Leigh Creek Energy

Statement of Environmental Objectives

ISG Demonstration Plant

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Revision History

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Leigh Creek Energy acknowledge the Adnyamathanha people, the traditional owners of the land on which our operations occur and pay our respects to their Elders past and present.

Contents

1 Introduction

1.1 Purpose

This Statement of Environmental Objectives (SEO) has been prepared to meet the requirements of Sections 99 and 100 of the *Petroleum and Geothermal Energy Act 2000* and Regulations 12 and 13 of the *Petroleum and Geothermal Energy Regulations 2013*.

The intent of the SEO is to outline the environmental objectives to which construction, operation and decommissioning of an ISG demonstration plant in Petroleum Exploration Licence (PEL) 650 will conform, and the criteria upon which the achievement of these objectives will be assessed.

The objectives of this SEO have been developed on the basis of the information provided in the Environmental Impact Report (EIR) (LCK 2017), and are in keeping with the objectives of the Petroleum and Geothermal Energy Act, which include:

- to minimise the environmental damage from exploration for, or recovery or commercial utilisation of, resources to which the Act applies;
- to establish appropriate consultative processes involving people directly affected by regulated activities and the public generally; and
- to protect the public from risks inherent in regulated activities.

The Act broadly defines the environment to include natural, social, cultural and economic aspects. The environmental objectives outlined in this SEO incorporate these aspects.

1.2 Scope

This SEO applies to the construction, operation and decommissioning of an ISG demonstration plant in the Leigh Creek Coalfield in Petroleum Exploration Licence (PEL) 650. These activities are described in the EIR (LCK 2017).

This SEO covers:

- construction, operation and decommissioning of a small-scale ISG demonstration plant; and
- well design, completion (excluding drilling activity), operation, maintenance and eventual decommissioning of the inlet, outlet and observation wells associated with the demonstration plant.

Drilling of the inlet, outlet and observation wells is covered by an existing Statement of Environmental Objectives for drilling (SAPEX 2013) and is not covered by this SEO.

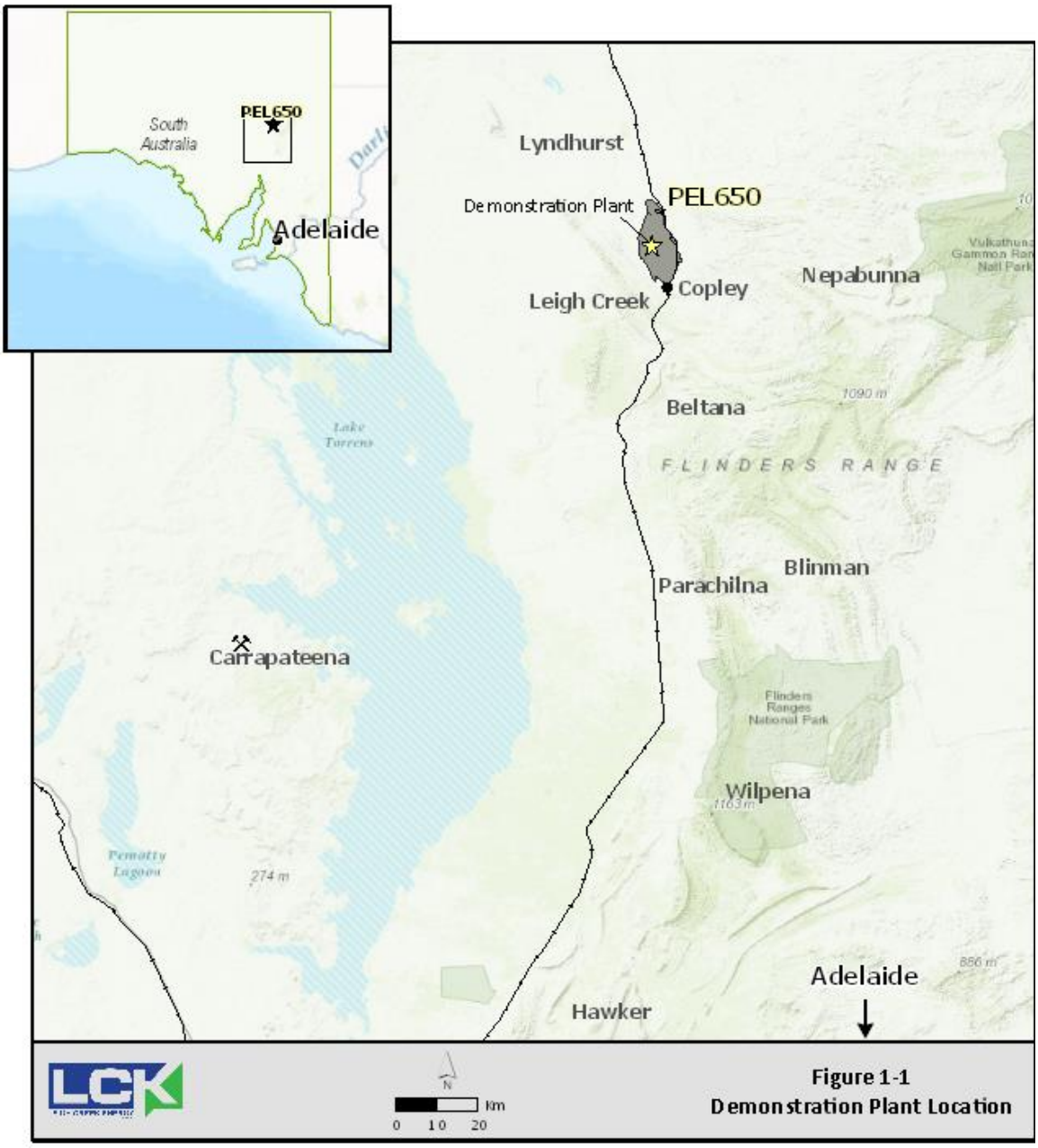

Figure 1-1
Demonstration Plant Location

2 Environmental Objectives and Assessment Criteria

2.1 Objectives

Potential environmental hazards and consequences associated with the construction, operation and decommissioning of the demonstration plant in PEL 650 have been identified in the Environmental Impact Report (LCK 2017).

Leigh Creek Energy (LCK) is committed to achieving a range of environmental objectives regarding these potential environmental hazards.

The environmental objectives for the ISG demonstration plant are:

1. Avoid damage, disturbance or interference to Aboriginal heritage sites, objects and remains by undertaking risk mitigation strategies or obtaining prior approval under relevant legislation;
2. No sustained change to background groundwater quality at the boundary of the gasifier buffer zone (i.e. containment is achieved);
3. No loss of gasification products to the surface or subsurface environment via pre-existing drill holes and/or transmissive geological features;
4. Well integrity is maintained to prevent loss of gasification products to the surface or subsurface environment;
5. No gasifier induced subsidence measured at the surface;
6. Minimise disturbance and avoid contamination to soil;
7. Avoid contamination of surface water resources;
8. Minimise disturbance to native vegetation and native fauna;
9. Avoid the introduction or spread of weeds, plant pathogens or pests (including feral animals);
10. Air pollution and greenhouse gas emissions reduced to as low as reasonably practical;
11. Avoid or minimise disturbance to stakeholders and / or associated infrastructure;
12. Minimise risks to the safety of the public and other third parties;
13. Optimise (in order of most to least preferable) waste avoidance, reduction, reuse, recycling, treatment and disposal; and
14. Remediate and rehabilitate operational areas to agreed standards.

2.2 Assessment Criteria

The environmental objectives identified above are subject to an assessment to measure the level of achievement. The assessment criteria for each objective are set out in Table 1 and will be one of the following:

1. Defined conditions – in some cases, the achievement of an objective can be assessed through ensuring defined conditions are met or carried out. Such conditions may include for example, prohibitions on undertaking a specific action (e.g. 'Rare, vulnerable or endangered flora are not removed without necessary permits or approvals.').

2. Defined requirements – the achievement of an objective can be assessed against the implementation of specific procedures or industry accepted standards required for an activity (e.g. 'All wastewater is disposed in accordance with the *South Australian Public Health (Wastewater) Regulations 2013* or to the satisfaction of the Department of Health'.

3. Scientific Studies / Monitoring – in some cases assessment of the environmental objectives may not be possible in the shorter term and may require longer term monitoring and scientific

evaluation. In such cases, assessment criteria may be in the form of longer term data and information gathering.

Each objective for construction, operation and decommissioning of the demonstration plant will be assessed using a selection of the assessment options outlined above. This will enable LCK to determine whether environmental objectives are being achieved. Comments on any variances will be recorded and reported where required as detailed in Section 3.

Table 1 also outlines the controls that are planned to be implemented to ensure that environmental objectives are achieved, in the "Guide to How Objectives Can be Achieved" column. These management measures provide a high-level overview of Leigh Creek Energy's systems, activities and / or procedures to achieve the environmental objectives.

Table 1: Environmental Objectives and Assessment Criteria

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
1. Avoid damage, disturbance or interference to Aboriginal heritage sites, objects and remains by undertaking risk mitigation strategies or obtaining prior approval under relevant legislation.	By way of a risk mitigation strategy, areas of proposed land disturbance have been subject to a cultural heritage Work Area Clearance and land disturbance will be undertaken in accordance with conditions of the cultural heritage clearance. Any Aboriginal heritage sites, objects and remains discovered during operations have been appropriately reported and responded to, consistent with the *Aboriginal Heritage Act 1988.*	All new land disturbance contained within cultural heritage Work Area Clearance area. Signage and fencing (where required) will be installed to delineate approved areas. Areas of sensitivity (e.g. cultural heritage exclusion areas, if present) flagged and / or fenced off where necessary to prevent disturbance. Training and induction for all personnel on cultural heritage issues and the importance of remaining within designated / approved areas. If suspected cultural heritage material is discovered during operations, investigations are undertaken with the Adnyamathanha Traditional Lands Association to identify an appropriate course of action. If Aboriginal sites, objects and remains are discovered, the discovery is reported to the Department of State Development, Aboriginal Affairs and Reconciliation.
2. No sustained change to background groundwater[1] quality at the boundary of the gasifier buffer zone (i.e. containment is achieved).	Groundwater monitoring in accordance with the monitoring plan does not indicate a sustained change[2] to background groundwater quality at the gasifier buffer zone[3] boundary as a result of demonstration plant activities. A sustained change to background groundwater quality at the sentinel wells (located inside the gasifier buffer zone) will be taken as an indication of sustained change at the gasifier buffer zone boundary, unless further investigations and/or remedial action demonstrate that there is (or will be) no	Gasifier operated automatically via a control system to keep pressure below surrounding groundwater pressure at top of gasifier chamber (including a safety factor) to avoid outwards pressure gradients and flows. Oxidant injection rate / pressure and outlet well pressure / flow used to control gasifier pressure. Real-time monitoring of pressure, temperature and flow at the inlet and outlet wells and sub-surface temperature monitoring of the casing strings. Pressure monitoring in vibrating wire piezometer wells surrounding the gasifier chamber to interpret groundwater pressure gradients. Abnormal and Emergency Operations Plan developed (scenario based) to detail actions required for each event (e.g. reduced pressure, increase sampling frequency).

[1] Note: There are no aquifers present. Groundwater at this site consists of the water in the approximately 530 m of carbonaceous mudstone and coal sequences, which are saturated from about 50 m below the surface. These strata are low permeability to virtually impermeable and are considered to be aquitards. The groundwater cannot be produced to the surface at a rate that would be suitable for use as a water supply (due to the low permeability of the strata) and is also poor quality. Refer to the EIR for details.
[2] Note: A sustained change will be defined in the Groundwater Monitoring Plan in consultation with the lead regulator, the Environment Protection Authority (EPA) and the Department of Environment, Water and Natural Resources (DEWNR).
[3] The gasifier buffer zone is a 100 m radius around the gasifier.

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
	sustained change to background groundwater quality at the gasifier buffer zone boundary. Real time monitoring demonstrates that the gasifier chamber is operated at a pressure below that of the groundwater pressure at all times[4].	Location and status of existing drill holes identified and avoided by site location. Geotechnical investigations and modelling undertaken to confirm absence of significant faulting, gasifier chamber stability and likely extent of any fractured or collapse zones. Conservative geotechnical design used for demonstration plant to avoid excessive gasifier chamber growth and unwanted gasifier chamber collapse. Oxidant supply shut off if required to control / halt ISG process and chamber growth. Decommissioning plan to minimise generation of chemicals of potential concern (COPC) and protect well integrity by: - removing oxidant supply. - active cooling of cavity through water injection to move though pyrolysis as quickly as practical without excessive thermal cycling of well. - using active cooling to steam the cavity of COPC. Sampling of the gasifier chamber after decommissioning via the observation well (if possible) for COPC and physical properties. Monitoring for gas and COPC undertaken in monitoring wells installed around gasifier and at selected surface locations. A Groundwater and Soil Vapour Monitoring Plan submitted to DPC-ERD for approval under Regulation 19 of the *Petroleum and Geothermal Energy Regulations 2013*. The Groundwater and Soil Vapour Monitoring Plan will include, but not be limited to, sample location, depth, frequency, analytical testing and reporting consistent with industry standards and relevant guidelines. The plan will also outline the methodology for assessing whether there has been a sustained change[2] to background water and soil vapour quality as a result of demonstration plant activities. Monitoring wells are planned to include (see Figure 2-1): - three soil vapour and three groundwater monitoring wells located in surficial sediments (Telford Gravels) at background locations distant from the gasifier and demonstration plant;

[4] Note: Whilst the inlet and outlet well pressures will be maintained below groundwater pressure, minor pressures changes may occur due to normal gasifier movements such as rock fall and rib spalling causing transient pressure changes which restabilise rapidly.

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
		- seven soil vapour and seven groundwater monitoring wells located in surficial sediments (Telford Gravels) above the gasifier and around the demonstration plant - three groundwater monitoring wells located in the Main Series Overburden at approximately 80 m below the ground surface at background locations distant from the gasifier and demonstration plant; - two sentinel groundwater monitoring wells located in the Main Series Overburden above the gasifier at approximately 80 m below the ground surface; - one operational groundwater monitoring well located through and adjacent to the coal seam approximately 10 m laterally from the gasifier; - one observation groundwater monitoring well pre-installed to intersect the gasifier (for monitoring post closure); - four sentinel groundwater monitoring wells located through and adjacent to the coal seam approximately 50 m laterally from the gasifier; and - five piezometer monitoring wells with vibrating wire piezometers positioned at multiple depths and located around and above the gasifier.
3. No loss of gasification products to the surface or subsurface environment via pre-existing drill holes and/or transmissive geological features.	Soil vapour monitoring indicates there has been no sustained change[5] in levels of chemicals of potential concern (COPC) in soil vapour monitoring wells as a result of demonstration plant activities. No gas detected at the surface resulting from migration of gasification products from the gasifier.	All pre-existing drill holes mapped and an exclusion zone of 100 m incorporated into delineating the gasifier location. 2D seismic undertaken and geological features mapped and an exclusion zone of 100 m from inferred faults incorporated into the gasifier location. Monitoring for COPC undertaken in soil vapour monitoring wells installed around gasifier and at selected surface locations. Personal gas detection / monitoring to indicate if dangerous levels of gas occur. Regular air quality and odour measurements undertaken throughout the project lifecycle.

[5] Note: A sustained change will be defined in the Groundwater Monitoring Plan in consultation with the lead regulator, the Environment Protection Authority (EPA) and the Department of Environment, Water and Natural Resources (DEWNR).

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
4. Well integrity is maintained to prevent loss of gasification products to the surface or subsurface environment.	Well Integrity There is no uncontrolled flow to surface or subsurface.	Well Integrity Steel casing string(s) and cement isolate well contents from surrounding strata and groundwater. Casing and wellhead designed to meet pressure, temperature, operational stresses and loads that will occur. Cement bond logs run to confirm quality of cement. Installation of tubing string in inlet and outlet well. Active cooling of outlet well via tubing string. Barrier verification and monitoring undertaken. Monitoring undertaken for leaks / fugitive emissions at wells. Ongoing well integrity monitoring. Emergency response plan (scenario based) in place and drills conducted.
	Well Decommissioning Records indicate inlet, outlet and observation wells decommissioned in accordance with recognised industry standards and to the satisfaction of DPC-ERD when no longer required.	Well Decommissioning Inlet, outlet and observation wells decommissioned in accordance with recognised industry standards and to the satisfaction of DPC-ERD when no longer required. Well decommissioning program will include (as a minimum) placement of a cement plug in the surface casing, removing the well head, cutting the casing off below ground level and installation of an above ground plaque. Decommissioning program submitted to DPC-ERD for prior approval. Note: There are no aquifers present requiring separation at decommissioning.
5. No gasifier induced subsidence measured at the surface.	Geotechnical settlement monitoring indicates there has been no sustained change in ground levels as a result of demonstration plant activities.	Geotechnical assessment report submitted and approved by DPC-ERD prior to initiation of the gasifier. Monthly monitoring of ground disturbance undertaken using geotechnical settlement markers installed at selected surface locations.
6. Minimise disturbance and avoid contamination to soil.	Land Disturbance Disturbance is limited to previously disturbed areas or areas of lowest sensitivity as far as practicable.	Land Disturbance Activities confined to defined site and areas of new disturbance minimised. Topsoil stockpiled (where present) during site construction for use in restoration. Areas where there is potential for (or signs of) soil erosion or sedimentation occurring will be stabilised and control measures implemented.

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
	The extent of soil erosion as a result of demonstration plant activities is consistent with or less than surrounding land. Refer to Objective 14 for rehabilitation criteria. <u>Migration of COPC</u> Monitoring indicates there has been no sustained increases in levels of COPC in soil vapour monitoring wells as a result of demonstration plant activities.	Training and induction for all personnel to educate them on the importance of remaining within designated / approved areas. Disturbed areas reinstated once they are no longer required e.g. by backfilling excavations, restoring natural contours, ripping areas of compacted soil and respreading topsoil and stockpiled vegetation. <u>Migration of COPC</u> Soil vapour monitoring wells installed to provide information on whether there has been any migration of gases to the surface from the gasifier or leaks from surface infrastructure. Refer to Objective 2 for further discussion.
	<u>Storage and Handling of Fuel, Chemicals and Produced Fluids</u> Any escape of petroleum, processed substance, chemical or fuel to land is either immediately contained and removed or assessed in accordance with NEPM[6] guidelines and remediated (where required) in a timely manner.	<u>Storage and Handling of Fuel, Chemicals or Produced Fluids</u> Demonstration plant facilities designed, constructed, operated and maintained in accordance with relevant standards and best practice. Implementation of appropriate chemical and fuel storage and handling procedures, in accordance with Safety Data Sheets and relevant standards and guidelines, including AS 1940, EPA *guidelines 080/16 Bunding and Spill Management* and the Australian Dangerous Goods Code. Appropriate spill capture methods implemented in refuelling areas (e.g. use of drip trays or liners). Tanks used for onsite storage of fluids produced during operation. Emergency / spill response procedures are established, and appropriate spill response equipment is available on site. Spills or leaks are immediately reported and clean-up actions initiated. Personnel have received training in the use of spill response equipment. Refer to Objective 14 for measures regarding assessment and management of site contamination.

[6] *National Environment Protection (Assessment of Site Contamination) Measure (1999)* amended in 2013.

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
	Waste Disposal Refer to Assessment Criteria for Objective 13.	Waste Disposal Refer to Objective 13.
7. Avoid contamination of surface water resources.	No unauthorised discharge or escape of petroleum, processed substance, chemical or fuel to surface water.	Storage and Handling of Fuel, Chemicals or Produced Fluids Refer to Objective 6. Waste Disposal Refer to Objective 13.
8. Minimise disturbance to native vegetation and native fauna.	Vegetation clearing is limited to previously disturbed areas or areas of lowest sensitivity as far as practicable. Rare, vulnerable or endangered flora are not removed without necessary permits or approvals. No native fauna casualties that could have been reasonably prevented. Waste Management Refer to assessment criteria for Objective 13. Storage and Handling of Fuel, Chemicals or Produced Fluids Refer to assessment criteria for Objective 6.	Activities confined to clearly defined designated approved work areas to minimise areas of new disturbance. Areas of sensitivity (e.g. significant vegetation if present) flagged and / or fenced off where necessary to prevent disturbance. Fencing installed where necessary to prevent access by large native fauna species. Excavations managed to minimise hazard to fauna (e.g. excavated areas left open for as little time as possible and regularly inspected for trapped fauna). Water supply sources (e.g. artificial water storages constructed for mine-site use) reviewed to ensure that their use does not impact adversely on environmental values. Water supply wells (if used) reviewed to ensure that their use does not impact adversely on existing groundwater dependent ecosystems. Fencing of contaminated areas if threat is posed to wildlife. Waste Management Refer to Objective 13. Storage and Handling of Fuel, Chemicals or Produced Fluids Refer to Objective 6.
9. Avoid the introduction or spread of weeds, plant pathogens or pests (including feral animals).	The presence of weeds, plant pathogens or pests is consistent with or better than pre-disturbance conditions and/or adjacent land or where this is not the case, a management plan is implemented immediately.	Pre-disturbance site inspection undertaken to document existing conditions. Earth moving equipment cleaned and inspected before commencing work at site or after operating in areas of known weed infestations. Imported material (e.g. gravel or road base) sourced from areas considered to be weed /disease free.

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
	Declared plants occurring as a result of regulated activities are reported and managed in accordance with the Natural Resources Management (NRM) Act and regional NRM plans.	If project activities result in the introduction or increased densities of weeds, a weed control plan will be developed and implemented. Note: Weeds are defined in this objective as any invasive plant that threatens native vegetation in the local area or any species recognised as invasive in South Australia.
10. Air pollution and greenhouse gas emissions reduced to as low as reasonably practical.	Reasonable practical measures implemented in design and operation to minimise emissions. Regular air quality measurements indicate levels are below relevant health-based air quality criteria (as listed in the Environment Protection (Air Quality) Policy) at sensitive receptors (i.e. towns or residences). Cold vent[7] operated for a maximum of 48 hours unless approval obtained from DPC-ERD. Stakeholder complaints regarding air quality or odour are documented and reasonable steps taken to address them can be demonstrated.	<u>Well Integrity</u> Refer to Objective 4. <u>Combustion Emissions</u> Thermal oxidiser used for destruction of syngas by thermal combustion at high temperature. Thermal oxidiser specification and operation to achieve high destruction efficiency of gas stream (including diesel firing to ensure this is maintained under low calorific syngas conditions). Modelling undertaken to confirm emissions from thermal oxidiser meet EPA criteria for maximum ground level concentrations outside site / PEL 650. All fuel burning equipment operated and maintained in accordance with design parameters and manufacturer specifications. Regular air quality and odour measurements undertaken throughout the project lifecycle, specifically once pre-gasification, monthly during gasification and once post-gasification. Demonstration plant operation kept to minimum length of time necessary to establish resource and production parameters. Greenhouse gas emissions recorded and reported in accordance with NGER requirements where applicable. <u>Syngas Release</u> Outlet well flow directed to thermal oxidiser under normal operating conditions.

[7] Note: Ignition of the flow from the cold vent using the pilot gas ignition source would occur as soon as reasonably practicable to allow the cold vent to be used as a standard flare. If the thermal oxidiser was to be unavailable for a prolonged period, flow rates would be reduced and an assessment undertaken to decide whether the gasifier operation should continue, based principally on capacity for storage of produced fluids (as well as any potential for odour impacts).

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
		Non-routine venting only carried out during initiation or under abnormal or emergency situations. Planned venting (e.g. at initiation) not undertaken when winds are in the direction of closest receptors (e.g. Copley) as far as practicable. Plant operated to minimise gas releases from vent. Cold vent ignited (with supplementary fuel (LPG) to allow low calorific value syngas to be combusted) to minimise odour potential if extended period of venting is likely. Personal gas detection / monitoring to warn if dangerous levels of gas occur. Management measures implemented for venting (e.g. exclusion zones downwind, notification of Flinders Power where appropriate) to minimise any hazard to personnel on the site. Liaison with local community regarding operations, with fact sheets developed specifically for local residents on Air Quality (with particular focus on odour) in relation to amenity and public health standards. DPC-ERD notified regarding venting operations. Equipment and piping designed, constructed and pressure tested in accordance with relevant oil and gas industry standards and guidelines (e.g. AS1940, ASME B16.5, AS3788, ASME B31.3, AS4100, AS4343, AS60079, API STD 520 – Part 1, API STD 521, API RP520 – Part 2, AS1210. Appropriate emergency response procedures in place for the case of a gas leak. See well integrity discussion under Objective 4. <u>Dust</u> Dust suppression measures implemented where required.
11. Avoid or minimise disturbance to stakeholders and / or associated infrastructure.	Stakeholder complaints are documented and reasonable steps taken to address them can be demonstrated. Where disturbance is unavoidable, infrastructure or land use is restored to the satisfaction of the owner or as near as practicable to undisturbed condition.	Site layout and construction designed to minimise adverse impacts to existing drainage patterns and secondary impacts to mine site operations. Adequate drainage of site and surrounds maintained, in consultation with Flinders Power. Overland flows are diverted around the site where required. Water supply sources reviewed to ensure that their use does not impact adversely on existing users.

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
		Water supply wells (if used) reviewed to ensure that their use does not impact adversely on existing users of groundwater. Existing water wells (if used) accessed in consultation with well owners. Monitoring of water extraction volumes. Plant and equipment operated and maintained in accordance with design parameters and manufacturer specifications. Plant operated to minimise gas releases from vent. Relevant stakeholders notified prior to undertaking operations, pursuant to Petroleum and Geothermal Energy Regulations. Liaison with Flinders Power regarding notification / management of works, traffic and site issues. Liaison with local community regarding operations. System in place for logging complaints to ensure that issues are recorded, addressed as appropriate and resolved in a timely manner. High standard of 'housekeeping' maintained. Induction for all employees and contractors covers stakeholder matters. Emergency services and potentially affected landholders / local community will be informed of significant activities (e.g. movement of large items of equipment) on public roads.
12. Minimise risks to the safety of the public and other third parties.	Reasonable measures implemented to ensure no injuries or health risks to the public and other third parties (e.g. Flinders Power) as a result of activities. No injuries, incidents or adverse health impacts involving the public or other third parties (e.g. Flinders Power) from regulated activities that could have been reasonably prevented by the operator. No uncontrolled fires as a result of activities.	Demonstration plant facilities designed, constructed, operated and maintained in accordance with relevant oil and gas industry standards and best practice. Relevant standards include AS1940, ASME B16.5, AS3000, AS3008, AS3788, ASME B31.3, AS4100, AS4343, AS60079, API STD 520 – Part 1, API STD 521, API RP520 – Part 2, AS1210. Safety, testing, maintenance and inspection procedures are implemented. Recognised risk management processes implemented in design through to decommissioning to identify threats and controls to mitigate risks. Site Management Plan implemented as agreed with Flinders Power (as the third party) documenting health and safety management systems. Emergency response plan (scenario based) in place and drills conducted. Continuous (24/7) operational presence on site including regular plant inspections.

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
		Signage and site access control measures in place to warn of hazards and restrict access to the site. Safe work permits be obtained to ensure only individuals with proper clearance can conduct works. Use of vent when high oxygen levels are present to prevent potentially explosive mixtures in surface equipment. Appropriate fire-fighting equipment on site. Designated no smoking site. Fire and Emergency Services Act requirements complied with (e.g. permits for 'hot work' on total fire ban days). Appropriate firebreaks are maintained. Compliance with relevant speed limits and restrictions. Driver behaviour and vehicle speed limits included in compulsory induction. Traffic and journey management procedures followed. All required authorisations (e.g. DPTI, police) obtained where required for significant activities (e.g. movement of large items of equipment) on public roads. Emergency services and potentially affected landholders / local community will be informed of significant activities (e.g. movement of large items of equipment) on public roads.
13. Optimise (in order of most to least preferable) waste avoidance, reduction, reuse, recycling, treatment and disposal.	Wastes are segregated and transported to an EPA licensed facility for recycling or disposal in accordance with the facility's EPA licence conditions. Reasonable steps are taken to securely contain waste prior to removal from site. All wastewater is disposed in accordance with the *South Australian Public Health (Wastewater) Regulations 2013* or to the satisfaction of the Department of Health.	Waste generation minimised (e.g. by compliance with EPA's Waste Hierarchy model (avoid, reduce, reuse, recycle, recover, treat, dispose)). Secure systems used for storage and transport of waste (e.g. covered bins in designated area for waste collection and storage prior to transport). High standards of 'housekeeping' implemented. Waste removed off-site and disposed of at an EPA licensed waste handling facility. Hazardous wastes handled in accordance with relevant legislation and standards. Licensed contractors used for waste transport. Liquid waste (e.g. water and condensate from the ISG process) stored in appropriate tanks and disposed in the thermal oxidiser or transported off site to an EPA licensed facility. All wastewater (sewage) disposed in accordance with the South Australian *Public Health (Wastewater) Regulations 2013* or to the satisfaction of the Department of Health.

Environmental Objectives	Assessment Criteria	Guide to How Objectives Can be Achieved
14. Remediate and rehabilitate operational areas to agreed standards.	Subsurface The gasifier is decommissioned in accordance with agreed procedures. Refer to Objectives 2 and 4 for criteria relating to groundwater quality and to well decommissioning.	Subsurface The gasifier is decommissioned by ceasing the flow of oxidant to the gasifier and injecting water to produce steam at the gasifier chamber margins which 'steam cleans' the chamber. The gas, steam and COPC are then destroyed by the thermal oxidiser. Sampling of the gasifier chamber after decommissioning via the observation well undertaken (if possible) for COPC and physical properties. Refer to Objectives 2 and 4 for management measures relating to groundwater quality and to well decommissioning.
	Surface Surface operational areas are rehabilitated to be reasonably consistent with the surrounding area (as per the following criteria) unless alternative agreement is reached with the regulator and stakeholders: - surface structures are removed - no evidence of waste on site - site contours are consistent with the surroundings - there has been appropriate preparation of the ground surface to promote revegetation. Any areas of contamination are assessed and managed using a risk-based approach, consistent with the principles of the NEPM[8].	Surface Infrastructure at the surface removed and site rehabilitated following the completion of all activities. Disturbed areas reinstated once they are no longer required e.g. by backfilling excavations, restoring natural contours, ripping areas of compacted soil and respreading topsoil and stockpiled vegetation. Existing drainage patterns will be restored. Any areas of contamination are assessed and managed consistent with the principles of the NEPM[8] and relevant EPA guidelines, in consultation with DPC-ERD and EPA where appropriate.

[8] *National Environment Protection (Assessment of Site Contamination) Measure (1999)* amended in 2013

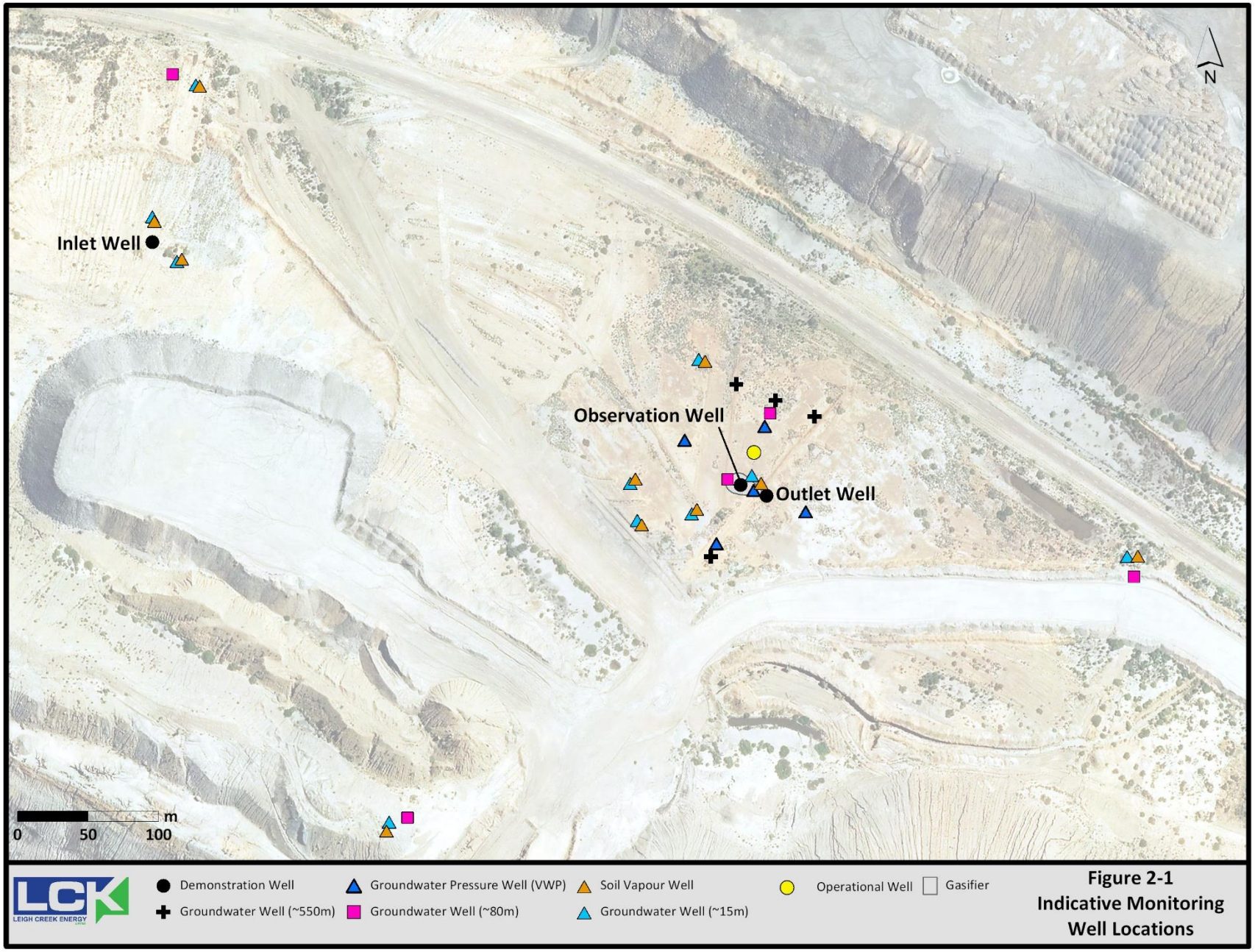

Figure 2-1
Indicative Monitoring Well Locations

3 Reporting

It is a requirement under Section 85 of the Petroleum and Geothermal Energy Act that 'serious' and 'reportable' incidents must be reported to the Minister.

Serious Incidents must be reported as soon as practicable after the occurrence, as per Section 85 of the Act and Regulation 32 of the Regulations.

Reportable Incidents must be reported on a quarterly basis within 1 month of the end of the quarter, as per Regulation 32 of the Regulations.

3.1 Incident Definitions

Regulation 12 (2) requires an SEO to identify events that could, if not properly managed or avoided, cause a serious incident or a reportable incident within the meaning of Section 85 of the Act. Table 2 identifies the potential serious and reportable incidents relevant to production activities. These definitions are based on standard definitions for facilities and pipelines developed by DSD and updated in recently approved SEOs (e.g. Beach 2016, Santos 2015), which are intended to expand on definitions provided in Section 85(1) of the Act and Regulation 32(1), and provide consistency for Licensee reporting.

In accordance with Section 85 of the Act and Regulation 32(1):

Serious incident means an incident arising from activities conducted under the licence in which:

(a) a person is seriously injured or killed; or

(b) an imminent risk to public health or safety arises; or

(c) serious environmental damage occurs or an imminent risk of serious environmental damage arises; or

(d) security of natural gas supply is prejudiced or an imminent risk of prejudice to security of natural gas supply arises.

(e) some other event or circumstance occurs or arises that results in the incident falling within a classification of serious incidents under the regulations or a relevant statement of environmental objectives.

Reportable incident is defined in Section 85(1) of the Act as incidents (other than a serious incident) arising from activities conducted under a licence that are classified under the Regulations as a reportable incident. Regulation 32(1) classifies the following as reportable incidents:

(a) an escape of petroleum, a processed substance, a chemical or a fuel that affects an area that has not been specifically designed to contain such an escape; and

(b) an incident identified as a reportable incident under the relevant statement of environmental objectives.

Table 2: Potential Serious and Reportable Incidents

Serious Incidents	Reportable Incidents
1. A person is seriously injured[9] or killed. 2. An imminent risk to public health or safety arises. 3. Loss of containment of the gasifier is detected (e.g. via sustained change[10] from background water quality in sentinel monitoring wells or sustained change in levels of COPC in soil vapour monitoring wells). 4. Gasifier induced subsidence is measured at the ground surface. 5. Serious environmental damage occurs or an imminent risk of serious environmental damage arises. For example: • Damage, disturbance or interference to sites of cultural and / or heritage significance without appropriate clearances, permits or approvals[11]. • An escape of petroleum, process substance, a chemical or a fuel to a water body, or to land in a place where it is reasonably likely to enter a water body by seepage or infiltration, or onto land that affects the health of native flora and fauna species. • Identification of uncontrolled flows to the surface or subsurface. • Any well incident or failure that threatens or poses an imminent risk to safety or a risk of serious damage to environmental values. • Detection of a declared weed, animal / plant pathogen or plant pest species that has been introduced or spread as a direct result of activities. • Any removal of rare, vulnerable or endangered flora and fauna or threatened ecological communities without appropriate permits and approvals[12]. 6. An event that results in a rupture of a pressure containing asset or facility. 7. A regulated activity[13] being undertaken in manner that involved or will involve a serious risk to the health or safety of a person emanating from an immediate or imminent exposure to a hazard.[14] 8. An uncontrolled gas release resulting in the activation of emergency response and / or evacuation procedures of an area in or adjacent to the gas release, and / or fire or explosion.	1. An escape of petroleum[15], processed substance, a chemical or a fuel that affects an area that has not been specifically designed to contain such an escape[16] (other than a serious incident). 2. Any event where an incursion outside a culturally cleared area has occurred or the conditions of a cultural heritage clearance have not been complied with (other than a serious incident). 3. An event that has the potential to compromise the physical integrity of an asset or facility. For example: • Identification of a through-wall defect on a pipeline[17] or plant component (other than a serious incident). 4. Malfunction or failure of critical plant or equipment that had (or still has) potential to cause a serious incident.

[9] Includes an immediately notifiable incident pursuant to section 38(2) of the *Work Health and Safety Act 2012.*

[10] Note: A sustained change will be defined in the Groundwater Monitoring Plan in consultation with the lead regulator, the Environment Protection Authority (EPA) and the Department of Environment, Water and Natural Resources (DEWNR).

[11] Pursuant to *Aboriginal Heritage Act 1988* and *Heritage Places Act 1993.*

[12] Pursuant to *Native Vegetation Act 1991* (flora) and *National Parks and Wildlife Act 1972* (fauna).

[13] Regulated activity as defined in Section 10 of the Petroleum and Geothermal Energy Act.

[14] Resulting in the issuing of a prohibition notice by SafeWork SA pursuant to Section 195 of the *Work Health and Safety Act 2012*.

[15] In gaseous, liquid or solid state, as per Petroleum and Geothermal Energy Act definition.

[16] An area assigned during a Hazard and Operability Process (HAZOP) study as a hazardous area for the purpose of gas venting, and designed as such, is considered to be an area specifically designed to contain a gas escape.

[17] As per Petroleum and Geothermal Energy Act definition, the term 'pipeline' includes tanks, machinery and equipment necessary for, or associated with, operation of the pipeline.

3.2 Reporting on Demonstration Plant Operational Matters

LCK will provide weekly progress reports to DPC-ERD during the operation of the demonstration plant. These reports will include details on the testing schedule undertaken during the week and the gasifier performance such as temperature, pressure and flow in the inlet and outlet wells and syngas chemical composition.

Notification will also be provided where relevant for the following non-routine operational matters. These matters will generally not fall into the reportable incident classification; the notification is intended to keep DPC-ERD informed on the demonstration plant operations.

Operational matters where notification will be provided to DPC-ERD will include:

- thermal oxidiser off-line for unscheduled extended period
- cold vent on-line for unscheduled extended period
- unexpected and sustained changes in groundwater pressure in vibrating wire piezometer wells surrounding the gasifier chamber
- unexpected and sustained changes in groundwater monitoring data (which will allow DPC-ERD and LCK to agree upon any further monitoring requirements to determine whether a 'sustained change' to groundwater quality has resulted)
- unexpected and sustained changes in soil vapour monitoring data (which will allow DPC-ERD and LCK to agree upon any further monitoring requirements to determine whether a 'sustained change' to soil vapour quality has resulted)
- deviations from standard process parameters (i.e. cavity pressure above groundwater pressure) that could lead to outward migration of COPC from the gasifier
- reasonable complaints from directly affected stakeholders.

Venting events and thermal oxidiser outages would be notified as soon as practicable. Other matters would be notified within one week.

LCK will also provide a closure report to DPC-ERD summarising performance of the demonstration including syngas composition, flowrates, temperature and pressures, and environmental monitoring including air quality, groundwater, surface water, soil and soil vapour.

3.3 Reporting to EPA

Where applicable, incidents causing or threatening serious or material environmental harm under the *Environment Protection Act 1993* must be reported to the EPA in accordance with section 83 of the *Environment Protection Act 1993*.

The reporting obligation under the Environment Protection Act does not apply to:

- petroleum exploration activity undertaken under the Petroleum and Geothermal Energy Act; or
- wastes produced in the course of an activity (not being a prescribed activity of environmental significance) authorised by a licence under the Petroleum and Geothermal Energy Act when produced and disposed of to land and contained within the area of the licence.

4 List of Abbreviations

AS 1940	Australian Standard *AS 1940 Storage and Handling of Flammable and Combustible Liquids*
COPC	Chemical(s) of potential concern. Chemicals with the potential (depending on background levels, where they are located and potential receptors) to have adverse impacts on human health or the environment.
DPC-ERD	Department of the Premier and Cabinet, Energy Resources Division
DPTI	Department of Planning, Transport and Infrastructure
EIR	Environmental Impact Report prepared in accordance with Section 97 of the *Petroleum and Geothermal Energy Act 2000* and Regulation 10.
EPA	Environment Protection Authority
HAZOP	Hazard and Operability Process
ISG	In situ gasification. In situ (underground) conversion of coal into an energy-rich product gas.
LCK	Leigh Creek Energy Ltd
NEPM	*National Environment Protection (Assessment of Site Contamination) Measure (1999)* amended in 2013
NGER	National Greenhouse and Energy Reporting (Act)
NRM	Natural Resources Management
PEL	Petroleum Exploration Licence
SEO	Statement of Environmental Objectives

5 References

Beach (2016). Statement of Environmental Objectives, Cooper Basin Petroleum Production Operations, December 2016. Beach Energy.

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Santos (2015). South Australia Cooper Basin Statement of Environmental Objectives: Drilling, Completions and Well Operations, November 2015. Santos Ltd, Adelaide.

SAPEX (2013). Arckaringa Basin Exploration Drilling Activities Statement of Environmental Objectives. Prepared for SAPEX Ltd, October 2007, RPS Ecos, Adelaide, South Australia. Reviewed August 2013.