13 Year 1	2013/14 Year 2	2014/15 Year 3	2015/16 Year 4	2016/17 Year 5	Total
USQ	97,500	162,500				260,000
Total Cash to Partners	**97,500**	**162,500**				**260,000**

Source of Cash Contributions	2012/13 Year 1	2013/14 Year 2	2014/15 Year 3	2015/16 Year 4	2016/17 Year 5	Total
Australia Pacific LNG	97,500	162,500				260,000
Total Cash Contributions	**97,500**	**162,500**				**260,000**

In- Kind Contribution from Partners	2012/13 Year 1	2013/14 Year 2	2014/15 Year 3	2015/16 Year 4	2016/17 Year 5	Total
USQ (Subcontractor)	37,958	42,032				79,990
Total In- Kind Contribution from Partners						

	Total funding over all years	Percentage of Total Budget
Australia Pacific LNG Investment	260,000	76.5%
USQ Investment	79,990	23.5%
Total Other Investment		
TOTAL	**339,990**	**100%**

Task	Mile-stone Number	Milestone Description	Funded by	Participant Recipient	Start Date (mm- yy)	Delivery Date (mm- yy)	Fiscal Year	Fiscal Quarter	Payment $
Task 1	1	Activity Planning Meeting	GISERA	USQ	Jul-12	Sep-12	2012/13	3rd	32,500
Task 1	2	Literature Review	GISERA	USQ	Oct-12	Dec-12	2012/13	4th	32,500
Task 1	3	Establishment of Case Study Sites	GISERA	USQ	Jan-13	Mar-13	2012/13	1st	32,500
Task 1	4	Case Study Engagement	GISERA	USQ	Apr-13	Sep-13	2013/14	2nd	65,000
Task 1	5	Case Studies Complete	GISERA	USQ	Oct-13	Mar-14	2013/14	4th	65,000
Task 1	6	Publication of Findings	GISERA	USQ	Apr-14	Jun-14	2013/14	2nd	32,500

6. Other Researchers (include organisations)

Researcher	Time Commitment (project as a whole)	Principle area of expertise	Years of experience	Organisation
Allen Jack McHugh	0.5FTE	Farming Systems Research; Mechanisation and the environment; Soil and water physics; Proximal sensing.	>15	USQ
Simon White	0.3FTE	Farming systems research; Broad-acre agronomy, field to catchment scale hydro-climatic modelling and sustainable farming system research	>10	USQ
Jochen Eberhard	0.45FTE	Agricultural engineering; Agronomy, Irrigation system optimisation, Spatial variability in farming systems	>15	USQ

7. GISERA Objectives Addressed

- Research that improves and extends knowledge of environmental impacts and their management, enabling the CSG-LNG industry to better meet the expectations of farming communities and the broader public
- Informing farmers and CSG operators on ways to improve current operations
- Publication of scientific papers
- Universities, particularly those local to CSG and LNG activity, participating in research projects.

8. Program Outcomes Achieved

Details are provided in *Section 13. Project Objectives and Outputs.*

9. Program Outputs Achieved

Details are provided in *Section 13. Project Objectives and Outputs.*

10. What is the knowledge gap that these research outputs will address?

The nature and extent of actual and potential soil damage caused by the different elements of CSG development is currently not well documented. Furthermore, the methods for avoiding, managing or remediating soil quality impacts are not fully understood. This research will

develop guidelines for minimising and remediating soil damage derived from literature review and on-farm case studies.

11. How will these Research outputs and outcomes be used by farmers or the CSG-LNG industry?

This research will provide clear and actionable guidelines for avoiding damage to soil productivity during the establishment and operation of gas infrastructure, as well as for remediating damage that is not avoidable. This information will be made publicly available, such that it can inform mutual deliberation and planning by agricultural and gas industry concerns. Where appropriate, links to regulatory considerations will be explored.

While the research focuses on impacts arising from gas development, the results will also find application in the minimisation and remediation of soil damage caused by other operations within farming enterprises. As such, it is expected to provide benefit beyond CSG production areas.

12. Project Development (1 page max.)

The project was developed in consultation with staff from Australia Pacific LNG, CSIRO and USQ, each of whom have engaged with a wide range of farmer/stakeholder groups. The issues being considered in this study were consistently identified as an important research need.

Much current public discussion arises from uncertainty within the farming community regarding the likely impacts and opportunities brought about by CSG development on farming land. Concern regarding possible soil damage is a common theme for farming and CSG communities, and is the subject of policy discussion, especially with regard to what are often termed ‘strategic cropping lands’.

The existing policy for protecting Queensland’s strategic cropping land states that, on such lands, temporary diminution of productivity during development must be followed by restoration to strategic cropping land condition when development has ceased (Department of Environment and Resource Management (DERM), 2010).

One possible cause of damage to agricultural soils is compaction by heavy machinery during the various phases of development. It has been shown that damage by heavy farm machinery can be ameliorated via modern farming techniques (McHugh 2009, Radford and Thornton 2011). Similarly, techniques currently used by farmers are likely to be useful in overcoming other possible damage to soils. The studies mentioned above showed that remediation took several years.

It is common for researchers, when selecting sites for long term field studies, to investigate the long term management history of sites through the use of aerial photography or satellite imagery spanning a long period of time (e.g. Huth 2010, Poulton et al 2005). The impacts of site disturbance can often be seen long after the fact and this information is used to locate trial sites. Soil measurements at these sites can then determine changes in site characteristics (Poulton et al 2005). Such methods allow researchers to identify, locate and study soil conditions for sites covering a range of durations since disturbance. Methods for quantifying impacts and remediation could be

tested on these existing locations thus providing insights to long term impacts and their management.

This project builds strongly on past and ongoing research activities of this and the companion project teams in farming systems research based upon strong stakeholder engagement. Team members are currently involved on a range of cross-disciplinary studies, many occurring within GISERA. Linkage with the *Shared Space* and *Making Tracks* projects of GISERA ensures the relevance of this research to the broader research portfolio.

References

DERM (2010) Protecting Queensland's strategic cropping land: A policy framework. Department of Environment and Resource Management, Brisbane. (http://www.derm.qld.gov.au/land/planning/pdf/strategic-cropping/strategic-cropping-policy-part.pdf)

Huth, NI (2010) Measuring, modelling and managing tradeoffs in low rainfall agroforestry for Australia's subtropics. PhD thesis, University of Queensland.
McHugh AD, Tullberg JN, Freebairn DM (2009) Controlled traffic farming restores soil structure. Soil & Tillage Research 104, 164-172.

Poulton PL, Huth NI, Carberry PS (2005) Use of simulation in assessing cropping system strategies for minimising salinity risk in brigalow landscapes. Australian Journal of Experimental Agriculture 45, 635-642.

Radford BJ and Thornton CM (2011) Effects of 27 years of reduced tillage practices on soil properties and crop performance in the semi-arid subtropics of Australia. IJEE Vol. 19, pp 6.

13. Project Objectives and Outputs

This project will:

- Identify risks of damage to agricultural soils and methods to avoid this damage by changes in management and design
- Assess the existing methods for ameliorating damage that is likely to occur
- Incorporate these insights into clear and actionable guidelines for avoiding damage to soil productivity during the establishment and operation of gas infrastructure, as well as for remediating damage that is not avoidable.

The first aim will be achieved via an extensive review of the literature and evaluation of existing methods of infrastructure development. This includes evaluation of data and findings from the *Making Tracks, Treading Carefully* project and further testing of options monitored during this work. The second aim will be met via case studies where similar damage has been observed on local farms. This may include remediation damage from CSG operations, previous farm laneways or other compaction damage by machinery or livestock. Case studies will cover a range of examples of soil damage and may even apply novel rehabilitation techniques with landholders if practicable.

Outputs include:

- An extensive literature review
- Evaluation of potential impacts and their management on case study farms
- Communication of findings via farmer engagement on case study farms and a range of communication forums
- A publication documenting the findings of the literature review and case studies.

14. Project Plan

14.1 Project Schedule

ID	Task Title	Task Leader	Scheduled Start	Scheduled Finish	Predecessor
1.1	Activity Planning Meeting	Allen McHugh	Jul-12	Sep-12	
1.2	Literature Review	Allen McHugh	Oct-12	Dec-12	Task 1.1
1.3	Establishment of Case Study Sites	Allen McHugh	Jan-13	Mar-13	Task 1.2
1.4	Case Study Engagement	Allen McHugh	Apr-13	Sep-13	Task 1.3
1.5	Case Studies Complete	Allen McHugh	Oct-13	Mar-14	Task 1.4
1.6	Publication of Findings	Allen McHugh	Apr-14	Jun-14	Task 1.5

Task 1.

TASK NAME: Activity planning meeting

TASK LEADER: Allen McHugh

OVERALL TIMEFRAME: 2012/13

TASK OBJECTIVES:

- Establish a project team including links with companion projects (*A Shared Space*, *Gas-Farm Design*, *Making Tracks*)
- Develop a plan for the literature review and case study site selection
- Refine work plan according to Australia Pacific LNG-CSIRO-USQ discussions.

Task 2.

TASK NAME: Literature review

TASK LEADER: Allen McHugh

OVERALL TIMEFRAME: 2012/13

BACKGROUND: A clear understanding of previous research findings is required before future work is planned.

TASK OBJECTIVE: Gather relevant information to provide a good understanding of the likely impacts and their management.

SPECIFIC DELIVERABLE: A draft literature review detailing previous research findings.

Task 3.

TASK NAME: Establishment of case study sites

TASK LEADER: Allen McHugh

OVERALL TIMEFRAME: 2013/14

BACKGROUND: A range of potential soil damage issues will be identified. Some of these will be investigated in detail on case study sites.

TASK OBJECTIVE: Identify, scope and benchmark case study farm locations for monitoring, testing or evaluation of soil damage and management issues.

SPECIFIC DELIVERABLE: A brief report describing the choice of study sites, their nature and soil damage issues to be studied within them.

Task 4.

TASK NAME: Case study engagement

TASK LEADER: Allen McHugh

OVERALL TIMEFRAME: 2013/14

BACKGROUND: By this stage of the project, case studies will have been undertaken to investigate likely soil impacts and their management.

TASK OUTPUTS & SPECIFIC DELIVERABLES: A brief progress report describing the work to date on the case study sites and plans for the remaining duration of the case studies.

Task 5.

TASK NAME: Case study complete

TASK LEADER: Allen McHugh

OVERALL TIMEFRAME: 2013/14

BACKGROUND: By this milestone, case studies should be complete. This timing should ensure adequate opportunity to document findings before the end of the project.

TASK OUTPUTS & SPECIFIC DELIVERABLES: A brief progress report outlining the results of the case studies, probable findings and plan for publication/communication of results.

Task 6.

TASK NAME: Publication of results

TASK LEADER: Allen McHugh

OVERALL TIMEFRAME: 2013/14

BACKGROUND: Research should be complete and results synthesised into a format for publication.

TASK OUTPUTS & SPECIFIC DELIVERABLES: A draft publication prepared for the scientific literature (journal and/or conference proceedings).

15. Budget Justification

The budget for this project has been approved by GISERA's Research Advisory Committee and Management Committee.

16. Project Governance

Progress against project milestones and tasks (specified in item 14) will be assessed regularly as part of GISERA's general research portfolio management.

17. Communications Plan

General communication of project results will be managed by GISERA.

Project outputs will be made available on the GISERA website and will, be further supported by a range of activities designed to facilitate adoption by the broader agricultural and gas industries, and awareness by appropriate regulatory agencies.

18. Risks

Capacity to deliver: Staff have sufficient experience to lead and supervise the various activities and ascertain the research outcomes. Close links with GISERA Land Management companion projects will provide extra support. Therefore the impact of key staff departure is low and can be mitigated.

In projects of short duration the risk of adverse weather conditions on field work is heightened. However, this will not affect the literature review component of the work, and the use of more than one case study should minimise the risk of weather being an impediment to project completion.

19. Intellectual Property and Confidentiality

Background IP (clause 10.1, 10.2)	**Party**	**Description of Background IP**	**Restrictions on use (if any)**	**Value**
Ownership of Non-Derivative IP (clause 11.3)	CSIRO			
Confidentiality of Project Results (clause 15.6)	Project results are not confidential.			
Additional Commercialisation requirements (clause 12.1)	Not Applicable			
Distribution of Commercialisation Income	Not applicable			

(clause 1.1)		
Commercialisation Interest (clause 1.1)	**Party**	**Commercialisation Interest**
	Australia Pacific LNG	N/A
	USQ	N/A

GISERA Gas Industry Social & Environmental Research Alliance

20. Approval from Project Parties

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

Australia Pacific LNG

SIGNED for and on behalf of Australia Pacific LNG

by Dan O'Sullivan

in the presence of

.....

Signature of witness

S. RAINERI

.....

Name of witness

21-9-12

.....

Date

CSIRO

SIGNED for and on behalf of CSIRO

by R Keating

in the presence of

Cathy Simpson

.....

Signature of witness

CATHY SIMPSON

.....

Name of witness

11/09/2012

.....

Date

2 Variations to Project Order

Changes to research Project Orders are approved by the GISERA Director, acting with authority provided by the GISERA Management Committee or Research Advisory Committee, in accordance with the GISERA Agreement (http://www.gisera.org.au/contract.html).

The table below details variations to research Project Order.

Register of changes to Research Project Order

Date	Issue	Action	Authorisation
25/07/14	Research project start date delayed; milestone date requires rescheduling.	Milestone 1.6 rescheduled to reflect later project start date.	

3 Progress against project milestones

Progress against milestones are approved by the GISERA Director, acting with authority provided by the GISERA Management Committee or Research Advisory Committee, in accordance with the GISERA Agreement (http://www.gisera.org.au/contract.html).

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
1.1	Activity Planning Meeting	Allen McHugh	Oct-12	Dec-12
1.2	Literature Review	Simon White	Jan-13	Mar-13
1.3	Establishment of Case Study Sites	Dio Antille	Apr-13	Jun-13
1.4	Case Study Engagement	Allen McHugh	Jul-13	Dec-13
1.5	Case Studies Complete	Allen McHugh	Jan-14	Jun-14
1.6	Publication of Findings	Allen McHugh	Jul-14	Sep-14

Project Schedule Report

Task 1.

TASK NAME: Activity planning meeting

TASK LEADER: Allen McHugh

OVERALL TIMEFRAME: 2012/13

TASK OBJECTIVES:

- Establish a project team including links with companion projects (*A Shared Space*, *Gas-Farm Design*, *Making Tracks*).
- Develop a plan for the literature review and case study site selection.
- Refine work plan according to Australia Pacific LNG-CSIRO-USQ discussions.

PROGRESS REPORT

A GISERA land management portfolio team meeting was conducted in Toowoomba with representatives of the Without a Trace project and the other GISERA agriculture projects in attendance. Staff from the Without a Trace project joined discussions on methods for using joint field case study sites across projects for increased efficiency and depth of study. Case study sites will be identified during wider engagement and detailed discussions with farmers in the Shared Space project. Case study sites will seek to cover enterprise changes from grazing dominated systems on the Western Downs, to dry land cropping systems in the central Downs region, through to intensive cropping/irrigated systems on the Inner Downs. Some key papers from the initial literature review were presented showing the current leading research in this area as a means of prompting further thinking and feedback from team members. The initial literature review includes the location, land use and predominate soil types of the existing CSG industry, risks and damages which can occur to the soil resource, the likely impacts which may occur from existing CSG activities, and research requirements to quantify impacts and effective management and amelioration.

Task 2.

TASK NAME: Literature review

TASK LEADER: Dr Simon White

OVERALL TIMEFRAME: 2012/13

BACKGROUND: A clear understanding of previous research findings is required before future work is planned.

TASK OBJECTIVE: Gather relevant information to provide a good understanding of the likely impacts and their management.

SPECIFIC DELIVERABLE: A draft literature review detailing previous research findings.

PROGRESS REPORT

A literature review has now been compiled. The review first contains a brief description of GISERA and the location of the CSG industry in Queensland. Land use and dominant soil types within the Surat and Bowen Basin have been defined and provide a broad insight into the types and extent of impacts to the soil resource that can occur. All potential impacts on the soil resource have been described and are grouped based on their adverse impacts on the soils physical (texture,

structure, density and porosity), chemical and biological characteristics, regardless of whether this is due to grazing and/or cropping practises, CSG development or other activities. Specific to CSG activities the: 1) Lease Area, 2) Access tracks, 3) Pipelines, and 4) Laydown yards and vehicle mustering points have been defined and reviewed in terms of the types of impacts to the soil resource that may occur. For this, the review found very limited literature specific to the CSG industry in Australia and is supplemented by drawing on published and grey literature found from overseas experiences regarding the Marcellus Shale Formation gas development in the US and Canada. Methods of impact management for CSG activities have also been reviewed and documented, and include impact elimination, minimisation and remediation for those impacts considered unable to be fully avoided. Reference is made to possible next generation developments in the CSG industry and the influence this may have on future types and severity of impacts to the soil resource. Finally, recommendation for research, based on knowledge gaps in review findings are described and options for case study/investigations are listed.

Task 3.

TASK NAME: Establishment of case study sites

TASK LEADER: Dr Dio Antille

OVERALL TIMEFRAME: 2013/14

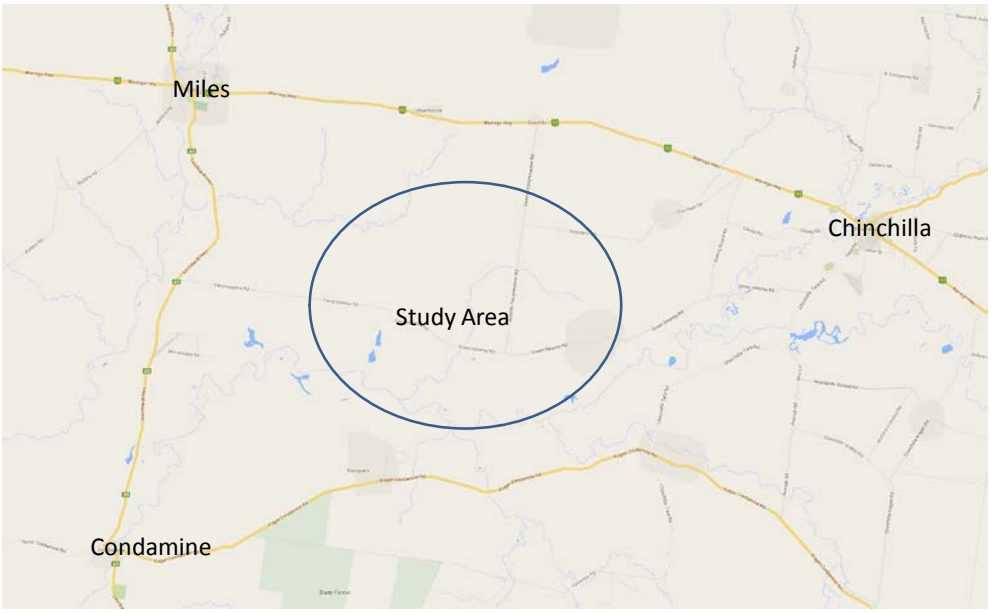
BACKGROUND: A range of potential soil damage issues will be identified. Some of these will be investigated in detail on case study sites.

TASK OBJECTIVE: Identify, scope and benchmark case study farm locations for monitoring, testing or evaluation of soil damage and management issues.

SPECIFIC DELIVERABLE: A brief report describing the choice of study sites, their nature and soil damage issues to be studied within them.

PROGRESS REPORT

One case study site has been surveyed prior to well installation. A 2.5ha site, on "Monreagh" farm, encompassing a future gas well site has been mapped using EM38 (in conjunction with *Project 3 – Gas Farm Design*) to look for existing soil variation. Soil cores to 1.8m from across the site have been collected for analysis of soil chemical properties and soil profile description. Soil samples have been taken for determining mechanical properties that may affect future damage due to compaction. The location of soil surface features, such as existing contour banks, have also been mapped. Multiple wells were to be studied in this way on this farm. However, logistical problems have resulted in the likely date for well installation to be delayed to 2014. This delay may cause problems for the delivery of this project. Therefore, the decision has been made to divert the rest of the survey effort to sites with existing wells, using a paired-site approach where, rather than studying sites before and after installation, we shall study inside and outside the lease area to look for impacts.



Location of existing case study area. Soils of the area include grey vertosols to red sandy loams. Land use includes mixtures of dryland cropping, grazing and irrigation.

Task 4.

TASK NAME: Case study engagement

TASK LEADER: Dr Dio Antille

OVERALL TIMEFRAME: 2013/14

BACKGROUND: By this stage of the project, case studies will have been undertaken to investigate likely soil impacts and their management.

TASK OUTPUTS & SPECIFIC DELIVERABLES: A brief progress report describing the work to date on the case study sites and plans for the remaining duration of the case studies.

PROGRESS REPORT

A first paired-site study has been commenced on a farm between Chinchilla and Condamine. EM38 surveys and some mapping of surface conditions are complete for two well sites showing soil disturbance impacts on crop production around wells and along pipelines. Soil impacts at this site include soil inversion that has brought sodic subsoil to the surface, compaction, residual impacts from temporary access roads, and subsidence along pipelines. The location of each of these measurement sites has been determined. Measurements are ongoing at this site with levels of compaction and impacts on infiltration now complete at some of these.

The Project 3 case study farm west of Dalby may be used in a similar manner pending further site evaluation and site accessibility (e.g. reduced access during cropping or after rainfall). Laboratory studies, once proven and deemed appropriate, may be used to infer findings from these sites to a broader range of soil types. There is also a possibility to investigate 'immediate' post-installation disturbance (i.e. prior to reclamation of the site) on the farm near Cecil Plains, also under cropping. Activity here will depend upon opportunities at existing sites, timing of well installation, and weather conditions over the coming summer.

Task 5.

TASK NAME: Case study complete

TASK LEADER: Dr Dio Antille

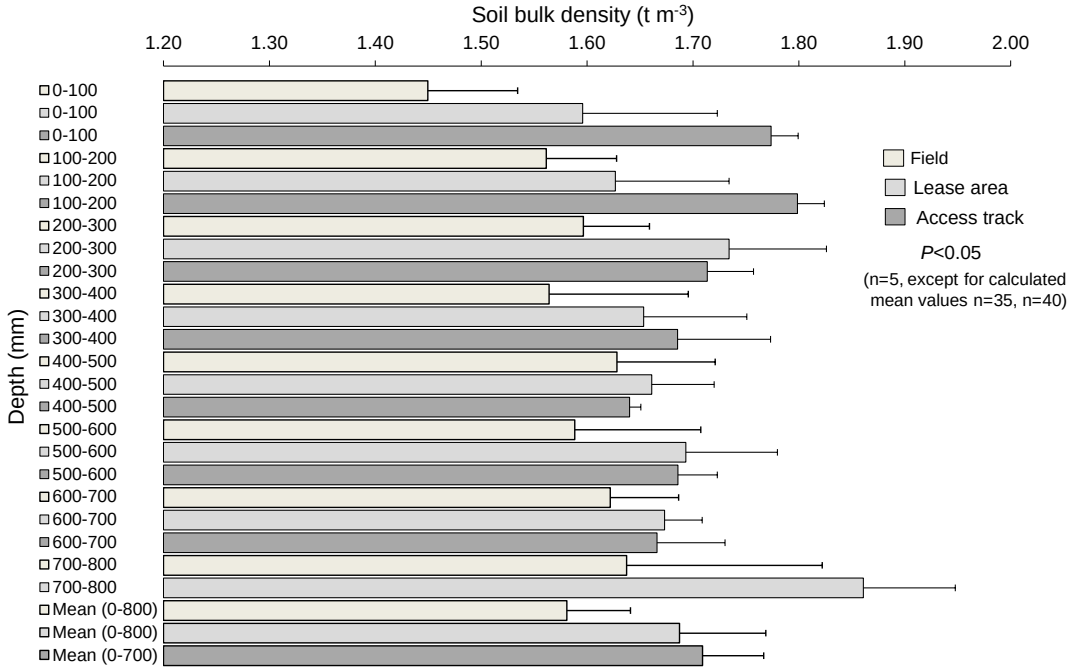
OVERALL TIMEFRAME: 2013/14

BACKGROUND: By this milestone, case studies should be complete. This timing should ensure adequate opportunity to document findings before the end of the project.

TASK OUTPUTS & SPECIFIC DELIVERABLES: A brief progress report outlining the results of the case studies, probable findings and plan for publication/communication of results.

PROGRESS REPORT

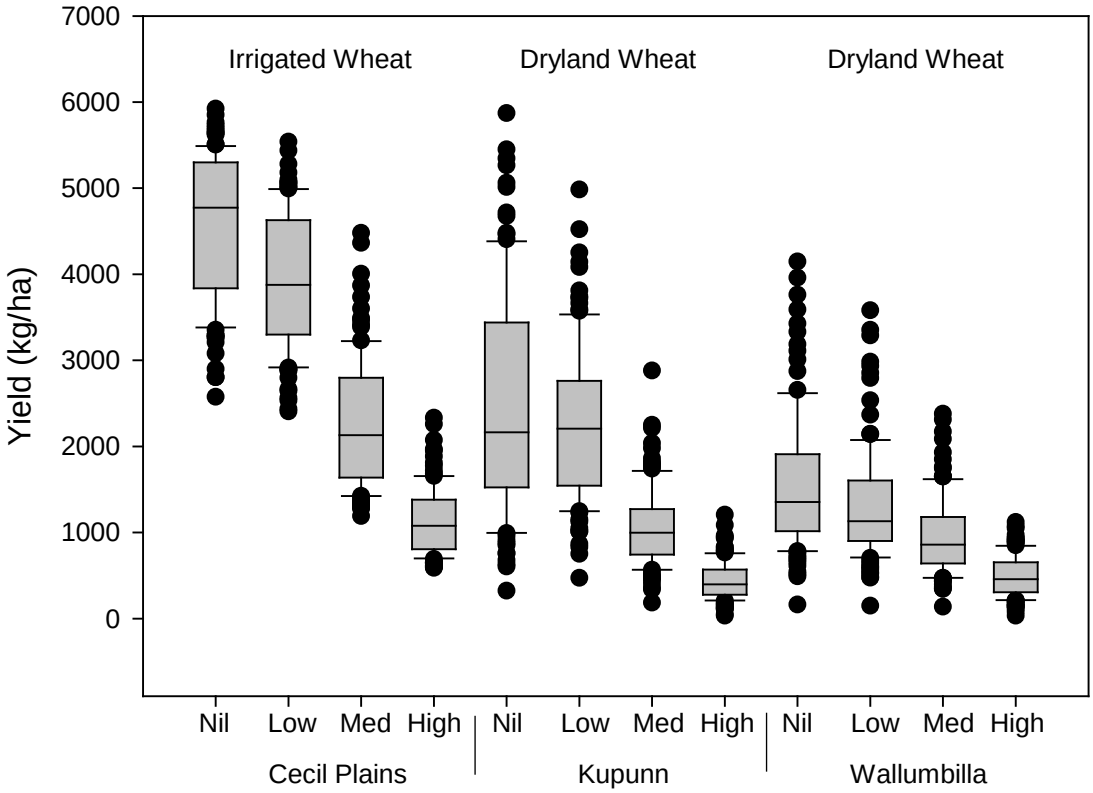
Paired site studies quantifying the impacts of drilling operations on soil compaction and hydraulic properties has been completed at 2 sites in each of the Chinchilla and Cecil Plains areas. At these sites, soil impacts on lease areas and access tracks have been compared to nearby unaffected sites as in the following figure.



Variation in soil bulk density for a well site in the Chinchilla region.

Other data include soil penetration resistance, infiltration and soil chemical properties. Whilst these data will be useful, a greater sample size is required to better capture site and soil differences. However, the project team has been unable to obtain permits for access to further sites for soil sampling. As a result, the team is exploring a third method for quantifying soil impacts. In conjunction with Project 3 (*Gas-Farm Design*), efforts will be undertaken to quantify likely impacts on crop production using published approaches for simulating the impacts of soil compaction. To enable this, soils have been collected sites for which characterised soil profiles are available in the APSoil Database. These sites extend from Cecil Plains to Wallumbilla. These

soils will be studied in the laboratory to understand their compaction risk, and this information will be incorporated into production estimates produced using the APSIM farming systems simulation model. Initial simulations (see following figure) have been completed to demonstrate likely results pending data from the laboratory study.



Estimated Yield distributions for 100 years for wheat at three locations with varing levels of soil compaction. (Preliminary results pending further information from laboratory soil analyses).

Task 6.

TASK NAME: Publication of results

TASK LEADER: Allen McHugh

OVERALL TIMEFRAME: 2013/14

BACKGROUND: Research should be complete and results synthesized into a format for publication.

TASK OUTPUTS & SPECIFIC DELIVERABLES: A draft publication prepared for the scientific literature (journal and/or conference proceedings).

PROGRESS REPORT:

A final report has been formally reviewed by experts in soil measurement and modelling and has been accepted for publication through CSIRO's e-Publish internal peer review system. The report is now available for viewing on the GISERA website Without a Trace project-Final Report. The content within the report will now be formatted for publication in a relevant scientific journal.