Leading Practices Guide for Coal Seam Gas Development in Australia

COAG Energy Council

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The growth in the coal seam gas industry over the past decade has presented challenges for governments, communities and the industry. The development of projects requires balanced consideration of their environmental, social, economic and governance aspects.

Impact assessment and management undertaken across project exploration (including exploration activities, design and approvals), construction and commissioning, production / operation, rehabilitation and closure (including suspension, decommissioning and abandonment) ensures sustainable development of the industry.

The industry and the natural gas it supplies is vital to the east coast gas market and liquefied natural gas exports.

The leading practices for development of natural gas from coal seams contained in this Guide have been framed around the following six themes:

1. Impact assessment and management including of air and noise emissions
2. Well planning and operations
3. Social performance including transparency, community outreach and adaptive management
4. Protection of water resources
5. Management of waste including produced water and sustainable options for solid and liquid waste streams
6. Rehabilitation and closure planning.

Each theme and associated leading practices are presented in this Leading Practice Guide for Coal Seam Gas Development in Australia. While these leading practices are aimed to provide guidance to regulators, information related to industry practices is also included.

Leading Practices for Coal Seam Gas Development in Australia

Themes (6) and Practices (16)

Theme 1: **Impact assessment and management including of air and noise emissions**

Leading Practice 1
Undertake a comprehensive impact assessment using a risk-based approach across the project lifecycle

Leading Practice 2
Develop and implement outcome-focused management plans, including monitoring programs for the project lifecycle

Theme 2: **Well planning and operations**

Leading Practice 3
Design and construct wells to minimise risk and satisfy well objectives

Leading Practice 4
Ensure well design and construction achieves isolation of all aquifers and ground water above hydrocarbon bearing formations

Leading Practice 5
Ensure well design is suitable for the life cycle of the well and field, including hydraulic fracturing considerations

Leading Practice 6
Ensure that any hydraulic fracturing activity does not degrade the hydraulic isolation of aquifers and ground waters

Leading Practice 7
Ensure responsible use of chemicals including disclosure of type and volume

Theme 3: **Social performance**

Leading Practice 8
Establish transparency by outlining conduct and compensation mechanisms with landholders

Leading Practice 9
Establish community outreach, adaptive management and reporting mechanisms for transparency across whole of project life

Theme 4: **Protection of water resources**

Leading Practice 10
Require implementation of baseline and ongoing monitoring

Leading Practice 11
Manage cumulative impacts through regional-scale assessments

Theme 5: **Management of waste**

Leading Practice 12
Maximise the recycling of produced water

Leading Practice 13
Ensure produced water volumes are accounted for and managed

Leading Practice 14
Develop and implement sustainable options for solid and liquid waste streams

Theme 6: Rehabilitation and closure planning

Leading Practice 15
Rehabilitation and closure planning is incorporated in an outcome focused, risk-based and systematic manner throughout a project's lifecycle

Leading Practice 16
Management and allocation of cost of rehabilitation and closure including addressing of residual risk post relinquishment.

Description of the leading practices

Theme 1

Impact assessment and management including of air and noise emissions

LP 1.1 (1)

Undertake a comprehensive impact assessment using a risk-based approach across the project lifecycle

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Undertake a baseline assessment to understand the sensitivity of environment and social landscape as a basis for impact assessment and comparison of later measurement of outcomes and validation of predictions • Develop and implement robust and transparent risk management processes following leading practices for and throughout the project lifecycle (exploration, construction, operation, and closure) • Undertake a robust environment impact assessment using a risk-based approach to address: – Soils, topography and land – Visual amenity – Aquatic and terrestrial ecology – Surface water (hydrology) and groundwater – Water management – Noise amenity – Air quality – Greenhouse gas – Indigenous and non-Indigenous cultural heritage – Social impacts	• Review and streamline legislation to be risk-based and consistent across all levels of government, for impact assessment, approvals and compliance • Develop risk-based, relevant, fit for purpose guidance and terms of reference documents to understand the impacts to receiving environments and their dependent ecosystems identified in project impact assessments, and provide a mechanism for continuous improvement of these • Consider long-term legacy and liabilities and drive industry's management practices to achieve long term sustainability outcomes • Provide technical review of environmental impact assessments, particularly with environmental and social elements that have the potential for high residual risk • Provide regulatory response proportionate to the risk (note: where there is limited information to assess the likelihood of a risk, adaptive management can be a useful approach) • Provide strong leadership and guidance with impact assessment, setting conditions of approval and

	Leading practice guidance - operators	Leading practice guidance - regulators
	– Traffic and transport – Chemical management – Waste management – Human health and safety – Hazards and risk – Disaster management and preparedness – Cumulative impacts • Use a risk-based approach that identifies all potential impacts/risks, their significance and mitigation to manage risks consistent with the ALARP principle (risk as low as reasonably practicable) • Apply a hierarchy of risk control measures to all aspects of the project across the project lifecycle • Ensure the project adopts the principles of ecologically sustainable development • Provide the opportunity for community comment on the identified impacts and management measures	compliance monitoring • Provide strong leadership with health and safety for project personnel and the community • Assess the need for baseline, regional and cumulative assessments and facilitate these where appropriate • Possess the appropriate technical capability, qualifications and resourcing to provide the required leadership and governance for regulation

LP 1.2 (2)

Develop and implement outcome-focused management plans, including monitoring programs for the project lifecycle

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Prepare an environmental management system in alignment with ISO 14001 • Prepare a management and monitoring framework to utilise the principles of adaptive management, ensure continual and timely review of monitoring data and contain a continuous improvement mechanism • Prepare and implement management plans and monitoring programs that are: - Effective - Practical - Outcome focused - Provide early detection of contamination or environmental harm - Consistent with the ALARP principle - Inclusive of a mechanism for continuous improvement • Prepare and implement management plans and programs that consider the project lifecycle e.g. construction, commissioning, operation and closure phases	• Develop risk-based guidance documents for developing adaptive management and monitoring frameworks for the receiving environment and their dependent ecosystems • Review monitoring data on a continual and timely manner to provide governance for non-compliance. • Assess and approve management plans based on the effectiveness, practicality and consistency with ALARP principle while also including allowance for continuous improvement mechanisms • Ensure management plans are developed for and consider all stages of the project lifecycle • Ensure access to and/or resourcing of appropriate technical capability, qualifications to provide the required leadership and governance for regulation

Theme 2

Well planning and operation including hydraulic fracturing, chemical and waste handling and management

LP 2.1 (3)

Design and construct wells to minimise risk and satisfy well objectives

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Address objectives and life cycle of exploration and production wells in risk management of well design, testing, and closeout (abandonment), including appropriate consideration of hydraulic fracturing activities • Where Commonwealth and State laws, regulations, and codes of practice are not applicable, ensure well design complies with good engineering and oilfield practice • The well design should be subject to a risk assessment to identify all risks in its construction, operation, and decommissioning, and to determine appropriate risk controls and mitigations • Lessons learnt from the construction and operation of similar onshore gas wells shall be incorporated into the well design	• Regulators should be satisfied that the well plan satisfies all regulatory requirements and has been the subject of risk assessment process (at least to AS 31000 latest edition) • Regulators should be satisfied that well planning has identified all aquifers to be isolated and that adequate provision has been made for their hydraulic isolation • Closeout requirements need to be approved

LP 2.2 (4)

Ensure well design and construction achieves isolation of all aquifers and ground water above the target formation

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Proper risk assessment, planning and well design includes identification of all aquifers and the well plan and construction ensures that individual aquifers and surface water sources are isolated from each other • Well construction is supervised by the operator and best cementing practices are employed to ensure effective cementation • Hydraulic isolation of the target formation is tested immediately the casing is cemented into that interval and remedial measures are taken if a hydraulic seal is not demonstrated • Water use for drilling or workover is within water extraction permit limits and does not excessively deplete surface water or aquifer water sources. Use non-potable water where applicable to minimize the draw on other sources.	• Regulators should be satisfied that the well plan has been the subject of risk assessment process • Regulators should be satisfied that well planning has identified all aquifers to be isolated and that adequate provision has been made for their hydraulic isolation, addressing any particular risks that may apply for exploration only or production only wells. • Require isolation of aquifers to be addressed by operators for end-of-well life and well abandonment • Require field development plans to include appropriate consideration of aquifer isolation during well abandonment guided by information obtained during production about aquifer communication and consideration of the long-term requirements for zonal isolation

LP 2.3 (5)

Ensure well design is suitable for the life cycle of the well and field, including hydraulic fracturing considerations

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Well objectives are included in a field development plan basis of design, including provision for hydraulic fracturing • Proper risk assessment and well planning will ensure that: – The well can be constructed safely – The well plan and construction will give the anticipated life of the well – All workover operations, such as hydraulic fracturing, can be conducted safely • Well construction is supervised by the operator and best oilfield practices are employed to ensure a high well construction quality • All surface and down-hole well components are tested after installation to ensure functional and pressure-retaining requirements are met	• Regulators should be satisfied that the well plan satisfies all regulatory requirements and has been the subject of risk assessment process • Regulators should be satisfied that the well plan provides adequately for the anticipated life cycle of the well, with attention to casing corrosion and the ability to conduct hydraulic fracturing where hydraulic fracturing is likely to be conducted

LP 2.4 (6)

Ensure that any hydraulic fracturing activity does not degrade the hydraulic isolation of aquifers and ground waters

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Inadvertent introduction of hydraulic communication between the geological strata and aquifers, or between aquifers is the subject of a thorough risk assessment. • Where the risk of establishing unwanted communication is assessed to be other than negligible or low, a Fate and Transport Model study is used to assess potential for hydraulic fracturing to introduce unwanted hydraulic communication channels • Conduct hydraulic fracturing operations in accordance with the plan approved by the operator and keep full operational records • Undertake monitoring of aquifers post-hydraulic fracturing and compare with the baseline sampling to demonstrate that no intercommunication between, or contamination of aquifers or between the geological strata has occurred • If aquifer interconnection is found then the onshore gas well should be shut-in until the communication is remedied or, if not remedied, the well decommissioned and the aquifer interconnection remedied in the process • Water use for drilling or workover is within water extraction permit limits and does not excessively deplete surface water or aquifer water sources. Use non-potable water where applicable to minimize the draw on other sources • Include remediation and disposal of water, flow-back fluids, or unused hydraulic fracturing fluids in the hydraulic fracture plan	• Require hydraulic fracturing of wells to be subject to an adequate risk assessment and management process including consideration of fracture extent in relation to aquifers • Require the operator to demonstrate by aquifer monitoring against a baseline survey that aquifer performance after hydraulic fracturing has not been affected

LP 2.5 (7)

Ensure responsible use of chemicals including disclosure of type and volume

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• To manage risk of aquifers/ ground water contamination associated with the use of chemicals (other than water and inert proppants) chemical use should follow the following risk-reduction hierarchy: – Avoid the use of added chemicals where possible – If chemical use is unavoidable, use not-toxic chemicals – Where a bio-degradable and a non-biodegradable chemical is available to perform the same function, choose the bio-degradable option • Risk assess the use of any chemicals added to the well, including during drilling, workover, and hydraulic fracturing • Flowback of hydraulic fracturing fluids should occur as soon as practicable after the hydraulic fracturing operation is complete • Re-use/recycle hydraulic fracturing fluid to the greatest extent possible	• Regulators should be satisfied chemical use has been the subject of an adequate risk assessment process (at least to AS 31000 latest edition), including appropriate determination of chemical fate, behaviour and toxicity in the receiving and surrounding environment • Regulators should be satisfied that the chemicals used are necessary, are not-toxic, and are bio-degradable where possible • Regulators should consider making a list of approved chemicals for onshore gas operations available to the industry and the public, together with requiring regulatory approval of any chemical not on the list • Regulators should require the CAS or equivalent chemical identification for all chemicals used, and intellectual property arguments should not prevent the public knowing exactly what chemicals may potentially be introduced into ground or surface water

Theme 3

Social performance including land access

LP 3.1 (8)

Establish transparency by outlining conduct and compensation mechanisms with landholders

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Operators engage with landholders early, and on an on-going basis, about proposed activities and potential impacts working together to plan infrastructure layouts • Operators establish conduct and compensation agreements (CCAs) with landholders which: – Include land access and communication arrangements – Encourage infrastructure layout and designs to reduce impact to the landholder's land use and property operations – Provide for dispute resolution mechanisms with landholders • Where landholder bores are impacted operators establish make good agreements • Landholder compensation arrangements appropriately consider: – Loss of use of surface area where infrastructure is installed – Diminution of the property value – Diminution of the use made or that may be made of the land or any improvement on it – Severance of any part of the land from other areas of the landholder's property – Any cost, damage or loss arising from activities on the land during operation, and following well closure – Accounting, legal or valuation costs the landholder necessarily and reasonably incurs to negotiate or prepare a conduct and compensation agreement	• Establish a legislative framework which provides the principles to support and manage (private) land access effectively, noting that: – It should be in place ahead of demand – Representatives from stakeholder groups should be involved in developing the framework to balance interests – A single code of conduct should be developed using consistent processes that are clear, fair and reasonable for all parties – The framework should be subject to periodic review as experience is gained and technology and processes change – The framework should be consistent across other sectors requiring similar access • Establish independent and credible body(ies) tasked with providing landholder information and referral services including in relation to: – Resource activity and land use – Land access framework – Rights and obligations – dispute resolution • The regulatory framework should be complemented by streamlined and efficient dispute resolution processes for entering into agreements – guidance in managing expectations is also beneficial • Establish landholder training programs delivered by trusted rural representative groups to build understanding among landholders, better prepare them for dealing with professional advisors, and improve negotiated outcomes

LP 3.2 (9)

Establish community outreach and reporting mechanisms for transparency across whole of project life

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Companies must engage stakeholders from the earliest planning stage and throughout the construction and operations phases, through to decommissioning • Companies should work closely with local government and community during all project phases to identify opportunities for allocation of social investment funds targeted at long-term sustainable projects which assist communities' capacity building, resilience and self-reliance • Engage openly for the life of the project with Traditional Owners to ensure that cultural heritage is understood and protected and to facilitate Indigenous participation in the project in a culturally appropriate way	• Independent advisory bodies should be established early to: – Provide factual, independent information and referral – Facilitate discussion and consultation to ensure stakeholders understand industry impacts – Facilitate sharing of data and modelling between agencies, and with landholders and communities – Coordinate research – Support development of community resilience and self-reliance • Support, leadership and governance should be provided for the established independent advisory bodies

Theme 4

Protection of water resources

LP 4.1 (10)

Require implementation of baseline and ongoing monitoring

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Identify key local and regional environmental sensitivities and receptors including but not limited to the following: – Groundwater users – Groundwater dependent ecosystems – Culturally significant sites – Connected groundwater and surface water sources • Design a surface and groundwater quality and flow monitoring program for key local and regional sensitivities and receptors incorporating: – Spatial information (local and regional) – Temporal information (existing, operational and post operational/closure) • Undertake co-ordination of monitoring needs with Industry and Government to ensure adequate local and regional coverage • Ensure that the monitoring regime will lead to an acceptable degree of certainty in prediction of impact or risks to existing and future groundwater and surface water allocations, potential water production volumes and water quality for short and long-term impacts. Use non-potable water where applicable to minimize the draw on other sources. • Provide landowner/ stakeholder participation and data sharing agreements in the establishment of baseline and ongoing monitoring networks • Implement a centralised real-time groundwater monitoring system • Implement a ground and surface water	• Provide a groundwater management framework which requires implementation of the following: – Investigation of hydrogeological characteristics in the impacted locality and region – Baseline and ongoing water monitoring with a well network capable of impact evaluation to an acceptable degree of certainty – Water monitoring on a continuous basis throughout the lifecycle of the gas field including post closure – Preparation of a groundwater monitoring plan which incorporates investigation, baseline and monitoring requirements – Assessment of impact to aquifers, groundwater and sensitive receptors – Staged management approach to determination of baseline and ongoing monitoring needs appropriate to exploration, appraisal and operational impacts

	Leading practice guidance - operators	Leading practice guidance - regulators
	management system for control, licence compliance, validation reporting and operational improvement • Obtain research on surface and groundwater issues of concern to from independent third parties such as the Gas Industry Social and Environmental Research Alliance (GISERA)	• Require groundwater investigation, baseline and ongoing monitoring to identify or achieve understanding of the following: – Hydro stratigraphy and hydraulic behaviour – Water level, pressure, quality and impact of water extraction activities – Hydraulic interactions between hydrogeological strata and any surface waters – Prediction of impacts to any identified sensitive receptors • Centralise governance and accountability for collection, analysis and dissemination of groundwater data • Align investigative, baseline and ongoing monitoring requirements adjacent to jurisdictional boundaries • Obtain expert advice and opinion on issues of concern (e.g. from the IESC)

LP 4.2 (11)

Manage cumulative impacts through regional-scale assessments

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Develop a regional groundwater model for a hydro geologically connected area in the following circumstances: – Where there is more than one proponent or lessor and the lease areas are adjacent or in hydraulically close proximity • Where water extraction has the potential to impact existing and future allocations, aquifers and ground and surface waters external or remote from the gas field. Use non-potable water where applicable to minimize the draw on other sources. • Develop nested groundwater models as required to evaluate local impacts to a greater degree of detail and sophistication • Undertake groundwater model development for cumulative impact assessment in collaboration with other industry operators and/or government • Ensure that cumulative impacts are maintained within acceptable levels considering environmental sensitivities and local and regional receptors including but not limited to the following: – Groundwater users both current and future – Groundwater dependent ecosystems – Culturally significant sites – Connected groundwater and surface water sources • Undertake assessments of impact and risk to existing and future allocations, aquifers and surface waters and the potential to impacts at a local and regional scale • Engage landowner and community	• Provide a groundwater management framework which requires implementation of the following: – Identification of hydrogeological areas impacted by exploration, appraisal or operational activities at the local and regional level – Adoption of a modelling platform and model formulation consistent with required information needs and impact consequences – Formulation of a numerical ground water model calibrated and validated to baseline data which is consistent with best practice guidelines – Definition of impact assessment criteria for sustainable management of available water resources including groundwater level, pressure, biota, quantity and quality considerations – Assessment of impact and risk to existing and future allocations, aquifers and ground and surface waters at a local and regional scale – Provision of groundwater impact and management reporting – Investigation of groundwater systems to establish if unique or distinct biotas are important to aquifer quality and permeability and are at risk from water extractive activities

	Leading practice guidance - operators	Leading practice guidance - regulators
	stakeholders in impact and risk assessment findings • Implement management and mitigation measures to restore, compensate or exchange impacted water resources • Manage groundwater data in association with industry and/or government for regional scale cumulative assessments • Obtain research on surface and groundwater issues of concern from independent third parties such as GISERA	– Inclusion of bioregional assessment findings into determination of impact to and required management of ground and surface water ecosystems – Account for water extraction impacts at a regional scale – Instigation of management and mitigation measures if groundwater is predicted to be impacted and actual and virtual injection – Establishment of data management and ownership requirements – Definition of responsibility for ongoing regional scale cumulative assessments • Centralise governance and accountability for collection, analysis and dissemination of groundwater analysis • Align cumulative management requirements across jurisdictional boundaries • Obtain expert advice and opinion on issues of concern (e.g. from the IESC)

Theme 5

Management of waste including produced water, water sourcing and efficient use

LP 5.1 (12)

Ensure sources water volumes are accounted for and efficiently managed

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Implement a strategy which maximises the reuse of produced water for the betterment of the environment, existing or new water users and existing or new water-dependent industries • Reuse/utilize non-potable water sources where applicable to minimize the draw on other sources • Account and plan for the management and use of the total volume of produced water expected for the life of the project • Ensure that untreated produced water used for exploration, appraisal and construction is suitably controlled and managed • Inject to the groundwater regime where pressurisation needs to be maintained and risks can be suitably managed • Treat produced water to a standard appropriate for the beneficial use application and subsequent disposal or release • Ensure treatment plant and components are installed, maintained and operated to best industry practice by qualified and highly trained and experienced personnel • Implement adaptive	• Regulate the management of produced water by operators in a sustainable and efficient manner • Ensure that all produced water used for beneficial reuse is of suitable quality to eliminate environmental and public health risk • Implement a beneficial use regime which prioritises the reuse of produced water for the betterment of the environment, existing or new water users and existing or new water-dependent industries including the following non-exhaustive options (Regulate that the operators use non-potable water where applicable to minimize the draw on other sources): – Injection into depleted aquifers for recharge purposes subject to elimination of environmental and public health concerns (this practice is subject to approval of the regulator) – Substitution for an existing water entitlement – Supplementary water for existing irrigation schemes – New irrigation use – Livestock watering – Urban and industrial water supplies – Release to the environment in a manner that improves local environmental values (this practice is subject to approval of the regulator) • Plan for produced water availability and eventual termination • Define appropriate water quality

	Leading practice guidance - operators	Leading practice guidance - regulators
	management organisational and operational structures and processes to accommodate changes in produced water quantity and quality (utilize non-potable water where applicable to minimize the draw on other sources) • Obtain research on surface and groundwater issues of concern from independent third parties such as GISERA	requirements for the various beneficial use applications • Allow discharge to watercourses only in the following circumstances (this practice is subject to approval of the regulator): – As a contingency measure for periods of high rainfall – Where environmental value protection is maintained without undue impact to the existing water quality and flow regime – Where there is no feasible alternative • Restrict use of evaporation for disposal to the exploration and appraisal period and to locations where there is no feasible alternative • Ensure injection processes and water risk are managed and necessary legal instruments are not unduly restrictive (injection is subject to approval of the regulator). • Implement an adaptive management framework to accommodate changes in produced water quantity and quality (regulate so the operator utilises non-potable water where applicable to minimize draw on other sources) • Require beneficial use provisions to apply to operational activities and not exploration and appraisal activities • Centralise governance and accountability for collection, analysis and dissemination of produced water data • Adopt incentives or penalties where control or minimisation of produced water is required to offset impact to sensitive receptors • Obtain expert advice and opinion on issues of concern (e.g. from the IESC)

LP 5.2 (13)

Ensure produced water volumes are accounted for and managed

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Transport and store produced water in secure containment facilities with appropriate buffer storage in ponds for high rainfall conditions • Provide flow and water quality monitoring stations throughout the transportation network and within key treatment and pumping facilities • Undertake automated monitoring, accounting and operation with central control and monitoring • Undertake monitoring in real time with outputs visually enhanced • Provide intelligent systems for fail-safe operation, reporting, trending and compliance management • Implement an adaptive management organisational and operational structure to accommodate changes in produced water quantity and quality (utilize non-potale water where applicable to minimize the draw on other resources) • Provide protective systems to containment facilities for leak detection and/or spill capture • Develop a response plan to manage operational risk	• Require storage facilities for the containment of produced water to provide the following capability: – Secure storage of contaminants – Able to withstand seasonal rainfall events without releasing contaminants – Storage availability for the wet season – Preventing access for terrestrial fauna • Account for the quantity and quality of produced water used, treated, stored or discharged for the following non-exhaustive system processes: – Injection to aquifers (this practice is subject to approval of the regulator) – Storage of untreated and treated produced water in ponds and dams – Transmission via pipelines – Treatment of produced water and comparison to water quality acceptance criteria – Beneficial use • Require measurement of environmental values impacted by produced water beneficial reuse or environmental release • Implement an adaptive management framework to accommodate changes in produced water quantity and quality (utilize non-potable water where applicable to minimize the draw on other sources) • Implement an accounting framework and process which: – Accommodates virtual reinjection through

	Leading practice guidance - operators	Leading practice guidance - regulators
		substitution for bore water use (this practice is subject to approval of the regulator) – Does not unduly restrict gas well or beneficial operation • Centralise governance and accountability for collection, analysis and dissemination of water data • Obtain expert scientific advice and opinion on issues of concern (e.g. from the IESC)

LP 5.3 (14)

Develop and implement sustainable options for solid and liquid waste streams

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Ensure secure containment of all waste streams • Account and plan for the total waste stream volumes expected for the life of the project • Implement a strategy which seeks to identify and develop viable and environmentally sustainably uses for brine and salt • Concentrate brine to reduce environmental impact and footprint. This practice is subject to approval of the regulator. • Crystallise concentrated brine to produce salt products • Inject brine into deep saline aquifers where feasible to avoid creation of brine or salt legacy storage facilities. This practice is subject to approval of the regulator. • Containment facilities to be fit for purpose and capable of retention for the intended life of the facility • Protective systems to be provided to containment facilities for leak detection and/or spill capture • Obtain research on surface and groundwater issues of concern from third parties such as GISERA	• Require storage and disposal in a manner to avoid environmental harm • Implement a prioritisation framework which promotes the sustainable use of brine or salt products for the creation of usable products • Subject salt disposal to landfill on a case-by-case approval by the regulator • Ensure pond containment facilities provide an appropriate buffer storage for high rainfall conditions • Consider need for financial assurance associated with brine disposal measures • Obtain expert advice and opinion on issues of concern (e.g. from the IESC) • Require reporting and auditing of waste stream quantity and quality management and accounting

Theme 6

Rehabilitation and decommissioning including progressive closure of unconventional gas projects

LP 6.1 (15)

Rehabilitation and closure planning is incorporated in a risk based and systematic manner throughout a project's lifecycle

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Planning for closure is undertaken progressively from early feasibility assessments and throughout the various stages of the project's lifecycle and integrated completely (including through provisioning) into normal business planning and practice • Develop an agreed set of rehabilitation and closure objectives and completion criteria as part of the approvals process to allow closure in a manner that meets regulatory requirements and community objectives • Establish a performance framework that facilitates a consistent approach and enables success in rehabilitation and closure to be measured • Incorporate a risk management for rehabilitation and closure planning throughout project lifecycle to identify risks and develop controls • Undertake regular review of rehabilitation and closure planning, to reflect both changes in physical status of the project and increase in knowledge and understanding of the project • Undertake ongoing stakeholder engagement with regulators and community throughout rehabilitation and closure planning, including measurement and monitoring of engagement • Ensure that closure plans reflect	• Develop policy, legal and regulatory frameworks to require and facilitate progressive rehabilitation and closure planning • Develop risk-based guidelines for rehabilitation and closure planning, including for identification of objectives and completion criteria and for incorporation of risk management and stakeholder engagement • Engage with project proponents to develop an agreed set of rehabilitation and closure objectives and completion criteria as part of the project approvals process, and undertake regular review of project status • Participate in community engagement in conjunction with project proponents throughout rehabilitation and closure planning • Manage potential impacts associated with legacy issues

	Leading practice guidance - operators	Leading practice guidance - regulators
	local circumstances and build on local strengths • Undertake comprehensive characterisation and management of materials (including soils, water and wastes) throughout the project lifecycle. Utilise non-potable water where applicable to minimize the draw on other sources. • Collect, assess and manage environmental, social and economic data early and throughout rehabilitation and closure planning • Undertake progressive rehabilitation of the site, with a continuous improvement focus and based on site-specific knowledge, research and monitoring incorporating the reduction of habitat and land fragmentation	

LP 6.2 (16)

Management and cost of rehabilitation and closure is made throughout a project's lifecycle including for address of residual risk, post relinquishment

	Leading practice guidance - operators	**Leading practice guidance - regulators**
Key elements / outcomes	• Reflect rehabilitation and closure planning in corporate standards and principles and regulatory guidelines and provides a suitable basis for estimating the cost of closure • Undertake planning for closure progressively throughout the various phases of the project's life cycle and provisioning is integrated completely into normal asset valuation, budgeting, financial reporting, business planning and practice • Recognise closure costs early to promote improved strategies for operations, to plan additional mitigation strategies and anticipate progressive closure and rehabilitation activities • Incorporate risk management for rehabilitation and closure planning throughout project lifecycle to identify costs associated with risks and controls and to justify management options • identify and assess residual risk and associated management for rehabilitation and closure planning requirements (including provisioning for these) that may exist for a site post-closure • Provide financial assurance to regulatory authorities in accordance with regulatory requirements	• Develop policy, legal and regulatory frameworks to require provision of financial assurance in a manner that: – Reflects the risk of default on rehabilitation and closure obligations for each proponent and associated project – Provides the authority with appropriate funds to complete rehabilitation and closure should the proponent default on obligations – Minimises the financial impact of financial assurance provision requirements – Provides for the most appropriate use of funds associated with financial assurance provision • Develop risk-based guidelines to facilitate the estimation and regular review (through the project lifecycle) of financial assurance provisioning • Develop guidelines for estimation and management of residual risk, which considers ongoing requirements and costs that may be associated with management and monitoring along with risk-related requirements and costs

Leading practices as in the original 2013 National Harmonised Regulatory Framework for Natural Gas from Coal Seams

1. Undertake a comprehensive environmental impact assessment, including rigorous chemical, health and safety and water risk assessments
2. Develop and implement comprehensive environmental management plans or strategies which demonstrate that environmental impacts and risks will be as low as reasonably practicable
3. Apply a hierarchy of risk control measures to all aspects of the project
4. Verify key system elements, including well design, water management and hydraulic fracturing processes, by a suitably qualified person
5. Apply strong governance, robust safety practices and high standards in design, construction, operation, maintenance and decommissioning for wells
6. Require independent supervision of well construction
7. Ensure the provision and installation of blowout preventers informed by a risk assessment
8. Use baseline and on-going monitoring for all vulnerable water resources
9. Manage cumulative impacts on water through regional-scale assessments
10. Ensure co-produced water volumes are accounted for and managed
11. Maximise the recycling of co-produced water for beneficial use, including managed aquifer recharge and virtual reinjection
12. Require a geological assessment as part of well development and hydraulic fracturing planning processes
13. Require process monitoring and quality control during hydraulic fracturing activity
14. Handle, manage, store, transport chemicals in accordance with Australian legislation, codes and standards
15. Minimise chemical use and use environmentally benign alternatives
16. Minimise the time between cessation of hydraulic fracturing and flow back, and maximise the rate of recovery of fracturing fluids
17. Increase transparency in chemical assessment processes and require full disclosure of chemicals by the operator in the recovery of natural gas from coals seams
18. Undertake assessments of the combined effects of chemical mixtures, in line with Australian legislation and internationally accepted testing methodologies.