GUNNEDAH BASIN

HEALTH IMPACT ASSESSMENT

PROPOSAL – DRAFT

DECEMBER 2012

Caroona District overlooking the Liverpool Plains to the Liverpool Range

Contact:

Phil Laird (Chairperson) ***Nicky Chirlian (Secretary)***

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1. Purpose of this document

The Gunnedah Basin Health Impact Steering Committee, constituted of community groups and organisations in the Gunnedah Basin, has been charged with commissioning a study of the health and welfare risks of mining and gas extraction in that basin. Refer to Appendix 1 for Draft Terms of Reference. This document is intended to:

1. present the objectives and the need for the Gunnedah Basin Health Impact Assessment to funding bodies; and to
2. provide background information for a call for Expressions of Interest for the Gunnedah Basin Health Impact Assessment.

2. Goals of Gunnedah Basin Health Impact Assessment (GB-HIA)

The purpose of this proposed study is to analyse the health and welfare risks associated with various mining and gas extraction scenarios for the Gunnedah Basin, and to consider potential strategies for the avoidance, minimisation and management of these risks.

The study should:

1. Assess risks to physical, mental, social/community and environmental wellbeing, potentially reflecting scenarios aligned to Namoi Catchment Water Study, broadened to include development scenarios across the Gunnedah Basin.

2. Establish baseline levels of water quality, air quality and noise in the region, subject to defined benchmarks. (See Appendix 3 for indicative benchmarks).

3. Identify cause and effect (or causal pathways) of a range of identified health and welfare issues.

4. Consider short, medium and long term including impact on future generations. As a guide, short term would include planning and ramp up (1-2 years) ; medium term would include construction, production and extraction (2-5 years) and long term would include (5 years until after mine/gas well closure); and,

5. Identify and consider cumulative impacts

The risks upon which the study will focus are in two categories:

1. Health and welfare effects of the direct impacts of mining and gas extraction, notably upon water, air quality and noise; and

2. Risks associated with diverse 'second order' effects of mining and gas extraction activities including (for example) impacts upon vulnerable people or industries, of workforce changes, impacts upon health or welfare services, and impacts of changes to the demand for services such as housing.

Broadly, the project will:

- cover the residents of Gunnedah Basin and workers (including fly/drive in, fly/drive out), and identify vulnerable groups, for example, children, and aged persons;
- assess different impacts on different groups;
- determine if benefits/costs may be experienced to a greater extent by one group and not others,
- identify what actions might be taken to maximise positive and mitigate negative health impacts. .

A range of potential risks relating to health and welfare are listed in Appendix 2. It is expected that the successful tenderer will specify in their proposals the following matters

1. which specific health and welfare risks they will evaluate, drawing on both the information provided and their own knowledge of the issues;
2. the sources of data (both primary and secondary) that they propose to use and the sources of this data, for each of the risks they propose to investigate;
3. the modelling or other methods that they propose to use for the analysis of the data for each type of risk;
4. The form of the outputs that will be delivered, and in particular the ways in which these will be delivered and presented so as to meet the potential uses of the HIA as specified below.

The study should identify the specific risks to health and welfare, the regional and planning implications of those risks, the implications for the approval of mining and gas extraction projects, and the implications for resourcing of health and welfare in the region.

3. Potential Uses of Gunnedah Basin Health Impact Assessment

1. To provide the community with clear and well-researched data and analysis to inform their decisions, including decisions to willingly host (or not) mining activities.
2. To provide the government with specific recommendations about safeguards and policy settings that are likely to maximise community health and welfare and to minimise risks.
3. To provide mining companies, local government and other key stakeholders:
    - with specific information about risk and risk mitigation options,

- with potential opportunities that might arise;
- recommendations for strategies to maximise community health and welfare.
- with proposed solution or avoidance issues where issues arise,
- where opportunities might arise, exactly how these might be secured.

4. To provide a framework for ongoing transparent dealing with health and welfare issues including interventions that may be needed to optimise health and welfare outcomes for host communities for mining.
5. To identify contingencies (positive and negative) and to specify the sorts of conditions and arrangements that ought to be put in place up front. This includes accountability for actions and for costs and proposals for investments that are needed/desirable, and compensation and risk accountability. Identify what arrangements can be put in place to ensure that proposed accountabilities and contingency measures can be made binding and effective (not empty promises or assurances). This includes cost sharing and actions to ensure that mining does lead to health investment benefits to the community.

It is the responsibility of the tenderer to ensure that the data and analysis are conducted and delivered in such a way as to ensure the utility of the HIA to meet these needs. Within this requirement, it is expected that the tenderer will address arrangements to ensure that the data and analysis remain readily accessible for the various users, and in forms that are compatible with their decision-making requirements. Tenderers are expected to address issues of ongoing data and information access in their proposals, including highlighting and costs of ongoing provision or access that are not included in the costing.

4. Project management and supervision

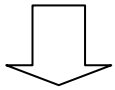
It is intended that this project be subject to oversight by The Gunnedah Basin Health Impact Steering Committee. Funding will be held by in independent organisation, such as the National Rural Health Alliance. The Committee shall have the following authority.

1. To approve (or not) the final project plan prior to any binding contracts and implementation plans
2. To approve (or not) acceptance of any project milestones including reports, relative to the contract requirements.

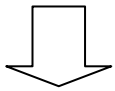
5. Timeframe

The project delivery goal is 18 months, with a completion date of June 2014. It is expected that many mining proposals will be submitted to the Department of Planning at this time.
The proposed time frame for the calling and letting of a tender to conduct this project is set out below.

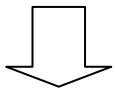
"Gunnedah Health Forum" (public information meeting)
4 August 2012
Resolved to initiate Gunnedah Basin HIA



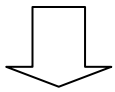
Calls for EOIs for members of Scoping Committee
August 2012



Scoping Committee developed draft Terms of Reference
September - October 2012

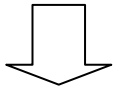


Steering Committee formed to refine HIA Study & Processes
November 2012

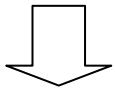


Current Date----------

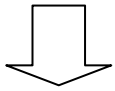
Approaches to Funding Bodies for Funding



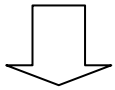
Call for EOIs to prepare Tender Documents



EOIs submitted by individuals/organisations to prepare Tender Documents and Request for Tender



Tender Documents Prepared, Request for Tender Advertised



Tenders submitted by individuals/organisations to conduct part, or all, of the Gunnedah Basin Health Impact Assessment

6. Justification for Gunnedah Basin Health Impact Assessment

The need for a Gunnedah Basin Health Impact Assessment is based on the following:

1. Current NSW Government Planning processes are based on incremental project approvals. These approval processes do not account for cumulative impacts of developments. There are major concerns in communities regarding increased health problems (for example Brereton et al, 2008), resulting from the interrelated systems of human, social and environment, including water, soil, flora and fauna. These concerns are based on both scientific and anecdotal evidence of serious health and social harms associated with coal mining and coal-fired power stations for people living in surrounding communities (Colagiuri et al 2012, p.iii). These health problems include higher risks of cardiopulmonary disease, chronic lung disease, hypertension and kidney disease (Hendryx & Ahern, 2008, cited by Deloitte Access Economics, 2012)

   Despite these potential dangers to health, there have been no significant formal epidemiological studies conducted anywhere in Australia, on the health impacts of mining (Deloitte Access Economics, 2012 p41). The significant costs and policy implications of these risks has not been recognized by Australian Governments to date. The Health Impact Assessment will assist in identifying costs, enable policy changes, and inform planning decisions.

2. Communities are concerned that the NSW Government does not consider the true costs and benefits of developments. While they value, in economic terms, the prospective royalty income from coal and coal seam gas companies, environmental and social impacts receive less attention. The costs of health impacts on populations do not appear to be considered either in the development approval processes or in health service planning.

3. The NSW's Department of Planning report *Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield Strategic Review* (2008) recommends the application of Precautionary Principle, which "requires risks associated with other options and socio-economic facts to be taken into account" (p107). To date, there appears to be little application by governments of the precautionary principle, regarding a range of impacts, including health. The Health Impact Assessment will work towards redressing this.

4. The Gunnedah Basin community is committed to pursuing a triple bottom line (TBL) assessment of impacts *prior* to developments being approved. These TBL studies must transparently and objectively identify and value the true long-term cumulative economic, environmental and social benefits and costs of coal and CSG extraction, as compared with current landuses and potential alternative business development. Health is a major component of the social aspects of TBL decision making, with interrelated impacts on the economic aspects due to costs. The Health Impact Assessment will identify these impacts and improve decision-making.

The hazardous nature of chemicals used in Coal Seam Gas extraction is documented (Lloyd-Smith and Immig, 2011; Witter et al, 2008). However, there appears to have been little work done in Australia. The health risks to communities are unknown, and based on work conducted overseas, seem to be substantial. These substantial risks equate to significant human costs, as well as significant financial costs to governments. The Health Impact Assessment will assist in identifying and valuing potential health issues related to coal seam gas extraction.

7. Gunnedah Basin Location and Description

The focus of the GB-HIA is the coalfields and gasfields existing within and adjoining the Gunnedah Basin. The Gunnedah Basin is a geological region in North West NSW covering 15,000 square kilometers (see map 1). It joins the Sydney Basin in the south and the Surat Basin in the north. Its boundaries do not completely coincide with catchment or local government boundaries. The area of interest includes the Namoi Catchment portion of the Basin (see map 2).

The region and its population are facing large-scale exploration developments of coal mines and coal seam gas, and associated infrastructure. Major towns are Quirindi, Gunnedah, Narrabri, Coonamble, Walgett and Moree. Tamworth is the region's biggest urban centre, and although coal and coal seam gas developments lie more than 60km to the west of the city, Tamworth is likely to be impacted by socio-economic factors, including increased demand for health services.

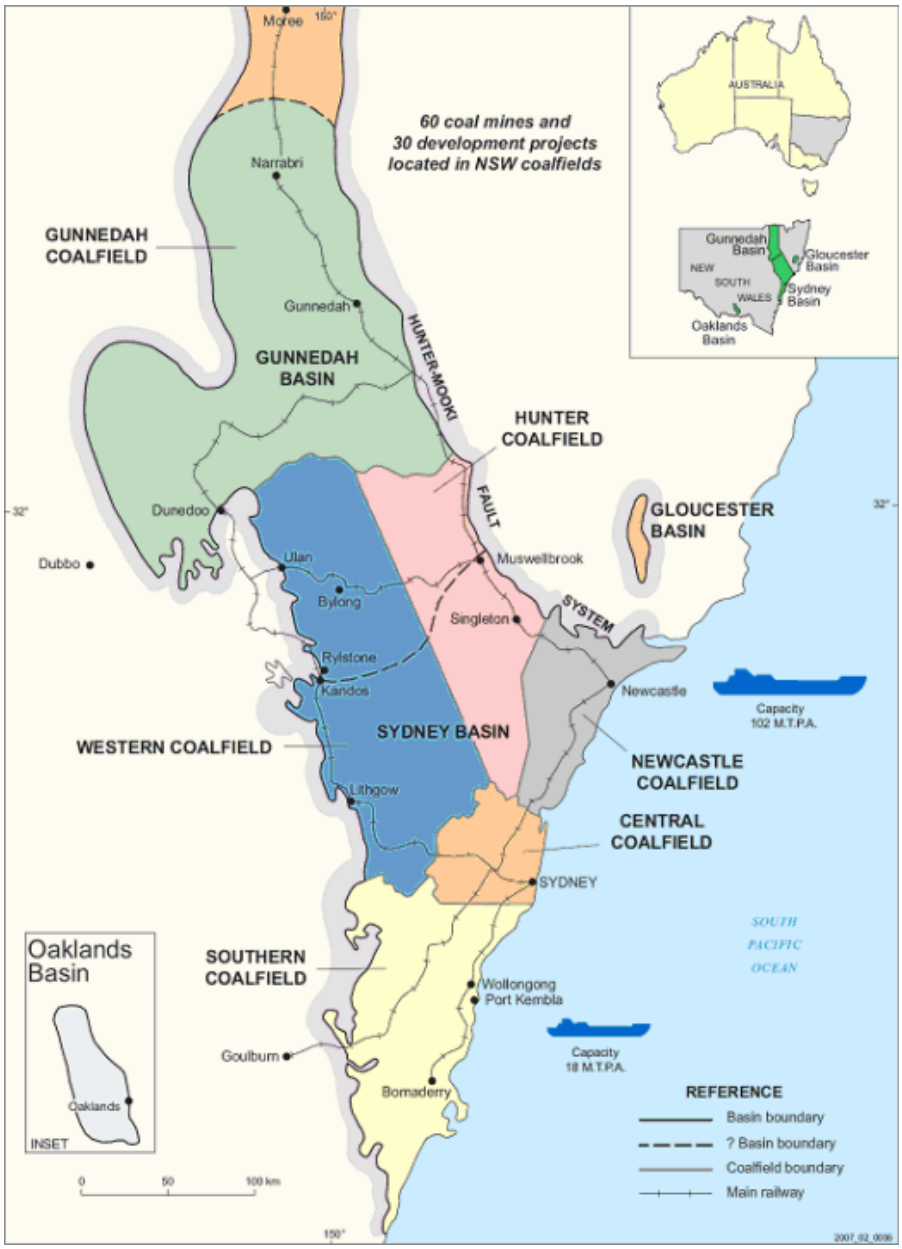
The Geographic Boundaries of the study can be loosely described as;

Northern Extent – the Queensland Border

Southern Extent – the Murrarundi Range

Eastern Extent - the Mooki Thrust

Western Extent – the western edge of the CSG gas fields west of Coonamble



Map 1: NSW coalfields (NSW Government Trade and Investment, 2012), showing location of the Gunnedah Basin.

Map 2: Catchment Boundaries, with Namoi Catchment identified in pink (Cotton CRC, 2011)

APPENDIX 1 – GB-HIA Draft Terms of Reference 23/10/12

Item	Comments/ examples
Project title	Gunnedah Basin Health Impact Assessment
Back ground/ Context	Gunnedah Basin population is facing large-scale developments of coal mines and coal seam gas development. Current State Government Planning processes are based on incremental project approvals - not cumulative. There is major concern in the community regarding increased health issues for environmental systems - humans, domestic animals, flora, fauna, and water. Communities are concerned that the NSW Government may not have balanced cost benefits of prospective royalties vs cost of health impacts to population, or have considered possible health impacts in its Health Service Planning. The community has expressed interest in a triple bottom line approach: to consider human, social, environmental factors on health impacts.
Purpose	To assess the potential cumulative impacts of current and potential coal and coal seam gas exploration, and other extractive industries and development on the health of the people living and working in the Gunnedah Basin.
Objectives of the Project	1. To assess current and potential developments against scoped areas of impact 2. To identify potential positive and negative health impacts resulting from current and potential coal, CSG and other extractive industries in the Gunnedah Basin. 3. To develop recommendations to facilitate the consideration and costs of health impacts within: a. Planning processes b. Health Services planning c. Legislation d. Government policy 4. To inform and influence key decision makers within those areas. 5. To build capacity to undertake health impact assessments. 6. To link the HIA to relevant existing studies such as the Namoi Catchment Water Study in order to develop an

	integrated approach to protecting and promoting health within natural resource management.
Project scope	Areas of impact • Assess positive and negative impacts on physical, mental, social/community and environmental wellbeing, using seven scenarios aligned to Namoi Catchment Water Study. • To identify cause and effect (or causal pathways) of a range of identified health issues. • Population groups: • The workers and residents of Gunnedah Basin • The project will assess different impacts on different groups and determine if benefits/costs may be experienced to a greater extent by one group and not others, and what actions might be taken to maximise positive and mitigate negative health impacts. Vulnerable groups eg children, aged persons will be identified. • A focus will be given to assessing whether differential impacts are unfair and avoidable Geographical area • Gunnedah Basin • Within the HIA specific geographical areas of focus may be defined Time frame of impacts • Short, medium and long term including impact on future generations • Cumulative impacts • If feasible the timeframe will be aligned with the Namoi Water Study to ensure comparability and integration Prioritisation of Impacts • Impacts will be prioritised according to likelihood of occurrence.
Values	**Health**: There was a consensus that health is a very broad term and we need to consider issues relating to equity and access to health services as part of health and the HIA process. There was agreement that there is a wide range of social, physical and mental determinants that impact on people and affect their quality of health at an individual and community level. The project will utilise a social or wellness model of health, which incorporates the

	social determinants of health and equity. **Equity**: The project adopts the principle of equitable distribution of health outcomes and reducing the differences in population health status and mortality rates. **Evidence:** The group discussed some of the types of evidence that could be relevant to the HIA. Different types of evidence will need to be gathered including both qualitative and quantitative evidence. The group identified that there will need to be further discussion about how different types of evidence will be valued and how to address conflicting sources of evidence. **Participation**: There was agreement that the HIA should incorporate a participatory process that will be open to the involvement of all relevant stakeholders. The **precautionary principle** to be adopted.
Type of HIA	Community led.
Depth of HIA	Comprehensive.
Governance	INCORPORATION: Gunnedah Basin HIA Association Inc. adopt the Model constitution, comprised of: • 5 members. To hold the contracts for funding. • Committee members from Scoping Committee
Committee membership	• + Reference group (=Scoping committee – short term, 2 meetings) • + Steering/management committee (6 – 10 members), • Wider group = stakeholders Terms of reference required. • University Technical expert • Project manager • Independent consultant to write report
Role of committee	Steering Committee is Governance Committee, with responsibility for carriage of process. Terms of reference required.
Roles and responsibilities of committee members	• . Terms of reference required.
Decision	Quorum

making	Consensus decision making, by majority vote. How to deal with conflict and the inability to achieve consensus
Peer review	The report will be independently peer reviewed.
Changes to TOR	(how changes to the terms of reference will be handled should they need to be made) • Changes to terms of reference be legitimized by quorum decision at Stakeholder meetings • Smaller process changes could be made by Steering Committee • Grievance process to be developed
Intellectual property	Report: The HIA report will be community led and therefore the Gunnedah Basin HIA Inc will own the report and it will be publically available.
Budget and sources of funding	To be determined.
Project plan	**Time frame**: It was agreed that the project Terms of Reference and project plan should be complete by the end of 2012. The Business Plan should be complete by the end of 2012 to include costing of the activities below. Cost to be determined by investigation of similar projects with Singleton Council As a comprehensive assessment there may also be some shorter term/intermediate outputs from the HIA to inform current decision-making processes. There was suggestion that the HIA process may take approximately 18 months. **Activities**: • Profile – (ie overview of current data of demographics, readily available). There was support for developing a community profile that could be used as a standalone product and form the basis for monitoring of impacts. This would include demographic and health data. HNE Health will provide support for the provision of health service data. In addition, there was some discussion but no decision about gathering additional primary data through, for example, lung function tests and surveys, current baseline data on air quality and noise. Where possible data will be disaggregated to identify differences between population groups. • Literature reviews – there are some already existing

literature reviews of health impacts related to Coal and CSG mining. These will need to be assessed for quality and suitability. In addition, literature reviews may need to be commissioned using standardised methods of review, similar to a Cochrane review. Upcoming coal literature review to be used.

- Local knowledge - there was agreement that evidence should be gathered from the local community and other relevant stakeholders. This would include identifying local concerns and anxieties, impacts on living conditions and how people live their lives, contextual information, and unanticipated impacts.
- Modelling of health impacts – some of the potential priority impacts relate to the physical environment (air quality and noise). There was broad agreement that the HIA should include a quantitative risk assessment (modelling) these potential health impacts according to scenarios that will be developed as part of the HIA. This will require commissioning experts to carry out this work.

Potential impacts of coal mining and coal seam gas extraction identified in scoping meeting:

A list of potential impacts/determinants identified in the WHIASU Guide to assessing the health and wellbeing impacts of opencast mining[i] was used as a starting point for discussion. Surveys of damaged communities requested by Steve Robinson eg disability adjusted life years, morbidity and mortality. The scoping group agreed that these are all applicable to the Gunnedah area. Additional impacts **(in bold**) were identified by committee members. The list includes but is not limited to the following determinants and outcomes:

- Air quality (Particulate matter, Nitrogen dioxide, Dust)
- Noise
- Visual impact
- Light pollution
- Vibration
- Loss of amenity
    - **Solastalgia**
- Severance and social capital
    - **Lack of volunteers**
- Mental health wellbeing
    - **Anxiety, stress, loss of control, uncertainty**
- Housing
    - **Affordable Housing**
    - **Lack of infrastructure**

	• **Agricultural Land devaluation**
	• Services
	  • **Access to GPs**
	  • **Access to Hospitals**
	  • **Access to Community Health**
	  • **Local infrastructure**
	• Employment
	  • **employment through mining**
	  • **lack of farm workers**
	• Transport
	  • **Increased traffic**
	  • **Increased traffic accidents**
	  • **Decreased air quality**
	• Safety
	  • **Crime**
	  • **Domestic violence**
	• **Lifestyle**
	  • **Alcohol consumption**
	  • **Sexually transmitted disease**
	  • **Physical activity**
	• Ground water
	  • **Drinking water quality**
	
	In addition the scoping group identified a range of potential health outcomes:
	
	• Respiratory Disease (measuring lung function currently and predicting to the future)
	• Cardiovascular disease
	• Cancer
	• Autism
	• ADHD
	• Neurological disorders (specific)
	• Sexually transmitted disease
	• Headaches
	• Nosebleeds
	• Depression
	• Suicide
	• Anxiety disorders
	• Sleep disorders using the Pittsburgh Sleep Quality Index.
	Other potential outcomes as identified through literature review

APPENDIX 2 – GB-HIA Key questions for the project

What is the impact of coal and coal seam gas developments on community health and wellbeing in the Gunnedah Basin? These questions include, but not limited to the following:

LIVING CONDITIONS & WORKING CONDITIONS	
WORK ENVIRONMENT	UNEMPLOYMENT
EDUCATION	WATER AND SANITATION • Drinking water quality
AGRICULTURE AND FOOD PRODUCTION	HEALTH CARE SERVICES • Access to GPs • Access to Hospitals • Access to Community Health/Allied Health
	HOUSING • Affordable Housing • Lack of infrastructure • Agricultural Land devaluation
HEALTH OUTCOMES • Respiratory Disease • Cardiovascular disease • Cancer • Autism • ADHD • Neurological disorders (specific) • Sexually transmitted disease • Headaches • Nosebleeds • Depression • Suicide • Anxiety disorders	PHYSICAL OUTCOMES: • Air quality • Water quality • Water quantity. • Increased traffic • Increased traffic accidents
MEASURABLES SOCIO: • Domestic violence • Solastalgia • Loss of amenity	QUALITATIVE/ANECDOTAL • Community Division • Equity

• Increased crime • Lack of volunteers	

- What are the current baseline levels for: ground and surface water quality, including organic, inorganic and microbial levels?
- What are the current baseline levels for air quality including particulate matter, nitrous oxides, methane and other gas?
- What are the current baseline levels for illness and disability in the Gunnedah Basin?
- What are the predicted incidence increase and costs of "mining related illness" (e.g. Asthma, cardiovascular illness) and accidents over the next 30 years (according to predicted mine life) in the Gunnedah Basin.
- What is the predicted cost of social disruption in the Gunnedah Basin over the predicted mine life.
- What will be the required increase in service infrastructure and cost of same within the Gunnedah Basin over the predicted mine life?
- What impact to the DALY's do the Namoi Water Study scenarios have?
- What contingency plans are required for any increased health cost?
- What binding obligations are held by the Department of Planning to support any additional costs?

  The information to be presented as a 30 year itemised cost analysis, mapping of high risk areas as "no go" zones.

APPENDIX 3 - Notes relevant to potential methodologies

The Project may be conducted in two components, with each of these components being further divided into specific parts, as described below.

First Component of Project - Identification of baseline levels

a) air and noise quality,

b) water quality,

c) existing health levels in the population.

The following process is proposed:

- Specific baseline parameter requirements, and thresholds, will be determined based on current knowledge. This will include investigation of number of data points and measurement timeframes to enable statistical significant results.

- It is likely that with further research into coal and coal seam gas hazards, that more parameters will be required in the future. Independent monitoring and trend analysis will used to determine baselines levels. Following baseline data collection, monitoring and trend analysis will continue, to enable identification of future changes and trends.

- Water Quality Management and Baseline Air Quality and Noise Management Project Teams will oversight the work.

- There will be three themes as detailed below:

    - Water Quality – monitoring stations will be set up to monitor surface and ground water, based on expert recommendations . Draft Data Management Guidelines, and a recommended Ground Water Analyte Suite appear in Appendix 4. Similar guidelines and recommended testing regime will be determined for surface water.

    - Air Quality and Noise - monitoring stations will be set up in locations recommended by experts. Draft recommendation for air toxins in coal seam gas fields that will be monitored are listed in Appendix 5. Information regarding relevant toxins to be monitored in coal fields will be sourced, and informed by Department of Environment

Climate Change and Water (2011). Noise monitoring will be implemented on the advice of experts.

- Existing health levels in the population – base level data from NSW Health and other organisations will be collated. This will focus on health issues likely to be impacted by coal and coal seam gas extraction, based on research and anecdotal evidence from other national and international coal and coal seam gas regions. Some of these issues are listed in Appendix 2.

Second Component – identification of impacts, modeling and assessment risks of based on future development scenarios, and risk assessment, as detailed below:

a) Identification of impacts to physical, mental, social and environmental health from coal and coal seam gas exploration and extraction, including existing, proposed and potential developments;

b) modeling of impacts based on development scenarios used in Namoi Catchment Water Study

c) risk assessment and mapping of modeled impacts

d) recommendations of strategies that will minimise the negative impacts and capitalise on the benefits.

Potential Methodologies

There are a number of methodologies and systems that may be used to guide and conduct the HIA. These will need to be assessed in terms of relevance, and ability to integrate with each other. Examples of systems, guidelines and tools are as follows:

- Health Impact Assessment: a Practical Guide (Harris et al, 2007) will provide the *broad guidelines* of the study.

- It is anticipated that any *modelling* for the HIA will use the coal and coal seam gas development scenarios that formed the base for the Namoi Catchment Water Study (Schlumberger, 2012) modelling. This will provide consistency and will enable mapping of levels of risk, similar to maps presented in the Namoi Catchment Water Study.

- The suitability and potential for using the *cumulative risk framework* developed for Namoi Catchment Management Authority by Ecological Australia Pty Ltd (2011) for NRM assets will be investigated.

- The *resilience approach* and use of thresholds as per the Namoi Catchment Management Authority's Catchment Action Plan (this may assist with appropriate threshold identification for baseline data monitoring.)

- *Cost Benefit Analysis* is likely to provide a useful and objective tool to identify costs of health impacts. The latest thinking and recommendations for impacts which are difficult to measure in a purely economic sense will need to be investigated, for example Deloitte Access Economics (2012, p 11)

- A systems and *adaptive management* approach to *cumulative impact* identification and monitoring. For example Franks et al (2010), "Cumulative Impacts - A Good Practice Guide for the Australian Coal Mining Industry."

APPENDIX 4 – Indicative Water Quality Benchmarks

Draft Data Management Guidelines - Forensic Groundwater Monitoring Program

FORENSIC GROUNDWATER BENCHMARKING PROGRAMME

DRAFT DATA MANAGEMENT GUIDELINES

J Polglase
6 September 2010

1 Objective

To perform cyclical, repeatable, groundwater quality and related tests on landholder-nominated water supplies in locales potentially impacted by non-agricultural developments such as mining or hydrocarbon extraction. The historical data generated is designed to "answer questions of interest to a legal system", and thereby constitutes a forensic groundwater quality benchmark.

2 Independent

Given the possibility of future legal usages, programme execution is to be demonstrably independent and objective, utilising third-party NATA-approved laboratories with the appropriate experience, skills and test equipments, and third-party field personnel with the appropriate training and experience.

3 Best Practice

The groundwater collection and test procedures and equipments will be according to best practice and standards, and be consistent with the requirements of the appropriate environmental and other agencies.

4 Test Suite

The groundwater test suite covers human, animal and plant (irrigation) usages, and is designed to detect the geochemical signatures of all groundwaters potentially impacted by shallow and deep drilling, mining and hydrocarbon extraction. That is, the test superset covers what is not there, as much as what is already there in today's water sample. Once waters are mixed, ensuing chemical and particulate matter does not distinguish its targets as human, animal or plant.

5 Test Cycle

Ideally, the initial test events need to be cyclical and repeated four times six months apart, or, at a minimum, two times six months apart. The planned cycle ideally runs September - March - (September - March), but also must accommodate the farming program. Such somewhat takes into account seasonal and climatic (eg. drought) variations.

The landowner benchmark also requires updating by further test events immediately prior to commencement of the local non-agricultural development concerned. Test events also need to be conducted over the long-term (eg. during and following the completion of mining).

6 Target Area and Sites

The landholder may nominate one or more groundwater supplies representative of his/her property's groundwaters, and/or water considered to be of significant economic value.

Coordination of contiguous neighboring properties, with all sampling on either the up-flow or down-flow sides of their properties, is desirable, as this would provide a more robust scientific and legal basis.

7 Data Ownership

The payee owns the data and has a veto over its usage. Other programme participants may not share any test results or contents of reports without the written permission of the owner(s) of the data concerned. Any subcontractor engaged to undertake part of this programme will also enter into an agreement to this effect with the data owner.

All associated landholder details likewise remain confidential and are to be treated as "Commercial-in-Confidence".

Groundwater Test and Analyte Suite

Groundwater Benchmark Test & Analyte Suite

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Introduction

The following groundwater benchmark test suite is inclusive, meaning it:

i. encompasses both inorganic and organic chemistry;
ii. includes microbial assays;
iii. includes both field and laboratory tests;
iv. anticipates human, animal and/or plant (irrigation, horticulture) usages of the target water;
v. anticipates geochemical signatures derivative of formation or coal seam water;
vi. anticipates geochemical signatures of groundwaters impacted by drilling, mining or oil & gas extraction.

It is an obvious truth that the dissolved or suspended chemical load of groundwater - whether virgin or mixed -, does not distinguish its terminal usage as only human, animal or plant. The following is therefore a test superset that is designed to record what may not be currently present, as much as what is already present in the groundwater sample. Further, it must be noted that the 'presence' of a chemical species may be more important than its 'concentration', and the 'absence' of a chemical species may be more important than its 'presence'.

To achieve a benchmark, the test suite needs to be applied via a 'best practice' and systematic programme that is:

i. accurate;
ii. repeatable;
iii. cyclical (cross-seasonal);
iv. traceable;
v. standards-based; and
vi. securely recorded and archived.

Note re. "dissolved" and "total" element testing:

"Dissolved" or "soluble" elements are elements in solution as dissociated chemical (ionic) species, here determined by ICP-MS (Inductively Coupled Plasma - Mass Spectrometry). This is also called the "dissolved fraction". Water samples for "dissolved" element testing are pre-filtered through 0.45 micrometre (micron) (µm) filter pores, ideally in the field at sample collection time. However, elements attached to Suspended Particulate Matter (SPM) smaller than 0.45 µm in size that pass through the filter, are not tested for in "dissolved" element analysis. Examples of ultra-fine SPM include fine clay colloids, carbonate particles, organic colloids (eg. humic acid, polysaccharides) and oxyhydroxides of iron, manganese and aluminium, all of which may host trace elements either on their charged surfaces or compounded within.

"Total" elements means "total recoverable". Testing for "total recoverable" elements is done on water samples that are not pre-filtered, and the SPM, whether smaller or larger than 0.45 µm in size, is "digested" by an acid solution before the ICP-MS determination. Thus the "total recoverable" concentration is the "dissolved fraction" value plus the "particulate fraction" value. Equally, the "particulate fraction" is the "total recoverable" value minus the "dissolved fraction" value. For certain trace element and "heavy metal" determinations, the "particulate fraction" can be both significant and important, in that it contributes to the abundance, speciation, bioavailability, and hence toxicity of that element to living organisms. Further, the "dissolved fraction" / "total recoverable" ratio may be indicative of pH, redox state, turbidity, water mixing, and other attributes.

APPENDIX 5 – Indicative CSG Air Quality Benchmarks

Coal Seam Gas - Compounds to be monitored
Information provided by John Polglase, Geochemist

Gases listed in the groundwater benchmark (Appendix 3) plus the following medium to high molecular weight Volatile Organic compounds (VOCs) are some 'suspects' that have been gas field tested elsewhere, and ought to be considered for inclusion in an evolving benchmark used by whoever / wherever emissions assessments are done:

Gp 1

Butane
Butane, 2-methyl-
Pentane
Pentane, 3-methyl-
Hexane
Hexane, 3-methyl-
Cyclohexane
Methylcyclohexane
Heptane
Heptane, 2,2,4,6,6-pentamethyl-
Hexadecane
Heptadecane

Gp 2

Benzene
1,2,4-Trimethylbenzene
Toluene
m/p-Xylene
o-Xylene
Phenol
Ethylbenzene
Naphthalene
alpha-Pinene

Gp 3

Phenylmaleic anhydride
Benzothiazole
1-Hexanol, 2-ethyl-
Ethyl acetate

background and 'up-wind' levels of organic and inorganic gases naturally emitted from coal seam bearing sedimentary basins must also be monitored.

Coal Seam Gas – Air Toxics to be monitored

Information provided by Dr Mariann Lloyd-Smith PhD (Law)
Senior Advisor, IPEN - International POPs Elimination Network
Senior Advisor, National Toxics Network Inc.

list of relevant air toxics :

Butane
Butane, 2-methyl-
Pentane
Pentane, 3-methyl-
Hexane
Hexane, 3-methyl-
Cyclohexane
Methylcyclohexane
Heptane
Heptane, 2,2,4,6,6-pentamethyl-
Hexadecane
Heptadecane
Benzene
1,2,4-Trimethylbenzene
Toluene
m/p-Xylene
o-Xylene
Phenol
Ethylbenzene
Naphthalene
alpha-Pinene

Phenylmaleic anhydride
Benzothiazole
1-Hexanol, 2-ethyl-
Ethyl acetate

I would also add the CFCs, Dichlorodifluoromethane & Trichlorofluoromethane and methylene chloride/dichloromethane as well as they are turning up. The National Measurement Institute does a volatile screen that includes all of these and then reports on the top 10 detected, or more depending on costs.

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